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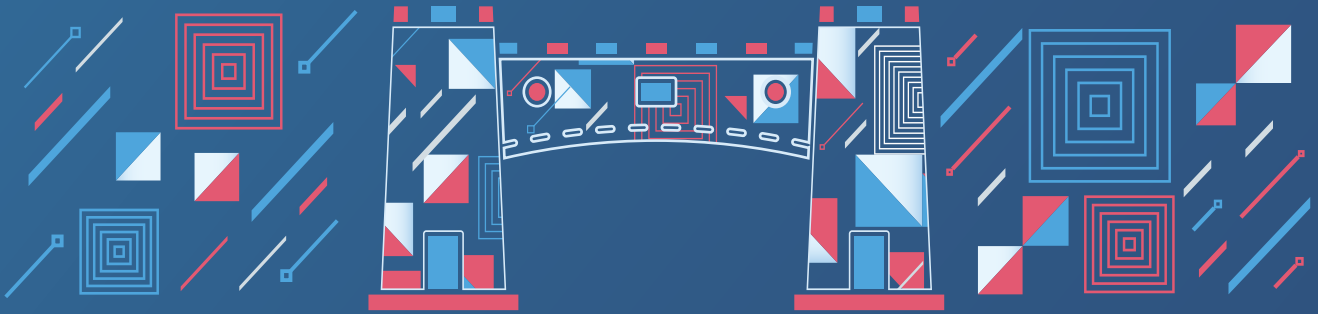
5TH INTERNATIONAL CONFERENCE

ON EMERGING TRENDS IN ENGINEERING, MANAGEMENT & SCIENCES (ICETEMS-2023)

Dec 20th–21st, 2023

PROCEEDINGS

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Implementation and assessment of outcome based education in engineering

Shaheer Shaida, Muhammad Yameen, Summaya Imran, Mubsahir Javed, Amber Lal, Bahadur Shah
City University of Science and Information Technology, Peshawar, Pakistan
shaheer.shaida@cusit.edu.pk

Abstract

This research paper explores the imperative role of implementing Outcome-Based Education (OBE) and specialized assessment methodologies aligned with the Washington Accord (WA) 2012 program outcomes within the domain of engineering education. The heightened interest of prominent multinational corporations in assessing the global competence of graduates, vis-à-vis established educational benchmarks, underscores the significance of this endeavor, particularly concerning international recruitment endeavors. The WA, a meticulously crafted accord tailored for engineers, revolves around the concept of mutual recognition of tertiary-level qualifications in engineering, spanning member countries. It commendably acknowledges the substantial equivalence in the accreditation of engineering qualifications. Adding a contextual perspective, it is essential to acknowledge that the Pakistan Engineering Council (PEC) had already initiated efforts related to quality assurance and accreditation in the realm of engineering education. PEC, entrusted with the pivotal role of regulating and accrediting engineering programs and institutions in Pakistan, diligently ensured that these entities met well-defined standards and quality benchmarks. Periodic assessments and evaluations were conducted by PEC to guarantee the delivery of high-quality education, all in adherence to specified criteria and guidelines. Nevertheless, it's crucial to recognize that the precise application of Continuous Quality Improvement (CQI) methodologies may vary among different institutions and organizations, PEC included. This variability is inherent in the multifaceted educational environment, as each entity customizes its approach in alignment with its distinct context. The integration of CQI principles and practices typically operates within the broader framework of quality assurance and accreditation processes within educational institutions. In this paper, we introduce a comprehensive approach that examines each Program Outcome (PO) as a central focus, accompanied by precise performance criteria. This method offers readers a transparent means of objectively evaluating whether students have met these criteria. Consequently, it supports the seamless implementation of Continuous Quality Improvement (CQI) within the program, ultimately contributing to the production of high-quality engineering graduates in Pakistan.

Introduction

Engineering plays a pivotal role in elevating the global quality of life, necessitating Engineering Education to be both relevant and effective in meeting contemporary challenges. The swift advancements in technology pose a significant challenge for academia, requiring curricula to be responsive to professional needs and deployment efficiency.

Traditional teaching methods and academic systems have exhibited limitations in terms of effective design and delivery [1]. In response, Outcome-Based Education (OBE) has emerged as a progressive solution. OBE entails a focused and organized approach, centering the entire educational system on essential outcomes for student success. This involves a meticulous process of restructuring curriculum, assessments, and reporting practices, particularly evident in fields such as electrical engineering education.

OBE aims to achieve high-order learning and mastery, surpassing the mere accumulation of course credits. The primary objective is to equip students to tackle challenging tasks, moving beyond rote memorization. OBE fosters elevated expectations, ensuring enhanced learning experiences for all students and preparing them for the demands of the 21st century [3].

With OBE, students gain the capacity to write compelling project proposals, successfully complete projects, analyze intricate case studies, deliver persuasive case presentations, and demonstrate critical thinking, questioning, research, and decision-making abilities based on findings. Program Educational Objectives (PEO) and outcomes play a pivotal role in designing programs to address crucial aspects. Failures in curriculum design can lead to ambiguous result attainment, emphasizing the need for a robust educational framework [2]. Engineering education underwent a transformative shift due to the guidelines set forth by the Pakistan Engineering Council (PEC). These guidelines, in line with global standards, underscore the importance of accreditation and Outcome-Based Education (OBE) methodologies. Graduates from Pakistani universities are required to demonstrate the expected outcomes outlined by PEC, ensuring alignment with international

engineering standards. This paper introduces a comprehensive method for PO assessment based on PEC guidelines, widely adopted by engineering faculties in Pakistan. An objective analysis will be conducted to identify weaknesses and areas for improvement, with the ultimate goal of proposing an enhanced and more practical method in accordance with PEC guidelines.

Implementation of Outcome-Based Education (OBE) in accordance with PEC Guidelines

Outcome-Based Education (OBE) serves as an educational model designed to fulfill the outcomes of an engineering undergraduate degree program. It prompts engineering schools interested in initiating such programs to ponder the question: "What type of graduate does the program aim to produce?" This is answered by formulating Program Educational Objectives (PEOs), Program Outcomes (POs), and Course Outcomes (COs). The implementation of OBE aligns with the Pakistan Engineering Council's (PEC) guidelines, requiring documentation such as SOP, Unit files, PBL assignments, exams/tests, lab manuals, samples, theses, industrial training reports, etc., to meet PEC requirements [4].

The OBE implementation involves three key aspects:
- Listing and achieving COs for individual courses.
- Listing and achieving POs in accordance with PEC guidelines.
- Listing and achieving PEOs.

OBE is a transformative process that entails the restructuring of curriculum, assessments, and reporting practices in education, emphasizing high-order learning and mastery over the mere accumulation of course credits [6]. The step-by-step process involves:
- Course Content Review: Adapting course content to align with specified Program Outcomes, current developments, industrial needs, job specifications, and professional body requirements.
- Teaching-Learning Methods: Introducing innovative and flexible teaching methods and delivery tools to cultivate PEOs and POs in students/graduates.
- Assessment & Evaluation Tools: Incorporating a variety of assessment and evaluation tools to measure the achievement of PEOs and POs.
- Data & Evidence Collection: Collecting evidence of the process involved and the achievement of PEOs and POs.

Continuous Quality Improvement (CQI): Closing the loop by developing improvement plans based on data and evidence collected.

Once PEOs, POs, and COs are established, program operation begins. Lecturers structure their modules based on relevant COs, and assessments are mapped accordingly. Key Performance Indicators (KPIs) are set, and if not met, lecturers devise Continuous Quality Improvement (CQI) plans. Similar CQI plans can be implemented at the program level based on PO attainment, ensuring ongoing improvement. Stakeholder endorsement is crucial throughout the process. CQI enhancements at the module level lead to improvements at the program level, ultimately enhancing PEOs. The diagram below illustrates the Outcome-Based Education process in line with PEC guidelines [10].

Course outcomes for each course are formulated based on the Pakistan Engineering Council (PEC) guidelines. These outcomes serve as statements describing significant and essential learning that learners should have accomplished and can reliably demonstrate at the conclusion of a course. The purpose of course outcomes is to identify what learners will know and be able to do by the course's conclusion. It is crucial that course outcomes are measurable and observable across cognitive, psychomotor, and affective learning domains.

In essence, course learning outcomes must encapsulate essential knowledge, skills, and attitudes, representing the minimum performance standards necessary for successful course completion. The formulation of course outcomes adheres to Bloom's Taxonomy [5], encompassing three learning domains: cognitive, affective, and psychomotor, as illustrated in Figure 2. This ensures a comprehensive and well-rounded approach to assessing and measuring the success of the learning objectives.

Step	Description
1. **Define Objectives**	Clearly outline the goals and objectives of the educational program.
2. **Assessment and Evaluation**	Regularly assess and evaluate Program Outcomes (POs) using defined criteria.
3. **Data Collection**	Collect data on student performance, feedback, and other relevant metrics.
4. **Analysis**	Analyze the collected data to identify strengths and areas for improvement.

Step	Description
5. **Identify Areas for Improvement**	Determine specific areas where the program can be enhanced.
6. **Implement Changes**	Introduce changes and improvements based on the analysis and identified areas for enhancement.
7. **Monitor and Measure**	Continuously monitor the impact of changes and measure their effectiveness.
8. **Feedback Loop**	Establish a feedback loop with stakeholders, including students, faculty, and industry professionals.
9. **Review and Revise**	Regularly review the effectiveness of the implemented changes and revise strategies as needed.
10. **Continuous Improvement**	Ensure a continuous cycle of assessment, analysis, improvement, and feedback for ongoing quality enhancement.

Figure 1. Continuous Quality Improvement (CQI) loop

Course Outcomes

Course outcomes are systematically developed for each course in accordance with the Pakistan Engineering Council (PEC) manual, aligned with Program Outcomes (POs). These outcomes serve as pivotal statements that articulate the significant and essential learning objectives learners are expected to achieve and proficiently demonstrate upon completing a course. In essence, course outcomes delineate what a learner will comprehend and be able to execute by the culmination of a course.

To ensure efficacy, course outcomes must be both measurable and observable across cognitive, psychomotor, and affective learning domains. This comprehensive approach implies that course learning outcomes should encapsulate essential knowledge, skills, and attitudes. Ultimately, they should signify the minimum standards of performance necessary for a learner to successfully conclude a course.

The formulation of course outcomes is guided by Bloom's Taxonomy, a structured framework encompassing three distinct learning domains: cognitive, affective, and psychomotor. This intentional approach ensures a well-rounded and holistic development of learners, encompassing not only cognitive understanding but also emotional and practical skills. This strategic alignment with Bloom's Taxonomy is illustrated in Figure 2.

In the context of Pakistan and the guidelines set by the Pakistan Engineering Council (PEC), adherence to rigorous standards in the development of course outcomes is crucial. This ensures that engineering education programs align with national accreditation requirements, providing students with a robust foundation and preparing them to meet the standards set by professional bodies and industry expectations.

Domain	Description
Cognitive Domain	Demonstrates the acquisition of knowledge, understanding, and the application of intellectual skills.
	- Recall of facts and concepts.
	- Application of knowledge to solve problems.
	- Analysis, synthesis, and evaluation of information.
Affective Domain	Displays the development of attitudes, values, and emotions.
	- Recognition and acceptance of values.
	- Development of emotional intelligence.
	- Cultivation of ethical responsibility.
Psychomotor Domain	Exhibits the acquisition of physical and motor skills.
	- Proficiency in hands-on tasks and procedures.
	- Coordination and precision in physical activities.
	- Application of practical skills in real-world scenarios.

Figure 2. Course Outcomes domain in OBE implementation

Student Achievement across Learning Domains

Cognitive: The cognitive domains encompass knowledge acquisition and the cultivation of intellectual skills. These domains encompass six major categories, ranging from the simplest behavioral aspects to the most intricate intellectual processes. The categories can be perceived as varying degrees of difficulty.

Psychomotor: The psychomotor domain involves physical movement, coordination, and the utilization of motor skills. The development of these skills necessitates practice and is gauged in terms of speed, precision, distance, procedures, or techniques.

Affective: This domain pertains to how students engage with content on an emotional level, encompassing feelings, values, appreciation, enthusiasm, motivation, and attitudes. It emphasizes the emotional and behavioral dimensions of the learning experience.

In the execution of this approach, specific strategies have been embraced to attain elevated proficiency across the three aforementioned domains.

Strategy	Description
1. Clearly Defined Program Outcomes (POs)	- Develop and articulate clear and specific Program Outcomes that align with institutional goals.
	- Ensure POs are measurable, observable, and achievable.
2. Course Outcome Development	- Systematically develop Course Outcomes for each course.
	- Align Course Outcomes with Program Outcomes.
	- Utilize Bloom's Taxonomy for diverse learning domains.
3. Mapping and Alignment	- Map Course Outcomes to Program Outcomes to ensure alignment.
	- Ensure alignment with industry needs and accreditation requirements.
4. Assessment and Rubrics	- Develop robust assessment methods and tools.
	- Implement rubrics for consistent and objective evaluation.
	- Align assessments with Course and Program Outcomes.
5. Stakeholder Engagement	- Involve stakeholders (faculty, students, industry) in the design and review of outcomes.
	- Seek feedback for continuous improvement.
6. Faculty Development	- Provide training and resources for faculty to understand and implement OBE.
	- Foster a culture of continuous professional development.
7. Continuous Monitoring and Review	- Establish mechanisms for ongoing monitoring of outcomes.
	- Regularly review and update outcomes based on feedback and changes in the industry.
8. Technology Integration	- Leverage technology for data collection, analysis, and reporting.
	- Use Learning Management Systems (LMS) for tracking and managing outcomes.
9. Feedback Mechanisms	- Establish channels for feedback from students, faculty, and industry.
	- Use feedback to make informed decisions for improvement.

Figure 3. Program outcomes

Evaluation of Course Outcomes

The assessment of course outcomes stems from the overarching program outcomes. When formulating course outcomes for a specific course, explicit reference is made to the program outcomes covered by those specific course outcomes. Table 2 explicitly outlines the specific Course Outcomes (COs) aligning with the Program Outcomes (POs) specified by the Pakistan Engineering Council (PEC) guidelines. The assessment of POs encompasses diverse evaluation methods such as final exams, mid-semester exams, laboratory work, assignments, etc. Calculation of the percentage achievement for each PO enables the determination of

individual CO attainment. For example, if PO2 is 60% and PO3 is 50%, the CO1 attainment would be calculated as (60+50)/2 = 55%. The continuous assessment of course learning outcomes, incorporating both direct and indirect assessment techniques, is the responsibility of departments and programs, in adherence to PEC guidelines. Lecturers for each course are accountable for maintaining a comprehensive course syllabus that precisely delineates the content and the POs aligned with PEC requirements. This syllabus should also include information about the course's learning objectives, offering a comprehensive overview of the educational pursuits in line with PEC standards.

Course Outcomes vs Program Outcomes Mapping Template:

Course Code: [Enter Code]	Course Title: [Enter Title]	Semester: [Enter Semester]
Course Outcomes (COs)	Program Outcomes (POs)	Mapping (COs to POs)
1. [CO 1]	1. [PO 1] - [Enter Description]	[Check if CO contributes to PO]
2. [CO 2]	2. [PO 2] - [Enter Description]	[Check if CO contributes to PO]
3. [CO 3]	3. [PO 3] - [Enter Description]	[Check if CO contributes to PO]
...	...	...

Figure 4. Course outcome vs. program outcomes mapping

List the specific Course Outcomes (COs) for the selected course.

Correspondingly, list the Program Outcomes (POs) that the course is intended to contribute to.

In the "Mapping (COs to POs)" column, indicate whether each Course Outcome contributes to the respective Program Outcome by checking the box or adding a brief description.

Example:

ourse Code: CS101	Course Title: Introduction to Computer Science	Semester: 1st
Course Outcomes (COs)	Program Outcomes (POs)	Mapping (COs to POs)
1. Understand basic programming concepts.	1. Demonstrate proficiency in programming.	[✓]
2. Analyze and solve simple programming problems.	2. Apply problem-solving techniques to programming.	[✓]
3. Develop a basic understanding of algorithms.	3. Demonstrate knowledge of algorithmic principles.	[✓]
4. ... (add more COs)	... (add more POs)	...

Figure 5. Course outcomes to subject

This template provides a structured approach to ensure alignment between the Course Outcomes and Program Outcomes, fostering clarity in the educational objectives of individual courses within a program.

Course Outcomes (COs)	Program Outcomes (POs) Covered
CO1 - [Enter Description]	PO2 - [Enter Description]
CO2 - [Enter Description]	PO3 - [Enter Description]
CO3 - [Enter Description]	PO1 - [Enter Description]
... (add more COs)	... (add more POs)

Figure 6: Course Outcomes (COs) and Corresponding Program Outcomes (POs)

Assessment Methods

The assessment of Program Outcomes (POs) is conducted through various methods, including Final Exam, Mid-Semester Exam, Laboratory Work, Assignments, etc.

Calculation of CO Attainment

The achievement of individual Course Outcomes (COs) is calculated based on the percentage attainment of corresponding Program Outcomes (POs). For example, if PO2 = 60% and PO3 = 50%, then the CO1 attainment will be (60 + 50) / 2 = 55%.

Responsibilities

Ongoing course learning outcomes assessment is the responsibility of departments and programs, ensuring a balance of direct and indirect assessment techniques. Lecturers are responsible for maintaining detailed course syllabi, explicitly outlining content, addressed Program Outcomes (POs), course objectives, taxonomy levels, instructional techniques, and evaluation methods.

Continuous Assessment Process

CO assessment is continuous throughout the course, starting from the first week until the last week of lectures. Course learning outcome assessment is divided into two parts: after test 1 (week 7) and after the final examination (week 14).

Course Evaluation

At the end of the course learning process and assessment, all lecturers must conduct a comprehensive course evaluation. This evaluation aims to analyze student achievement in terms of POs and Taxonomy Levels.
This upgraded information provides a structured format with a table that explicitly outlines the mapping of Course Outcomes to Program Outcomes. It also integrates the continuous assessment process, responsibilities, and course evaluation, aligning with the guidelines from the Pakistan Engineering Council.

Program Outcomes Po's

A comprehensive approach to the assessment of Program Outcomes (POs) has been developed, aligning with the guidelines provided by the Pakistan Engineering Council (PEC) [8]. The assessment practices currently in use adhere to the following principles:

Alignment of Course Outcomes (CO) with POs

Each course within the curriculum is directly linked to specific Program Outcomes.
This ensures that the learning objectives of individual courses contribute to the overall achievement of program goals.

Assessment of Course Outcomes

Course Outcomes are assessed through various methods such as quizzes, tests, exams, lab reports, assignments, and project reports.
These assessments provide a comprehensive evaluation of students' understanding and proficiency in achieving the desired outcomes.

Calculation of Final Marks

The final marks for each course are determined by combining individual assessment components, with each component assigned a specified percentage.
The total marks are then normalized to 100 percent to establish a standardized grading scale.

Determination of Program Outcome Achievement

The achievement of each Program Outcome is calculated based on the aggregated marks obtained by students in the associated courses.
The Program Outcome achievement is determined by averaging the marks achieved across all relevant courses.

Performance Indicator

A standard performance indicator, typically set at around 60 percent, is utilized to assess the overall performance of students in relation to Program Outcomes.

Indirect Assessment Methods

Indirect methods, including surveys such as exit surveys, end-of-course surveys, and industrial training surveys, complement the direct assessment.
Survey findings are presented separately from the average marks, providing additional insights into the effectiveness of the engineering program.
The process of establishing and monitoring progress toward Program Outcomes is an iterative one, occurring at two primary levels: Curriculum and Course. This approach ensures continuous improvement by incorporating feedback, adjusting assessments, and refining educational strategies to better align with the standards set by the Pakistan Engineering Council.
Assessing Program Outcomes (POs) in an engineering program can be done through various assessment tools. Here's a table outlining different assessment tools that can be used to evaluate specific Program Outcomes:

Program Outcome (PO)	Assessment Tool(s)
PO1: Engineering Knowledge	Examinations, quizzes, tests, assignments, projects, and comprehensive final exams.
PO2: Problem Analysis	Case studies, problem-solving assignments, and practical exams.
PO3: Design and Development of Solutions	Design projects, capstone projects, and design reviews.
PO4: Investigation of Complex Problems	Research projects, case studies, and investigative reports.
PO5: Modern Tool Usage	Assessment of proficiency in relevant software and tools.
PO6: The Engineer and Society	Essays, case studies, and projects addressing societal impacts.
PO7: Environment and Sustainability	Assessments on environmental impact analyses and sustainable design projects.
PO8: Ethics	Ethical dilemma scenarios, case studies, and reflective essays.
PO9: Individual and Team Work	Evaluation of teamwork in group projects and collaborative assignments.
PO10: Communication	Written reports, oral presentations, technical documentation, and communication critiques.
PO11: Project Management	Assessment of project planning, execution, and completion.
PO12: Lifelong Learning	Continuous professional development records, reflective journals, and learning portfolios.

Figure 7. Program education outcomes

The assessment strategy, incorporating course outcomes and program outcomes, is presented in Table 3. This template facilitates the execution of direct assessment.

Program Outcome	Description
1.	[Description of Program Outcome 1]
2.	[Description of Program Outcome 2]
3.	[Description of Program Outcome 3]
...	...

Course Outcome	Description	Related Program Outcome(s)
1.	[Description of Course Outcome 1]	[Related Program Outcome(s)]
2.	[Description of Course Outcome 2]	[Related Program Outcome(s)]
3.	[Description of Course Outcome 3]	[Related Program Outcome(s)]
...	...	...

Assessment Methods	Method	Description	Alignment	Criteria
1.	[Description of Assessment Method 1]		[Specify Course Outcome(s)]	[Detailed criteria]
2.	[Description of Assessment Method 2]		[Specify Course Outcome(s)]	[Detailed criteria]
...	...	...	...	...

Weighting of Assessments	
Assessment	Percentage
[Assessment 1]	[Percentage]
[Assessment 2]	[Percentage]
...	...

Schedule of Assessments	
Week	Description of Assessments
Week X	[Description of Assessment 1]
Week Y	[Description of Assessment 2]
...	...

Feedback and Improvement	
Formative Assessments	Description of how formative assessments will be incorporated for feedback
Continuous Improvement	Plan for using assessment results to improve the course

Figure 8: Assessment strategy

This condensed table provides a comprehensive overview of program outcomes, course outcomes, assessment methods, weighting, assessment schedule, and feedback/improvement plans in a single table format.

In accordance with the guidelines set forth by the Pakistan Engineering Council, alternative direct assessment methods may also be employed for the measurement of Program Outcomes (PO) [9]. The evaluation of laboratory work and assignments, for instance, can be conducted using rubrics. The rubric template for laboratory work and assignments is detailed in Table 4.

Criteria for assessment can be developed in alignment with the relevant Program Outcomes intended for measurement. The provided rubric is structured based on five performance indicators, with each criterion assigned a weight of 5 marks. The total marks obtained through evaluation should be divided by the total number of criteria multiplied by 5. The resulting value is then multiplied by the marks allocated for the specific Program Outcome being assessed.

A comprehensive illustration of the Program Outcome assessment method is clearly delineated in Figure 4. This systematic approach ensures a transparent and standardized process for evaluating and measuring Program Outcomes in accordance with the stipulated guidelines.

Criteria	Description	Marks
Criterion 1: Technical Proficiency	Demonstrates a high level of technical competence in executing laboratory tasks or assignments.	[Specify marks allocated, e.g., 0-5]
Criterion 2: Problem Solving	Effectively identifies and solves problems related to the laboratory work or assignment, showcasing analytical skills.	[Specify marks allocated, e.g., 0-5]

Criteria	Description	Marks
Criterion 3: Documentation and Reporting	Produces accurate and well-organized documentation and reports in line with PEC standards.	[Specify marks allocated, e.g., 0-5]
Criterion 4: Safety Compliance	Adheres to safety protocols and demonstrates a clear understanding of safety measures during laboratory work.	[Specify marks allocated, e.g., 0-5]
Criterion 5: Professionalism	Exhibits professionalism in communication, teamwork, and overall conduct during laboratory sessions or assignment work.	[Specify marks allocated, e.g., 0-5]

Figure 9.Criteria in OBE

Total Marks: [Specify the total marks for the entire rubric, e.g., 25]

Evaluation Guidelines:

0-1: Unsatisfactory - Does not meet the minimum standards set by PEC.

2-3: Satisfactory - Meets the basic requirements but with room for improvement.

4-5: Excellent - Exceeds expectations, demonstrating a high level of proficiency.
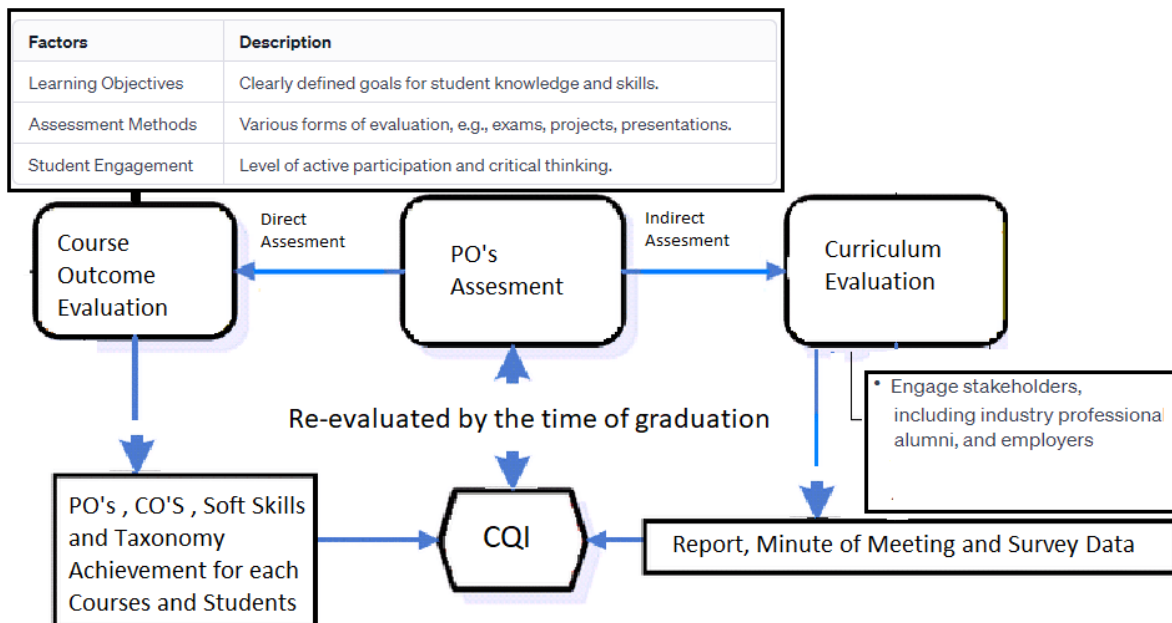
Figure 10. Program Outcome Assessment method

In accordance with the guidelines of the Pakistan Engineering Council (PEC), the Program Educational Objectives (PEOs) serve as foundational statements outlining the expected attributes of engineering graduates. These specific and measurable outcomes aim to be realized by each student within 3 to 5 years post-graduation. For most engineering programs, a well-crafted set of PEOs ensures that graduates attain the status of a Professional or Chartered Engineer within the specified timeframe, thereby contributing to the broader vision and mission of the university and program.

Upon the formulation of the PEO statements, Program Outcomes (POs) are derived, maintaining specificity and measurability. These POs, also aligned with relevant criteria defined by the Pakistan Engineering Council (PEC), constitute a set of statements to be achieved by students upon graduation. The crafting of POs is intricately connected to the PEOs, reinforcing the overarching objectives of the program.

Subsequently, the definition of relevant modules and their associated Course Outcomes (COs) takes place. COs are specific and measurable outcomes designed for achievement by students upon the completion of the respective modules within an engineering program. Table 5 provides a comprehensive mapping of the relationship between POs and PEOs, emphasizing the structured alignment between the program's broader educational objectives and the specific outcomes targeted at each stage of the educational journey. This meticulous approach ensures a coherent and purposeful progression in engineering education, in accordance with PEC guidelines.

Program Educational Objectives (PEOs)	Program Outcomes (POs)
1. PEO 1 - [Description of PEO 1, e.g., Develop a Comprehensive Understanding]:	1. PO 1 - [Description of PO 1, e.g., Apply Fundamental Engineering Principles]:
- [Elaborate on the overarching goal of PEO 1 and its relevance to students' career growth and societal needs.]	- [Specify how PO 1 reflects the application of fundamental engineering principles in practical scenarios.]
2. PEO 2 - [Description of PEO 2, e.g., Foster Critical Thinking Skills]:	2. PO 2 - [Description of PO 2, e.g., Demonstrate Analytical and Problem-Solving Abilities]:
- [Provide details on how PEO 2 emphasizes the development of critical thinking skills for effective problem-solving.]	- [Detail how PO 2 specifically measures students' abilities to analyze and solve engineering problems.]
3. PEO 3 - [Description of PEO 3, e.g., Cultivate Effective Communication]:	3. PO 3 - [Description of PO 3, e.g., Communicate Effectively in Written and Oral Forms]:
- [Explain the significance of PEO 3 in nurturing communication skills and its impact on professional success.]	- [Describe the elements of PO 3, focusing on effective written and oral communication as essential engineering skills.]
4. PEO 4 - [Description of PEO 4, e.g., Instill Ethical and Social Responsibility]:	4. PO 4 - [Description of PO 4, e.g., Demonstrate Ethical and Social Responsibility]:
- [Elaborate on the ethical and social aspects emphasized by PEO 4 and their implications in engineering practice.]	- [Specify the ethical and social responsibility components reflected in PO 4, illustrating how students demonstrate these attributes.]
5. PEO 5 - [Description of PEO 5, e.g., Promote Lifelong Learning]:	5. PO 5 - [Description of PO 5, e.g., Engage in Lifelong Learning and Professional Development]:
- [Discuss the importance of PEO 5 in fostering a commitment to continuous learning throughout one's engineering career.]	- [Highlight specific aspects of PO 5, showcasing how students are encouraged to engage in lifelong learning and professional development.]

Figure 11.PEOs

To align with the guidelines set forth by the Pakistan Engineering Council (PEC), it is imperative to formulate Program Educational Objectives (PEOs) based on all attributes of Program Outcomes (POs) as specified in the PEC manual. Figure 5 shown below elucidates the process for defining, evaluating, and assessing program educational objectives. The crafting of PEOs is intricately linked to the standards stipulated by the PEC and the mission statement of the program [7]. This ensures that the PEOs not only align with the regulatory framework established by the PEC but also resonate with the broader mission and vision of the engineering program.

Assessment of PEO's

In alignment with the guidelines stipulated by the Pakistan Engineering Council (PEC), the assessment of Program Educational Objectives (PEOs) is conducted by each graduating student approximately 3 to 5 years post-graduation. This evaluation process is facilitated through Alumni and Industry surveys. The faculty actively involves its alumni in the assessment mechanism through two key approaches:

Alumni Advisory Board

This board comprises 10 representatives from both industry and alumni.
The board convenes once or twice annually to scrutinize matters related to alumni activities, industry feedback, and the faculty's performance in achieving its Educational Objectives and Program Outcomes.
The insights gathered from the Alumni Advisory Board contribute significantly to gauging the department's effectiveness in meeting educational objectives and aligning with industry expectations.

Alumni Survey

Administered to alumni from previous graduating years, the alumni survey serves as a crucial feedback mechanism.The survey is designed to collect comprehensive feedback from alumni working across diverse industries.

Alumni, many of whom hold managerial positions in companies hiring a substantial number of graduating seniors, provide valuable perspectives on the relevance and effectiveness of the engineering program.

The collaborative engagement with the Alumni Advisory Board, comprising industry professionals, strengthens the department's connection with industry partners. The board's periodic assessments serve as a vital link between the department's educational objectives and the evolving needs of the industry. Simultaneously, the Alumni Survey ensures a broader spectrum of feedback, gathering insights from alumni dispersed across various industries. This dual approach not only adheres to PEC guidelines but also enhances the continuous improvement cycle by incorporating diverse perspectives for the refinement of Program Educational Objectives.

Assessment of Program Educational Objectives (PEOs)

tep	Action
Define PEOs based on PEC guidelines	
Implement Alumni Advisory Board and Alumni Survey	
- Alumni Advisory Board Assessment	- Alumni Survey Assessment
- Evaluate alignment with industry needs, faculty performance, and overall achievement of PEOs.	- Collect feedback from alumni regarding PEOs based on their professional experiences.
- Meets once or twice yearly.	
Collect and Analyze Feedback from Alumni and Advisory Board	
- Gather insights on PEO effectiveness, areas for improvement, and alignment with industry expectations.	
Utilize Feedback for Continuous Improvement of PEOs	
- Implement changes based on recommendations from the Alumni Advisory Board and Alumni Survey.	

Figure 12.PEOs

This simple table format outlines the steps and corresponding actions involved in the assessment process of Program Educational Objectives. Adjustments can be made based on your specific program and requirements. Table 6, presented below, serves as an illustrative template for both alumni and industrial surveys. The survey forms delineate the specific attributes to be assessed, aligning with the defined Program Educational Objectives (PEOs) crafted for the respective courses. Each attribute is assigned a certain point value, and if the cumulative points fall below 4, it signals an opportunity for enhancing Outcome-Based Education (OBE). This improvement process involves revisiting PEOs and refining the curriculum to ensure a more robust alignment with the desired educational outcomes.

Alumni Survey
Objective: To gather feedback from alumni for continuous program improvement.
Section 1: General Information
1. Name (Optional):
2. Graduation Year:
3. Current Position:
4. Company/Organization:
Section 2: Program Assessment
5. How well did the program prepare you for your current role? (Scale: 1-5)
6. Please rate the relevance of the curriculum to industry needs. (Scale: 1-5)
7. Are there specific skills or knowledge areas you feel were lacking in the program?
Section 3: Program Outcomes (POs) Assessment
8. Rate your perceived achievement of the Program Outcomes (POs) in your professional role. (Scale: 1-5)
9. Are there any specific POs that you believe need more emphasis in the curriculum?
Section 4: Additional Comments and Suggestions

10. Please provide any additional comments or suggestions for improving the program.
Industrial Survey
Objective: To collect insights from industry professionals for program enhancement.
Section 1: Respondent Information
1. Name of Company/Industry:
2. Position/Title:
3. Number of Years in the Industry:
Section 2: Collaboration with Graduates
4. Have you employed graduates from our program? (Yes/No)
5. How would you rate the performance of our graduates in your organization? (Scale: 1-5)
6. In what ways can our program better prepare graduates for industry roles?
Section 3: Program Curriculum and Relevance
7. How relevant do you find the program curriculum to current industry needs? (Scale: 1-5)
8. Are there specific skills or knowledge areas you believe should be emphasized more in the curriculum?
Section 4: Collaboration Opportunities
9. Are there opportunities for increased collaboration between the program and industry? (Yes/No)
10. Please suggest potential areas for collaboration or improvement.

Figure 13.

Results and Discussion

The proposed assessment method aims to establish a comprehensive framework for evaluating each Program Outcome (PO), fostering a more objective and strategically aligned Continuous Quality Improvement (CQI) implementation within the program. Importantly, it is anticipated that this approach will significantly enhance the quality of graduates emerging from engineering programs in Malaysia. The implementation of the proposed Outcome-Based Education (OBE) is anticipated to yield both short-term and long-term benefits.
Benefits of Assessments:
- Educational Values and Student Learning:
- Acknowledges that student learning originates from educational values.
Multidimensional Learning:
- The proposed assessment method reflects an understanding of learning as multidimensional, integrated, and manifested in performance over time.
Curriculum Effectiveness and Alignment:
- Evaluates the effectiveness and alignment of the curriculum with the desired outcomes.
Impact of Program Changes:
- Provides insights into the impact of changes made to the program.
Resource Justification:
- Offers evidence of the need for resources when requesting them.
Considering these benefits, it is imperative for every program to adopt a holistic perspective on the assessment method. It serves as a means to evaluate students' achievement of Program Outcomes, leading to enhancements in their knowledge, skills, and attitudes. Each Program Outcome should be regarded as a significant focus, accompanied by specific performance criteria. Measurement against these criteria enables an objective evaluation of whether students have successfully attained the stipulated objectives. Table 6 illustrates the objectives of the proposed assessment method in comparison to traditional methods.

Aspect	Traditional Method	Proposed Method
Focus	Primarily on testing knowledge through exams.	Emphasizes a comprehensive assessment of Program Outcomes (POs).

Aspect	Traditional Method	Proposed Method
Learning Perspective	Often limited to a one-dimensional view of learning.	Acknowledges learning as multidimensional, integrated, and revealed in performance over time.
Curriculum Evaluation	Limited evaluation of curriculum effectiveness.	Evaluates the effectiveness and alignment of the curriculum with desired outcomes.
Impact Assessment	Limited insights into the impact of program changes.	Provides a method to understand the impact of changes in the program.
Resource Justification	Limited ability to provide evidence when requesting resources.	Offers evidence of the need for resources during resource requests.
Student Achievement Evaluation	Primarily assesses student knowledge.	Evaluates student achievement of Program Outcomes, enhancing knowledge, skills, and attitudes.
Measurement Criteria	Often lacks specific performance criteria for each PO.	Defines specific performance criteria for each PO, allowing objective evaluation.

Figure 14.comparison

Conclusion

In the past decade, there has been a notable surge in the number of institutions offering technical education worldwide. However, the quality of education and training in many of these institutions falls short of desired standards. In the context of workforce mobility and international accords, ensuring quality assurance in education, particularly in engineering education, has become imperative. This need for quality assurance was further underscored by the transformation of engineering education spurred by the requirements imposed by the Washington Accord agreement.

In Pakistan, the engineering education landscape has also experienced a paradigm shift, emphasizing the assessment and evaluation of Program Outcomes (POs). The Washington Accord agreement has played a pivotal role in shaping these developments. The compulsory nature of assessing Outcome-Based Education (OBE) methods in engineering programs has revealed challenges, with many programs facing issues of clarity and demonstrating tangible continual quality improvement.

To address these challenges and align with the guidelines set by the Pakistan Engineering Council (PEC), a proposed assessment method is introduced. This method streamlines the implementation and assessment of OBE, providing specific performance criteria for each Program Outcome. It is anticipated that this proposed method will facilitate a more straightforward and effective evaluation of whether students have met the defined criteria. This, in turn, is expected to foster a neutral and transparent evaluation process, enabling the identification of areas for improvement.

The implementation of this proposed assessment method is poised to contribute significantly to the Continuous Quality Improvement (CQI) within engineering programs in Pakistan. By offering a clear framework for assessment and aligning with PEC guidelines, the proposed method seeks to enhance the quality of engineering education, ensuring that graduates are better equipped to meet national and international standards.

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Evaluation of Machine Learning Models for Predicting Smart Grid Parameters

Ahsan Zafar[1], Yanbo Che[1], Shafquat Rasool[1], Usama Afzal[2], Aamina[3]
[1]School of Electrical and Information Engineering, Tianjin University, Tianjin, China
ahsanuetp@hotmail.com, ybche@tju.edu.cn, shafquatr26@gmail.com
[2]School of Microelectronics, Tianjin University, Tianjin, China
mohammadusamafzal7@gmail.com,
[3]City University of Science & Information Technology, Peshawar, Pakistan
amnadurani8@gmail.com

Abstract

Machine learning and deep learning algorithms have become indispensable tools for addressing prediction challenges in time series data, with a particular focus on efficiently managing and forecasting energy production, especially in the integration of renewable energy sources into smart grids. In this study, two distinct machine learning models, Gated Recurrent Units (GRUs) and Long Short-Term Memory (LSTM), are implemented to predict solar power generation for the upcoming year. The models are trained and evaluated using real-time solar power production data spanning a year, and performance metrics like Mean Absolute Error (MAE) and Mean Squared Error (MSE) are utilized for assessment. The findings indicate that the LSTM model outperforms the GRU model in terms of accuracy. Additionally, the predictions are further enhanced using a proposed hybrid model, Convolutional Neural Network Autoencoder LSTM (CNN AE-LSTM), which excels in capturing intricate patterns and long-lasting correlations in time-series data. In particular, the Hybrid Autoencoder LSTM model yielded a lower RMSE of 0.132 for daily power generation parameter and also a lower RMSE of 0.0877 for grid connected power generation parameter. This research underscores the potential of machine learning techniques, particularly the CNN AE-LSTM approach, in advancing the integration of renewable energy resources into smart grids, contributing to the development of more efficient and environmentally friendly power systems.
Keywords: Renewable Energy, Smart Grids, Time Series Forecasting, LSTM Model

Introduction

In the current global landscape, there is a prevailing trend towards the integration of renewable energy sources into the electricity generation mix, driven by the imperative of enhancing energy security and establishing ecologically sustainable electrical systems [1]. Nevertheless, the adoption of renewable energy is not without its challenges, characterized by price volatility, fluctuations in demand, and the inherent variability in renewable energy production. In light of these formidable hurdles in managing the energy mix, the development of robust forecasting models for renewable energy sources becomes imperative. These models, as expounded in [2], serve a pivotal role in optimizing and aligning the supply-demand dynamics by furnishing advanced insights into power availability, ultimately contributing to the maintenance of a stable grid operation and facilitating the judicious engagement of energy units and economic dispatching strategies. In this research endeavour, our focus centres on the domain of solar energy forecasting, as elaborated in [3, 4]. Forecasting methods for photovoltaic (PV) energy generation can be broadly categorized into two groups: direct and indirect prediction models. The former directly estimate power output from the solar panel's performance, while the latter involve predicting solar radiation at various time scales and subsequently converting it into power using panel characteristics. Notably, diverse approaches, encompassing statistical, physical, and artificial intelligence (AI) techniques, have been harnessed to prognosticate PV solar energy [5]. Nonetheless, the allure of AI, particularly Deep Learning (DL) methods, has been compelling, owing to their capacity to unearth intricate patterns from PV power datasets, thereby furnishing more dependable predictive outcomes. For instance, in [6], Recurrent Neural Networks (RNN) are showcased as a valuable tool for forecasting solar irradiation time-series, leveraging recorded meteorological data. Moreover, [7] introduces an RNN-based forecasting methodology tailored for short-term PV power predictions. Furthermore, [8] presents a hybrid deep learning model incorporating Wavelet Packet Decomposition (WPD) and Long Short-Term Memory (LSTM)

techniques, effectively forecasting PV power one hour ahead with a five-minute interval. The study reveals that the WPD-LSTM approach outperforms alternative methods, including LSTM, Gated Recurrent Units (GRU), RNN, and Multilayer Perceptron (MLP) in diverse seasonal and weather conditions. In a similar vein, [9] presents a deep LSTM model based on historical power data for predicting PV system output power an hour ahead. [10] advances a hybrid model integrating LSTM and an attention mechanism to enhance short-term PV power forecasting. The attention mechanism is trained within the LSTM framework to target pertinent features, amplifying the predictive power of LSTM. Additionally, [11] deploys an LSTM-based approach for short-term forecasts, encompassing global horizontal irradiance (GHI) one hour and one day ahead. Furthermore, [12] demonstrates the implementation of univariate and multivariate GRU models utilizing historical solar radiation, external meteorological variables, and cloud cover data for solar radiation prediction. Moreover, [13] explores multivariate GRU models for hourly predictions of Direct Normal Irradiance (DNI), comparing their performance with LSTM using historical irradiance data. [14] introduces a hybrid deep learning model that marries a GRU neural network with an attention mechanism for solar radiation prediction. While these referenced studies significantly contribute to the field of solar energy forecasting, they remain limited in their ability to identify crucial parameters influencing prediction accuracy and in offering real-time forecasting capabilities for efficient and optimized energy management [15]. Given the dynamic and unpredictable nature of PV power generation, influenced by meteorological factors such as temperature, wind speed, cloud cover, atmospheric aerosol levels, and humidity [15], the need for accurate parameter identification and real-time predictions is paramount. Notably, PV forecasts span a range of time horizons from very short-term to long-term, with a predominant research focus on short-term forecasts, spanning hourly and daily intervals, as these are pivotal for PV management and addressing security constraints within the electricity market [16]. In contrast, long-term forecasts primarily cater to maintenance needs [16]. In light of this context, this study embarks on an exploration of the effectiveness of three distinct DL models. Furthermore, this research has a specific emphasis on real-time solar energy prediction, a critical aspect for aiding planners, decision-makers, power plant operators, and grid operators in making proactive decisions and managing smart grid PV systems with enhanced reliability and efficiency [17]. Real-time prediction affords the flexibility to respond to production fluctuations and adapt to complex events, ultimately reducing the necessity for operating reserves and minimizing system balancing costs [18]. The selected DL models exhibit promising outcomes and appear suitable for long-term forecasting due to their inherent deep learning capabilities and their proficiency in handling extensive datasets.

This study focuses on enhancing the accuracy of time series predictions in solar energy generation using the GRU, LSTM and hybrid CNN AE-LSTM frameworks. Real-time data from a year at a solar facility is employed to forecast critical parameters such as daily power generation, and grid-connected power output. The main contributions of this study are as follows:

- The key finding is that the hybrid CNN AE-LSTM model demonstrates superior accuracy and performance compared to the other two benchmark models LSTM and GRU model in predicting solar power generation for various parameters. The hybrid CNN AE-LSTM model introduces a novel architecture that combines the feature extraction functionality of Autoencoders with the memory capabilities of LSTM networks.

- The study employs performance metrics such as MAE, MSE and RMSE to evaluate the effectiveness of the models. Results demonstrate that the hybrid CNN AE-LSTM model consistently outperforms the LSTM as well as GRU model across multiple parameters including "daily power generation," and "maximum grid-connected power generation".

- By improving the accuracy of solar power generation predictions by hybrid CNN AE-LSTM model. This contribution is crucial for enhancing decision-making processes related to solar power facilities and optimizing resource distribution.

The remainder of this paper is organized into four sections. Section 2 gives an overview of our comparative methodology. Subsequently, section 3 presents the approach applied to elaborate the forecast models. Section 4 presents and discusses the obtained results. Finally, section 5 summarizes the conclusions and perspectives of this study.

Proposed Framework/Methodology

In this research paper, the methodology involves the application of three machine learning models: GRU (Gated Recurrent Unit), LSTM (Long Short-Term Memory) and CNN AE-LSTM (Convolutional Neural Network Autoencoder Long Short-Term Memory), to analyze a stationary time series dataset. This dataset encompasses one year of data, ranging from January 2022 to December 2022, comprising two key parameters: daily power generation (measured in kWh), and grid-connected power generation (in MW). The models are trained on a designated portion of the dataset, while the remaining data is split into testing and validation sets. Performance evaluation is conducted on the testing set, with subsequent tuning to enhance accuracy. The validation set is used to validate the models' performance on unseen data. Once optimized and validated, the models are utilized to forecast power generation for the upcoming year. Overall, this methodology employs machine learning techniques to analyze power production data from a large-scale solar power plant. The accompanying flowchart in Figure 1 illustrates the entire process for visualizing predictions from the models. Subsequent sections delve into the structural intricacies of the GRU, LSTM, CNN AE-LSTM models.
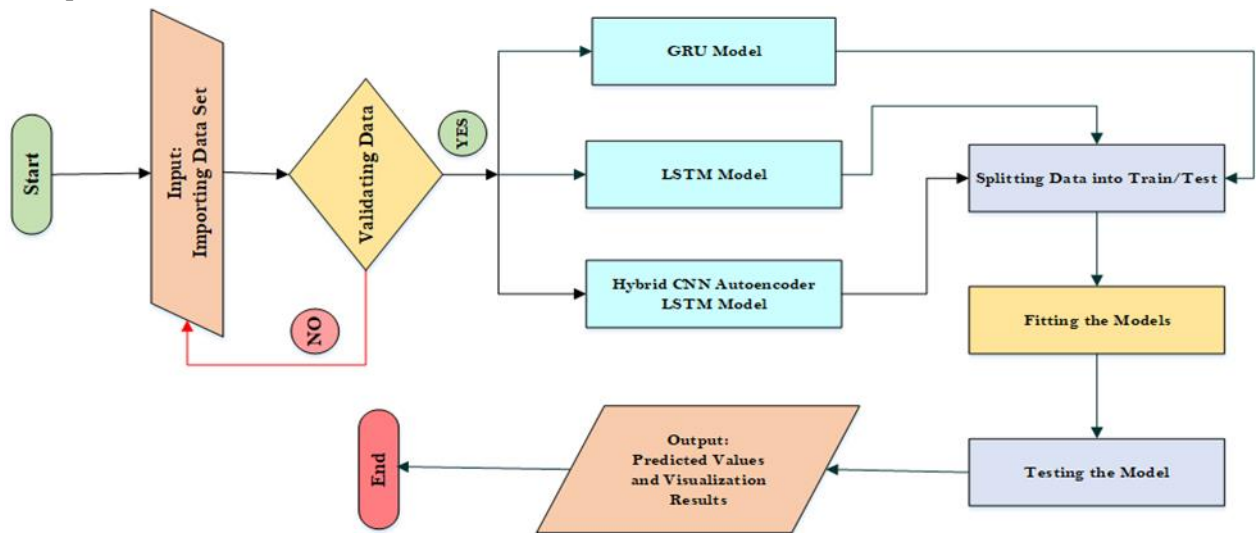
FIGURE 1: Results visualization process using GRU, LSTM and CNN AE-LSTM.

Gated Recurrent Units Architecture

The GRU (Gated Recurrent Unit) is a specialized type of recurrent neural network introduced by Cho in 2014, serving a similar purpose as the LSTM (Long Short-Term Memory) by addressing the challenge of retaining long-term memory and facilitating effective backpropagation. The core structure of a simple LSTM cell as shown in Fig.2. Within the GRU network, multiple cells are meticulously designed to store and retain essential information while discarding what is considered irrelevant for future processing. The feedback loops inherent in the GRU network can be likened to a time loop, wherein the output of a cell from the previous time step is incorporated as input in the subsequent cell, alongside the current input. This pivotal feature empowers the model to capture and remember relevant patterns, making it proficient in predicting sequential time-series datasets over extended periods.
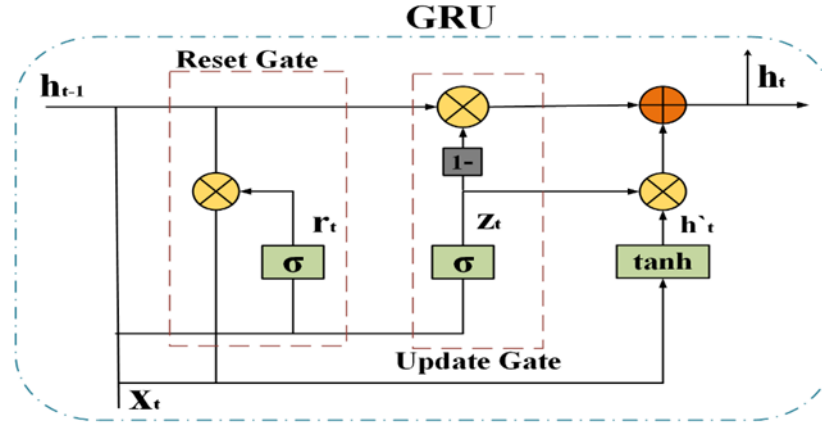
FIGURE 2: GRU internal structure.

The GRU simplifies the architecture by featuring just two gates: the update gate and the reset gate. The update gate assessing the relevance of previous state information to be carried forward into the current cell. Meanwhile, the reset gate determines whether new information should be integrated into the preceding state. This design has positioned GRU as an efficient RNN technique, recognized for its ability to learn and capture long-term dependencies within data sequences of varying lengths. This characteristic proves particularly advantageous in handling time-series data while also contributing to reduced computational complexity. The GRU cells are mathematically described by a set of equations that govern their behavior [8].

$$z_t = 6 (W_z [h_{t-1}, x_t]$$
$$r_t = 6 (W_r [h_{t-1}, x_t]$$
$$h'_t = tanh \{ W (r_t - h_{t-1}, x_t) \}$$

$$h_t = (1 - z_t) h_{t-1} + z_t . h'_t$$
$$y_t = 6(w_o . h_t)$$

Long Short-Term Memory Architecture

The LSTM (Long Short-Term Memory) is a specialized type of recurrent neural network (RNN) designed to overcome issues like the vanishing gradient problem that hinder the effectiveness of basic RNNs. An LSTM network as shown in Figure 3. Comprises memory blocks interconnected through layers and is equipped with three vital gates: the input gate, the forget gate, and the output gate. This architecture proves particularly adept at handling a wide range of time-series learning tasks, especially when dealing with complex and nonlinear datasets. Each LSTM block manages its internal state and output and operates at different time steps, passing its output to the subsequent block. Ultimately, the final LSTM block generates the sequential output. Moreover, LSTM is renowned for its robustness in efficiently processing time-series data, with its memory blocks specifically designed to counteract the vanishing gradient issue by retaining network parameters for extended periods. When an LSTM block receives an input sequence, the activation units in each gate determine whether to activate it. This dynamic operation allows state changes and the incorporation of conditionally relevant information as data passes through the block.
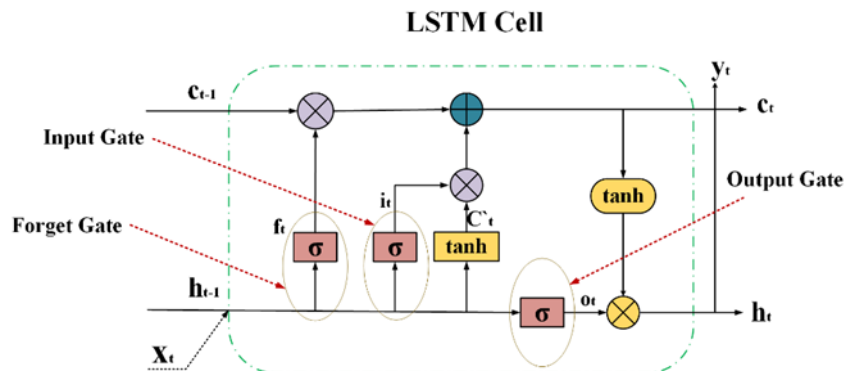
FIGURE 3: LSTM internal structure.

During training, the gates have adaptable weights that can be learned. Essentially, these gates imbue LSTM blocks with a level of intelligence beyond that of traditional neurons, enabling them to remember information from earlier sequences. The flexibility of LSTM lies in its ability to capture dependencies of varying time scales, making it adept at handling long sequences and identifying long-range patterns. In essence, LSTM begins its operation with a forget gate layer (ft) employing a sigmoid function that takes into account the previous hidden layer (ht−1) and the current input (xt), as expressed in the following equations [11]:

$$f_t = \sigma(wf_1 . x_t + wf_2 . z_t + wf_3 . h_{t-1} + b_f)$$
$$i_t = \sigma(wi_1 . x_t + wi_2 . z_t + wi_3 . h_{t-1} + b_i)$$
$$\overline{C}_t = tanh(wc_1 . x_t + wc_2 . z_t + wc_3 . h_{t-1} + b_c)$$
$$C_t = f_t . C_{t-1} + i_t . \overline{C}_t$$
$$o_t = \sigma(wo_1 . x_t + wo_2 . z_t + wo_3 . h_{t-1} + b_o)$$

Convolutional Neural Network Autoencoder Long Short-Term Memory Architecture:

The CNN AE-LSTM, a hybrid machine learning model, represents a cutting-edge approach to tackling prediction challenges within time series data, particularly in the context of forecasting solar power generation. The hybrid model as shown in figure 4. This model combines three essential components – Convolutional Neural Network (CNN), Autoencoder, and Long Short-Term Memory (LSTM) – to harness their individual strengths. The CNN is employed for extracting spatial features from the input data, crucial for capturing multidimensional patterns inherent in time series datasets. The Autoencoder plays a pivotal role in dimensionality reduction and feature learning by encoding and decoding input data, aiding in the extraction of essential information while minimizing noise. Finally, the LSTM component excels in capturing long-term dependencies in sequential data, making it highly effective for time series forecasting.
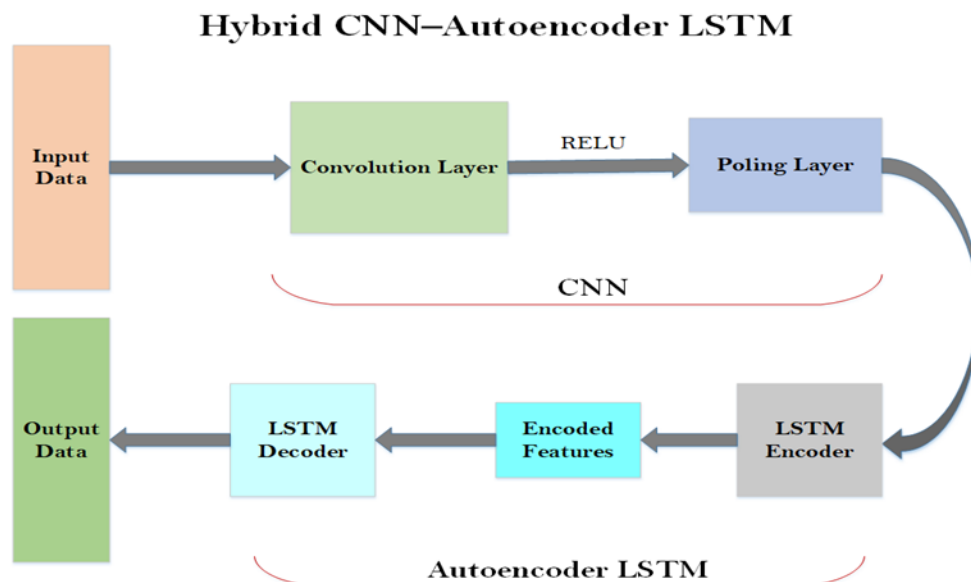
FIGURE 4: CNN AE-LSTM internal structure.

The working of the CNN AE-LSTM model involves a multi-step process. Initially, the CNN processes the input data, identifying spatial patterns and relevant features. The Autoencoder then compresses this information into a compact representation, discarding unnecessary details. Lastly, the LSTM component takes this encoded information and captures long-term dependencies, ensuring that the model understands the sequential nature of the time series data. Through training on historical solar power production data, the model refines its parameters, learning to discern complex patterns and correlations within the dataset. This comprehensive approach allows the CNN AE-LSTM to provide accurate predictions for future solar power generation. In summary, the model's synergy of spatial feature extraction, dimensionality reduction, and long-term dependency capture positions it as a robust tool for enhancing the precision of time series forecasting, particularly in the critical domain of renewable energy integration into smart grids.

Case Study

In Chakwal, Punjab, Pakistan, there is a notable 100 MW solar plant called the Sapphire Solar Power Plant (SSPP). The Sapphire Group, a well-known Pakistani corporation with diverse holdings in textile production, electricity generation, and property development, built this remarkable plant. The installation, which spans a vast area of over 650 acres, impressively contains over 400,000 solar panels. The National Transmission and Dispatch Company (NTDC) painstakingly built a 132 kV transmission line that efficiently connects the SSPP to the national grid. Since it began doing business in April 2018, the SSPP has faithfully performed its duties by producing clean and renewable energy to meet Pakistan's rising energy needs. With an estimated 165 GWh of yearly power production, the plant significantly lessens Pakistan's dependency on energy from fossil fuels and actively aids in the country's attempts to tackle global warming. The SSPP's successful development and operation represent an important turning point for Pakistan's renewable energy industry, demonstrating unequivocally the viability and potential of large-scale solar power projects there. Figure 5. Is showing the structure of solar plant from where the data is collected.
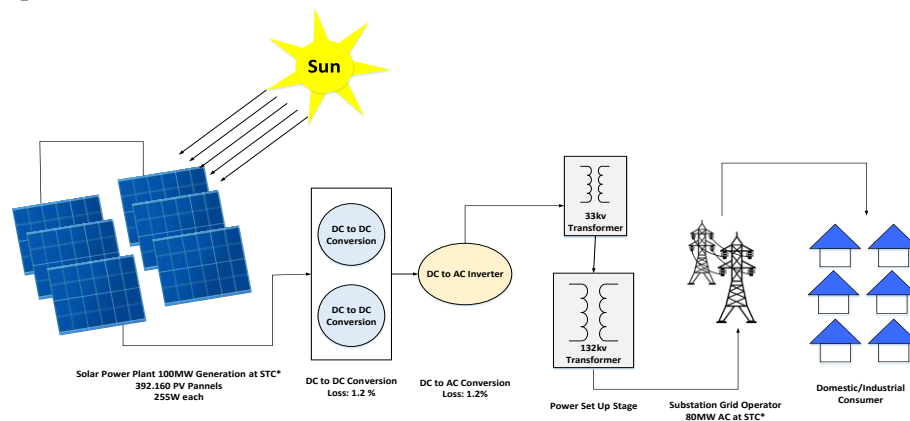
Figure 5: Single Line Diagram of Solar Plant

Box plots provide a concise and informative summary of extensive datasets, offering insights into their distribution. Fig. 6 showcases box plots representing three features extracted from a substantial solar power facility: "Daily Power Generation" (measured in kWh), "Maximum Grid Connected Power Generation" (measured in MW), and "Radiance" which is measured in $MJ \cdot m^{-2}$. The vertical extent of each box displays the data's middle 50%, with the lines extending from the box indicating the minimum and maximum values falling inside the range that is interquartile by 1.5 times. Any data points beyond these intervals appears as separate dots or circles as well, which may indicate potential significant anomalies.

In the first box plot, "Daily Power Generation in kWh," displays the interval of generated units on the y-axis, spanning from 100,000 kWh to 600,000 kWh. First quartile (Q1) covers the range from 330,000 to 450,000, representing the data's lowest 25%. The second quartile (Q2) ranges from 450,000 to 500,000, signifying the midpoint of the data, or 50%. Third quartile (Q3) encompasses the range from 500,000 to 530,000, representing the upper 25% of the data. Finally, the fourth quartile (Q4) spans from 530,000 to 610,000, indicating that this interval includes the top 1% of the data.

The box plot in second, "Maximum Grid Connected Power Generation in MW," displays the power generation range from 10 MW to 90 MW on y-axis. Q1 runs between 60 to 70, indicating the bottom 25% of the data. Q2 covers the range from 70 to 73, representing the midpoint of the data, or 50%. Q3 encompasses the interval from 73 to 78, signifying the upper 25% of the data. Lastly, Q4 ranges from 78 to 88, indicating this interval includes the top 1% of the data.

The last box plot, "Radiance," presents the power generation found between 5 MJ·m^{-2} - 30 MJ·m^{-2} on y-axis. Q1 spans from 14 to 20, representing the bottom 25% of the data. Q2 ranges from 20 to 22.5, signifying the middle 50% of the data. Q3 encompasses the range from 22.5 to 23.5, representing upper 25% of the data. Finally, Q4 ranges from 23.5 to 27, indicating that this interval includes the top 1% of the data, as depicted in Fig. 6.
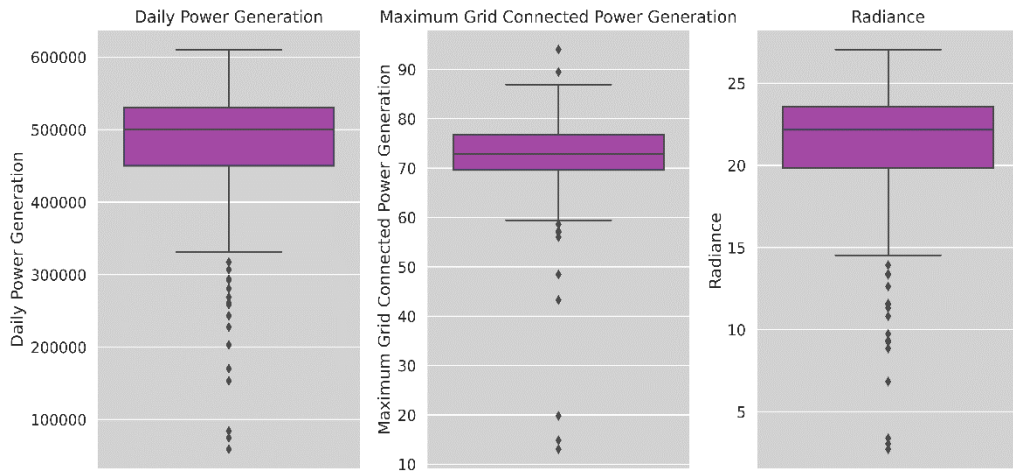
FIGURE 6: Data Analysis of Solar Plant parameters via Box Plot.

Results and Discussion

In this study, a one-year dataset is collected from a solar plant, daily power generation (kWh), and grid-connected power generation (MW) parameters in real time. These two parameters are utilized to forecast the following years. This prediction is accomplished using three distinct machine learning models: the gated recurrent unit (GRU), a long short-term memory (LSTM) and Convolutional Neural Network Autoencoder Long Short-Term Memory (CNN AE-LSTM) model. The selection of these models was based on a comprehensive literature review, which identified them as the most accurate and refined approaches for this purpose. While the results of these models indicate predictions that are very close to the actual real-time data values, the hybrid CNN AE-LSTM model outperforms the LSTM and GRU model. In this section, we discuss the results and graphical visualizations of these models, along with detailed analysis of the mean absolute error and mean square error values.
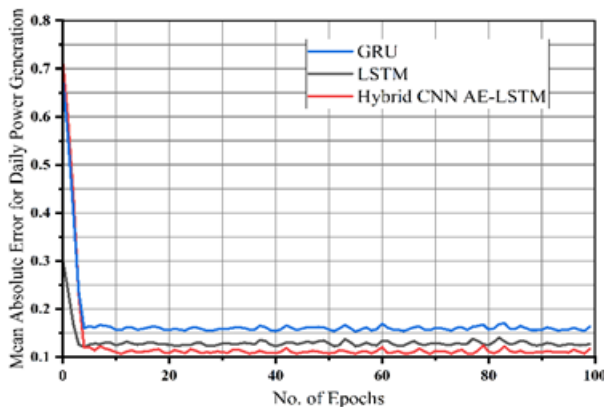
Figure 7(a): MAE Comparison of Daily Power Generation
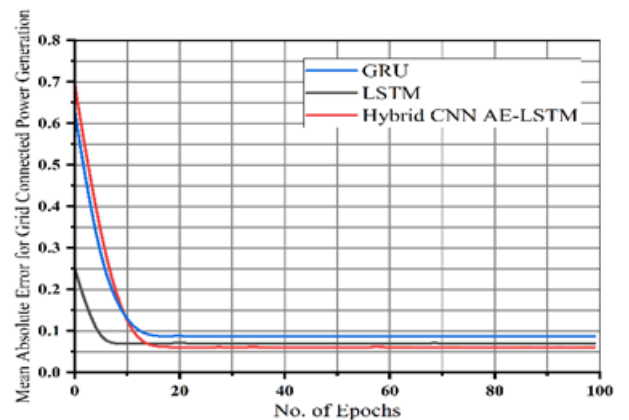
Figure 7(b): MAE Comparison of Grid Connected Power Generation

Table 1 presents the results of the mean absolute errors (MAEs) comparison between the GRU, LSTM and the hybrid CNN AE-LSTM model using the parameters "daily power generation," and "grid-connected power generation," from a power plant of solar. Additionally, Fig. 7(a-b) depict that the hybrid CNN AE-LSTM model achieves significantly lower validation MAE results compared to the GRU and LSTM model. Specifically, in Table 1, the CNN AE-LSTM model achieves the lowest MAE values of 0.08427 for "daily power generation (kWh)," 0.05282 for "grid-connected power generation,". In contrast, the LSTM model

scores 0.1112, 0.0609 while GRU model scores 0.2223, 0.1219 for "daily power generation (kWh)," "grid-connected power generation, (MW)" respectively. These results clearly indicate that the CNN AE-LSTM model outperforms both the models in minimizing MAE. The results emphasize the improved effectiveness and performance of the hybrid Autoencoder LSTM model in capturing the fundamental patterns and generating more precise forecasts for the power generation of the solar plant.

In Fig. 8(a-b), the results of validation mean squared error (MSE) between the GRU, LSTM and hybrid CNN AE-LSTM models are compared using the parameters "daily power generation," "grid-connected power generation," from a solar power plant. As shown, all the models MSE results are acceptable but the CNN AE-LSTM model's MSE results are significantly lower. Moreover, in Table 1, the CNN AE-LSTM model achieves the lowest MSE of 0.01736 for "daily power generation (kWh)," while the LSTM model has an MSE of 0.04876 and GRU model has 0.09752. For "grid-connected power generation (MW)," the CNN AE-LSTM model achieves the lowest MSE of 0.00776 compared to the LSTM model's 0.0193. These results clearly demonstrate that the CNN AE-LSTM model outperforms both the models in minimizing MSE.

TABLE 1: Comparison Table between GRU, LSTM and Hybrid CNN AE-LSTM.

Parameter	GRU		LSTM		Hybrid CNN AE-LSTM	
	MAE	MSE	MAE	MSE	MAE	MSE
Daily Power Generation	0.22233	0.09752	0.111165	0.04876	0.084274	0.017364
Grid Connection Power Generation	0.12196	0.03872	0.06098	0.01936	0.052823	0.007765
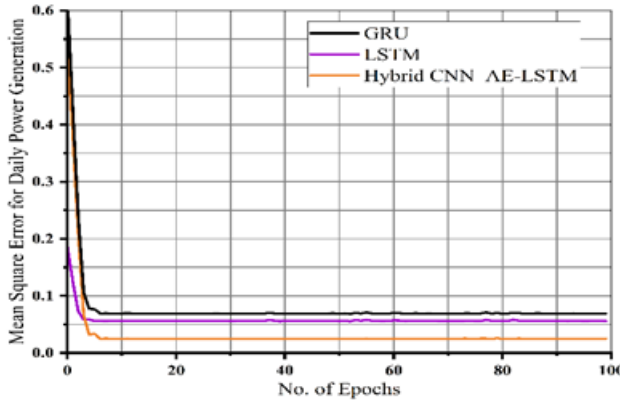
Figure 8(a): MSE Comparison of Daily Power Generation
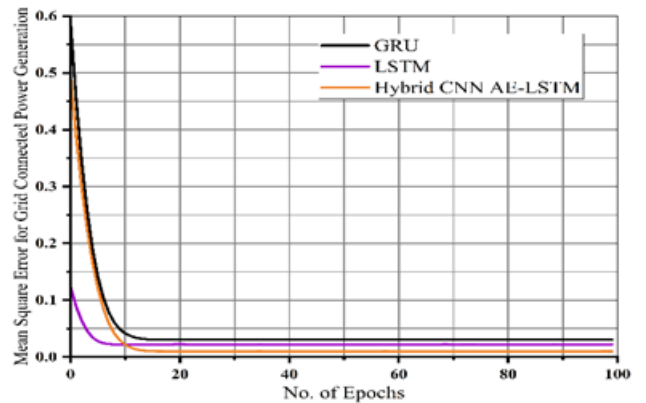
Figure 8(b): MSE Comparison of Grid Connected Power Generation

Fig. 9 and 10 provide graphic representations of forecast results from an analysis given data, exercise carried out on a 100 MW solar power facility. In this study, three machine learning models GRU (Gated Recurrent Units), LSTM (Long Short-Term Memory) and hybrid CNN AE-LSTM (Convolutional Neural Network Autoencoder Long Short-Term Memory) were trained on three key parameters using 80% of an entire year of data available in real-time: "daily power generation (kWh)", "grid-connected power generation (MW)". An additional data of 20% was dedicated for testing and validation. To compare the performance of the two models, a comprehensive analysis was conducted using training data of 10-months and test data of 2-months. Moreover, each of the models produced forecasts for the next year for each of the three parameters. The graphical representations in Fig.9, and 10 provide an easy-to-read comparison of the findings and forecasts for factors in a single graph. Ideally, the prediction data should closely align with the test data, indicating that the models have successfully captured the true trends and patterns in the solar plant's parameters. The closer the prediction data aligns with the test results, the more accurate the models are in forecasting the values of the parameters.
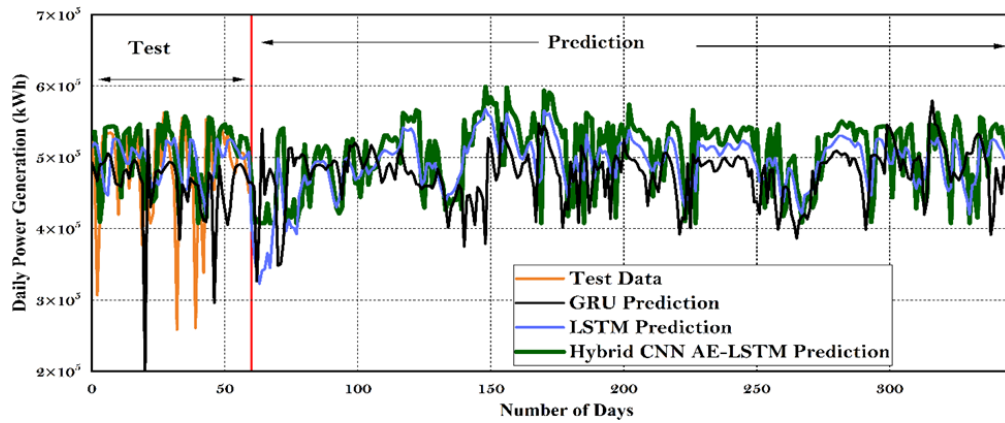
FIGURE 9. Comparison Between Tested and Predicted Data of Models on Daily Power Generation of a Solar Plant.

Fig. 9 displays the range of the "daily generation (kWh)" parameter, whose y-axis spans 200,000 to 700,000 kWh and whose x-axis represents the number of days. The predicted data from the GRU, LSTM as well as hybrid CNN AE-LSTM models and the actual 60-day test data can be compared, and it can be shown that the predictions from all these models are in acceptable range but the hybrid CNN AE-LSTM model are well synced with the findings from the test, with just tiny differences at select places. On the other hand, LSTM and GRU results do not match the test data closely, likely due to their limited ranges. However, the results of LSTM are slightly better when compare to GRU which shows out of range at certain time. The daily generating statistics for the upcoming entire year (365 days) will be predicted using each trained models for prediction after this comparison. Fig. 9 shows that the hybrid CNN AE-LSTM model's predictions are much closer to the test data as compared to LSTM and GRU results, displaying minimal deviations. As a result, the hybrid CNN AE-LSTM model is highly recommended for its superior performance in accurately forecasting the parameter's values.

Similarly, Fig. 10 represents the "grid-connected power generation (MW)" parameter, y-axis fluctuates between 40 MW to 90 MW, while the x-axis represents the total number of days. The comparison of predicted data using GRU, LSTM and CNN AE-LSTM models with the test data of 60-days demonstrates that hybrid CNN AE-LSTM predictions are well synced with the findings from the test, with just tiny differences at select places. Conversely, LSTM results do not match the test data closely but better than GRU results which shows much deviations. The grid-connected power statistics for the upcoming entire year (365 days) will be predicted using each trained models for prediction after this comparison. Upon evaluating the accuracy and performance of the models based on the test and prediction data graphs in Fig. 10, It's clear that the hybrid CNN AE-LSTM model performs better than the other models. The hybrid CNN AE-LSTM model's predictions exhibit closer alignment with the test data, showing minimal deviations and higher accuracy in forecasting the parameter's values.
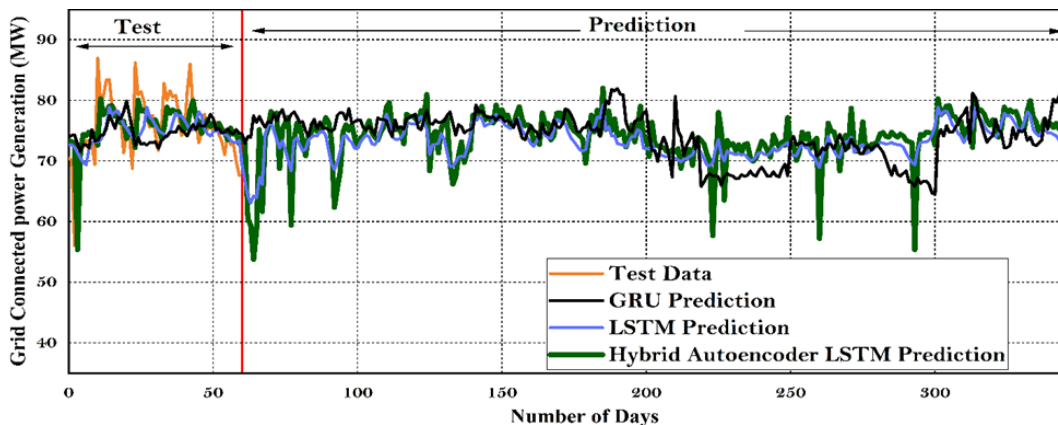
FIGURE 10. Comparison Between Tested and Predicted Data of Models on Grid Connected Power Generation of a Solar Plant.

Conclusion

The findings of this investigation demonstrate that our proposed Hybrid CNN AE-LSTM (Convolutional Neural Network Autoencoder long short-term memory) model outperformed the both LSTM (long short-term memory) as well as GRU (gated recurrent unit) model in regards of accuracy and performance measures for each of the parameters. The visual representations provided compelling evidence that the Hybrid CNN AE-LSTM model consistently outperformed the other models in every scenario. However, all these models exhibited expected behaviors, but the Hybrid CNN AE-LSTM model consistently showed lower error rates and higher data similarity. In particular, the daily power generation parameter yielded an RMSE of 0.132 for the Hybrid CNN AE-LSTM model, 0.219 for the LSTM model and 0.312 for the GRU model. Similar results were obtained for the grid-connected power generation parameter, where the RMSE for the Hybrid CNN AE-LSTM model was 0.0877 and the RMSE for the LSTM model was 0.138. while the RMSE for the GRU model was 0.196 These findings show that the Hybrid CNN AE-LSTM model can make more accurate and reliable predictions for these parameters, especially crucial for controlling solar power facilities in an efficient manner.

Future studies should examine the use of additional deep-learning models for power forecasting in time series from renewable sources, such as artificial neural networks (ANNs) and other hybrid-based models. Additionally, adding more pertinent elements, including information on the grid load and weather, might improve the models' forecasts substantially.

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Unraveling the Impact of Corporate Governance on KSE-100 Firms' Resilience in the Age of COVID-19

Safeer Khan[1], Sharif Ullah Jan[1], Faiza Gul[2]
[1]FATA University, Peshawar, Pakistan
[2]University of Peshawar, Peshawar, Pakistan

Abstract

This study examines CG's effect on KSE-100 firms pre and post-COVID, aiming to evaluate its influence on firm performance. To achieve goals, collected data from Pakistan Stock Exchange and SBP aided analysis of 69 firms, encompassing CG, financial metrics, and pre/post-COVID eras. The study used event analysis, employing t-tests and OLS methods to explore COVID-19 effects on CG and firm performance. Variables involved financial indicators (ROA, ROE) and CG factors like board size, independence, diversity, and audit committees. Study findings revealed CG's substantial impact on KSE-100 Index performance, highlighting audit committee meetings' positive influence. Yet, nuances existed as some CG factors lacked significant impact, offering multifaceted insights. In summary, this study emphasizes the ever-changing impact of corporate governance on firm performance, notably amid the challenging COVID-19 phase. It emphasizes the significance of astute financial management, liquidity, and dividend strategies in bolstering financial outcomes. This research lays groundwork for future exploration of evolving corporate governance effects during economic upheavals, offering crucial insights for businesses aiming to enhance financial performance. It stands as a significant contribution benefiting academia and corporate realms, guiding the pursuit of robust governance practices and improved financial results.
Keywords: Corporate Governance, Financial Performance, COVID-19, KSE-100 Index.

Introduction

The global COVID-19 pandemic has unleashed far-reaching effects on economies, industries, and corporations worldwide. Its rapid spread compelled governments to implement measures such as lockdowns, social distancing, and stay-at-home orders, significantly impacting various sectors. This impact is evident in the stock market, labor market, business models, financial sectors, small and medium-sized enterprises, and numerous other areas, as highlighted in multiple studies (Ashraf, 2020; Mayhew & Anand, 2020; Yahaya et al., 2020; Baicu et al., 2020; Ratten, 2020; Abate et al., 2020).

Particular industries bore the brunt of COVID-19's economic toll, resulting in substantial losses, with global businesses facing trillions of dollars in financial setbacks. To mitigate the pandemic's impact, companies rapidly adopted new business practices, enhanced operational flexibility, and leveraged technology. Notably, early stages of the pandemic led to a decline in the global economy, prompting discussions on how COVID-19 affected company performance, corporate governance, capital structure, dividends, and share repurchases. Shen et al. (2020) found that COVID-19 had a detrimental effect on the performance of listed companies on the China Stock Exchange, especially for smaller businesses, offering empirical evidence of the pandemic's impact.

In an effort to understand the relationship between COVID-19 and firm performance, research on corporate governance and company performance emerged. A study by Khatib et al. (2021) examined 69 companies listed on the Karachi Stock Exchange during the 2019-2020 trading year. They found that board size and administrative mechanisms had a positive, significant impact on firm performance during the pandemic. Additionally, liquidity and dividend per share showed positive associations, suggesting that firms increased cash reserves to manage operational risks during the crisis. However, board and audit committee meetings were linked to negative effects on firm performance due to the associated high costs. Overall, it is clear that COVID-19's effects on businesses have been multifaceted, affecting various aspects of corporate performance and governance.

Research Gaps

We have found a lot of Literature on the impact of CG on the FP but they have limited Literature on the impact of corporate governance on FP during the COVID-19.for example The impact of CG on the FP during COVID-19. (Khatib & Nour., 2021). Corporate governance and COVID-19. (Koulouris, et al., 2021). the effect of CG on FP during COVID-19 in Vietnam (Le, et al., 2022). but in the Pakistani context, we have not found any

Literature on the impact of CG on the FP of the KSE-100 index during COVID-19 so we will start work on it.

Research Objectives

- To determine the impact of CG on the KSE-100 firms in the pre-COVID-19 scenario.
- To determine the impact of CG on the KSE-100 firms in the post-COVID-19 scenario.
- To compare the difference of CG impact on the KSE-100 firms in both pre- and post-COVID-19 scenarios.

Literature review

COVID-19 Impact on Businesses

In the midst of the COVID-19 pandemic, a range of academic investigations have illuminated its multifaceted impact on businesses, delving into various dimensions such as supply chain disruptions, economic fluctuations, digital transformation, and the financial well-being of enterprises. Meyer, Prescott, and Sheng (2022) have examined how large firms, with substantial stock market presence, experienced notable supply chain disruptions and shifts in their expected selling prices during August 2022. Seetharaman (2020) explored the transition of business models from physical to virtual markets, emphasizing the information intensity of COVID-19 on products and services in different industries. Grida et al. (2020) conducted a meticulous examination of COVID-19's effects on supply chain effectiveness, highlighting its diverse impacts on supply, demand, and logistical performance within the supply chain. Golubeva (2021) scrutinized financial performance during the pandemic, revealing that equity contributions played a substantial role in financing, while country-specific factors, such as governance infrastructure and economic development, played pivotal roles in business success. Indriastuti and Fuad (2020) addressed the sustainability of small and medium-sized enterprises (SMEs) and the imperative digital shift during COVID-19, particularly in light of SMEs' vulnerability and the need to leverage technology for long-term viability. Devi et al. (2020) assessed the impact of COVID-19 on Indonesian listed companies, observing notable shifts in profitability and liquidity ratios during the pandemic. Tahu and Yuesti (2021) analyzed the financial impact of COVID-19 on Indonesian LQ-45 firms, with discernable differences in solvency and activity ratios pre and post-pandemic. Gregurec, Tomii-Pupek, and Tomii-Furjan (2021) examined how COVID-19 disruptions prompted SMEs to embrace technology and alter their business models for sustainability. Fabeil et al. (2020) shed light on micro-enterprises' business continuity and recovery strategies during the pandemic, offering valuable insights into subsistence approaches for these businesses. Lastly, Verma and Gustafsson (2020) conducted a bibliometric analysis of COVID-19 research in the business and management field, identifying key research themes and suggesting future avenues for study. Collectively, these studies emphasize the diverse and profound effects of the COVID-19 pandemic on businesses across various sectors and aspects of operation. They offer valuable insights that can inform both academic research and practical decision-making, underscoring the need for adaptive strategies and resilient business models in the face of unprecedented challenges.

Corporate Governance impact on Firm Performance

The field of corporate governance and its impact on financial performance has been significantly enriched by several notable studies. For instance, Nakhaei and Hamid (2013) conducted a rigorous investigation into the Tehran Stock Exchange (TSE), meticulously analyzing the intricate interplay between market value added (MVA), economic value added (EVA), return on equity (ROE), and return on assets (ROA), revealing a substantial connection between EVA and ROE with MVA. Conversely, the work of Arumona, Onmonya, and Omotayo (2019) offered critical insights from the Nigerian healthcare industry, shedding light on the correlation between board members' financial education and business performance, emphasizing the pivotal role of financial literacy across board members of diverse educational backgrounds. Datta (2018), in the context of Bangladesh's insurance sector, provided a comprehensive examination of the influence of corporate governance, underscoring the significance of factors like board size, composition, meetings, and audit committees in driving business performance. Moreover, Oroud (2019) delved into the attributes of audit committees in Jordan's industrial enterprises, unveiling their substantial influence on profitability and highlighting the relevance of resource dependency theory in the realm of corporate governance. In a different geographical context, Lenka (2017) offered an insightful dissection of the relationship between leverage and corporate performance in the Czech Republic, unearthing sector-dependent correlations and elucidating the nuanced role of leverage in diverse industries. Additionally, Rehman (2013) explored the intriguing dynamics

between financial leverage and the financial performance of the sugar industry in Pakistan, unveiling both positive and negative correlations between debt-equity ratios and various financial metrics. These studies collectively present a nuanced and academically robust understanding of the multifaceted relationship between corporate governance, financial performance, and industry-specific intricacies, thereby offering invaluable insights for academic scholars, corporate leaders, regulatory authorities, and prospective researchers (Nakhaei & Hamid, 2013; Arumona et al., 2019; Datta, 2018; Oroud, 2019; Lenka, 2017; Rehman, 2013).

Corporate Governance and COVID-19

The impact of the COVID-19 pandemic on corporate governance and business performance has sparked significant research interest in recent years. Hsu et al. (2021) focused on the U.S. stock market, evaluating the pandemic's influence on stock price volatility, trading activity, and stock returns, particularly under the CARES Act, highlighting the changing dynamics of corporate governance during the crisis. In Malaysia, Naeem et al. (2022) explored the nuanced relationship between gender diversity on corporate boards and firm performance amid the pandemic, emphasizing the importance of sustainable corporate governance. Hsu et al. (2022) delved into the solvency and default probability of EU-listed firms, revealing the complexities of tax policies and hybrid support strategies as safeguards against financial collapse in the face of escalating economic shocks. Shifting the focus to emerging markets, Le et al. (2022) analyzed the role of corporate governance principles in fostering business continuity among SMEs during the pandemic, highlighting the moderating effect of governance on sustaining firm performance in turbulent external environments. Lastly, Koutoupis et al. (2021) conducted a broad examination of the relationship between corporate social responsibility (CSR), corporate governance (CG), and environmental, social, and governance (ESG) aspects amid the pandemic, emphasizing the need for a more comprehensive global assessment to understand the intricate dynamics. Within the Malaysian context, Khatib and Nour (2021) scrutinized the role of the Audit Committee in corporate governance within the post-COVID era, revealing the profound influence of board size and diversity on firm performance, as well as the critical impact of audit committee and board meetings on company outcomes, shedding light on corporate resilience amidst a time of uncertainty. These diverse studies underscore the evolving landscape of corporate governance in response to the pandemic's challenges, emphasizing the need for adaptive governance frameworks to ensure sustainable business performance in an ever-changing environment.

Theoretical Framework
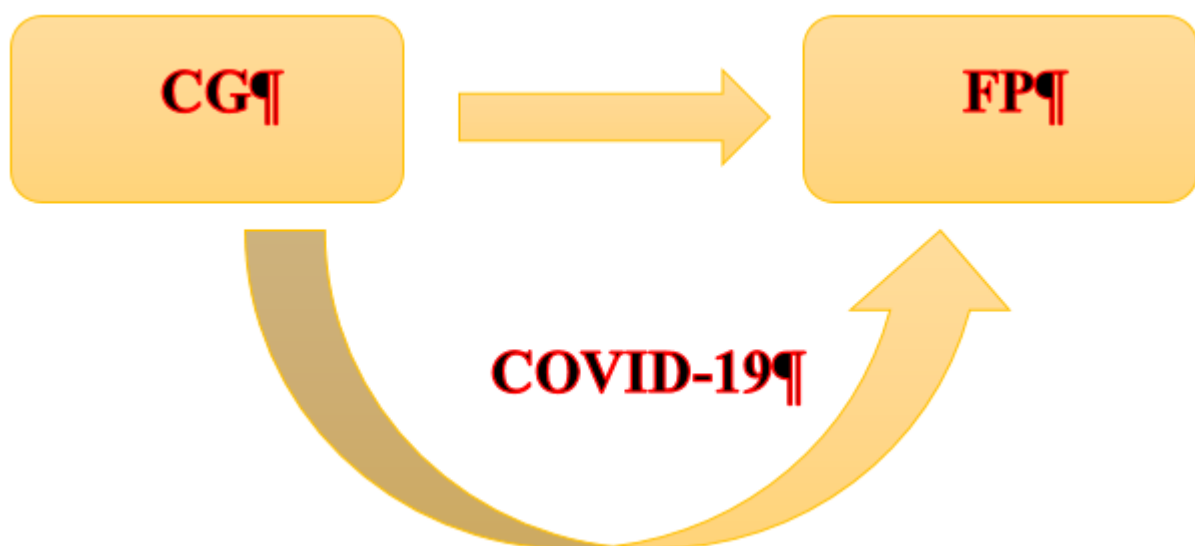
Research Hypotheses

H1: CG has a significant impact on the FP of the KSE-100 Index during COVID-19.

H2a: Ceteris paribus, board size has a significant positive impact on firm performance.

H2b: Ceteris paribus, board independence has a significant positive impact on firm performance.

H2c: Ceteris paribus, board gender diversity has a significant positive impact on FP.

H2d: Ceteris paribus, board meeting has a significant positive impact on firm performance.

H2e: Ceteris paribus, board financial qualification has a significant positive impact on FP.

H2f: Ceteris paribus, audit committee size has a significant positive impact on firm performance.

H2g: Ceteris paribus, audit committee meeting has a significant positive impact on FP.

H3: CG has a significant impact on the FP of the KSE-100 Index.

H4: The significant difference of CG impact on the KSE-100 firms in both pre-and post- COVID-19 scenarios.

Methodology

Data and Sample

The data will consist of both quantitative and qualitative nature. In this paper, we use panel data. We collected the data from the website of the Pakistan stock exchange and the SBP Publication to screen out all data including all the firms which are listed on the Pakistan stock exchange. In the sample, we exclude all the financial firms and all those firms whose data is not available in the state bank of Pakistan (SBP) publication. Due to this, our sample consists of the 69 non-financial firms which are registered on PSX.

The annual reports are manually gathered for CG information such as board composition, impartiality, gender parity, meetings, size of the audit committee, and audit committee meetings. With the aid of SBP Publication, further financial information was gathered, covering all financial measures of business performance.

Nature of Research

This paper will conduct an event study. This paper is exploratory research to explore corporate governance's effects on a company performance both before and after COVID-19. To see that COVID-19 has a significant effect on corporate governance of firm performance.

Technique

The subsequent A standard t-test was performed by various researchers (Khan et al., 2020; Hazaea et al., 2020; He et al., 2020) to investigate the effects of COVID-19 on the CG traits both before and after the pandemic (2019 and 2020). The table lists and describes every variable used in the study.

	Variable name		**Definition**
	Return on assets	**ROA**	**the proportion of total assets to profits before interest and taxes.**
	Return on equity	**ROE**	**the proportion of equity to profits before interest and taxes.**
Firm Performance	**Earnings before interest and tax**	**EBIT**	**An indicator of profitability is the ratio of assets to profits before interest and taxes.**
	Leverage	**LEV**	**how much total debt is compared to total assets.**

	Liquidity	LIQ	The quick asset ratio and the cash to current liabilities ratio at the conclusion of each fiscal year have been used to gauge liquidity.
	Dividend per share	DPS	According to the number of outstanding shares, cash dividends are distributed.
Corporate Governance	Board size	BSIZ	a total number of board members.
	Board independence	BIND	the number of non-executive directors that are independent on the board.
	Board gender diversity	BGD	There are a number of female directors on the board.
	Board meeting	BM	The board met many times throughout the fiscal year.
	Board financial qualification	BFQ	how many directors have financial and economic backgrounds.
	Audit committee size	ACS	The audit committee includes a number of directors.
	Audit committee meeting	ACM	The audit committee met often during the fiscal year.
COVID-19	COVID-19	COV	2020
	Non-COVID-19	NCOV	2019

In order to look at the connection between governance and performance, we also used the Ordinary Least Square (OLS) method. We carry out Hausman and Breusch tests as well as Pagan Lagrangian multiplier testing to determine the best panel data analysis. In order to Corporate governance affects business performance, we also created a regression model.

Result and discussion

Descriptive and Correlation Analysis

Person Correlation of Firm Performance Table 02

	ROA	ROE	EBIT	LEV	LEQ	DPS	BSIZ	BIND	BGD	BM	BFQ	ACS	ACM
ROA	1												
ROE	(0.163)	1											

EBIT	0.417**	(0.134)	1										
LEV	0.079	(0.717)**	0.067	1									
LEQ	0.513**	(0.022)	0.293**	0.019	1								
DPS	0.314**	0.035	0.120	0.023	0.114	1							
BSIZ	(0.069)	0.097	0.072	(0.061)	(0.031)	(0.030)	1						
BIND	0.051	0.089	(0.059)	(0.111)	0.199*	(0.025)	0.549**	1					
BGD	(0.094)	0.055	0.157	(0.034)	0.009	(0.046)	0.134	0.155	1				
BM	(0.080)	0.232**	(0.041)	(0.254)**	0.075	0.048	0.458**	0.397**	0.076	1			
BFQ	0.062	0.064	0.042	(0.109)	(0.057)	(0.094)	0.474**	0.242**	(0.160)	0.162	1		
ACS	0.085	0.134	0.159	(0.110)	0.253**	0.046	0.470**	0.311**	0.011	0.570**	0.169*	1	
ACM	(0.141)	0.226**	(0.095)	(0.118)	(0.081)	0.006	0.344**	0.232**	0.036	0.677**	0.200*	0.463**	1
Obs	138	138	138	138	138	138	138	138	138	138	138	138	138
VIF	--	2.251	1.28	2.283	1.368	1.053	2.333	1.7	1.173	2.606	1.469	1.894	2.128
Min	(61.80)	(455.30)	1.33	(195.51)	0.06	-	1.62	-	-	3.70	-	1.10	1.18
Max	24.60	784.79	19.00	30.97	7.02	105.00	13.00	6.00	3.00	22.00	9.00	10.00	10.00
Mean	0.50	19.99	16.83	1.27	1.31	3.38	8.27	2.41	0.81	6.67	3.45	3.84	4.53
Std. Dev	12.56	111.66	1.87	18.91	1.09	11.65	1.70	1.31	0.74	3.68	1.81	1.11	1.20
Obs	138	138	138	138	138	138	138	138	138	138	138	138	138

Table 02, presented in the study, elucidates the intricate web of relationships among the variables, delineating both significant and insignificant correlations, both positive and negative, while also highlighting their levels of statistical significance through asterisks. Notably, the positive associations between variables are evident, with ROA positively correlated with EBIT, LEQ, and DPS at a 5% significance level. Similarly, ROE exhibits positive connections with BM and ACM at a 5% threshold, while EBIT and LEQ also showcase favorable relationships. Moreover, BM positively correlates with several variables, such as ACS and ACM, at a 5% significance level. Conversely, certain factors display substantial negative associations, such as the negative correlation between ROE and LEV at a 5% significance level. This comprehensive table not only captures the relationships between these variables but also serves as a foundational basis for further research. The VIF values, representing variance inflation factors, offer insights into multi-collinearity, with notably high values for some variables like ROE, suggesting interdependencies, while minimum and maximum values, means, and standard deviations provide a comprehensive understanding of variable distributions and trends, vital for accurate research interpretation (Khan, Tanveer & Malik, 2017).

Paired Sample T-Test Of Firm Performance Table 04	Before (2019)	COVID-19	After (2020)	COVID-19	Mean Deference	T-Test
	Mean	Std. Deviation	Mean	Std. Deviation		
ROA	1.19	14.15	(0.35)	10.89	1.54	1.757
ROE	38.59	137.96	0.07	74.66	38.53	2.735
EBIT	17.01	1.32	16.87	1.34	0.35	2.036
LEV	(0.22)	24.59	2.51	10.86	(2.73)	(1.467)
LEQ	1.29	1.10	1.33	1.10	(0.05)	(0.889)
DPS	3.98	13.96	2.65	8.98	1.33	1.577
BSIZ	8.23	1.54	8.41	1.70	(0.17)	(1.988)
BIND	2.32	1.29	2.52	1.34	(0.20)	(2.574)
BGD	0.75	0.76	0.87	0.75	(0.12)	(2.637)
BM	6.45	3.57	6.94	3.83	(0.49)	(1.978)
BFQ	3.39	1.70	3.54	1.94	(0.14)	(1.165)
ACS	3.83	1.01	3.88	1.18	(0.06)	(0.893)
ACM	4.48	0.85	4.62	1.44	(0.14)	(1.165)

The presented table provides the results of the paired sample t-tests, which aim to ascertain the variations in mean values for an array of variables, encompassing ROA, ROE, EBIT, LEV, LEQ, DPS, BSIZ, BIND, BGD, BM, BFQ, ACS, and ACM, between the pre- and post-COVID-19 periods. The primary objective of this analysis is to detect any substantial alterations induced by the pandemic. While nine variables display negative coefficients and matching t-test values, these results do not achieve statistical significance when compared to tabulated t-values. In contrast, four variables—ROA, ROE, EBIT, and DPS—exhibit positive t-values, with four of them achieving statistical significance. Notably, mean ROE values exhibit significant findings, indicating a substantial difference of 38.53 units between the two periods, with a significance level of 0.8%. Similarly, EBIT demonstrates a significant change of 0.35 units with a significance level of 4.6%, and BIND exhibits a highly significant difference of -0.2 units with a significance level of 1%. These results contribute to a more comprehensive understanding of how the COVID-19 pandemic has impacted the analyzed parameters. Furthermore, these findings present variations in correlation between corporate governance characteristics and financial indicators, deviating from some previous literature, and thus contribute to the ongoing scholarly discourse on the subject. In line with Table 03, these results support Hypothesis H4, emphasizing the significant divergence in the impact of corporate governance on KSE-100 firms in both pre- and post-COVID-19 scenarios.

Regression Results and Discussion

Panel OLS Regressions of Firm Performance Table 04

	ROA	ROE
Const	−44.9245 ***	70.0904
	(-3.637)	(0.7137)
EBIT	2.73427 ***	−9.39318 *
	(3.838)	(−1.674)
LEV	0.0286521	−4.26656 ***
	(0.6154)	(−11.55)
LIQ	4.55017***	5.04718
	(5.113)	(0.7126)
DPS	0.261270 ***	0.601719

	(3.563)	(1.035)		
BS	−0.988378	6.39628		
	(−1.250)	(1.020)		
BIND	0.835189	−4.63062		
	(1.001)	(−0.7011)		
BGD	−1.64136	6.15795		
	(−1.355)	(0.6414)		
BM	−0.156261	−3.74968		
	(−0.4277)	(−1.299)		
BFQ	0.976941 *	−2.94924		
	(1.747)	(−0.6650)		
ACS	−0.122080	1.63379		
	(−0.1156)	(0.1957)		
ACM	−0.471682	19.0358 **		
	(−0.4643)	(2.358)		
R-Squared	0.440481	0.555810		
Obs.	138	138		

The findings in Table 4 reveal a comprehensive analysis of the relationship between key variables and the dependent variables, ROA and ROE. Notably, ROA is positively influenced by several study variables, including EBIT, LEV, LEQ, DPS, BIND, and BFQ, while it exhibits a negative correlation with variables such as BS, BGD, BM, ACS, and ACM. While six factors demonstrate a positive impact on ROA, only four of them attain statistical significance, with EBIT, LEQ, and DPS showing strong statistical significance at the 1% level. Conversely, when examining ROE, it becomes evident that six variables, including LEQ, DPS, BS, BGD, ACS, and ACM, have a favorable impact, while EBIT, LEV, BIND, BM, and BFQ exhibit a negative correlation. However, only ACM achieves statistical significance at the 5% level. In conclusion, the research highlights the intricate relationship between these variables and the financial metrics of ROA and ROE, with only certain variables demonstrating statistically significant impacts.

The significant increase in Earnings Before Interest and Taxes (EBIT) affecting the positive change in Return on Assets (ROA) aligns with recent scholarly works, emphasizing the importance of operational performance for ROA. The inverse relationship between EBIT and ROE suggests that a surge in EBIT may not consistently benefit ROE, underscoring the influence of capital structure and debt financing. Similarly, the positive impact of LEQ on ROA underscores the significance of prudent financial management, while the connection between DPS and ROA highlights the importance of balanced dividend policies. The positive influence of BFQ on ROA supports the role of board financial expertise in asset returns, and the positive impact of ACM on ROE underscores the significance of effective financial oversight. These findings offer valuable insights into the complex interplay of variables with financial performance metrics.

In Table 5, the results lend support to Hypothesis H3, affirming the significant impact of corporate governance (CG) on the financial performance (FP) of the KSE-100 Index. Furthermore, it validates Hypothesis H2g, suggesting that audit committee meetings have a significant positive impact on FP, thus strengthening the understanding of the role of such meetings. However, Hypotheses H2a-H2f are rejected based on the results presented in Table 5, emphasizing the nuanced nature of the relationships examined.

Robustness Test

Panel OLS Regressions of Firm Performance: Year Sub-Samples Table 06

	ROA		ROE	
	2019	**2020**	**2019**	**2020**
Const	−37.6273	−36.0606 **	132.747	−61.0484
	(-1.592)	(-2.426)	(0.7142)	(−0.6125)
EBIT	3.32924 ***	1.53300 *	−21.1037 **	1.65406
	(2.718)	(1.701)	(−2.191)	(0.2736)
LEV	0.0467616	0.0255910	−4.20666 ***	−4.51769 ***
	(0.7447)	(0.2458)	(−8.520)	(−6.470)

LEQ	3.63250 ** (2.415)	5.08571 *** (4.761)	8.94859 (0.7567)	5.85199 (0.8169)
DPS	0.232959 ** (2.288)	0.372890 *** (3.192)	0.328689 (0.4106)	0.942941 (1.204)
BSIZ	−1.91569 (-1.369)	−0.125076 (-0.1382)	15.0969 (1.372)	−1.15967 (−0.1911)
BIND	0.0223002 (0.01553)	0.975975 (0.9754)	3.14001 (0.2780)	−4.95919 (−0.7391)
BGD	−2.36115 (-1.123)	−0.239131 (-0.1638)	2.69121 (0.1628)	13.3008 (1.359)
BM	0.153963 (0.2524)	−0.532644 (-1.143)	−5.86543 (−1.223)	−0.709892 (−0.2272)
BFQ	1.30160 (1.170)	0.655973 (1.070)	−1.42491 (−0.1629)	−3.19150 (−0.7765)
ACS	1.14651 (0.5992)	−0.461078 (-0.3915)	−11.5643 (−0.7686)	9.81394 (1.243)
ACM	−3.50609 (-1.469)	0.858676 (0.7220)	45.6179 ** (2.430)	4.98010 (0.6244)
F-statistic	4.625381	5.402687	9.891959	5.872166
R-Squared	0.471631	0.510434	0.656236	0.531226
Obs.	69	69	69	69

The findings presented in Table 4.1 illustrate the distinct effects of various research factors on Return on Assets (ROA) and Return on Equity (ROE) for the years 2019 and 2020. In 2019, multiple factors had a positive impact on ROA, including EBIT, LEV, LEQ, DPS, BIND, BM, BFQ, and ACS, while BSIZ, BGD, and ACM had a negative influence. A similar pattern continued into 2020, with EBIT, LEV, LEQ, DPS, BIND, and ACS positively affecting ROA, and BSIA, BGD, BM, BFQ, and ACS showing a negative correlation. Notably, only EBIT, LEQ, and DPS held statistical significance. The significance of these variables varied between the two years, with EBIT, LEQ, and DPS demonstrating different degrees of importance. On the other hand, for ROE in 2019, six factors showed a positive influence, while EBIT, LEV, BM, BFQ, and ACS had a negative impact. In 2020, LEV, BSIA, BGD, BM, BFQ negatively influenced ROE, while EBIT, LEQ, DPS, ACS, and ACM had a positive correlation. Significance was observed for only three of the six factors that positively affected ROE in 2019, with just one variable establishing a meaningful relationship in 2020. Consequently, these findings underscore the complex and evolving relationships between these variables and ROE. Coefficient analysis also reveals noteworthy impacts, with EBIT positively affecting ROA but negatively influencing ROE. Similarly, LEV showed a negative relationship with ROE but had a positive impact on ROA. The relationship between LEQ and DPS with ROA and ROE also exhibited varying degrees of significance. These results align with existing academic literature and emphasize the multifaceted nature of these interactions. However, Table 06 indicates that the study findings do not support Hypothesis H1, which posits that corporate governance significantly impacts the financial performance of the KSE-100 Index during the COVID-19 pandemic.

Conclusion

This study investigates the impact of corporate governance (CG) on the performance of KSE-100 Index-listed companies, specifically focusing on Return on Assets (ROA) and Return on Equity (ROE) in the pre- and post-COVID-19 eras. It hypothesizes that the influence of CG differs across these periods and plays a significant role in firm performance. Using pooled regression analysis with Gretl software, the research uncovers key insights. Notably, variables like Earnings Before Interest and Taxes (EBIT), Liquidity and Earnings Quality (LEQ), Dividend Payout Ratio (DPS), and certain CG-related factors consistently impact ROA and ROE, though not all exhibit statistical significance. What's intriguing is how these effects evolving over time, with factors like EBIT, LEQ, and DPS maintaining their influence but with varying significance levels between 2019 and 2020. In contrast, Leverage (LEV) and Board Gender Diversity (BGD) consistently show negative effects. This analysis underscores the dynamic nature of CG's impact and the importance of adaptive governance strategies. It also highlights the critical role of prudent financial decision-making, effective liquidity management, and sound dividend policies in driving improved financial outcomes. The study suggests avenues for future research, including an exploration of the specific drivers behind these changing

effects and an evaluation of CG practices during times of economic turbulence, such as the COVID-19 pandemic. In sum, it sheds light on the intricate interplay between corporate governance practices and financial metrics, offering valuable guidance for businesses seeking to make informed decisions and enhance their financial performance.

Future Recommendations

The paired sample t-test was conducted to examine potential differences in mean values for various variables, including ROA, ROE, EBIT, LEV, LEQ, DPS, BSIZ, BIND, BGD, BM, BFQ, ACS, and ACM, before and after the onset of the COVID-19 pandemic. Results indicate that while several variables exhibit negative coefficients and t-test values, they fail to reach statistical significance. However, four variables—ROA, ROE, EBIT, and DPS—stand out with statistically significant outcomes, signifying substantial changes during the pandemic. Most notably, ROE demonstrates a significant difference, with a 38.53-unit shift, reflecting the pandemic's profound impact. EBIT, BIND, and BGD also reveal significant variations, emphasizing the intricate influence of COVID-19 on corporate performance and governance. Understanding these changes is crucial for organizations as they navigate the evolving landscape shaped by global events, providing valuable insights into the pandemic's implications for business dynamics.

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The Figures of Speech in Twenty Pakistani Print Advertisements

Shahbaz Khan, Zulfiqar Ali
City University of Science and Technology Peshawar, Pakistan,
shahbaz.gulozai@gamil.com

Abstract

The current paper bases the research upon the twelve figures of speech based on Perrine's theory (1969), namely: metaphor, simile, personification, synecdoche, metonymy, symbol, allegory, overstatement, apostrophe, paradox, understatement, verbal irony. This research paper is conducted by applying the qualitative and quantitative methodology. The researcher took twenty Pakistani print advertisements randomly from different media like electronic newspapers, TV channels and magazines. The result shows that there are only six figures of speech used in the print advertisements, they are: hyperbole, metaphor, personification, apostrophe, simile and synecdoche. The most dominant and frequently occurred figure of speech is hyperbole among the given twenty advertisements. This dominancy in certain figures of speech always occur to attract customers as well as audience towards the product.

Keywords: Advertisement, figures of speech, functions of figures of speech

Introduction

Language has a great and effective role in our lives. We as a social beings need language as a medium to communicate with each other's. Language is a communicating tool using sounds, symbols and words to convey our feelings and meanings to others. One of the devices of communication that we communicate with our people in surrounding is advertisement.

In modern society, advertising has invaded every aspect of our life. It has effected modern people's lifestyles. We are surrounded by various kinds of advertisements. Whenever we open a newspaper, turn on the TV or the radio, or look at the billboards in city on a building, we are exposed to various advertisements. More importantly the advertisements have impact on our socio economic life. As (Geis, 1982: xi) states, '*Advertising is as omnipresent as the air we breathe'.* (Cook, 2001, p.203) writes, '*We are inevitably bombarded with various advertisements in our daily lives. Given the pervasiveness, it is likely that adverts will be easily ignored by audiences as some features of advertising are unsolicited and invasive, thrust upon the audience without consultation'.* Advert designers, therefore, try to employ some tactics to make ads more persuasive and to grab the attentions of customers.

Although and advertisement is composed with verbal and non-verbal communication, language in advertisements is considered as a powerful tool to achieve advertising goals. '*It is the main vehicle to convey messages to consumers and plays a vital role in facilitating people's memory of desirability of products or services'* (Geis, 1982, p. 2). Advertising language thus is frequently exploited by advertisers. The use of words in the language of advertisement has great effect on the success of the advertisement as it directly impact the readers. The master of the advertising world, Burnett, once said, "*Words are the best arm in our industry. In expression of ideas and feelings, words give advertising passion and soul".* He also added to his views that good advertising is a happy marriage of words and images, not the contest between them.

As a special form of communication, most advertisements are actually a kind of persuasive speech act with an aim to persuade consumers into buying or accepting certain product of service. To achieve this purpose, advertisers frequently employ strategies and skill in advertising language. Researches show that people pay attention to what interests them and ignore what does not. In order to arouse people's attention, advertisements express the ideas indirectly by applying figures of speech which leads to captivate the minds of people.

The figures of speech includes twelve famous figures of speech which were presented by Laurence Perrine (1969), in his book, *Sounds and Sense*.

This research paper is concerned with the analysis of written adverts of different brands consumed in Pakistan. Different written products of Pakistan with attractive taglines are analyzed with the model of Laurence Perrine that is the twelve figures of speech. They are metaphor, simile, personification, synecdoche, metonymy, symbol, allegory, overstatement, apostrophe, paradox, understatement and verbal irony.

This research paper observes that how different figures of speech are directed towards the communicative intentions in advertisements. Language is the more persuasive and influential tool in order to convince anyone. There is relation between the advertiser and the audience which depends upon the choice of words which affects the audiences. The Perrine's theory is employed on twenty taglines of famous advertisements of Pakistan. How different taglines has an effect on the audiences by different advertisers, what rule they follow to attract the audience.

Problem Statement

Language has a power that no other instrument can have. Individuals can express their feelings, thoughts and ideas based on language. People use different communicative tactics to get favor from others, influence them by their words or sometimes manipulate other's minds. Persuasive and tactful language is primarily used by journalists, people in business, political leaders and advertisers. The researchers in this paper aimed to find out linguistic choices and to explore intended or hidden meanings of the words used by advertisers in the language of advertisements.

Research Objectives

The objectives in this study are formulated as the following:
* To describe what types of figures of speech are used in Pakistani print advertisements.
* To identify the types of figures of speech dominantly used in the taglines.

Significance of the Study

The study gave insight to the readers on how advertisers use persuasive language to grab the attention of the readers. Every person needs to be familiar with the reality and truth of the advertisers that how they manipulate the ideas of readers and how they sell their products. To give a better understanding about figures of speech in the language of different advertisements. Linguists and the students of literature must know about the discourse of the advertisers that how they spread the false language through their advertisements' taglines. Students of science of language must know the reality of these tactful use of language by adverts and how they make fool of people as well as how they compel them to buy the products they really don't need. A discourse producer should spread such language which shows the true and positive image of the material world. The study provided a reference and a comparison for further study in the same topic.

Literature Review

This chapter begins by discussing the various views about the meaning, nature and function of advertisements for the understanding of the present study. It further elaborates the meaning and function of advertisements adopted by various researchers. This chapter also clears the role of advertisement in TV commercial and its function in the world of Economy. It focuses on the language and structure of advertisements and tactics followed by the advertisers for the attraction of the audience.

Advertisement

The word "advertise" originated from "advertere" in latin, with the meaning of "attention", "induce" and "drawing others' attention". Its literal meaning is "to turn toward to" and its literary meaning is "pay heed to or drawing attention to something".
One definition of advertising is: "*Advertising is the non-personal communication of information usually paid for and usually persuasive in nature about products, services or ideas by identified sponsors through the various media.*" (Bovee, 1992, p.7).
According to Philip Kotler, (1984, 556) "*Advertising is any paid form of non-personal presentation and promotion of ideas, goods, or services by and identified sponsor.*" In simple words, "Advertising is a mean of informing and communicating essential information."
As advertisement is the part of communication which deals with the attraction of the attentions of the readers, therefore there are some rhetorical devices which beautify the language of the advertisements.

Since advertising is so important in our life, many people try to analyze advertising language to have a better understanding of advertising. They analyzed advertising language from different perspectives.

Akinbode (2012) views about advertising as one of the oldest professions of the world. He talks about the function of language as effective tool which makes advertising unique and persuasive. He discussed all the essential elements of advertising language which enables advertisers reach the target audience and influence the consumer's purchasing attitude. This sociolinguistic analysis proves that apart from the language used in advertising to persuade consumers, some extra-linguistic factors such as context of situation and illustrations also play significant role in deciding the overall texture of an advertisement and its effectiveness.

Emodi (2011) has analyzed the language of advertisements from the perspective of semantics and is of the view that language of advertisement is highly innovative and fascinating. The purpose to keep the information in the minds of readers for a longer time, the advertisers manipulate the language in a very persuasive way. "Therefore the novelty and freshness of advertising language is justified for the purpose of attracting people's attention, winning their trust and swaying their thinking". (P.10)

Charles (2001) talks about the language of advertisement in this way, although advertisements take liberties as far as linguistic conventions are concerned, they still do not disregard all of the conventions. Advertisements disregard rules and conventions that end up affecting mainly the reference to the product and would make readers have to reconstruct them and insert a referent. In doing so, readers will arrive back at a certain entity as the referent and at the product as the focus of the advertisement. This pattern of rule-breaking then is very valuable and beneficial to the realm of advertising as it helps advertisers achieve their goal of marketing a product as one that is desirable. (.P .25)

Ezejideaku and Ugwa (2010) have explored the language of African advertisements. They have observed various linguistic devices at phonological, semantic, syntax and morphological level. They have proved that language of African print media advertisements is more focused on 'aesthetic' issue than commerce. All these linguistic devices contribute in success of advertising and leave a permanent impression on the mind of the reader. (p.15)

Kagira (2009) is of the view that the language of advertisement not only informs the audience about the product but also possessing persuasive effect. "From a linguistic point of view, it is evident that, among other things, designers of adverts pay attention to the morpho-syntactic, semantic and phonological aspects of the language used in an advert". (P.1)

Djafarova (2008) has analyzed the function of pun in advertisements. Through qualitative content and pragmatic analysis, the ambiguous nature of pun is explained as it can be interpreted differently according to the context. Pun not only conveys double meaning but also creates a sense of humor and sometimes ambiguity which gives readers liberty to interpret the meanings according to their cultural context.

According to Waller D.S (2000), while many products are not perceived as controversial in nature and have no restrictions on how it is sold, there may be restrictions on the type of images that can be used in its advertising. Some images in advertising, including nudity, anti-social behavior, racist and sexist images, are openly used in some cultures, but restricted in others to reduce the degree of offense in the community. Thus, it is the viewpoint of most Malaysians and the Malaysian government that advertising needs harnessing in order to help construct a just society, not just a consumer society (Frith, 1996).

Maria Cecilia Countinho de Arruda and Marcelo Leme de Arruda conducted a study with a purpose is to persuade the individuals involved in the advertising industry to mediate about the values embedded in the campaigns they developed, guiding them towards the universal goal, helping them to find a wise and prudent way of acting (Arruda & Arruda, 1999).

In order to identify misleading and deceitful advertising, Russo, Metcalf and Stephens suggested three alternative views such as fraud, falsity and misleadingness because they are parallel to the three components of advertising communication; the advertiser, the message, and the consumer beliefs about the advertised product (Russo, Metcalf, & Stephens, 1981).

A study done by Frazer emphasizes on the importance of educators to instill advertising ethics in the students (Frazer, 1979). This is because one of the paths that the advertising major students have after graduation is to work with advertising agencies or advertising related organizations.

Another study was done by Hackley with the objective to explore how ethics in and of advertising may be subject to examination within a broadly social constructionist perspective (Hackley, 1999).

Deception in advertising such as price misleading advertising can generate negative consumer reactions in terms of attitude and intention and these are highlighted with the presence of suspicion (Romani, 2006).

Jacoby and Hoyer argue that people cannot always assume that an advertisement is misleading because there is evidence that the viewer or reader does not understand a particular claim and this is due to miscomprehension and not deceptive advertising (Jacoby & Hoyer, 1990).

A study reported by Rajesh Kumar (2010), culture does affect the perception of global advertisement. Therefore, the understanding of cultural differences is often considered a pre-requisite for successful international advertising because consumers grow up in a particular culture and become aligned with that culture value system and beliefs.

Although there are number of studies done in the field of advertisements from the perspective of different theories like, syntactical analysis, semantic analysis, phonological level, CDA, cooperative of Grice. Desired attention was not paid to the Pakistani print advertisements from the perspective of figures of speech model of Perrine. Taking into account Pakistani famous print advertisements' tagline related with the famous brands, the researcher aims to analyze these ads from the point of view of twelve figures of speech.

Methodology and Framework

This research is conducted by descriptive qualitative and quantitative design. Punch (1998: 59) defines qualitative research is empirical research where the data are not in the form of numbers and quantitative research is where the data are in form of numbers.

Qualitative research involves analysis of data such as words, examples from interviews, pictures, transcripts, notes, documents, etc. Quantitative research involves analysis of numerical data, from either counting or scaling both.

The present research employs the twelve figures of speech presented by Laurence Perrine in his book *Sounds and Sense.* According to Wren and Martin (1990:359), a figure of speech is a departure from the ordinary form of expression, or the ordinary course of ideas in order to produce a greater effect. Therefore, figures of speech are a way to express our mind so that the listeners or readers can be interested in our expression and those are used to increase shock, novelty, appearance or illustrative consequences.

In this research, the researcher discusses the figurative language based on Perrine's perception. According to Perrine (1969:61-109), figurative language consists of 12 kinds, they are: simile, metaphor, personification, apostrophe, synecdoche, metonymy, symbol, allegory, paradox, hyperbole/overstatement, understatement, and irony.

Source of Data

The data of this research are the advertisements which were published between 2014 and 2020. There are twenty advertisements to be the samples of the study which will be taken randomly from different sources.

Sampling Techniques

Firstly, read the related books. Secondly read the magazines. The third is choosing the advertisement, finding out the figure of speech in the advertisement then counting and arranging them in tables to find the dominant type of the figures of speech in the advertisements.

Analysis and Discussion

Here the researcher studies different advertisements with its taglines to analyze. These taglines may be in Urdu language but they are translated into English for better understanding of the audience. Different companies have different products and services, for advertising their products the advertisers uses such attractive statements due to which the readers and viewers get their interests in the products. The advertisers indirectly uses rhetorical devices in the shape of figures of speech. According to Perrine (1969: 65), figures of speech are any way of saying something other than the ordinary way, and he has classified it into three categories. The first one is figures of speech by comparison, which are metaphor, simile, apostrophe, and personification. Second, there are figures of speech by association which consist of metonymy, synecdoche, symbol, and allegory. The last classification is figures of speech by contrast which include paradox, irony, hyperbole, and litotes.

Advertisements

Following are the advertisements which are most famous in Pakistani channels having attractive taglines in Urdu and English language. This analysis discusses the famous advertisement's taglines of the products and brands of detergents, creams, cooking oil, milk, biscuits and mobile networks.

Detergents

Ad No: 1

'Haar ko haranay me agar daagh lag jain to daagh achay hain, Surf Excel, Daagh to achay hotay hain.'
(Dirt is good if it teaches you to defeat failure)

Analysis

This brand has worked hard to aware the people, especially the children through experience. It gives message to the children about their learning through experience because Surf Excel is so good at cleaning that the children should not worry about the stains and the dirt. They can learn with experience anywhere anytime in playgrounds and other engagements for growing and nurturing well and can develop. It promotes the success, by defeating the failure. Failure occurs when there is some obstacle or hindrance in your way, therefore the advertisers assured the children that do not worry about the stains or getting dirty because this washing powder can clears your way for development.

Apart from the message which is given in the tagline, the language contains the figures of speech. The use of *metaphor* is used in the first part of the advertisement. Metaphor according to (Perrine, 1969: 65) is, *'the comparison between two objects in metaphor is implied or indirect.'* That means that the metaphorical word is closely connected with the lateral term. It does not use any connector to compare the two objects. As it can be seen in the first part of the tagline, '*the dirt is good',* the use of metaphor can be seen. '*Dirt*' is the thing which has been compared directly with the *good.* The second part of the tagline, '*if it teaches you to defeat failure'*, describes the activity of inanimate things which is same as the activity of human beings. Teaching is the type of action which can only be done by humans. Thus the second part of the tagline contains the figure of speech i.e. *personification.*

Ad No: 2

Ariel– *'Yeh daagh humain kya rokengay!'*
(How these stains can stop us

Analysis

The famous detergent Ariel has got an interesting tagline too. It conveys the message that stains cannot stop anyone from doing something. Looking from the point of view of Perrine, the tagline contains the rhetoric in the shape of *personification.* (Perrine 1969: 67), '*personification gives the attributes of a human being to an animal, an object, or a concept.'*

So, the advertisement's tagline contains the words that attributes the human quality. '*Stains'* is a thing which cannot perform an action by itself because it is a dead thing. Here, in the tagline it performed the human action and that is '*can stop us'.*

Ad No: 3

Dettol — *'Aap kay ghar ka muhafiz'*
(Defender of your family)

Analysis

The advertisement of the Dettol is most interesting because of its tagline. The attraction in the statement is due to its uses of words and idea. The meaning of the advertisement is that the Dettol can defend your family by killing the germs.

The advert has used the tactful use of words in the tagline with the beauty of language. He has adorned the tagline with the use of *personification*. The tagline contains the words, '*defender of your family',* which is the quality of the human being. The human can defend your family, the father can and other persons like mother or elder brother can defend the family, but the *Dettol* which is a liquid and cannot perform an action like humans. Therefore the advert has used the false use of language and adorned it with poetic language to grab the readers' attention.

Ad No: 4

'Brite sab right kar dega!'
(Brite will make all thing right)

Analysis

The famous television commercial of the detergent named BRITE has also an amazing tagline. Brite is brand name and the advertiser has attributed the special quality to it that it can make everything right. The use of *hyperbole* in the language of the advertisement is used in beautiful manner. *Hyperbole is concerned with personal values and emotions that make a subjective exaggeration* (Leech, 1968: 168).
This advertisement exaggerated the sense of making all the things right. How a small thing could make all things right and it is impossible but the advert has used it to divert the reader's attention.

Ad No: 5

Lemon Max — 'Aik drop chalay non-stop'
(One drop works non-stop)

Analysis

The meaning of the ad is that the liquid of *lemon max* is the chemical liquid which is used for the purpose of the washing of dishes. The one drop of the liquid is more enough to clean all dishes. It is so good in washing dishes that even one drop of the liquid is enough for non-stop washing.
The advert has used the '*hyperbole'* in the line of the advertisement and exaggerated the sense of work and time. It is impossible for a chemical detergent that it would work non-stop.
Another figures of speech which is also present in the tagline is *personification.* In Urdu tagline sentence, the word '*chalay',* can be translated in English as '*walking',* which is the quality of human being. A soap, lemon max, is not possible to walk.

Beauty Cream and Beauty Soap

Ad No: 6

'Zubaida Apa whitening soap, Ab gora hoga Pakistan.'
(Now Pakistan will be white!)

Analysis

The famous whitening soap named *Zubaida aapa whitening soap* launched by Zubaida tariq. She is considered an icon for the women of Pakistan because of her immense experience in home remedies and recipes. The famous soap which has an exaggerated slogan that *Let's Make Pakistan Whiter!* The meaning of the slogan is that she promises people that this soap will make all people of Pakistan white.
The *hyperbolic* ad has attracted the readers and in this slogan the advertiser has also overstated because the soap cannot make the whole Pakistani people white.
The advertisement contains the word *Pakistan* which is a form of *synecdoche.* Kovecses (2001:152) says that '*it is kind of figures of speech in which a part acts for the whole or the whole represent a part.'*

The tagline is form of *synecdoche* as well because the whole Pakistan does not mean everything present in Pakistan but it represent its parts and that is its people.

Ad No: 7

Golden pearl — 'khoobsorti ek sacha khuwab'
(Beauty is a true dream).

Analysis

This ad describing the beauty cream, have a tagline that beauty *is a true dream.* Although the meaning is that it is the dream of everyone that he or she becomes beautiful. The two opposite words *true dream* gives the sense which is confusing because it is an oxymoron. The explicit figure of speech is the use of '*metaphor'* in the tagline, where the *beauty* is directly compared with the *true dream.* This beautiful comparison has drawn the attention of the readers towards itself and has increased the value of the product.

Ad No: 8

Face Fresh — 'Jo face fresh wo hi beautiful'
(Only fresh face is beautiful)

Analysis

This beautiful ad has presented the tagline very cleverly. In this ad the standard of the beauty is compared by its own name. The implied meaning in this ad is that the person who uses this cream will become fresh which means that the person will become beautiful. The beautiful use of '*metaphor'* in the tagline has created the charm in the advertisement of the cream.

Ad No: 9

L'Oréal– ('because you're worth it!')

Analysis

'*Apostrophe*' is used because a directed statement is made to somebody who is not present. Apostrophe is closely related to personification. '*It is a figure of speech which addresses someone absent, dead, or something non-human as if that person or thing were present and could reply'* (Perrine, 1969: 67). It addressee here is addressed which is unknown to all and this creates the beauty in the tagline.

Ad No: 10

Dettol Herbal — 'Sehat mand jild ka mukamal ehsas'

(The complete sense of healthy skin)

Analysis

The tagline is exaggerated use of sense and words. The ad contains the word *complete sense* which implies that it is the overstated use of words which conveys the sense that have an exaggeration.
Hyperbolic use of word in the ad of the Dettol portrays the sense that the product is the complete sense of healthy skin.

Cooking Oil

Ad No: 11

Habib Cooking Oil — 'Kyonkey yay dil ka mamla hay'
(Because it's all about heart-matters)

Analysis

This is the ad of cooking oil, named *habib cooking oil,* in which the advertiser has said that it is the matter of heart. This ad is full of literary meanings which is more poetic and emotional. The figurative language has affected the audience because it has touched the feelings of the people. The advertiser plays with the emotions of the readers because the said slogan of the cooking oil contains the use of *metaphor.* The cooking phenomena with this special type of cooking oil is compared with the heart.

Ad No: 12

Meezan Cooking Oil — 'Har cheez meezan me achi pakti hain'
(Everything cooked in meezan is good)

Analysis

The advertiser of this ad has very good mind because he has put double meaning in the tagline which is very attractive in nature. The Urdu word *meezan* means balance, and in this context it also means the product name. The tagline has also overused the sense of goodness in cooking with the words *everything cooked in meezan is good.* The use of *hyperbole* by the advertisers has played the role in the tagline which attracted the readers towards the product. This cannot be true because it is not possible for everything to be cooked well but the figurative use of language has increased the beauty of the advertisement.

Ad No: 13

Momin — 'Naam ki tarha khalis'
(Pure like its name)

Analysis

The advertisement of the cooking oil *momin,* has also performed well with respect to its name and tagline. The name of the cooking oil has a name which defines purity. *Metaphor and simile are both used as a means of comparing things that are essentially unlike* (Perrine, 1969: 65). This tagline comprises the use of *simile.* The purity is compare with its name with the work *like.*

Ad No: 14

Shan Cooking Oil — 'Shan se behter kya hay!'
(What is better than shan!)

Analysis

The tagline describes the quality of the cooking oil by overstating the quality. The advertiser has used the words with tactful way to affect the people with its words style. The ad contains the *hyperbole* which says that there is nothing better than *shan* cooking oil. The impossibility of goodness is shown in the poetic use of language.

Ad No: 15

Super Habib Cooking Oil — 'Oil that know everybody!'

Analysis

The title of the product is as attractive as its tagline.
The title contains the words that shows the high quality of the oil. The use of the overstatement in the form of *hyperbole* is present in the title of the cooking oil. The word *super* represent the quality which is only shared by this cooking only. The word *everybody* shows the use of *hyperbolic statement* too, because how a cooking oil know all the things in our lives?
Another figure of speech that is present in this specific ad is the *personification.* Human attributes are given to the oil. The quality of *knowing* is of human beings and not cooking oil. Therefore the advertiser has used the oil as best quality user in its knowing everyone.

Mobile Networks

Ad No: 16

Warid —'Life ka network'
(Network of life)

Analysis

The mobile networks have advertisements which have different sologans based on figurative language, emotive language and untruth beliefs. The slogan of the Warid network, *life ka network,* is the tagline of Urdu language which means, *network of life.* This tagline means that due to Warid network we are so connected with each other that it became a network of life by connecting us with people. The name of the network is compared with life. The network name is used as the network of life with the help of *metaphor.*

Ad No: 17

Telenor — 'Sachi Yari'
(True friendship)

Analysis

The Telenor mobile network has a slogan in the advertisement, *sachi yari: a true friendship* which is emotional slogan. The Telenor is a mobile network which connects the different people by mobile networks. The advertiser has used the *metaphor* by calling the network a true friendship. Through the use of this figure of speech, the advert has shared the love and harmony of the people with the symbol of Telenor mobile networking as the true friendship.

Ad No: 18

Zong — 'Sab keh do'
(Say it all)

Analysis

The tagline of the network shares the idea that with *zong network* we can say all the things. The advertiser has cleverly used the language poetically. It is not possible for us to say all the things which are in our minds because there are something which is in our minds and we cannot say it in front of others. The use of *hyperbole*

in the tagline is used. The wordings like *say it all* conveys the sense that we should say all the things with *zong* network.

Ad No: 19

Ufone — 'Tum hi to ho'
(You are the one) or (It's all about you)

Analysis

This is the tagline of the Ufone mobile network which is defined by its best quality coverage system of signals. The advertiser has presented the Ufone with its best quality networking system.
The advertiser has used two figures of speech explicitly. The first one is the *apostrophe* and other is *hyperbole.* Here an anonymous addressee is addressed with the word *you.*
The use of *hyperbole* can be seen when we see the words *you are the one*. The advertiser has gone too far by exaggerating the slogan that is only Ufone mobile network that is good.

Ad No: 20

Jazz — 'Jazz apna hay'
(Jazz is ours)

Analysis

The famous tagline of the Jazz mobile network is advertising the best mobile networking by attributing it. The advertiser has stated a slogan that the Jazz network belongs to us because it is so good in network coverage that it's our relative in the sense of its good relation with us.
The advertiser has used the *metaphor* in the tagline of the advertisement. The quality of Jazz network is directly called relative of us. This has attracted the readers' minds towards the product.

Table A: The Proportion of Figures of Speech in the Advertisements

No.	Types of Figures of Speech	Frequency	Percentage
1.	Metaphor	7	28%
2.	Simile	1	4%
3.	Personification	5	20%
4.	Synecdoche	1	4%
5.	Metonymy	0	0%
6.	Symbol	0	0%
7.	Allegory	0	0%
8.	Hyperbole	9	36%
9.	Apostrophe	2	8%
10.	Understatement	0	0%
11.	Paradox	0	0%
12.	Verbal Irony	0	0%
	Total	**25**	**100%**

After collecting the data, the Pakistani print advertisements are classified on the basis of figures of speech. There are twelve types of Figures of Speech, namely: Metaphor, Simile, Personification, Synecdoche, Metonymy, Symbol, Allegory, Hyperbole, Apostrophe, Understatement, Paradox and Verbal Irony.
The Table A shows that there are only six type of figures of speech found from twenty advertisements of five different brands.
Following are the six figures of speech mentioned according to their frequencies in descending order:

Hyperbole 9 times, 36%, Metaphor 7 times, 28%, Personification 5 times, 20 %, Apostrophe 2 times, 8%, Simile 1 time, 4 %, Synecdoche 1 time, 4 %.

Research Findings

The findings of this study show that there are six figures of speech were found in twenty famous Pakistani print advertisements, they are Hyperbole, Metaphor, Personification, Apostrophe, Simile and Synecdoche. The total number of sentences in the advertisement is 25. It consists of 9 hyperbole (36%), 7 metaphor (28%), Personification 5 times 20 %, Apostrophe 2 times 8%, 1 simile (4%) and Synecdoche 1 time 4 %. The most dominant type of figure of speech is Hyperbole with score 36%.

The hyperbole is the most dominant type because the exaggerating meaning usually leaves something in the customer's mind so the customer would easily remember the advertisement and they would believe and eventually buy the product. The hyperbole is found in almost every advertisement. In another words, the hyperbole is used by the advertisers to hypnotize the customer to buy the product.

Conclusion

After analyzing the data in Pakistani print advertisements, conclusions are drawn as the following:
1. There are only six types of figures of speech were found in twenty famous Pakistani print advertisements. They are Hyperbole 9 times, Metaphor 7 times, Personification 5 times, Apostrophe 2 times, Simile 1 time, Synecdoche 1 time
2. The percentage of each type of advertisements is Hyperbole 36%, Metaphor 28%, Personification 20 %, Apostrophe 8%, Simile 4 % and Synecdoche 4 %.

The hyperbole is the most dominant type because the exaggerating meaning usually leaves something in the customers' minds so the customers would easily remember the advertisement and they would believe and eventually buy the product.

Suggestions and Recommendations

Related to the conclusions above, it is well suggested that:
1. The reader should study figures of speech because by learning the figures of speech, they will able to differentiate the each type of figure of speech.
2. And by knowing the difference of each type of figures of speech then the reader will be able to find the real meaning in cosmetic advertisement of a magazine, so they wouldn't easily be fooled by the words of advertisers.
The readers should take this journal as a reference when they decide to discuss about figures of speech for their thesis.

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Genderlect of Transgenders: A Conversational Analysis

Nimra Pervaiz, Professor Zulfiqar
City University of Science and Information Technology, Peshawar, Pakistan

Abstract

The primary goal of this research project is to differentiate genderlect of transgender from that of men and women. For this purpose, eighteen interviews of transgender were analyzed under the light of six set of features given in the theory of genderlect by Debora Tannen (1990). Language of transgender was examined keeping all the six features in mind. It was found that not only those features stated by Tannen are present in the language of transgender but also some other features were discovered. Therefore, the work adds to the evaluative understanding of the language of the transgender. It sums up how the language of transgender is different from the language of the other two genders highlighting the features of language that are particular to the genderlect of the transgender.

Keywords: Translect, Genderlect, Transgender, Features, A1-A8, Z1-Z10, Reasons, Conversation analysis.

Introduction

In genderlect theory given by Deborah Tannen (1990), she focuses on analyzing the dialect between humankinds at the binary level, both female and male, in order to demonstrate their dialogue patterns and rituals, to examine how gender differences generate a linguistic difference in communication. In her work, she shows that women are quite different from men in that they are more concerned about making connections and showing intimacy. Connection and intimacy are their main characteristic as they try to seek connection with others and their deep drive for connections makes them use language in certain ways that distinguish their speech from that of men. Their priority is to discuss feelings, relationships and people they will try to seek so speaking what sort of feelings other person have and the how relationships among their circle are. Overview about the genderlect of men and women, one gender which is naturally present in this world and is totally neglected. Transgender is the third natural gender of the world but in theory of genderlect there is no room for transgender they are totally out of the list. They also have their own way of speaking, their own way of putting their ideas across the world, the way they speak or the way they react in different situation also matters. This research focusses on the language of transgender in comparison to the language of other genders.

Thomson (2001) stated that gender is a socially developed ideology and norm that determines the actions and behavior of women and men. It is all the mindset of society how they want various actions work by categorizing them in genders. That is the people point of view that makes them think that one thing is for men and other for women. When children are born people decide how their life works and what is better for them. They know nothing about gender (Thomson, 2001). According to Cakcii (2011), Sex is a biology-based categorization on the basis of reproductive potential, whereas gender is the social elaboration of biological sex. Gender is built on biological sex. It exaggerates biological difference and, indeed, it carries biological difference into domains in which it is completely irrelevant. There is no biological reason, but while it was thought that sex as biological and gender as social, this distinction is not clear-cut (Cakici, 2011).

Sultana (2010) stated that in simple terms, gender explains the differences between men and women in social terms. A man can do things like a woman and same is with women. Therefore, gender is an analytical category that is constructed socially to differentiate the biological difference between men and women but it is not necessary that what is thought will be exactly the same when it comes to people (Sultana, 2010).

To understand the concept of gender is very important, Gender is a way of how power structures and social norms impact the life of people and opportunities that are available to men and women (Sunderland, 2006).

Mill (2015) explains that there are certain elements that influence the gendered usage of linguistic variations in terms of gender. The first is the availability of work opportunities. When people attempt to work, they are frequently required to demonstrate various sorts of language abilities. Men and women can pick various types of employment because they may be gender specialized, or only males or females may be interested in some jobs due to local or transitory concerns. Even though the work circumstances do not always compel individuals to talk in a certain way, being in a given workplace allows people to develop their own variations. As a result,

when exposed to different types of workplaces, men and women might employ distinct language variations (Mills, 2005).

Then she further says that Marriage possibilities are the second element that may influence the gendered usage of linguistic variations. When a girl marries a wealthy, educated, and powerful man, her learning process may shift to match her husband's linguistic variety (Mills, 2005).

Rahm (2015) adds to this work and says that the third element is urbanization and industrialization. People's languages alter and shift as a result of urbanization and industrialization. When individuals relocate from a small town or rural community to a larger town or metropolis to shift jobs from farmers to workers in large factories or corporations, their language changes from a local one to a global one. They may adhere to regional or national guidelines. Meanwhile, the cultural change that occurs at or near the workplace will have an impact on the gender pattern of change (Rahmi, 2015).

Aims and objectives

- To distinguish the key factors involved in the language of transgender keeping in mind the six set of genderlect theory.

- To interpret the practice adopted by binary genders and portray what transgender people think about that practice.

- To evaluate and interpret the language in use and see the perception it has created.

Literature Review

Deborah Tannen (1990) argued that men and women speak differently and that women and men just do not understand each other. She viewed those men and woman are being socialize in different subcultures, and cross-cultural communication occurs between them, so, this is the reason of miscommunication. Other reasons for this miscommunication are sexual in equality on the basis of gender can be seen she also says that different methods of language are being used by men and women both (Tannen, 1990).

Lakoff (1975) raised the issue of gender differences in speech, sparking decades of research on language and gender. She stated that her goal is to learn what language can show regarding gender injustices among males and females. She viewed women as they have been supposed to use language that do not show them superior then men. Lakoff theory is found on self-reflection, based on media analysis, and unsystematic observations. It initiated a variety of hypotheses that were used by other researchers for further investigation like females hesitate more while taking as compared to men, women use more hedges, expressions and they do not request directly as men and women are more polite than men and use tag questioning in talk. In her analysis she found that women were seen as to be hesitant for expressing their emotions, opinions and avoid confrontation. She proposed a gender and language difference model. In which comparison to men's standard or neutral language, she saw women show weakness, unimportance, uncertainty. She claimed that their language contributes to women's inferior status. Lakoff (1975) conveyed her viewpoint that men's speech is the standard language and women's speech is less acceptable. Despite her assumption she found that women were deficient as compared to men and realized that female could not smoothly fix their problems. Women who talk like men are criticized for not being feminine, while women who speak like women are unable to participate in important conversations and are unable to think clearly (Lakoff, 1975).

Language, Gender and Inequality

Gender according to Cameron (1992) an illustration of unfair social relations is maintained through language (Cameron, 1992). Gender differences in verbal behavior, according to Coupland (1991), should be investigated in terms of gender inequalities. They investigated for instance, whether men's speaking styles can be interpreted as neutral or not. Men's speech could be described as privileged, self-centered, uncooperative and disruptive. They came to the conclusion that language styles associated with men are the language of

dominance and power, while language styles associated with women are the language of powerlessness (Coupland, 1991).

MacKinnon (1990) discussed the topic of gender differences in status and power. He found that differences come after inequality. Discussion and debate of gender difference functions as ideology to neutralize, rationalize, and conceal power social inequality (MacKinnon, 1990).

James and Drakich (1993) found out that how men and women respond in different situations which are affected by cultural perceptions about their skills and proficiencies. Individuals who have knowledge in particular context will speak more in that type of context. So, topics and contexts where one gender are found to be more knowledgeable so they will result in a gender difference (James and Drakich, 1993).

According to Samar and Alibakhshi (2007), women were much more likely than men to interrupt each other during a discussion, and the interruption rate is greater for women who talk to other women than men talking to other men (Samar and Alibakhshi, 2007).

Fishman (1978) investigated the conversations of three heterosexual couples by picking up tape recordings of the couple interactions at apartment. The study found that men controlled the communication in a variety of ways. Men in the couples, turned on and off the tape recorder. When one male participant did not want the interaction to be taped, he specifically ignored the researcher's instructions and turned off the tape recorder. Men also attempted to control the researcher's interpretation of the tapes. So, they found that men are more dominant (Fishman, 1978).

Tannen's Theory of Genderlect

Deborah Tannen (1990) focused on analyzing the dialogue patterns among male and females while examining how difference in gender results in different communication patterns among male and females (Tannen, 1990). As a result, it is supposed that Gender Theory is also focused at demonstrating how people interact and how they create understanding, as well as the best way to achieve a high-level dialogue. She stated in her book (1994) about gender theory that "Adult men and women represent cross-cultural communication." She prefers sex as a value of human interaction. According to it, when people first meet, they classify each other based on gender, and then they consider other categorizing factors such as culture, age, background religion etc. According to her, women prioritize meaningful connections through relationships whereas men priorities gaining status through reporting conversations for status development and exchange of information. She appears to believe that the socialization of young men and women creates two distinct subcultures. She said that a gender linguist, appears to believe that from childhood to adulthood, boys and girls are socialized differently, resulting in the formation of two separate same-sex sub cultures. To describe it, she highlighted the differences in discourse among males and females. Women use gestures and show their feeling during communication as compared to men. Men talk in such a way that they look strong while women use stories for showing themselves strong (Tannen, 1994).

She further mentioned that women use informal discussion for asking too much questions and shows their feelings or emotions quickly as compared to men. Men are more direct in the conversation and they ask fewer questions. She depicted some conversational rituals between men and women in order to recognize each other for potential working situations. She displayed how men and women react in different ways to the very same situations, and it also demonstrates how males and females develop speaking style in their professional and personal relationships (Tannen, 1994).

Gender and language studies are important however Tannen's book (1990) received a lot of attention in this regard. The thesis concerns binary sex, as well as men and women reflection. It only mentions two sexes (male and female). She uses binary scale for identification of gender. In her book there is no focus on gay, lesbian and transgender people (Tannen, 1990).

The Deficit Theory

Henley and Kramarae (1991) states this theory and according to this theory it is believed that language used by women is not as good as language used by men. Due to this woman copy men's language as men play an important role in creation of language (Henley and Kramarae, 1991). But in the work of Barker (2003) he puts

Lakoff's work ahead and in its light, he says that according to Lakoff this point of view is different. She described that this happened because of gender inequality and when women are considered below as men in their social life. Women hoped to speak in other ways according to their social status that is lower than men and she said that is the reason for inefficient language expression by females (Barker, 2003).

Dominance Theory

There have been a number of ideas that clarify gendered language. Dominance Theory given by Helweg (2004) explains both non-verbal and verbal reflections. According to this theory females have an inferior social position in society as compared to males that dominate women. He further found that the features of male and female speech are a result of distinct social positions and that language is employed by males to obtain dominance or by women to exhibit submission (Helweg, 2004). According to Mulac (1986), gender is a cultural phenomenon, and gendered speech is comparable to cultural linguistic variances and is not always a reflection of dominance and submission (Mulac, 1986). Cummins (2021) says that according to dominance theory, men and women might express different language due to inequitable power interactions among males and females. Since males had more authority in culture and politics and in social life. Men, because of their authority, could exert influence over many elements including use of language (Cummins, 2021).

General Process Model of Speaker Evaluations

The General Process Model of Speaker Evaluations proposed by Giles and Marlow (2011) was one of the first to completely address the role of the receiver in determining the speaker's behavior. The recipient's attitudes are factored into the recipient's judgments of the speaker that impact the speaker's linguistic behavior, according to this model attitudes about education, race, or gender can impact the information received by the receiver but the effect of the recipient on the speaker is less certain (Giles and Marlow, 2011). Mulac (2013) proved the existence of gender schemas and stereotypes in an actual test in which men were writing first as female and then as male so in that participant used different language while writing as a man than when writing as a woman (Mulac, 2013).

The difference Theory

Whaley and Samter (2013) gave this theory in which they discussed girls and boys and their subcultures. She says just because boys and girls were not socialized in the same way, they developed distinct sociolinguistic subcultures known as male and female subcultures. In this idea, feminists attempted to reclaim the position of women's communication by claiming that style of female's speech differed than that of males. Although women are supposed to have some verbal competence in certain sectors. But this theory was generally questioned for focusing on the contribution of females to language and neglecting males (Whaley and Samter, 2013).

Concept of transgender

Breaking gender identity and gender roles or going across the gender boundaries from one to other gender is known as transgenderism as stated by Nogoshi and Brzuzy (2010). They further said that transgender expresses gender-based identities outside the traditional definitions and they express themselves in most natural ways no matter what others think of them, and they have no intention for having hormone treatments or surgeries for sex reassignment. Transsexual people can be operating through the process of surgical and hormonal reassignment and postoperative but they keep themselves as who they naturally are and avoid all these things (Nagoshi and Brzuzy, 2010). Transgender is an umbrella term that refers to various type of identities within the transgender community as it is most widely recognized term says Green et al (2018). Levitt and Ippolito (2014) says that the term "Transgender" includes trans-men, trans-women, gender queer and non-binary people. Everyone who's apart from being man or women all are transgender no matter in which gender they were born, if they don't feel like that particular gender, they will become transgender and will come in the domain of this term (Levitt and Ippolito, 2014).

Neumann (2018) states that transgender people are also called as Hijras in South Asia, Kethoeys in Thailand, and Muxes in Mexico there are various names for them all around the world but all of them are classified as 'transgender' (Neumann, 2018).

According to Alipour (2017) transgender are people who were neither male nor female but they shift genders according to their environment and mood, he further says that this sort of behavior has been noticed from ages (Alipour, 2017). Minwalla (2015) writes that both the Greeks and the Romans considers transgender as second-class citizens, having only domestic occupational choices that are available to them, they don't have much independence to live freely and neither do much rights to ask for various thing out loud so that's why there's less room for them to live in proper order (Minwalla et al., 2015). Since ancient times transgender had no rights to present their case in any court for justice, and they were not treated equally with other citizens says Stryker (2006). He further claims that they were not considered as either males or females and their gender identity varies with their apparent biological sex at birth. Transgender's legality is questioned at the time of Hajj, marriage, buying properties etc. In China, this Umbrella term (transgender) split into two categories: transgender people and cross-dressers (Stryker, 2006). Naseem (2021) takes this claim of Stryker (2006) furthermore and says that cross dressers were those who use to change their identity for short period of time just to present something and they were historically significant characters, therefore they were praised, while transgender people were frequently abused. Cross dressing has long been an essential aspect in Chinese operas. Due to the lack of women in society, men played female roles in Peking Operas. However, there was a universal obsession with cross-dressing in theatrical during the Ming and Qing eras so, sometimes transgender would act as cross dressers to keep themselves safe and by hiding their real identity they use to live peacefully (Naseem, 2021).

Zimman (2019) says that language is playing an important role in the environment, he further explains that because of its social function, language may play a significant part in conveying the picture of new gendered communities in a society where gender diversity is a commonly discussed topic (Zimman, 2009). The existing binary (male, female) and heteronormative (heterosexual) categories which are commonly used for defining gender, are colliding with the current emerging communities and previously unrepresented communities, potentially leading to the creation of social, cultural and legal issues (Zimman, 2010). Baker (2014) selected UK as the geographical area under investigation since it was one of the first to introduce the world to the issue of transgender equality. Aim of that study was to investigate how transgender individuals and their communities are shaped through language, beginning with an assumption that language can extremely influence how society understands gender, being one of the most powerful means of manipulation, through which it is possible to convince and even to introduce with specific beliefs or convictions (Baker, 2014).

Gender-based violence against transgender

Fazi and Bibi (2020) say that society reacts angrily to transgender with names like monsters or abnormal people. Transgenders were frequently subjected to harsh punishments once their identities were revealed or they were caught having intercourse with someone they could/should not have in their normal gender identities. Being a transgender was a crime in the sight of other genders and they didn't even like to be close to them such as avoid talking or even interacting (Fazi and Bibi, 2020). Walker (2017) says that nowadays there are pride parades, film festivals, and a variety of key events taking place in China, and there is an environment of inclusiveness in society for individuals of various sexual orientations. Western traditions and beliefs subsequently allow some specific genders to be authorized as third genders; for example, the Supreme Court of the United States approved intersex marriage (Walker, 2017).

Wirtz (2020) says that as a third gender, they should have equal access to education, health care, and employment as well as they should have the right to be acknowledged in society with decency and honor. He further states that looking at transgender history from a Western viewpoint, it is discovered that their presence is since the post-Christian world. Church is a location where transgender people feel content and protected since it is a 'Bible' believing place. The Church provides them with fulfillment since they have opposing gender identities, which produces stress. The main point is love for humans, and how they treat each individual with love and respect (Wirtz et al., 2020).

Transgender rights

Trans persons had similar concerns as the LGB (Lesbian, Gay, Bisexual), their acknowledgment was restricted by the government says Testa et al (2012). Then he says that the first ordinance prohibiting discrimination against transgender people was passed in the city of Minneapolis in 1975, and Minnesota became the first state to offer discrimination protection to transgender people in 1993. The rights of lesbian, gay, bisexual, and transgender people were given special attention. The Human Rights Commission has played an important role in studying and organizing the Trans community to reduce inequality. Finally, various researches and statistical data assisted is outlining their concerns and determining the degrees of prejudice (Testa et al., 2012).

Islam (2020) says that historically, transgender persons have been severely underrepresented in public sector positions in the West. For example, the British Empire's Criminal Tribes Act 1871 labelled the whole transsexual population as Criminal (Islam, 2020). According to John (2018) in socialist literature, sex is increasingly disassociated from related gender roles. This allows theorists, political philosophers, jurists, and activists to continue fighting for the realization of the goal of universal human rights and nondiscrimination based on gender. In Pakistan, it was British discriminatory laws that disadvantaged the Trans people. These regulations, like the Criminal Tribes Act of 1871, remained after Pakistan's independence. As a result, the transgender minority is Pakistan's most socially underprivileged group. They turn to prostitution and dancing at social festival events because to a lack of educational possibilities and societal marginalization.

Transgender persons have a slim possibility of escaping their powerless circumstances since they are treated as bound slaves under the Guru Doctrine (Johns et al., 2018)

Khan (2014) further elaborates that when transgender rights movement began in West in the 1950s and 1960s, they also impacted Asian countries. Pakistan began to develop policies for this specific population after the Supreme Court acknowledged their gender identification rights in 2009. In its judgment, the Supreme Court also mentioned a system built by the Bihar government in India, where they are working on fresh concepts. The government was to give education and technical training to enable the community to be helpful in the long term. In addition, the court ordered the provinces to safeguard the community from harassment and abuse. Laws should be enacted to protect transgender people in society. The transgender population in Pakistan is a socially extract and poor minority. They are in a hopeless social, economic, and political situation since they are not recognized in society (Khan, 2014).

Gender-determining

West and Zimmerman (2009) say that under an identity-based gender ideology, persons can be acknowledged as members of the gender category with which they identify, provide their identity and where other people decide their gender, such as their spouse, friends, and medical specialists. This social process of verifying another person's gender identification is referred to as "gender determining gender." Determining gender is the reaction to doing gender in face-to face encounters. When people communicate with one another, they offer information about their gender. Others then evaluate this information, categorizing them and identifying their gender. However, the process of determining gender does not necessarily rely on visual and behavioral indicators. Extending on interactional gender attribution theories (West and Zimmerman, 2009).

Westbrook and Schilt (2014) says that Gender determination criteria in police and court cases where there is a lot of biographical and body knowledge about the person whose gender is being debated, as well as how gender is determined in imagined interactions specifically, cis-imagined people's interactions with trans people where knowledge about the person's body and identity is based on. The phrase "determining gender" refers to many procedures of assigning a person to a gender category (Westbrook and Schilt, 2014), However, since the "liberal moment," a societal shift in 1960s towards the principles of autonomy and equality, there has been greater acceptance of a person's gender self-identity in nonsexual contexts in many workplaces (Schilt, 2010). Further Westbrook and Schilt (2010) states that when it comes to access to gender-segregated areas, however, identity-based and biology-based decisions crash. They say that in investigations which are done on transgender so far, it focuses on such instances, federal and state proposals made between 2009 and 2011 to prohibit discrimination based on gender identity and expression in employment, housing, and public accommodations, a 2006 proposed policy in New York City to eliminate the genital surgery requirement for a

change of sex marker on birth certificates and controversies surrounding transgender athletes participating in competitive sports. Researchers dealt with a variety of social contexts, including sports, employment, and government papers. In these ideological clashes, social actors cope with where actual and imagined transgender individuals fit in gender-segregated settings such as public toilets. These conflicts cause what we call "gender panics," which occur when individuals react to disturbances in biology-based gender ideology by precipitously repeating the naturalness of a male female binary (Westbrook and Schilt, 2014).

Shy (2007) states that while establishing laws mandating surgical and hormonal criteria for entrance into gender-segregated venues brings the fear to an end. Identity-based factors can be sufficient to ascertain a person's gender in gender-integrated public contexts such as the workplace. However, social actors prefer to apply stricter, biology-based rules in interactional circumstances that take their shape and logic from gender oppositeness, such as heterosexual acts and gender segregated sports contests. Gender-segregated areas, however, are not uniformly policed, since the conditions for admission are carefully explored exclusively in women's places. Exploring the implications of this difference, it is proposed that bodies (particularly the presence or absence of the penis) matter for determining gender in women's spaces because cultural ideologies of women as inherently unsafe. The liberal moment of gender, access to gender-segregated areas is decided by genitals rather than fixed measurements like chromosomes, a step that reflects a wider acceptance of an identity-based determination of gender (Shy, 2007).

Positive shift

There are platforms that show positive awareness can be seen regarding transgender, various ads are being made on this topic in which there is some message can be seen embedded; Bhima Jewelry (2021) shows the journey of a boy who became a trans-woman. This advertisement is not just about the journey but also love and acceptance of his family, who supported him well in his journey from a boy to a trans-woman. The advertisement begins while showing a boy who is sitting on the bed and he is looking towards a pair of anklets which he wishes to wear, same things as other women do. In the mean while his parents are seeing him while standing at the door of his room. They show full support and help him in the process of accepting himself as a trans-woman. His mother took him to the jeweler for piercings, parlor for manicure and pedicure and to the tailor for clothes. At the end, she becomes a perfect trans-woman and is much confident in herself, all this was shown in Bhima jewelry (2021).

It is rare when an advertisement looks at a broader picture not just the obvious material which benefits a brand; Vicks (2017) spreads a beautiful message of the token of love. This is a story of a girl who was adopted. Her mother wants her to become a doctor. The girl heads for boarding school. While she is traveling, she recalls all the beautiful moments of her life that she spent with her mother. She also discusses her struggles and complexity of life that her mother faced. By the end she reveals that her mother is a transgender. Transgender never get their basic living rights in the society. To promote the basic human rights and respect, the girl wanted to be a lawyer Vicks (2017). This is the true story of Gauri Sawant, a Mumbai-based transgender rights activist who raised Gayatri (the adopted girl who narrated her story) after her birth mother succumbed to HIVAIDS.

Since the Supreme Court of India's landmark 2014 verdict calling for equal treatment and the creation of a third gender category in school and employment, this topic was highlighted just because of several brand advertisements built on themes inclusive of the transgender community, according to the report scroll in (2017).

Nazir and Yasir (2016) investigated the occupational willingness and skills of transgender community to switch over to other jobs that are available for common people. Researchers cover 5 Khyber Pakhtunkhwa Province districts and population size was 150 which was scattered and unknown. A positive aspect of transgender population in terms of employment is their willingness to engage in other honorable professions. Their acceptance of other professions is appealing, but they require government assistance to adopt the careers of their preference (Nazir and Yasir, 2016). Khan (2014) described that transgender community of Pakistan was granted rights after decades by Supreme Court of Pakistan without any legal protection and recognition. In this initiative many organizations at government and nongovernment level were involved. Since 20th century organizations that are involved in intervention of HIV is supported by the foreign agencies and government of Pakistan. Additionally, the observation and control of diseases, funds awarded by Pakistani government and

donor agencies so those funds also meant for empowerment and support of vulnerable groups like khwaja siras. NGOs have created programs and opportunities for khwaja siras for learning about their rights, advocacy and management of organization that results in activism of transgender community (Khan, 2014).

Saddique (2017) explored the political participation of transgenders community in Pakistani political sphere. By researching on Jung and Dawn News reports, articles from July to October 2018 the researcher investigated the representation of transgenders community involvement in Pakistani elite print media. Research found that by participation of transgenders in media Industry of Pakistan changed the thoughts and Perceptions of people about transgenders community. They are not treated in the media as normal people, with no opportunity for becoming equal citizens with engaging in all aspects of life, particularly political life and participation in the country's political affairs. In Pakistan, the media contributes to the acceptance of the transgender community (Saddique, 2017).

Kanwal (2019) says that it is evident that transgender are now becoming important part of Pakistani society in almost every field of life like first transgender news anchor that joined the Pakistani Television is Marvia Malik. First Pakistani transgender actor and model is Kami Sid who has started her profession in showbiz industry. Ayesha Mughal is the first transgender that has been selected as a lecturer in Quaid-e-Azam University of Islamabad. She is also the first transgender woman that participated UN Convention for elimination of all types of Discrimination against Women Committee in Geneva. Since 2018. Transgender community also started to participate in politics. Now they can cast votes, eligible for inheriting property, can run for election and they can also take loan form government for starting their business in Pakistan society. Pakistani media played a very important role in raising awareness about their rights. Kanwal further states that while speaking to Marvia Malik which is who first transgender that joined her career as a news anchor about media, says that "Media is also putting an end to the myths about transgenders by showing them in different positive roles". All this is going towards positivity and good future of transgender people (Kanwal, 2019).

Methodology and Framework

This research adopts the Conversational analytical approach has been used in this study for analysis. The entire interviews were analyzed by keeping in mind the six sets of features of genderlect theory given by Tannen (1990) that include, status vs support, independence vs intimacy, information vs feelings, order vs proposal, advice vs understanding and conflict vs compromise.

Source of Data

Interviews were conducted for this study. Eighteen interviews of transgender including eight in person and ten pre-recorded interviews were collected. Pre-recorded interviews became a part of this study due to pandemic caused by Covid-19. Strategy of face-to-face interviews was shifted to online interviews and analysis is done on the basis of both (face to face and online) interviews. Written consent for ten pre-recorded interviews was taken by the authorities through official emails and official Instagram channels like Bol News, Capital TV, Urdu point, Daily News TV, Lahore News and Punjab Euro TV.

Sampling Techniques

Non probability sampling technique has been used in this study. In pre-recorded interviews clarity of thoughts was the focal point where as in-person interviews were focused on confidence and comfort level.

Sample size

As interviews were conducted in person initially, and subsequently pre-recorded interviews were chosen because of COVID-19. So, to ensure diversity and get a countrywide point of view, transgender living in various parts of Pakistan were targeted. A total of eight transgender interviews were done, with two of them taking place in Islamabad. Five interviews were conducted in Peshawar and one in Lahore. Five of the interviews were between 20 and 30 minutes long, while the other three were between 40 and 50 minutes long.

For the selection of pre-recorded interviews, in all, eighty-eight different interviews were watched. Ten of them were selected to be a part of this study.

Research limitations

Limitation of this study involves, traveling from one location to the next for interviews, with three-day stay in Islamabad and two days in Lahore, the transgender accessibility is taken into account at all times. One of the most significant limitations was Covid-19, which forced the researchers to switch from in-person to online interviews

Research Delimitations

The delimitation of this study includes the fact that it only concentrates on transgender genderlect in comparison to the genderlect of men and women. Another delimitation is that the researcher does not take into account any and all sub-types of transgender by treating all of them under the umbrella term, transgender.

Analysis and Discussion

Tannen's Theory of Genderlect is that male and female communication is cross-cultural. According to this theory men use communication for achieving status and females use communication for connecting with others. There are six features of Tannen's theory that are status vs support, independence vs intimacy, information vs feelings, order vs proposal, advice vs understanding. By focusing on every feature this chapter analyzes and discusses analysis of research study.
In this study, two types of interviews were conducted: online interviews and in person interviews. In-person interviews are labeled A1 through A8, and online interviews are labeled Z1 through Z10. 4.3 Online interviews

Z1

Z1 is a 30 years old transgender who lives in Karachi.

Status vs Support

According to Tannen's (1990), men grow in a world in which conversation is mostly competition, either to be dominated or to avoid others. For women, it is quite the opposite, talking is often a way of giving verification. As interviews were analyzed, there was this transgender person, named as Z1 who showed the feature of support in his communication. While being ask "With regards to trans-community, what tends to be the mainstream problem for society". He replied "Community has no acceptance here, despite the growing acceptance and visibility, life is harder for trans-community". He agrees with the interviewer that yes there is some problem, he is concerned about his community and on being asked such a question which involves all the members of his community he is taking their side that due to other genders his gender(people) is facing difficulties which is making life harder.
By agreeing that there is this problem Z1 agrees with the Question being asked. Then he further gives evidence that yes this is a problem because of which our community is not in as good position as others. And one thing is that. While he was speaking, it shows that he is supporting not just the interviewer but also his community, that due to these problems we all are suffering. As support is in which others try to connect and give verifications to the given statement, here Z1 is trying to connect with the interviewer through his use of words which shows empathy and he is also supporting his community.

Expressive

The way he talks about the situation his body language is quite expressive, his use of hands and gesture adds life to his words, when he says "life is harder" he utters these words with calm and soft expression which

shows that despite of his hard situation he is still maintaining his way of speech, as if it is important for him that how he would look when he is saying something.

Independence vs Intimacy

Women mostly think of being close to others and try extremely hard to connect by all such efforts they fight to safeguard Intimacy. On the other hand, men are anxious about status.

Z1 showed the feature of independence on being asked "What still needs to be done for equality among all genders in Pakistan". He replied "The implementation of the bill is the need of hour. Especially when it comes to inheritance, job, education, discrimination and harassment and health care all should be given priority". This shows that being loved in the shadow of others is not what they want. They want to feel the same as other genders and enjoy their life under all legal possibilities. Like others they also want proper rights so no one can question them. This will make them feel good and independent.

The way he talks shows confidence and the way he delivers his words shows that they don't want to live under the shadow of others. They also want proper rights in every field of life. So, they can also live like other genders. As being anxious about status is what independence show, so here when Z1 speaks he clearly want to be on his own, he talks about rights of transgender because he do not want to live without solid identity.

Information vs Feelings

Men are more likely to be accurate in their communication as compared to women. Women use less accurate and more emotional language. Taking about transgender people in regards to this set of features, Z1 showed both features in his speech. While he was questioned "How can you begin to develop more empathy in society? ". He said "I am empowering millions". There is no ambiguity in his speech, he is clear and stating facts in his point of view without making it look vague or unclear.

His statement is clear, and the first thing he wanted the world to know is that he is empowering others. Leaving all other details, his focus is on himself, and while he was saying these words, he was confident as if he knew that this is the only correct thing. He is concerned with the direct information. That is why he did not use any other way of answering that question. As being accurate in speech is concerned, Z1 used a Four-word answer to tell what he thinks, he didn't even think for a second. His answer was direct as if he knows how much he must say.

Feelings

He also, showed the feature of feeling on being asked "what tends to be the mainstream problem for your community? ". He says "I have a brother who is proud of me and my sister supports me in every decision". He could have mentioned that society is not supportive towards him but his family supports him. So, the problem is society but instead of that he gave an indirect answer which is not clarifying the question. He thought for a few seconds before answering the question and then he used an indirect way to answer it.

As Z1 was less accurate and he was using emotional language more, by saying that his brother and sister supported him show that he wanted to connect through his language emotionally.

Order vs proposal

Men are mostly direct in their answers as they are making a command and want others to follow. Although women are most likely to be more indirect and suggest language to the opposite command. This interview expressed the feature of the proposal, answering a random question Z1 said, "please don't take me wrong". This way shows that although he knows he is right and will state a correct statement but still he is making the conversation feel smooth.

He made his voice extremely polite and then said those words. He knew he would say the thing but still he wanted his language to be indirect. Z1 knew he was not wrong while he was answering a random question but still, he used an opposite command, in the proposal an indirect speech is used to convey a message.

Politeness

He is extremely polite while saying those words and also the way those words are uttered, his way of politeness can be seen clearly when he says "please" and moves a bit forward towards the interviewer making a hand gesture that don't mind.

Conflict vs compromise

Men do not care about what others think while they speak, so they use language to argue on a point whereas women avoid such conflicts and try to negotiate by finding solutions or while compromising.
On being asked from Z1 that "regarding trans issues in the society, what is your view on improving others behavior towards your community" To which he said "it is important that we must show care towards people and also portray selflessness". By giving such an answer it is clear that he does not fight with people of other gender, he is trying to negotiate by saying "We" which means he is talking under one term and states that all of them must care and be selfless.
In a very kind manner he answers this question, as if he understands the obstacles of life. And then by talking all under one umbrella term "we" he justifies that everyone should blend in and work as one unit not separate genders. As he is trying to negotiate and giving solutions by saying "We be selfless" shows that he does not want any competition with other genders although he wants all the genders to live in peace by staying united.

Neutral thinkers

By bringing all genders under one umbrella term "we" Z1 is showing neutrality. He clearly sees all the genders as one community not three separate communities.
4.3.6 Advice vs Understanding
Men will give solutions to a problem through their speech, on the other hand women use language which shows empathy and understanding of the given solution. While looking for these features in transgender, Z1 showed both features through his speech. On being asked "How can we spread positivity?". He answered "My message to all is to show understanding and spread love". Here he is telling others that by this we all will be united and it is one of the solutions to the problem.
His tone shows that he wants others to understand that look, without being united, we cannot solve this problem. In response to the question being asked the interviewee could have denied giving any Recommendations to his community but instead he gave advice that by doing these things the world can improve.

Endurance

On being asked such a question which clearly states that other communities do not respect their community, Z2 was still smiling as if he knows this thing and he is aware of his community being disrespected by others. But his words in the answer were polite showing politeness and also, he took this thing as a fact that yes, we know where we stand which shows endurance.

Z2

Z2 is a strong individual who is serving Pakistan as an anchorperson.

Status vs Support

While talking with Z2 it was reflected that she has the feature of status. When she was asked "You are the first transgender anchor person in Pakistan, how does that feel!? ". She replied "Most people tell me that my name is more than enough for my introduction". By these words it can be analyzed that through her words she is showing the feature of status that her name is enough which means she knows her worth and she can stand against the world without being discriminated against.

As this is a feature that was present in men when we talk about Tannen's (1990) work. So here when she says "My name is more than enough", while saying it her tone shows that dominance that I am aware of who I am and her self-confidence can be clearly seen when she says these words. The biggest factor that can contribute to her way of speech is "Education". And she is a bachelor's holder so she can differentiate between right and wrong. Education made her able to know about her worth. Here the interviewee is aware of his current position and she is not afraid of showing the world that yes, I am self-built and my gender is not an obstacle for me.

Expressive

Although she is confidently saying who she is and wants others to know about herself, still she maintains her body language expressively and tries to utter those words with positive expression. She does not want her way of speech to sound harsh.

Independence vs Intimacy

Z2 showed the feature of intimacy through her speech.

While she was asked "What does the normal day in the life of Z2 look like?" she replied "I love spending time with my friends so my evenings are often busy with them". Here it is seen that she tries to connect with people and through that connection she seeks closeness with her closed ones. As Tannen's (1990) says that women try to maintain closeness. So, when she was saying this her way of talking was as such which reflected this feature of intimacy, by stating that she is mostly busy with her friends but look she is still giving interviews which means she is connecting with the interviewer as well.

It is analyzed that her time is precious, but she is giving an interview and is happy to be here and likes talking to the interviewer. She tries to connect with others not only with the people she loves but also with the ones she is sending time with.

Politeness

She is extremely polite when she talks about her day being spent, she tries to connect with the one she is talking to through being extremely polite, she is mostly smiling while answering the question.

Information vs Feelings

She showed the feature of feelings. When she was asked "How would you describe your journey towards success" in a response she replied that "Getting to where I am today has not been easy. My family refused me and I was kicked out of my home". Here she used emotions at first, she could have given a direct answer but instead of that she explained it further that how her family treated her. Through this it can be analyzed that she is being emotional and using such words to connect with other people.

When she said she was kicked out of her home, those words build empathy in the listeners heart so she wants it to be built that way before answering the question she made that connection. She is using less accurate and more emotional words, trying to connect with the listener. She wants others to understand her situation emotionally.

Order vs proposal

This set of features was not present in this interview.
4.4.5 Advice vs understanding
This set of features was not present in this interview.
4.4.6 Conflict vs compromise
This set of features was not present in this interview.

Z3

Z3 is a 38 years old worker who works for the rights of transgender in Pakistan.
4.5.1 Status vs support
This set of features was not present in this interview.
4.5.2 Independence vs feelings
This set of features was not present in this interview.

Information vs Feelings

On being asked that "Tell us about yourself and the work you are doing for social justice". She said "I have been working to improve the standards of living, providing access to basic health care". Here she directly answers the second part of the question by avoiding the first things, it clearly shows that she is more focused on sharing the important details, she does not care that the first thing which was asked about herself was also important but she came up with the part which she thought was more important which shows the feature of information.
While she was answering this, she gave a direct answer without even thinking for a second. Her answer was direct and clear, there was no ambiguity in her speech. When she speaks, she is telling directly about what she has done, avoiding talking about herself, as if her work is more important and she only wants to share that information with others.

Order vs proposal

This set of features was not present in this interview.

Advice vs compromise

This set of features was not present in this interview.

Conflict vs compromise

While she was asked, "what are your views on the concept of working communities of gender?". She replied "Everyone works for the goodness of their community. Women have their own organization to support their rights, as men. So, why should we not work for our community rights as well"? This statement clearly stated that she is not ready to accept this fact that their community is something lesser than others. Although she is positive that if others can speak for themselves, why can they not come forward with the same energy. And while they can come up with it, they should not be afraid of anyone as she thinks everyone is equal. This reflects the feature of Conflict.
While saying "so why should we not work for our community". Her tone was a little harsh which showed that she is not afraid of any gender sitting beside him, all she is saying is clearly showing that she thinks of themselves as one strong community. When she talks about other communities in comparison to her

community, she is not negotiating she knows that this might be something which can make a conflict but she is not clear if such thing happens.

Neutral thinkers

When she talks, she uses the word "We" for her community not for all, so this represents that she is a neutral thinker who does not think about herself but about her whole community.

Z4

Z4 is a student of BS Hons and lives in Lahore.

Status vs Support

Z4 on being asked that "The Trans community is getting education and this is one good thing for your people". Replied "yes, I believe this is one of the highest standards which is being set because people are accepting us and we are becoming somehow neutral". Her answer clearly shows that what the interviewer is asking, Z4 is also accepting that he is correct, and the trans community is actually getting better with awareness and acceptance which shows the feature of support.
When the interviewee says "yes" in response to the question of the interviewer, here half of his hold up is shown but when the interviewer gives evidence in support of the question being asked. So, it clears that she is fully accepting what another person has said. She is accepting what the other person is saying as she wants to connect with the interviewer and further, she also supports his question by giving her point of view on the question being asked.

Independence vs feelings

This set of features was not present in this interview.

Information vs Feelings

This set of features was not present in this interview.

Order vs proposal

This set of features was not present in this interview.

Advice vs compromise

This set of features was not present in this interview.

Conflict vs compromise

On being asked "what do you think about gender inequality". Z4 said, "people talk about us as third gender, we are not the third gender, what you are a woman, so are you a first gender. What is the first and second gender"? The use of words clearly states that she is not happy with being called as third gender nor do she believe in the numbering of gender, for her gender mean just an opposite sex, there are no numbers which can describe any position among gender. And when she asks the interviewer if you are a woman so what you call

yourself as first gender. It tells us that she is confronting her and is not afraid of her response; it clearly reflects the feature of conflict.

When Z4 says "what" her tone is clearly showing that she is not very sound while making this statement and though she does not care that it is an interview and she might look quite harsh while making such a statement, all she cares is just what she thinks and what is correct in her sight. When she talks about themselves being called third gender, she asks the interviewer that you are a woman so does that make you first gender, which shows that she is not afraid of any conflicts being raised in the interview, all she is concerned is to put her mentality ahead that there is no such thing as first second or third gender.

Keen observer

In her interview she was listening to the interviewer with full heart and without any lack of interest she was interested in whatever she was being asked and whatever the other person thinks but when she was answering she also wanted the same attention from the interviewer as several times she continuously asked "are you listening" "am I clear". Which shows that she is a keen observer.

Z5

Z5 is a 45 years old transgender who's serving as a member of trans right community.

Status vs support

This set of features was not present in this interview.

Independence vs intimacy

This set of features was not present in this interview.

Information vs Feelings

Z5 was asked "why is there so much discomfort and stigma associated with transgender among society". Z5 said, "the thing is that we are completely excluded from society". By making such statement he is searching to gain some soft corner for their community that it is not their fault or there is any flaw from their end, despite of all he says that it is the people of society who are on the weak note and just because of them it is difficult for their community to blend in with others as men and women do. It shows the features of feelings.

Tone of the interviewee is extremely soft as if he wants the other person to actually understand that they are the victims and other genders are way too cruel with them when he says "we are completely excluded", there is depth in his voice as if he wants the listener to actually understand his insight. The use of words shows that the interviewee wants to connect with the person who's listening to him. His tone of voice shows empathy in his words.

Politeness

He is extremely polite and tries to use hand gestures to show his positive attitude towards the question being asked.

Advice vs Understanding

When Z5 was asked "how the huddles can be removed within your own society". Z5 in response said that "I would like to say that the trans community should believe in themselves and move forward with self-acceptance". He wants his people to always stay positive in every situation and the first thing which they should do is to believe that they are capable of doing what they think in just dreams. They must come forward and do whatever comes in their heart. Then he asks his community to always go ahead with accepting themselves. He is clearly showing the feature of advice.

While saying all these words, his way of talking was very polite as if he wants others to understand him and take his words seriously, like when he says that "trans people should believe in themselves". So, on the word "believe" he puts stress as he wants it to. He sounded as an important part which must be listened to. When he talks and gives the answer, he is trying to say that this could be the only way which can solve the problem which shows that he is giving advice to all his community members that if you do spend your life this way you will be something someday but if you do not, you would not become anything.

Order vs proposal

This set of features was not present in this interview.

Advice vs compromise

This set of features was not present in this interview.

Conflict vs compromise

This set of features was not present in this interview.

Z6

Z6 is 28 years old and lives in Lahore, she is working as a private school teacher.

Status vs support

This set of features was not present in this interview.

Independence vs intimacy

This set of features was not present in this interview.

Information vs Feelings

When Z6 was asked "what are your thoughts on gender itself so she replied "we all are struggling it is just not about transgender people, men and women also face challenges in their life". By saying this she wants to be connected with other genders too. She wants to express her insight by connecting with the interviewer as well. By saying that look, all of us are suffering and we can mutually feel each other's pain, so let us confront this reality. The features of feelings are reflected in her speech

Through her speech she is trying to gain and give emotional support when she says "we all are struggling" so, by saying "All" she wants to connect mutually with every gender.

Inclusion

By saying "All " the interviewee is trying to take all the human kind under one frame that it's not just one gender but all are struggling. by saying All the interviewee is showing the feature of inclusion.

Order vs proposal

This set of features was not present in this interview.

Advice vs compromise

This set of features was not present in this interview.

Conflict vs compromise

When Z6 was asked "how do you think trans people are treated in this society". So, she said, "some treat us better and some worse, but we know this is the world and there are all kinds of people all over so we have to live with them". While she answers the question, she is positive and trying to show that this is a fact and we are used to it. They have accepted that this is a fact and we are used to it. They have accepted that one has to live in this world and there are lots of people, some will treat you well and others would not but this is what it is whether someone accepts it or not. This shows the feature of compromise.
While saying this her body language was relaxed as if this was not the first time, she has been asked about such a thing or like she knows there is only one answer to it.

Endurance

On being asked such a question which clearly states that other people do not treat them well, she is still smiling and answering it without any disappointment. This clearly shows the feature of endurance that they have accepted such miserable situations and are trying to deal with them, with full positivity.

Z7

Status vs support

This set of features was not present in this interview.
4.9.2 Independence vs intimacy
This set of features was not present in this interview.
4.9.3 Information vs Feelings
Z7 showed both these features when he was asked "Ap ka bachpan kaisa tha" [How was your childhood?] he replied "Mai tu bohat kabil thaa" [l was very intelligent]. Here when he was asked about his childhood, he would have started with random things as I had this many siblings or we were this many members in the family but instead of all he decided to go to the thing he thought was most important, which was his mind. He avoided all other details about himself except one thing which matters for him. And through this we can analyze that he shows the feature of information.
He did not even take a few seconds while answering the question, it was on the spot, as if he knew what he had to say. Throughout his interview his answers were short and to the point.
4.9.3.2 Feeling

On the other hand, on being asked "Ap un logon ko kesy deal karty thy Jo ap ko Marty thay" (How you treated those who used to beat you?). Z7 replied "main kabhi b wapis nhi larhna chahta thaa" (I never wanted to fight back). By using such words, he is trying to connect with the listeners that look like I am not one of those who likes to fight back or try to create more problems. I am the other type of person who wants to stay out of everything, showing the feature of feelings.

There is empathy in his voice when he is saying these words, as if he wants them to be felt, when he says "never" there is this cracking voice as if another person would cry right on the spot. Which clearly shows that he wants that connection to be made.

4.9.4 Order vs proposal

This set of features was not present in this interview.

4.9.5 Advice vs compromise

This set of features was not present in this interview.

4.9.6 Conflict vs compromise

This set of features was not present in this interview.

4.10 Z8

A 38 years old transgender.

4.10.1 Status vs support

This set of features was not present in this interview.

4.10.2 Independence vs intimacy

This set of features was not present in this interview.

4.10.3 Information vs Feelings

This set of features was not present in this interview.

4.10.4 Order vs proposal

This set of features was not present in this interview.

4.10.5 Advice vs Understanding

Z8 showed both these features in an interview when she was asked "app ko Kya lagta ha k Kya cheez zarori ha agay barhny k liye" (what do you think is the most important thing for moving forward?). She replied "Taleem bohat zaroori hai. meri taleem nahi hai to iss liye mujhe andaza ha" (education is very important, I am not educated that is why I know). Here she starts the fact that education is important for going forward. It can make you something and help you to move ahead. Then she gives evidence to her answer, that I am not educated, that is why I know the importance. This shows the feature of advice.

She might have seen educated transgender ahead so; she thinks that just because she was uneducated, she knows the hardships and challenges of this world.

4.10.4.2 Understanding

In the very same answer of the question (4.9.1) she showed the feature of understanding as well, while saying, "main umeed karti hoon ke ek din hamara bhi apna school ho ga aur wahan koi hamare bachon ko judge nahi karega" (I hope one day we will have our own school where no one would judge us). By such words one can analyze that she understands that although education is important but they do not have proper place to go and get proper education, where no one would taunt them, they are inferior or not one of them, she wants to see an education system which is built for their gender only.

She is justifying her own statement by saying that education is important and everyone should get it but she also says that she definitely understands that there is no proper way of getting education such as boys and girls have. But her tone was very polite, as if she is trying to listen that yes you are right.

4.10.6 Conflict vs compromise

This set of features was not present in this interview.

4.11 Z9

Z9 is 30 years old and lives in Karachi.

4.11.1 Status vs support

This set of features was not present in this interview.

4.11.2 Independence vs intimacy

This set of features was not present in this interview.

4.11.3 Information vs Feelings

This set of features was not present in this interview.

4.10.4 Advice vs Understanding

This set of features was not present in this interview.

4.10.5 Order vs proposal

Z9 was one of the interviewees who showed both these features in his speech as he was talking to the interviewer he asked in between" is it hot here", as if he wants the answer to be yes but not in a direct way so, he made such comment and wanted the interviewer to response back when the interviewer said "yes". So, he told his fellow transgender "Turn on the AC". By such a comment it is shown that his speech changes according to the gender he is talking to. When he was talking with the interviewer who was male so, he was polite but when he talks with his fellow who was a transgender his words seemed like a command.

While talking with an interviewer his words are polite like his speech is not questioning or ordering, he makes an indirect comment that "is it hot" but while talking to fellow transgender he used direct speech which is more as an order "turn on the AC". Both his comments show that he had both these features but it varies according to gender. There is also this possibility that they might not connect with other genders but within their own community they feel very much confident and connected so that all these things do not matter.

4.11.6 Conflict vs compromise

This set of features was not present in this interview.

4.12 Z10

Z10 belongs to Multan.

4.12.1 Status vs support

This set of features was not present in this interview.

4.12.2 Independence vs intimacy

This set of features was not present in this interview.

4.12.3 Information vs Feelings

This set of features was not present in this interview.

4.12.4 Order vs proposal

This set of features was not present in this interview.

4.12.5 Advice vs Understanding

On being asked about how you want society to treat you and what are your views on being treated in various ways. Z3 replied that, "Islam teaches peace, love and oneness with mankind, it does not teach us to hate". Her response clearly shows that she is using religion and telling others to follow the right path. Always stay connected and act as we all are not separate genders but act as we are one. This shows the feature of Advice.

Using religion is one of the main and common things which people do while giving advice, this person is aware of the law and solid messages of Islam. That's why he wants to convey his feelings, through something of which people are aware of.

4.12.6 Conflict vs compromise

This set of features was not present in this interview.

4.13 In person interviews

4.13 A1

A young transgender who is 17 years old, lives in Peshawar.

4.13.1 Status vs support

This set of features was not present in this interview.

4.13.2 Independence vs Intimacy

Interviewer asked "how long it's been that you're living here with these transgender" in reply A1 said, "I left my home as my family was not supportive. They used to taunt me and treat me as a servant". Here she is expressing her feelings in such a way that she left home because she knew her worth that there is nothing wrong with being a trans person. She acknowledged that the way she is treated is not the way she should be treated. Her family was punishing her for something which is not a crime. She needed their support but they were just treating her as a servant. So, she left her home and came out to prove herself or maybe to live in peace. She shows the feature of independence through her speech.

When she says "I left my home" here she is putting stress on her words as if she has done the right thing, and that was the only way to be whatever she wanted to be. She did not allow herself to stay in that place where

no-one was considering her. Her tone was very confident when she was telling this. She showed this in her speech that she does not rely on others.

Politeness

She is extremely polite when she is speaking about herself and how people treated her throughout her life, although her life was not easy but still, she kept her way of utterance of words polite.

4.13.1 information vs feelings

While talking to A1 the interviewer asked "Tell us about yourself" in response to which A1 said "I'm 17 years old and I turned 17 one week ago". Here he is trying to give accurate and specific detail about himself, avoiding all other details. He just used digits and completed his answer in two lines: yes, this is my age and my current age is the latest. He thinks that this much information is enough for others and they should know specific details about him. This shows the feature of information.

His tone was normal and confident as if he knows how much he has to talk about himself. He completed his Introduction in just two lines by stating digits. He did not even care about other things which are part of him, or he might care but his speech was not showing it in front of the interviewer.

4.13.4 Order vs proposal

This set of features was not present in this interview.

4.13.5 Advice vs Understanding

This set of features was not present in this interview.

4.13.6 Conflict vs compromise

This set of features was not present in this interview.

4.14 A2

A2 is a 23 years old interviewee who is doing his Bachelors and lives in Peshawar.

4.14.1 Status vs support

This set of features was not present in this interview.

4.14.2 Independence vs intimacy

This set of features was not present in this interview.

4.14.1 Information vs Feelings

On being asked "how people around your circle treat you". A2 said, "As I am young so everyone treats me as a child and they always tell me that one day I will become successful". He is confident in himself as well but he used words of others to show that not just me but my people around me always encourages me that you will become successful one day, he is using his words through which he can show his happiness that with such positive minds he lives and trying to convey his feelings that he is happy to have them. Showing the feature of feelings.

When he says "As I'm young" he wants the listeners to connect with him and try to look at him with that point of view that he is not successful yet as he is young but he will surely become something because he is putting his efforts. Then to connect he says that others also acknowledge his efforts and tell him that yes you will be a successful person. He just not wants to connect with the interviewer but also with those who would listen to him.

4.14.4 Order vs proposal

This set of features was not present in this interview.

4.14.5 Advice vs Understanding

When A2 was asked "How do you think you can get ahead in this world" he said, "This world is a place where all are running, as fast as you run the stronger you become". He is telling others that this is the only way one can go ahead and become something, if someone wants to be successful, they must get up and start working for it, the more one works the more successful they will be. Here it can be seen that words are clear as if it is his way of living life and he wants other people to follow it. Showing the feature of advice.

His tone is soft when he says these words. Through his tone it can be analyzed that he wants others to understand that this is the only way they can achieve something, he wants to put this thing in others head that you must go fast because that is the only way.

4.14.6 Conflict vs compromise

This set of features was not present in this interview.

4.15 A3

A3 is 32 years old transgender person who lives in Lahore and sell stationary for living.

4.15.1 Status vs Support

The interviewer asked "Ap log roz bohot c mushkilat ka samna kartay hain, aap ki baat par kya soch hai?" [On a daily basis you face quite a lot of difficulties, what are your thoughts on this thing]. A3 said, "Ye sub roz mara ki sakht zindagi ka hissa hai hum jeso kay liye, dhuk, zulm, khudkushi. Hamare ghar walo ka chorna humay be-ghar kar deta hai humay asani se nokriyan bhi nahi milti" [it's all part of a painful social cycle for many of us. We suffer depression, violence and suicide. Family rejection leads us to increased homelessness, we don't get jobs easily]. Her response to the interviewer was that as if he agreed that yes, our life is difficult and not just difficult but painful as well, he agrees to the question being asked and then further add on it by saying that this thing is making them so depressed that people are killing themselves in our community when they become so helpless that they don't even know how to deal with all this. Showing the feature of support. The interviewee connects with the interviewer through his body language and speech that yes you are right, when this question was being asked the interviewer shook his head as if he is saying yes, you are right this is what happens with us. He further gives evidence by adding to the statement which was being asked that yes this happens and these are the drawbacks of it.

4.15.1.1 Expressive

while interacting with the interviewer the interviewee is quite expressive. She says all those words while keeping the same expression which is very positive although she talks about difficult life experiences.

4.15.2 Independence vs intimacy

This set of features was not present in this interview.

4.15.3 Information vs Feelings

This set of features was not present in this interview.

4.15.4 Order vs Proposal

When the interviewer was coughing, A3 said "You're coughing, do you want me to bring something for you?". He was asking if the interviewer needed some water or not. His words were interrogative, as if the other person needed water or not. He wants to make sure that if I bring water, would he take it or not. Showing the features of the proposal.

His voice was polite and caring, he wanted to make sure that either the person was fine or not. He asked in an extremely kind way that he can go and bring something because the other person is not feeling well. He also wanted to make sure that either the person would take water from him or not.

4.15.5 Advice vs Understanding

This set of features was not present in this interview.

4.15.6 Conflict vs compromise

This set of features was not present in this interview.

4.16 A4

A4 is a 27 years old transgender who sells book on the roads of Lahore.

4.16.1 Status vs support

This set of features was not present in this interview.

4.16.1 Independence vs Intimacy

The interviewer asked, "Ap ko kya lagta hai kay kya waja ho sakti hai kya aap log abhi tak itnay taqatwar nahi huwe" [what do you think are the reasons that you people are unable to make yourself powerful yet]. A2 replied, "Mujy lagta hai ak waja Jis ki waja se humay ziyada waqt lagta hai bakiyon kay barabar honay may wo ye hai kay hum logo ko auro se ziyada baatey suni parti hain aur hum par zulm bhi ziyada hota hai" [I think one of the reasons why transgender takes more time to reach equality is because in general, transgender people face higher rates of discrimination and violence". It looks like that he knows that they have done nothing wrong but still they accept this fact that world is harsh on them as compare to other genders. Violence on their gender is way more in comparison to others. Showing the feature of intimacy.

While answering questions there was this pain in his voice which conveyed the message that we are struggling but this is the only way we can live and we must accept this fact.

4.16.2 Independence vs intimacy

This set of features was not present in this interview.

4.16.3 Information vs Feelings

This set of features was not present in this interview.

4.16.4 Order vs Proposal

This set of features was not present in this interview.

4.16.5 Advice vs Understanding

This set of features was not present in this interview.

4.16.6 Conflict vs compromise

This set of features was not present in this interview.

4.17 A5

She is a 34 years old transgender who works for human rights in Islamabad.

4.17.1 Status vs support

This set of features was not present in this interview.

4.17.2 Independence vs intimacy

This set of features was not present in this interview.

4.17.3 Information vs Feelings

On being asked "why do you think gender is so important for everyone". A5 replied, "Infants might be clad in pink or blue. People cloth babies according to their gender, it is something which we create ourselves and label everything". According to her gender is something which we people self-create. We label things although Those things do not need labels. It's us who decide what baby should wear when he or she is born? If she's a girl, she wears pink but if he is a boy, he will wear blue. We made this thing difficult. Showing the feature of information.

It's clear in the speech that while he is speaking, he is stating facts and giving information.

It's us who decide what a gender is, and how the gender should be Portrait. We are making all this difficult ourselves. And while he was saying this his body language showed that he does not really believe in this gender thing.

4.17.3.1 Neutral thinkers

According to A5 gender is what we humans made, and this is not the correct thing to do when it comes to children. We all are humans and we must avoid these categories which shows that he is thinking neutrality, by excluding the idea of separate genders and bringing all under one umbrella term 'human'.

4.17.4 Order vs Proposal

This set of features was not present in this interview.

4.17.5 Advice vs Understanding

This set of features was not present in this interview.

4.17.6 Conflict vs compromise

This set of features was not present in this interview.

4.18 A6

Is a 27 years old transgender.

4.18.1 Status vs support

This set of features was not present in this interview.

4.18.2 Independence vs intimacy

This set of features was not present in this interview.

4.18.3 Information vs Feelings

This set of features was not present in this interview.

4.18.4 Order vs Proposal

This set of features was not present in this interview.

4.18.5 Advice vs Understanding

This set of features was not present in this interview.

4.18.6 Conflict vs Compromise

In the response to a question A6 said "Transgender people may indeed see themselves as born in the wrong body, but others simply don't identify strictly as male or female at all. And that's a challenging concept when it comes to cisgender (those who are not naturally trans). This was one of the best points made by A5, as he says that, ok, we might say that we are born in a wrong body like we are not perfect as male or female. So.

What is the thought of the world on those who are not transgender but change themselves? Those who are born perfect as male and female but change their identity as a trans person when they feel any need personally. We might say it's because of body so why then do they do as such despite having a perfect body Showing the feature of conflict.

While making this statement his tone is questioning as if he needs to hear some answer and if the listener does not have any answer so they must agree with him that yes you are right and this is true.

4.19 A7

A7 is 31 years old and lives in Peshawar.

4.19.1 Status vs support

This set of features was not present in this interview.

4.19.2 Independence vs intimacy

This set of features was not present in this interview.

4.19.3 Information vs Feelings

This set of features was not present in this interview.

4.19.4 Order vs Proposal

This set of features was not present in this interview.

4.19.1 Advice vs Understanding

A7 was asked "what should those do, who have been in the same situation as you". She replied "I want to tell them, whoever they are, they should go to face the world, find their hidden talent, and focus on education and skills". Here she showed the feature of Advice. While saying this she was confident enough in herself that yes, she has done all this so she would ask others also to do all this, so they can become something. She definitely understands life is quite difficult for them, but says that let's not make it an excuse and go out face the world. Fight with what you feel is difficult and try to be a better version of yourself, that is the only way you can become something in that competitive world. Showing the feature of advice.

When she says "Find their hidden talents", it can be understood that she already knew what her hidden talents are as she has already found it and became something due to it. So, she has the authority to tell others to also go out and find their talents as she thinks this is the only way of becoming a person one can dream off.

4.19.6 Conflict vs Compromise

This set of features was not present in this interview.

4.20 A8

35 years old transgender who lives in Punjab.

4.20.1 Status vs support

This set of features was not present in this interview.

4.20.1 Independence vs Intimacy

While answering the same question A8 said "Ak yakeen kay such may kuch ghalat hai kisi ka transgender hona but se bari rukawat hai hum logo kay liye" [A belief that there is something morally wrong with being transgender is one of the biggest barriers for us]. By use of these words A8 wants the listener to understand that being transgender is not a wrong this thing. He wants others to feel that connection that looks like we are also one of you people, then why are we treated in such a way. He is saying this so that others must stop this behavior and only then they would be able to move forward because this is one the biggest huddles in their way.

His tone was low and heartbreaking while saying those words. He was in pain but he did not hide that pain which means he wants others to connect with him through his words.

4.20.3 Information vs Feelings

This set of features was not present in this interview.

4.20.4 Order vs Proposal

This set of features was not present in this interview.

4.20.5 Advice vs Understanding

This set of features was not present in this interview.

4.20.6 Conflict vs Compromise

This set of features was not present in this interview.

Findings

The set of features of Tannen's theory of genderlect has been applied to the research study. All the features where applied and explored within the chosen data.

The analysis showed various common features as those of the language of men and women. Apart from those features they also showed new entities which were not present in Tannen's work. One of the biggest features of the transgender language is **Politeness**. When they speak their use of words and the pitch of voice is mostly polite, they have this charm in their personality that through their speech they would always try to be kind and humble. The way of talk, body posture, utterance of words and tone of their voice is always low and sound. Although while saying quite harsh things they still maintain their polite way of talk, such as "please do not mind" "best wishes for you".

Their speech shows the factor of **Endurance**. They can tolerate difficult things being asked very easily. While they speak, they can continue speaking on sensitive topics in as such manner that other person also feels comfortable under their shadow. Whatever is asked from them no matter how much difficult the questions are, they answer them as if that is not a problem at all, without making it look awful or sentimental as other genders do e.g., on being asked "you do not have proper rights in the society" they say "yes we know". This detail was missing in other genders, their language work quite opposite from transgender.

One of the features of transgender is that they are **Neutral thinkers**. As compare to other genders they can think more neutrally, as other genders focus on various other things such as status/support, trans focus is on everyone not only on themselves such as they always use the word "we" not "I" or "me" which shows that they always think neutrally. As transgender speaks, they do it on behalf of everyone as they would say "we" to address all at the same time. Due to this they give great advice, because they don't think of themselves while they talk, they are mostly thinking of all, keeping everyone in mind. They think that all of us are one.

Transgender are **Keen observer**. Man listen more and speak less and female listen less and speak more whereas transgender can do both the things simultaneously. They can listen to a person for hours and then they can also speak more. They will show patience and a sense of understanding when they are listening to the other person. And while they are speaking themselves, they want others to listen to them with full attention. As they will ask you again and again "Are you listening" or "am I clear" like this they will try to know either other person is playing full attention or not.

They are way more **Expressive** in their speech. While they speak, they make expression the key to communicate, their sentences have a different way of utterance. They would try to maintain their way of talk all the time such as, "I would like you to think" "full of heart" their use of words show they want their speech to maintain in a proper way.

Conclusion

This Paper has attempted to tease out the genderlect of transgender in comparison to the theory of genderlect by Tannen (1990). The set of six features given by Tannen, were applied to the language of transgender, in interviews. Genderlect of transgender is completely new concept and it tells how transgender speak as compared to other genders.

Interviews are the tool in which the language of transgender is studied, and this project is an attempt to discover the genderlect of transgender. There are researchers who have worked on the language of transgender before but this research only focusses on the language in the light of genderlect theory given by Tannen (1990).

The research is done by keeping in mind the framework of Tannen (1990). This theory is based on the six features of language. Genderlect theory sums up quite important and amazing aspects regarding the life of both male and female. It clearly states that the way men and women react to the same situation differently is not because either of them is right or wrong, superior or inferior. It is simply because they are just different.

Comparative analysis was done by applying features of genderlect theory on the interviews. The interviews were analyzed keenly and while examining language of transgender. They showed the feature of genderlect theory as well as few new ones which were then discovered. All the interviews reflected the feature of general theory few had All features and others had selected ones.

It was discovered that the feature of politeness, the way they speak is very polite such as "kindly", "please don't mind", "best wishes for you" and many more endurance, such as they show patience in their speech after having so many harsh comments they show patience, on being asked quite harsh questions such as "you are

neglected" "you don't have proper rights. They answer quite well without being offended, for example "yes we know". While they are speaking their body language shows that they already know all these things and these things are not new to them or offending them.

Suggestions and Recommendations

Related to the conclusions above, it is well suggested that:
1. The reader should study and analyze different other discourse types with the perspective of Translect.
2. This work can be extended to future work under the term of Translect: genderlect of transgender. Under this umbrella term transgender there are various types of transgender (trans-male/trans-female), so this research can be applied on them.

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Salience Pattern in the Selected Poems of ESL Textbooks in Pakistan: An Eco linguistic Perspective

Amin Ullah, Zulfiqar Ali

City University of Science & Information Technology Peshawar, Pakistan

Abstract

The present research explores the salience pattern in the primary level English textbooks in Pakistan. The study employs one category of Stibbe's framework (2015) i.e. Salience pattern to five poems and concludes that nature is given salience or foregrounding through various linguistics techniques such as transitivity, personal pronouns, sense image and individualization. The finding reveal that the language used in the text help in the sustainability of natural environment as the text conveys a bio centric approach rather than an anthropocentric approach which focuses upon human's interest only. The text represents nature as an active being and describes its intrinsic worth and thus communicates a beneficial discourse. Hence, the text could encourage the young readers to take care of nature in their daily lives .The study recommended that the textbook writers should follow the Eco linguistics principles prior to design the English textbooks for students.

Keyeords: Salience pattern, eco linguistics, transitivity, bio-centric approach, anthropocentric approach

Introduction

In the 1990s, eco linguistics emerged as a new paradigm in the study of linguistics. It is an expanded branch of sociolinguistics that considers interactions among human beings, other living things, and their physical surroundings.

According to Stibbe (2015, p.)the interaction between ecology and language is known as eco-linguistics. A perfunctory justification is that language influences how we think about the world. For instance, although nature writing might inspire us to care for and cherish the natural world; the language of advertisement can persuade us to purchase unnecessary and environmentally detrimental things. Our actions are shaped by our thoughts; therefore, language affects how we decide whether to preserve or destroy the ecology on which life depend. So, Eco linguistics critiques the form of language that aid in the destruction of ecosystem and support or appreciate the form of language that contributes in the protection of natural environment.

One of the founders of Eco linguistics, Stibbe (2015, p.8) emphasizes the interdependence of language and ecology. Fill (1993) states that Eco linguistics inspects the role of language in the promotion and potential resolution of ecological and environmental problems. Eco linguistics connects language study with ecology. It examines environmental discourse from a Critical stance (ibid, p.8). According to Eco linguistic viewpoints, language and culture are suffering because of the loss of biodiversity.

Pakistan National Curriculum (SNC) brings all of the country's educational system under one agenda "one Nation, One Curriculum". The old curriculum (2006) has been replaced by the SNC (2020). The new curriculum SNC (2020) incorporate topics such as Pakistan National Policies, topics related to religious, social, political and economic factors; international agendas like UN Sustainable Development Goals (SDGs), environmental themes and climate change. Moreover, the insertion of environmental topics in the curriculum would make the students able to distinguish between living and non-living objects, to recognize the plants and animals and their basic habitat; to observe the weather and develop understanding of the seasons and their significance to people; to develop a caring attitude in the children towards environment; and to identify natural and physical resources of the earth (Mohsen and Gul, 2021).

This research study makes an attempt to analyse the language used in the selected text especially the salience pattern in order to find out how the text help in the sustainability of natural environment.

Aim of the Study

The study aims to explore the salience pattern in the selected poems of English textbooks in Pakistan, which are taught in the public school of Khyber Pakhtunkhwa. The ecosophy assumed by the researcher is 'care of nature' 'sustainability' and a sense of respect for nature'. The objectives of this research are as follow:

- To analyse ecological discourse in the selected text in order to see how the text helps in the sustainability of natural environment
- To analyse the technique of salience pattern in the selected text and to point out whether the selected text convey a beneficial or destructive discourse to the readers?

    The following research questions will be answered during the analysis;

- Do the linguistic patterns given in the selected text helps in the sustainability of natural environment?
- Does the selected text convey a beneficial or destructive discourse to the readers?

Review of Literature

This part deals with the review of related literature and other important concepts related to the research topic. Stibbe (2004) analysed Japanese EFL books from the perspectives of critical Discourse analysis and found that most textbooks deal with environmental issues from an anthropocentric approach, focusing on the "immediate physical symptoms" of these issues related to humans' interest while ignoring the "underlying cultural, political and ideological matters" (Stibbe, 2014).

Stibbe (2007) examined how nature, plants, and animals are depicted in Japanese haiku poetry. Animals and plants are shown in haiku as entities who actively participate in living their own lives and who deserve compassion and respect. As a result, haiku fosters ecological awareness in the context of the local ecosystem, in contrast to western culture, which views animals as resources, commodities, and symbols of species. Haiku establishes relationships between humans and non-humans in seven different ways: by emphasizing the value of the commonplace (plants, birds, insects, and animals), avoiding metaphors and abstraction, highlighting specific animals and plants, portraying them as agents of their own actions and activities they perform in accordance with their natures, and by evoking empathy and positive regard for them.

Goatly (2000) carried out a research study on the ecological analysis of nature poetry and a scientific report (Goatly, 2000). He compared The World Watch Institute Report, the state of the world (2012) (SOTW) and Edward Thomas's collected poems and Wordsworth's "The Prelude" for the representation of nature by using eco critical discourse analysis. The findings reveal that nature is more frequently represented as an actor and sayer in Words worth and Thomas's poetry than in the world watch Institute report .Similarly, both Wordsworth and Thomas have represented 'nature' as 'experience' in their poems but we do not see such representation of nature in the scientific report.

Research Design

This section presents the data analysis tools and procedures. The chapter includes data collection, a theoretical framework and data analysis techniques.

Data Collection

The Data has been taken from the English textbooks which are based on single national curriculum (SNC-2020) and are taught in the primary schools (from grade 1 to grade 5) of Khyber Pakhtunkhwa Pakistan. The following six poems have been taken for analysis. They are as follow:

1. I am the Earth
2. The Caterpillar
3. The Sun
4. The Bug
5. My Kitty Cat

The researcher employs a purposive sampling technique and makes an effort to highlight the linguistic patterns that may either support environmental sustainability or contribute to its destruction.

Theoretical framework

This research study is based on Stibbe's framework of eco linguistics (2015) as mentioned in his book "Language, ecology and the stories we live by". Stibbe's model is essentially a cognitive framework that combines Critical Discourse Analysis and the notion of 'the stories we live by' from human ecology.
Stibbe's framework of eco linguistics consists of 8 types of stories which are: ideologies, framing, metaphor, evaluation, identities, convictions, erasure and salience. The researcher has focused upon the technique of salience in order to reveal the linguistic patterns that may either influence the readers positively or negatively.

Salience

Salience is a story in the mind of the people, which describes that an area of life is important and admirable of consideration. One of the devices through which salience is built in a discourse is the use of the pronoun. For instance, animals are given more prominence when the pronouns "he," "she," "they," and "who" are used to refer to them instead of "it" and "which .Salience patterns can be revealed by analysing a range of linguistic features such as focus, the use of pronouns, levels of abstraction, transitivity, vitality, and metaphor, etc. that represents an area of life prominently, vividly and concretely. Furthermore, salience can be built in a text by personalization, individualization and foregrounding techniques. According to embodied cognitive theory (Johnson, 2013; Lakoff, Johnson, & Sowa, 1999), "meaning is based in the body, and terms that relate to actual or potential bodily experience have much more power to invoke images and emotions than more abstract terms". Lakoff and Wehling (2012, p. 42) describe that the word 'environment' is an abstract category that does not create a clear image in the mind of the readers whereas the words 'forest', 'soil', 'water', 'air' and 'sky' bring clear imagery to mind. The basic level words such as 'cat' activates motor program whereas

abstract terms such as plant and animals and other superordinate terms like furniture do not arouse a specific image (ibid.p.41). Other characteristics of salience are personalization and individualization. In individualization, plants and animals are represented as matchless and unique as opposed to homogenization where plants and animals are shown as types or mass.

According to Van Leeuwen (2008, p.33), "salience can also be built by foregrounding participants in a clause" (Van Leeuwen, 2008). When social actors are represented as active beings that are doing, thinking, feeling or saying things they are said to be foregrounded in a clause

Another device through which salience is built in a text is sense image. This technique is frequently used in new nature writing. Sense image is a description of how an outside force affects the senses. For instance, the following discourse conveys the idea that apparently there is no observer but the lexical words such as reflected, showing and sunlight imply eye receiving the image.

"He [a peregrine] flew in an easy loop, and when the sunlight glanced his undersides, they were pale and banded like rippled sycamore" Stibbe (2015, p.178).

Data analysis techniques

1. Ecolinguistic analysis of the poems which exposes a particular pattern in the text .The   following linguistic features are emphasized during the analysis and are given below:

Vocabulary e.g. connotations of words, pronoun use, transitivity patterns, assumptions and presuppositions, how participants are represented e.g. as individuals or an aggregated mass and figures of speech such as simile, personification and metaphor, etc.

2. Exposure of underlying ideologies

3. The underlying ideologies are judged against the given ecosophies which are given below:

 The researcher keeps in mind the following ecosophies:

1) Care and respect of animals,2) well beings of both humans and nature ,3) connectedness of humans with nature ,4)

Analysis and Discussion

The following poems have been analyzed to look for salience pattern and the underlying concepts behind the text.

The poem entitled 'The Earth' gives high salience to the earth as a living organism through personification, personal pronouns, and by assigning it an active participant role in clauses.   In the very first line of the poem, the writer has used the relational process in which the speaker, I, is the earth. The second line defines the earth as the home for humans. The stanza has two social participants: the earth which is referred to as "I," and human beings who are referred to as "you."

Human beings are represented as actors in the material process. They destroy the skin and bone of the earth as in the following lines:

"But you destroy,

My skin and bone,"

The earth is also given salience by representing it as an actor in the material process of the verb (live) as it provides living conditions to human beings; and a sensor in the mental process of the verb (regret) as it feels regret when humans destroy the bone and skin of the earth. The same feeling is continued in the second stanza "Do you realize,

I am your only hope,

So don't stand around and mope,

I need saving, It's up to you,

This is what I need you to do."

In these lines, the earth has been given salience by representing it as a carrier of attribution (I) of the attribute (hope) in the relational process of the verb (to be) .so, humans are required not to destroy the earth as it is their only hope. The line 'I am your only hope' entails that the earth is the only place in this world where human beings find suitable living conditions which is being destroyed by them. Moreover, the earth needs care and saving as Humans lives are dependent upon the earth.

This poem also uses a rhetorical device called personification. The earth is endowed with human qualities and is capable of performing different actions like human beings. Being personified as a living organism, the earth's intrinsic values are highlighted, encouraging care and admiration for it like any other living organism. The following lines contain the technique of personification:

'But I forget

I forgive

And let you live'

Through the mental process, the earth is also personified as a living organism that feels and realizes the pain given by human beings in the following lines:

But you destroy,

 My skin and bone,

In the last stanza of the poem, both humans and the earth have been given salience by representing them as actors in the material processes.

'Because I am fading at a fast pace,

Because you are polluting my air'

The earth is fading at a fast speed because human being throws plastic and other waste materials on the earth. Moreover, the earth needs care and love as human beings are polluting its air.

The text employs a beneficial discourse in which the technique of personification has been employed and representing the earth as a sentient being who is being destroyed by human beings. But contrastively, the earth is the only hope for human beings as they find suitable living conditions on it. The ideologies entrenched in the discourse emphasize the protection and saving of the earth for a sustainable life to make it a place worth living for human beings and other living organisms.

The poem entitled 'The Caterpillar' gives high salience to the caterpillar by presenting him as an active living being through the technique of sense image to encourage the readers to personally imagine the scene being described. Sense image is the description of how an external thing influences the senses.

Moreover, the absence of the definite article 'the' before the word 'caterpillar' suggests that the writer describes the activities of a particular caterpillar. The caterpillar is described as a living individual who lives

its life according to its free will. In the first two lines, the writer describes the physical characteristics of the caterpillar that is 'brown' and 'furry' and is always busy in doing something in the world. Salience is given to the caterpillar by representing it as an actor in the material process of the verb (take) in the following lines:

Take your walk

To the shady leaf, or stalk,

In the second stanza, the writer describes that the caterpillar faces dangers from the birds of prey and toad. Moreover, the caterpillar is given salience by representing it as an actor of the verb spin and die, which is a life cycle in which a caterpillar is converted into a butterfly.

This is a beneficial discourse that implicitly describes the importance as well as care of ordinary creatures i.e., the caterpillar.

The poem entitled 'Golden Sun', also gives salience to the Sun as it is a source of life for all things i.e. human beings, animals, birds and plants, etc.

In the first stanza, the sun has been given prominence by describing its attributes such as Great, Glorious, and Golden which are associated with shining .In the second stanza, the sun has been defined as a source of life for both plants and birds on this earth, which presupposes that plants and birds also depend on the sun for their lives.

In the third stanza, the sun has been given prominence by representing it as a source of life for flowers and fields as it provides them with sunlight continuously.

In the last two lines, the sun has been represented as an actor in the material process, which is the subject of the verb 'give' and acting i.e., giving light to all living things including plants, animals, presupposes that the sun is the source of life for all living things.

It also presupposes that there would be no life on this earth if the sun stops working.

This is a beneficial discourse stresses the importance of nature for all things including plants, animals and human beings. The text highlights the intrinsic worth of nature emphasizing the deep ecological connection between plants, animals, human beings and the sun.

In the poem entitled 'The Bug', the bug is represented as a living individual by giving it an active participant role in clauses. Additionally, the pronoun 'he' has been used to personify the bug.

In the first stanza, the poet creates a sense image by encouraging the readers to imagine the scene being described by the poet. The poet sees a little bug after the rain had stopped and the sun was shining. The following lines contain the sense image.

I ran out on the walk to play

And found a little bug was there.

In the second stanza, the poet describes the activity of the little bug by presenting him as an active living being that performs different actions in the physical world. The following lines have been given for illustrations:

'And he was running just as fast

As any little bug could run'

'Until he stopped for breath at last'

In these lines the bug is given salience by representing him as an actor in the material processes of the verbs 'was running' and 'stopped'. The intransitive verbs indicate that the bug cannot control its surrounding.

In the third stanza, the writer observes the bug when it chirped a song to him. In this way, the writer again creates a sense image in the minds of the readers. Moreover, the bug is portrayed as an actor in the material process of the verbs: chirped, gave, and showed. The bug is also given prominence by using the pronoun 'He' rather than 'it'.

This is an example of beneficial discourse, which describes the intrinsic worth of nature giving us a message that the ordinary creature is important for itself leading its own life for its purpose. The implicit meaning of the poem is the worth and importance of the ordinary creature the bug.

The next poem entitled 'My Kitty Cat' gives high salience to a cat through foregrounding techniques.

The cat is described as an individual being with its peculiar traits, colour (black and white) and behaviour. The cat is given salience notably through the proper name 'Kitty' which performs different actions according to its free will. Moreover, the speaker of the poem uses the pronoun 'She' to refer to the cat. The cat is represented as an active being that performs different actions in the material process of the verb. She is represented as an actor in the martial processes of the verb (sleeps, walks, gets her food, adopts a happy mood, stretches out, hunts me down, bats my pen ,hits my pen, goes to bed, nibbling my toes, licks my feet) and a sensor in the mental processes of the verb (knows).

This is a beneficial discourse that describes the characteristics behaviour of a cat which is being cared of. The underlying concept of the poem is the appreciation of the ordinary animal which has a great role in the maintenance of the ecosystem.

Discussion

The poem entitled 'the earth' focuses upon the interaction between human beings and nature. The earth provides living conditions to human beings, but in response human beings violate the natural environment by doing activities that harm the natural environment. Hence, the underlying concept of the poem is taking care of nature for a sustainable development. The poem- 'The Caterpillar' employs the techniques of transitivity and sense image to give salience to the caterpillar by representing him as an individual creature that lives its life freely. Hence this sort of language creates a sense of love and respect in the students towards nature. The poem – The bug also uses salience pattern through sense image, individualization, and transitivity. The bug has been represented in the poem as a living organism that performs not only physical activities in the world but also sensing or realizing its surroundings. The text highlights the importance of the ordinary creature- the Bug. Similarly, the poem entitled as 'My Kitty Cat' gives salience to the cat through individuation, transitivity and proper noun, giving a story that the cat is important and worthy of consideration.

The present research study is in line with Goatly (2000), who carried out a comparative analysis of the World Watch Institute report, the state of the world 2012 (SOTW) and Edward Thomas's collected poems, and William Wordsworth's "The Prelude" from the perspective of ecological critical discourse analysis. His findings reveal that nature is represented more frequently as an actor/ sayer than an affected participant in both Thomas and words worth's poetry than in SOTW.

Conclusions

Eco linguistics has long explored "the role of language in the life-sustaining Interactions of humans, other species and the physical environment" (Stibbe 2021).In this connection, Ginsburg and Audley (2020) demonstrated that integrating environmental education and sustainability goals positively in early childhood schooling (preschool) results in buildings of positive habits and attitudes towards the natural and sustainable environment. Similarly, children have the capacity to deduce the meaning from a text. Therefore, they are regarded as active meaning makers whose knowledge directly affects how they behave with nature (Foucault, 2013, as cited in Stibbe, 2015).The study aimed to study the salience pattern in the six poems of the textbook English that are taught in the public schools of Khyber Pakhtunkhwa Pakistan. For this purpose Stibbe's framework of Salience (2015) was applied to highlight the linguistic patterns that may either contribute to the preservation of natural environment or help in its destruction.

The analysis exhibits how poems can introduce the readers to more beneficial ways to interact with nature. Linguistic patterns were examined analytically in terms of transitivity, individuation, sense image and personal pronoun use that give prominence to nature in the text and revealing a story that nature is important for the maintenance of ecosystem. According to the ecosophy, all the poems assist in revealing constructive discourses that encourage the readers to have regards for nature. Hence this sort of using language encourages the readers, especially the young students to give regards and consideration to nature in their surroundings in daily life. The findings reveal that language is used positively in the selected text and thus communicate a bio centric approach to the readers.

(Macalay and poole 2022) suggest that ELT must be more critical to take into account our practices and pedagogies that contribute to the attitudes, ideologies, identities, and behaviors that cause environmental harm and the climate crisis. At the same time, we must think about how to advance ecological sustainability and well-being.

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A Direction-aware Multicast Mechanism to Reduce Control Overhead in Manets

Muhammad Murtaza, Osama Nazimi, Noreen Khan, Shahab Haider
City University of Science and Information Technology, Peshawar, Pakistan, Pakistan.

Abstract

The utilization of mobility nodes has witnessed a rise, necessitating the need for rapid, efficient, and secure data transmission. An Optimizing Rebroadcast Mechanism for Minimizing the Control Overhead in Mobile Ad-hoc Networks (ORMMCO), a protocol that divides nodes into three regions and determines multiple paths based on the shortest distance, often leads to issues such as delayed packet delivery, packet loss, and packet flooding on the network when a node unexpectedly leaves the region without prior notice. To address these concerns and ensure network stability, A Direction-aware Multicast Mechanism to Reduce Control Overhead in MANETS (DMMTCO) proposes a solution that establishes multiple pathways among nodes that all share the same direction. To assess the performance of DMMTCO, a simulated network environment was created, and 42 iterations were conducted. Compared to ORMMCO, DMMTCO exhibited a significant improvement in network performance, achieving a 63% enhancement. Additionally, DMMTCO saved 98 packets from being lost and demonstrated a 42 ns reduction in delay compared to ORMMCO. In a congested network scenario, DMMTCO outperformed ORMMCO by 25% in terms of efficiency. In summary, the DMMTCO protocol offers a solution to address the challenges posed by ORMMCO in terms of delayed packet delivery, packet loss, and packet flooding. Through the establishment of multiple pathways with consistent directions, DMMTCO improves network performance, reduces packet loss, and minimizes delays.

Keyword: Multicast, direction-aware, MANETS, packet flooding, network overhead.

Introduction

In today's interconnected world, having reliable and secure online connections is essential. To meet this requirement, a robust communication infrastructure is necessary to ensure fast, dependable, and long-term connectivity. This infrastructure relies on devices that establish stable connections among senders and receivers. When these devices are connected through wired or wireless connections, they form networks. These networks serve various purposes for users, including communication, online business, entertainment, education etc. The network is formed with or without infrastructure, such networks are known as ad hoc networks. These ad hoc networks are formed among wireless devices, such devices having Omni directions known as mobility devices (here referred as nodes). The network type for such nodes is known as Mobile Ad-hoc Networks (MANETS). These networks perform a major duty in various domains such as military operations, disaster recovery efforts, gaming, and file sharing. However, these applications come with their own set of challenges, including security concerns, efficient routing of data, and effective allocation of network.

In MANETs, ensuring secure, fast, and reliable information sharing among nodes is crucial. To address these requirements, several frameworks have been introduced that perform multiple tasks. Some of these frameworks facilitate the sharing of idle resources among connected nodes, while others provide multiple paths for fast and secure transmission. However, one of the most challenging tasks in MANETs is selecting the optimal route among Source Node (Sn) and Destination Nodes (Dn). To prevent network flooding and enhance performance, various frameworks analyse different parameters to identify multiple routes for data transmission. In [1], a framework is introduced that focuses on identifying multiple routes based on the minimum distance. This method enhances overall performance and reduces network flooding. However, a number of problems could occur when sending data, such as nodes joining or leaving the network without warning, a rise in the data packet loss ratio, transmission delays, and possible difficulties keeping the Sn and Dn delivery ratio high [2]. To identify a route, neighbouring nodes receive RREQ messages from the routing protocols in use. The optimal route is then chosen by these protocols depending on the shortest distance between nodes. Everyday broadcast floods raise the community's communique overhead, which causes congestion and lowers community performance [3]. A route-conscious Multi-forged Mechanism to reduce manipulate Overhead in MANETs (DMMRCOM) is the name of the proposed framework that ambitions to discover more than one routes

based totally on the equal course. In assessment to different frameworks, this method gives greater balance and calls for fewer hops for the selected routes. This framework allows to reduce facts packet loss ratio, lessen packet receiving delays, and improve packet transport ratio inside the community by means of selecting the handiest routes.

Literature Review

This phase examines the literature on dynamic routing, wi-fi multicast protocols, and single- and a couple of-direction selection in multi-hop networks (MANETs). The authors advocate some of tactics to address issues in MANETs, inclusive of information transmission accuracy, network site visitors, and routing overhead [4-7]. The authors suggest an ODMRP-primarily based wi-fi multi-cast protocol that improves community performance by using removing flood packets [8]. The reactive AODV Protocol for MANETs provides a hassle, though, because it builds a course from a target node to some other node, which clogs the community and lowers performance [9]. In addition, the authors of [10] recommend an algorithm for the AODN protocol that uses direction nodes and links to check whether any community node is engaged in course discovery for the reason of sending control packets. This technique from [11] improves network performance and lowers flood packets. The authors of [12–15] also suggest the Neighbor Coverage Established Topology Control Algorithm for Latency (NCTCAD), which uses the Ad-hoc On-Demand Distance Victor Velocity and Dynamic (AODV-VD) protocol for effective broadcast control packets in order to improve MANET performance and lower latency[16]. A load balancing system, congestion control mechanisms for MANETs, and hybrid probabilistic and parametric broadcasting techniques are also covered by the authors in [17]. In order to customize routes according to the conditions of the network, they also advise merging the routing protocols AOMDV, AODV, and OLSR [18]. In conclusion, these authors in [19-22] propose various routing protocols and algorithms to address challenges in MANETs, such as network traffic, routing overhead, and data transmission accuracy. They also propose a novel design for scalable table-driven routing protocols that incorporate the benefits of both link-state and distance-vector routing methods [23]. The authors in [28] emphasize the importance of probabilistic broadcasting in mobile ad hoc networks to circumvent broadcast storm problems. They provide an overview of Ad hoc On-Demand Vector (AODV), Route Request (RREQ), Smart Probabilistic Broadcasting (SPB), Multi point Relay (MPR), Dynamic Source Routing (DSR), and Point-to-Point (P2P). The Mobile AdHoc Network (MANET) is a network that uses a software layer protocol for provider discovery and path discovery. To reduce congestion, the authors in [29 - 31] propose a strategy using Data Priority and Streaming Delay Weights (SDWs), which utilize SCTP multi-streaming. The design includes a Priority Manager to select information streams based on priority. Despite congested MANETs, throughput increases for all data categories, and jitter, loss, and overhead decrease. The study in [33] aims to characterize MANETs and analyse various information dissemination strategies, including source tree adaptive routing, wireless routing, destination sequenced distance vector routing, global state routing, fisheye state routing, hierarchical state routing, and wireless

The Proposed DMMRCOM Framework

The flowchart in Figure 3.1 illustrates a network procedure for minimizing packet transmission distance. It begins with Node Ni, initiating the packet transmission, sending an initial multi-cast request to neighbouring nodes. If responses are received, the process moves to the "Node Have Same Direction" node, which directs the selection of the shortest route. If no responses are received, the flowchart veers to the "Node Have Minimum Distance" node, which directs the selection of the shortest route. The process converges at the pivotal "Role Decision" node, where the current node's role is determined based on its relationship with the source and destination nodes. If Node *Ni* is a Source Node (*Sn*), the packet is transmitted towards the destination. If no acknowledgment is received, the packet is held briefly before being dropped. If no acknowledgment is received, the packet is forwarded in the direction of the destination node. The flowchart's steps are coherent, accounting for acknowledgments and potential waiting periods, ultimately guiding towards successful packet delivery or appropriate handling in case of disruptions.
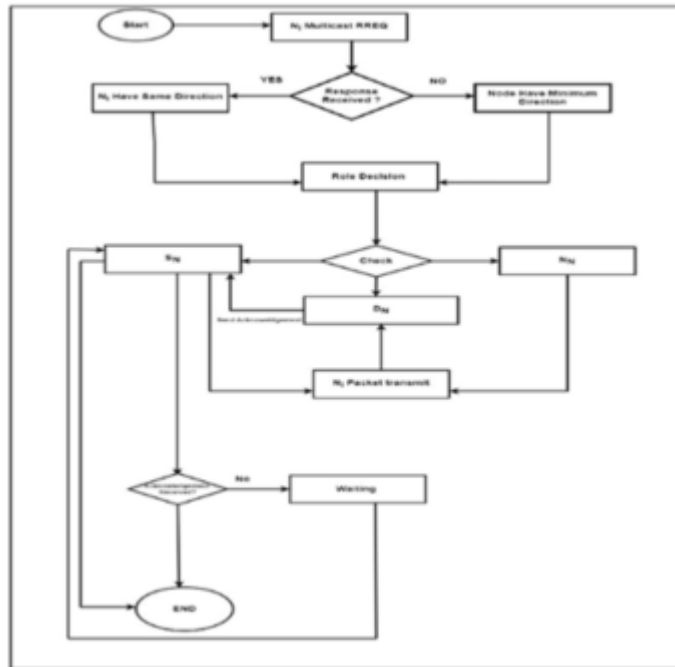
Figure 3.1: Procedural Flowchart of the Proposed DMMRCOM Framework

Results Evaluation

This section evaluates the performance of both frameworks based on network throughput, delivery ratio, end-to-end delay, and packet loss ratio in three types of networks: sparse, medium, and dense.

Table 4.1: Simulation Parameters

Description	Value
Number of nodes	100
Communication range	100 meters
Transmission range	10 dBm 2.4
Carrier frequency	GHz 1024
Packet Size Simulation	bytes
duration Mobility	100 seconds
Model	Random Waypoint
Routing Protocol	AODV (Ad hoc on-demand Distance vector)

Throughput Improvement

When it comes to assessing a network's effectiveness and ability to manage data traffic, throughput is a critical component. In today's data-driven world, a network's capacity to process and deliver more data is reflected in its higher throughput. A baseline, or standard network architecture, is set in order to assess the network's performance without any alterations or improvements. The study then presents improvements to maximize the capacity for data transfer. The network with the suggested improvements is represented by the result line, which demonstrates a notable increase in throughput—1000 packets are transmitted in 60 seconds. This improvement can be ascribed to improved data transmission protocols, more bandwidth, or optimized routing algorithms. The efficacy of the suggested improvements is shown by comparing the result line to the baseline, showing the possibility of improving network capacity and efficiency. Faster data transmission, more seamless communication, and enhanced user experiences are all possible outcomes of this improvement.
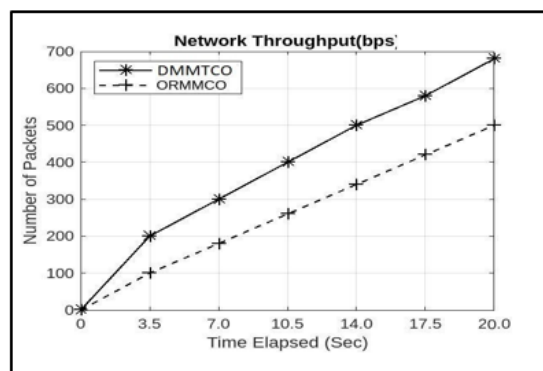

Figure 4.1: Network Throughput

Network Packet Delivery Ratio

By improving the network's delivery ratio, the study sought to raise the proportion of packets that were delivered successfully. Numerous network components, including routing algorithms, congestion control systems, error correction methods, and reliability protocols, were included in the suggested improvements. The delivery ratio significantly improved in the results, almost doubling the baseline's performance in just 10 seconds to reach 17%. As more packets arrive at their intended destinations, this improvement indicates an improvement in the network's reliability. This result has important practical ramifications, especially for applications that depend on accurate and timely delivery of data packets. Higher delivery ratios guarantee seamless user experiences and enhanced network performance in sectors like telecommunication, streaming services, and online gaming. Even with network challenges like congestion or complexity, the delivery ratio improvement is consistent throughout the network, making it dependable and efficient in guaranteeing data packet delivery. Maintaining network-dependent applications' integrity and performance under conditions of fluctuating network conditions or heightened traffic loads requires continuous improvement.
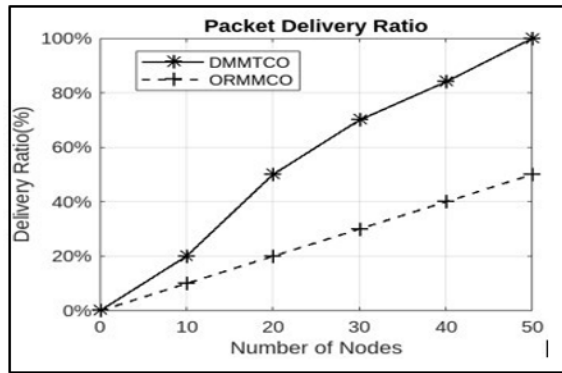
Figure 4.2: Network Delivery Ratio

Reduced Packet Loss

When evaluating the efficiency and dependability of a network, packet loss is an essential metric. It counts the quantity of packets that are lost or corrupted during transmission because they are unable to reach their intended recipients. Efficient data delivery depends on minimizing packet loss. A baseline scenario was created in which 2800 data packets were sent in total, but 400 were dropped during transmission. The objective was to determine and put into practice methods for minimizing packet loss, such as algorithms for congestion control, error detection and correction, and quality of service optimizations. With only 280 packets lost, the result line demonstrated a significant decrease in packet loss. This decrease in packet loss shows how well the suggested improvements mitigate the factors that cause packet loss. Because there is less need for retransmissions or data reassembly, accurate data delivery is ensured by this decrease in packet loss. Because fewer resources are needed to handle retransmissions and recover lost data, this also improves network efficiency. To sum up, the suggested improvements have successfully decreased packet loss, increasing the efficiency and dependability of the network. This reduction fosters smooth communication, uninterrupted data transfer, and improved user experiences, which has significant implications for a variety of network-dependent applications.
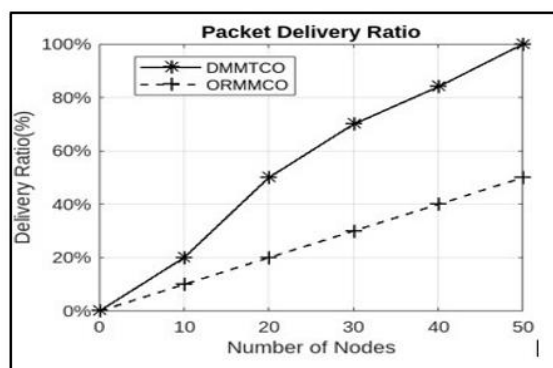

Figure 4.7: Network Packet Loss

Reduced End-to-End Delay

In network communication, end-to-end latency must be kept to a minimum for optimal user experience, effective data transfer, and real-time responsiveness. A network sending 6000 packets with an average delay of 210 nanoseconds was used to create a baseline scenario. The objective was to determine and put into practice methods to reduce packet transmission latency from beginning to end. The suggested

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improvements included processing overhead reduction, better packet scheduling, and routing algorithm optimization. The result line, with an average delay of just 120 nanoseconds, demonstrated a notable decrease in end-to-end latency. There are various effects this enhancement will have on the responsiveness and performance of the network. It benefits real-time applications such as online gaming, video conferencing, and real-time data streaming by lowering latency and guaranteeing timely delivery of time-sensitive data. By cutting down on congestion and packet transmission latency, it also increases overall network efficiency, resulting in improved resource management and enhanced network performance. The suggested improvements have successfully decreased the end-to-end latency, leading to increased application performance, faster and more dependable data transmission, and better user experiences.
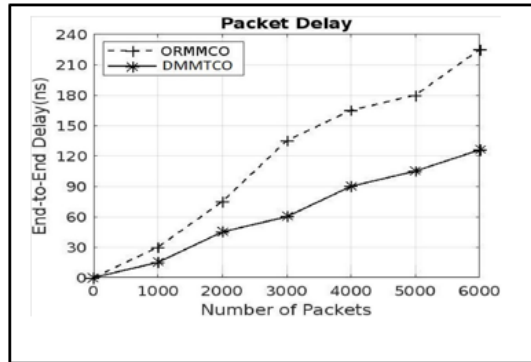

Figure 4.10: End-to-End Delay

Conclusion and Future Work

The increasing use of mobility nodes necessitates efficient and secure data transfer. Current protocols like ORMMCO, which use the K-Means method, have limitations due to potential node movement. DMMRCOM, a protocol that defines multiple paths in the same direction, aims to avoid packet flooding and ensure node stability. Simulations show that DMMRCOM outperforms ORMMCO in typical traffic, with a 27% higher capacity for transmission and a 19% greater packet delivery ratio. It also reduces packet loss, preventing at least 98 packet losses. Simulation results show a delay reduction of up to 112 ns, proving the validity of DMMRCOM. The study contributes to the advancement of wireless communication systems and offers practical implications for network designers and engineers. However, DMMRCOM framework performs better than ORMMCO, however it does have some limitations. These include the absence of packet prioritisation and the notification of received packets after they have arrived at their intended paths. It is essential to address these problems, come up with suitable solutions in order to guarantee reliable packet transmission and improve the framework's overall functionality.

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On Computation of M-Polynomial And Topological Indices Of M˙Bius Octagonal Networks

Tahreem Ashraf1, Nazeran Idrees1, Saima Aslam

Department of Mathematics, GC University, Faisalabad, Pakistan

Abstract

In this article, the focus is on computing the M-polynomial for three types of fractal networks: Möbius linear octagonal networks Q_n, linear octagonal-quadrilateral networks $L_n^{8,4}$, and Möbius octagonal-quadrilateral network $Q_n^{8,4}$. The general form of the M-polynomials is utilized to calculate various degree-based topological indices for these networks. Additionally, graphical repre-sentations in both $2D$ and $3D$ are provided for the M-polynomial and certain topological indices of the specified networks.

Keywords: M-polynomial, Topological Index, Fractal Mo¨bius Octagonal Networks, Fractal Mo¨bius Octagonal-quadrilateral Networks

1. Introduction

Graph theory, a branch of mathematics focused on the study of graphs, stands out as one of the most influential and extensively referenced domains within mathematics. In recent years, complex networks have emerged as crucial tools for mathematical exploration, contributing significantly to scientific and social research, garnering scholarly attention, and yielding notable results (Barabásasi, R. Albert, 1999; Watts and Strogatz, 1998; Wang et al., 2004). This paper adopts a perspective where networks are perceived as simple, finite, and undirected. Unless specified, our use of terminology and notation is primarily drawn from (Afzal et al., 2020; Devillers and Balaban, 2000; Diudea et al., 2001; Bondy and Murty, 2008). For a simple connected graph $\partial = \partial(V, E)$ with vertices $V = v_1, v_2, ..., v_n$ and edges $E = e_1, e_2, ..., e_n$, where d_{v_i} denotes the degree of vertex v_i, representing the number of connected edges, this paper focuses on computing degree-based topological indices for specific categories of octagonal networks—a type of network characterized by octagonal geometry, where vertices are interconnected under specific patterns.
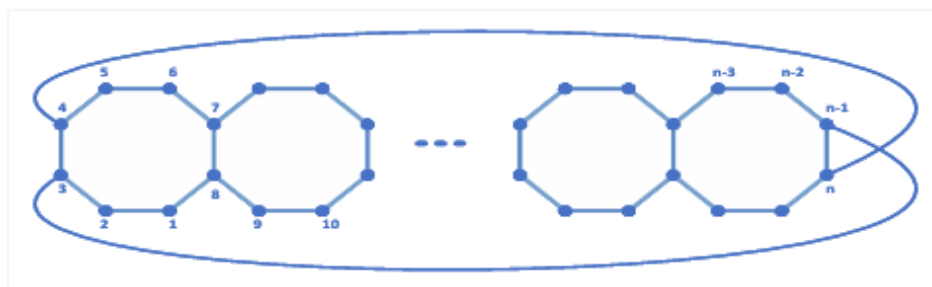

Fig 1. The fractal Möbius octagonal networks Q_n

Indicated as $\mathcal{L}_n^{8,4}$, the fractal linear octagonal-quadrilateral network is defined by the presence of n eight-member rings and n four-member rings, as shown in Figure 1. In contrast, the fractal Möbius octagonal-quadrilateral network, denoted as $\mathcal{Q}_n^{8,4}$, is formed by inversely connecting opposite edges within a fractal linear octagonal-quadrilateral network, as illustrated in Figure 2.
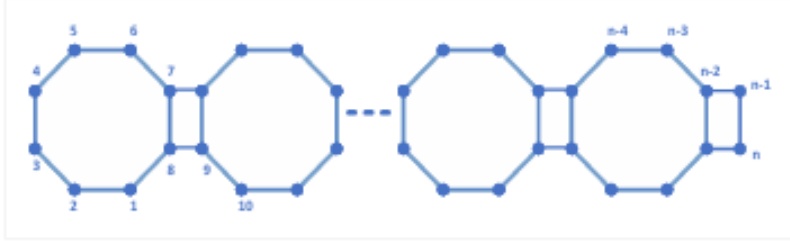

Fig 2. The Linear octagonal-quadrilateral networks $\mathcal{L}_n^{8,4}$

2. Preliminaries

We propose the use of symbols and their associated calculation methods as a conceptual framework, facilitating the substantiation of the remaining content in the article.

Definition 2.1. (M-Polynomial) (Deutsch and Klavzar, 2015)For a graph ∂, the M-polynomial is denoted by $M(\partial; x, y)$ and defined as:

$$M(G; x, y) = \sum_{\alpha \leq i \leq j \leq \beta} \omega_{ij}(\partial) x^i y^j,$$

$\omega_{ij}(\partial)$ symbolize the number of total edges $v_i v_j \in E(\partial)$ such that $(d_{v_i}, d_{v_j}) = (i, j)$, $\alpha = min\ d_{v_i} : v_i \in V(\partial)$, and $\beta = max\ d_{v_i} \in V(\partial)$.

Here, we present a series of topological indices computed in this study. These indices are outlined as follows:

Definition 2.2. (Randić Indices)

The foundational structure of the Randić indices was initially devised by Bollobás and Erdös in 1998 and revisited by Amić $et,\,,al.$ in the same year. Referred to as $R\alpha(\partial)$ and $RR\alpha(\partial)$, these indices, representing the general Randić index and inverse Randić index for a given graph ∂, are computed through the utilization of the M-polynomial. Specifically, with $M(\partial; x, y) = h(x, y)$, the computation of the previous two indices is as follows:

If $D_x = x\frac{\partial(h(x,y))}{\partial x}$, $D_y = y\frac{\partial(h(x,y))}{\partial y}$, $S_x = \int\limits_0^x \frac{h(t,y)}{t}dt$ and $S_y = \int\limits_0^y \frac{h(x,t)}{t}dt$ then

$$R_\alpha(\partial) = (D_x^\alpha D_y^\alpha)(h(x, y))|_{x=y=1},$$

$$RR_\alpha(\partial) = (S_x^\alpha S_y^\alpha)(h(x, y))|_{x=y=1},$$

Another rendition of the Randić index, termed the Harmonic index, was introduced by Zhong, 2012 and is defined as:

$$H(\partial) = 2S_x J(h(x, y))|_{x=1},$$

where, $J(h(x, y)) = h(x, x)$.

The Zegreb indices, recognized as the most costly topological indices, were introduced by Gutman and Trinajstić, 1972, further explored by Gutman and Das, 2004, and discussed by Trinajstic et al., 2010. The formulation of these indices is as follows:

Definition 2.3. (Zegreb Indices)

Consider a graph ∂. The first, second, and second modified Zegreb indices are denoted as M_1, M_2, and M_2^m, respectively, and are expressed as follows:

$$M_1(\partial) = (D_x + D_y)(h(x, y))|_{x=y=1},$$
$$M_2(\partial) = (D_x D_y)(h(x, y))|_{x=y=1},$$
$$M_2^m(\partial) = (S_x S_y)(h(x, y))|_{x=y=1}.$$

$\mathcal{A}(\partial)$ is known as Augmented Zegreb index and introduced by Furtula et al., 2010 and defined as:

$$A(\partial) = S_x^3 Q_{-2} J D_x^3 D_y^3 (h(x, y))|_{x=1},$$

where, $Q_{-2} = x^{-2} h(x, y)$.

Definition 2.4. (Symmetric Division Degree Index)
Gupta et al., 2016 introduced the significant index for a graph ∂, denoted by $SDD(\partial)$ and formulated as:

$$SDD(\partial) = (D_x S_y + S_x D_y)(h(x, y))|_{x=y=1}.$$

Definition 2.5. (Inverse Sum Index)
Let ∂ be graph. Then a toplogical index, known as Inverse sum index (Pattabiraman, 2018) and denoted by $\mathcal{I}(\partial)$ and defined as:

$$I(\partial) = S_x J D_x D_y (h(x, y))|_{x=y=1}.$$

3. Main Results

In this section, we give our computation results.
Table 1 contains partitioning of the edges of fractal Möbius octagonal networks. This partitioning is degree-based of end vertices of each edge.

Table 1

(d_{v_i}, d_{v_j})	$(2, 2)$	$(2, 3)$	$(3, 3)$
Frequency	$2n$	$4n$	n

Theorem 3.1. *Let $\mathcal{Q}_n$ be a fractal Möbius octagonal networks. Then M-polynomial of $\mathcal{Q}_n, n > 1$ is*

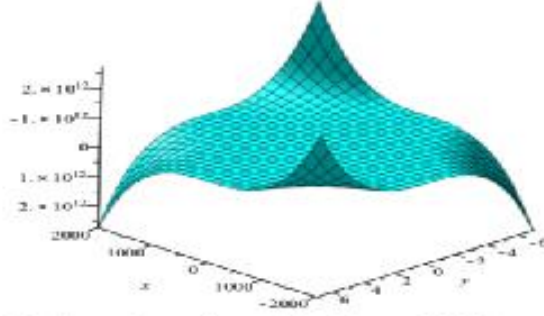$$M(\mathcal{Q}_n; x, y) = (2n)x^2 y^2 + (4n)x^2 y^3 + (n)x^3 y^3.$$

Fig 3. The $3D$ plot of M- polynomial of fractal Möbius octagonal network

Proof. Let Q_n be a network. Then there are three edge partitions, having the following edge sets:

$$E_1(Q_n) = \{v_i v_j \in \mathrm{E}(\partial) : d_{v_i} = 2, d_{v_j} = 2\},$$
$$E_2(Q_n) = \{v_i v_j \in \mathrm{E}(\partial) : d_{v_i} = 2, d_{v_j} = 3\},$$
$$E_3(Q_n) = \{v_i v_j \in \mathrm{E}(\partial) : d_{v_i} = 3, d_{v_j} = 3\},$$

then $|E_1(Q_n)| = 2n, |E_2(Q_n)| = 4n$ and $|E_3(Q_n)| = n$.

Now by applying the definition of M- polynomial on fractal Möbius octagonal network we have:

$$
\begin{aligned}
\mathrm{M}(Q_n; x, y) &= \sum_{i \leq j} \omega_{ij}(Q_n) x^i y^j \\
&= \sum_{v_i v_j \in E_1(\partial)} \omega_{22}(Q_n) x^2 y^2 + \sum_{v_i v_j \in E_2(\partial)} \omega_{23}(Q_n) x^2 y^3 \\
&\quad + \sum_{v_i v_j \in E_3(\partial)} \omega_{33}(Q_n) x^3 y^3 \\
&= |E_1(Q_n)| x^2 y^2 + |E_2(Q_n)| x^2 y^3 + |E_3(Q_n)| x^3 y^3 \\
\mathrm{M}(Q_n; x, y) &= (2n) x^2 y^2 + (4n) x^2 y^3 + (n) x^3 y^3.
\end{aligned}
$$

$\square$
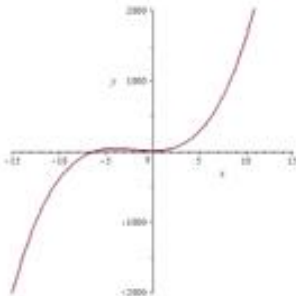
4(a) Plot of M-
polynomial of fractal
Möbius octagonal
network by fixing x
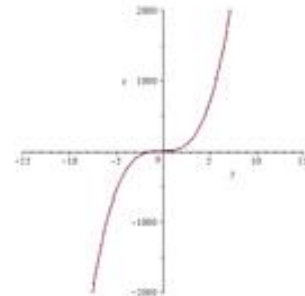
4(b)Plot of M-
polynomial of fractal
Möbius octagonal
network by fixing y

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Proposition 3.2. *Let Q_n be a fractal Möbius octagonal networks. Then following are the topological indices of $Q_n, n > 1$ based on degree :*

(1) $M_1(\partial) = 34n$

(2) $M_2(\partial) = 41n$

(3) $M_2^m(\partial) = 23n/18$

(4) $SDD(\partial) = 44n/3$

(5) $H(\partial) = 88n/3$

(6) $I(\partial) = 83n/10$

(7) $A(\partial) = 3801n/64$

(8) $RR_\alpha(\partial) = n2^{2\alpha}(3^{2\alpha} + 1) + (4n)^2/6^{2\alpha}$

(9) $R_\alpha(\partial) = 2^{2\alpha}(2n) + 3^\alpha(2^\alpha n + 3^2 n).$

Proof. Let $Q_n, n > 1$ be a fractal Möbius octagonal networks, its M-polynomial is computed in last theorem.

$$M(Q_n; x, y) = (2n)x^2 y^2 + (4n)x^2 y^3 + (n)x^3 y^3.$$

$$D_x[(h(x,y)] = (2n)2x^2 y^2 + (4n)2x^2 y^3 + (n)3x^3 y^3 \tag{1}$$

$$D_y[(h(x,y)] = (2n)2x^2 y^2 + (4n)3x^2 y^3 + (n)3x^3 y^3 \tag{2}$$

$$D_x D_y[(h(x,y)] = (2n)4x^2 y^2 + (4n)6x^2 y^3 + (n)9x^3 y^3 \tag{3}$$

$$S_x[(h(x,y)] = (2n)\frac{x^2 y^2}{2} + (4n)\frac{x^2 y^3}{2} + (n)\frac{x^3 y^3}{3}, \tag{4}$$

$$S_y[(h(x,y)] = (2n)\frac{x^2 y^2}{2} + (4n)\frac{x^2 y^3}{3} + (n)\frac{x^3 y^3}{3}, \tag{5}$$

$$S_x S_y[(h(x,y)] = (2n)\frac{x^2 y^2}{4} + (4n)\frac{x^2 y^3}{6} + (n)\frac{x^3 y^3}{9}, \tag{6}$$

$$S_x D_y[(h(x,y)] = (2n)x^2 y^2 + (4n)\frac{3x^2 y^3}{2} + (n)x^3 y^3, \tag{7}$$

$$D_x S_y[(h(x,y)] = (2n)x^2 y^2 + (4n)\frac{2x^2 y^3}{3} + (n)x^3 y^3, \tag{8}$$

$$D_x^\alpha D_y^\alpha[(h(x,y)] = (2n)2^2 \alpha x^2 y^2 + (4n)6^\alpha + (n)3^2 \alpha x^3 y^3, \tag{9}$$

$$S_x^\alpha S_y^\alpha[(h(x,y)] = \frac{2n}{2^{2\alpha}}x^2 y^2 + \frac{4n}{6^\alpha}x^2 y^3 + \frac{n}{3^{2\alpha}}x^3 y^3, \tag{10}$$

$$J[(h(x,y)] = (2n)x^4 + (4n)x^5 + (n)x^6 \tag{11}$$

by using above expression we have,

$$S_x J[(h(x,y)] = (2n)\frac{x^4}{4} + (4n)\frac{x^5}{5} + (n)\frac{x^6}{6} \tag{12}$$

$$S_x J(D_x D_y)[(h(x,y)] = (2n)x^4 + (4n)\frac{6x^5}{5} + (n)\frac{3}{2}x^6. \tag{13}$$

In consequence of the values from the equation (1) to (13) and M-polynomial, the topological indices are obtained are(1)to(9) as in the statement.

□

Table 2 presents the edge partition of Linear octagonal-quadrilateral networks, denoted as $\mathcal{L}_n^{8,4}$, organized according to the degrees of the end vertices for each edge.

Table 2

$(d_{v_i} d_{v_j})$	$(2,2)$	$(2,3)$	$(3,3)$
Frequency	$2n+4$	$2n+8$	$4n-3$

Theorem 3.3. *Let* $\mathcal{L}_n^{8,4}, n > 1$ *be a Linear octagonal-quadrilateral networks. Then M-polynomial of* $\mathcal{L}_n^{8,4}$ *is*

$$M(\mathcal{L}_n^{8,4}; x, y) = (2n+4)x^2y^2 + (2n+8)x^2y^3 + (4n-3)x^3y^3.$$
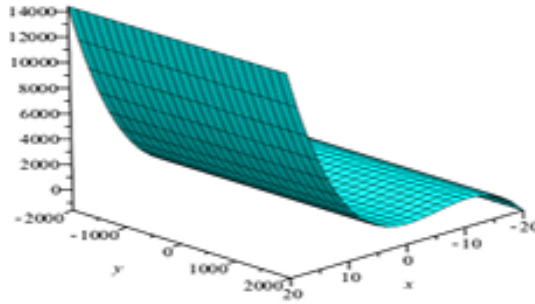
Fig 5. The $3D$ plot of M- polynomial of Linear octagonal-quadrilateral network

Proof. Let $\mathcal{L}_n^{8,4}$ be a network. Then there are three edge partitions, having the following edge sets:

$$E_1(\mathcal{L}_n^{8,4}) = \{v_iv_j \in \texttt{E}(\partial) : d_{v_i} = 2, d_{v_j} = 2\},$$
$$E_2(\mathcal{L}_n^{8,4}) = \{v_iv_j \in \texttt{E}(\partial) : d_{v_i} = 2, d_{v_j} = 3\},$$
$$E_3(\mathcal{L}_n^{8,4}) = \{v_iv_j \in \texttt{E}(\partial) : d_{v_i} = 3, d_{v_j} = 3\},$$

then $|E_1(\mathcal{L}_n^{8,4})| = 2n+4, |E_2(\mathcal{L}_n^{8,4})| = 2n+8$ and $|E_3(\mathcal{L}_n^{8,4})| = 4n-3$. Now by applying the definition of M- polynomial on Linear octagonal-quadrilateral network we have:

$$
\begin{aligned}
M(\mathcal{L}_n^{8,4}; x, y) &= \sum_{i \leq j} \omega_{ij}(\mathcal{L}_n^{8,4})x^iy^j \\
&= \sum_{v_iv_j \in E_1(\partial)} \omega_{22}(\mathcal{L}_n^{8,4})x^2y^2 + \sum_{v_iv_j \in E_2(\partial)} \omega_{23}(\mathcal{L}_n^{8,4})x^2y^3 \\
&\quad + \sum_{v_iv_j \in E_3(\partial)} \omega_{33}(\mathcal{L}_n^{8,4})x^3y^3 \\
&= |E_1(\mathcal{L}_n^{8,4})|x^2y^2 + |E_2(\mathcal{L}_n^{8,4})|x^2y^3 + |E_3(\mathcal{L}_n^{8,4})|x^3y^3 \\
M(\mathcal{L}_n^{8,4}; x, y) &= (2n+4)x^2y^2 + (2n+8)x^2y^3 + (4n-3)x^3y^3.
\end{aligned}
$$

$\square$

Proposition 3.4. *Let* $\mathcal{L}_n^{8,4}$ *be a Linear octagonal-quadrilateral networks. Then following are the topological indices of* $\mathcal{L}_n^{8,4}, n > 1$ *based on degree:*

(1) $M_1(\partial) = 56n + 37$
(2) $M_2(\partial) = \frac{33n}{18} + 2$
(3) $SDD(\partial) = \frac{49n}{3} + \frac{58}{3}$

(4) $H(\partial) = \frac{112n}{5} + 86$

(5) $I(\partial) = \frac{52n}{5} + \frac{23}{5}$

(6) $A(\partial) = \frac{1241n}{16} + \frac{3957}{64}$

(7) $RR_\alpha(\partial) = \frac{(2n+4)23^{2\alpha}+(2n+8)^2+(4n-3)2^{2\alpha}}{6^{2\alpha}}$

(8) $R_\alpha(\partial) = 2^{2\alpha}(2n+4) + 6^\alpha(2n+8) + 3^{2\alpha}(4n-3)$.

Proof. Consider $\mathcal{L}_n^{8,4}$ as a Linear octagonal-quadrilateral network with $n > 1$. The computation of its M-polynomial is detailed in the preceding theorem.

$$M(\mathcal{L}_n^{8,4}; x, y) = (2n+4)x^2y^2 + (2n+8)x^2y^3 + (4n-3)x^3y^3.$$

By using the formulas, some computations are collected:

$$D_x[(h(x,y)] = (2n+4)2x^2y^2 + (2n+8)2x^2y^3 + (4n-3)3x^3y^3 \qquad (14)$$

$$D_y[(h(x,y)] = (2n+4)2x^2y^2 + (2n+8)3x^2y^3 + (4n-3)3x^3y^3 \qquad (15)$$

$$D_xD_y[(h(x,y)] = (2n+4)4x^2y^2 + (2n+8)6x^2y^3 + (4n-3)9x^3y^3 \qquad (16)$$

$$S_x[(h(x,y)] = (2n+4)\frac{x^2y^2}{2} + (2n+8)\frac{x^2y^3}{2} + (4n-3)\frac{x^3y^3}{3}, \qquad (17)$$

$$S_y[(h(x,y)] = (2n+4)\frac{x^2y^2}{2} + (2n+8)\frac{x^2y^3}{3} + (4n-3)\frac{x^3y^3}{3}, \qquad (18)$$

$$S_xS_y[(h(x,y)] = (2n+4)\frac{x^2y^2}{4} + (2n+8)\frac{x^2y^3}{6} + (4n-3)\frac{x^3y^3}{9}, \qquad (19)$$

$$S_xD_y[(h(x,y)] = (2n+4)x^2y^2 + (2n+8)\frac{3x^2y^3}{2} + (4n-3)x^3y^3, \qquad (20)$$

$$D_xS_y[(h(x,y)] = (2n+4)x^2y^2 + (2n+8)\frac{2x^2y^3}{3} + (4n-3)x^3y^3, \qquad (21)$$

$$D_x^\alpha D_y^\alpha[(h(x,y)] = (2n+4)2^{2\alpha}x^2y^2 + (2n+8n)6^\alpha x^2y^3 + (4n-3)3^{2\alpha}x^3y^3 \quad(22)$$

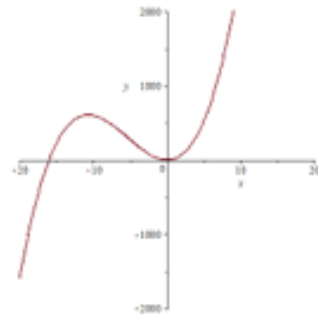$$S_x^\alpha S_y^\alpha[(h(x,y)] = \frac{2n+4}{2^{2\alpha}}x^2y^2 + \frac{2n+8}{6^\alpha}x^2y^3 + \frac{4n-3}{3^{2\alpha}}x^3y^3, \qquad (23)$$

$$J[(h(x,y)] = (2n+4)x^4 + (2n+8)x^5 + (4n-3)x^6 \qquad (24)$$

by using above expression we have,

6(a) Plot of M-polynomial of Linear octagonal-quadrilateral networks by fixing x

6(b) Plot of M-polynomial of Linear octagonal-quadrilateral networks by fixing y

$$\mathbf{S}_x \mathbf{J}[(h(x,y)] \quad = \quad (2n)\frac{x^4}{4} + (4n)\frac{x^5}{5} + (n)\frac{x^6}{6} \qquad (25)$$

$$\mathbf{S}_x \mathbf{J}(\mathbf{D}_x \mathbf{D}_y)[(h(x,y)] \quad = \quad (2n)x^4 + (4n)\frac{6x^5}{5} + (n)\frac{3}{2}x^6. \qquad (26)$$

In consequence of the values from the equation (14) to (26) and M-polynomial, the topological indices are obtained as in the statement. □

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Comparing Diabetic Retinopathy in Type I and Type II Diabetes Patients at a Tertiary Hospital Screening Clinic

Khurram Ghafoor[1], Tasneem Khalid[1], Umar Ghafoor[2], Tahreem Ashraf[3], and Khawar Ghafoor[3]

[1]Faisalabad Medical University, Faisalabad, Pakistan
[2]National University of Sciences and Technology, Islamabad, Pakistan
[3]Government College University, Faisalabad, Pakistan
E-mail: drkhurram883@gmail.com

Abstract

Diabetic Retinopathy (DR), a vision-threatening complication associated with diabetes, is a prevalent concern in Pakistan due to low socioeconomic status hindering proper diagnosis and treatment. Early detection through DR screening is vital since most individuals remain asymptomatic until the disease has progressed. The study aimed to determine the prevalence of DR in Type I and II diabetic patients attending the DR screening room at Allied Hospital Faisalabad. Among the 86 patients (43 in each group), the average age was 43.98 years for Type I and 52.30 years for Type II diabetes. A majority of patients were employed, and oral treatment was the primary regimen. Good diabetes control was observed in a significant portion of patients. Notably, 34.9% of patients had DR, with a higher proportion in Type II (46.5%) compared to Type I (23.3%). This study provides essential insights into the prevalence of DR in different diabetes types in the region.

Keywords: Diabetic retinopathy, Type I diabetic patients, Type II diabetic patients, Tertiary hospital screening clinic

Introduction

Diabetic retinopathy (DR) is a common complication of diabetes, especially in developed countries, and is a major cause of blindness (Vadloori et al., 2019). It involves microvascular issues and diabetic macular edema, affecting visual acuity and potentially causing blindness. In advanced stages, abnormal blood vessel development in the retina leads to complications like proliferative diabetic retinopathy (PDR) (Ting et al., 2016). Accurate classification of DR is vital for selecting appropriate treatments, with early intervention in the non-proliferative stage offering the best chance for improving diabetes management and preventing progression. Risk factors for DR include uncontrolled diabetes, long-standing diabetes, diabetic complications, hypertension, dyslipidemia, and elevated glycated hemoglobin levels (Saranya et al., 2022).
DR is a global concern, impacting about 3.4% of the population (4.1 million people), and projections indicate a rise by 2030. Early detection through routine eye exams is vital, given the often-asymptomatic initial stages. The risk, especially for proliferative diabetic retinopathy, is higher in those with longer durations of type I diabetes (Laiginhas et al., 2019). To minimize the risk of blindness from sight-threatening retinopathy, effective strategies involve early identification through routine eye exams and proper disease management (Lalithadevi et al., 2022).
Essential steps to reduce diabetic retinopathy-related blindness include timely screening for individuals with diabetes, ensuring prompt treatment by ophthalmologists, minimizing screening-related anxiety, and fostering communication between the public and healthcare professionals (Sabanayagam et al., 2019). Digital retinal photography is a cost-effective screening method that meets program standards. Early screening is crucial, given that symptoms often appear only in advanced stages. Tailored screening

recommendations for Type I and Type II diabetes highlight the significance of regular eye exams in diabetes management (Ansari et al., 2022).

Existing works

Diabetes mellitus (DM) is a common metabolic condition linked to micro- and macro-vascular complications such as cardiovascular disease, kidney issues, neuropathy, and blindness (Bodapati et al., 2021). Diabetic retinopathy (DR) is a major cause of blindness, impacting around 35% of individuals aged 20-79. Its occurrence is closely tied to the duration of diabetes, affecting nearly all individuals with type I diabetes within two decades and approximately 60% of those with type II diabetes. In the younger-onset group, DR constitutes 86% of blindness cases (Calderon et al., 2017).

DR progresses from mild non-proliferative diabetic retinopathy (NPDR) with increased vascular permeability to severe NPDR with vascular closure. Proliferative diabetic retinopathy (PDR) involves the development of new blood vessels on the retina and vitreous surface (Chua et al., 2018). Complications like macular edema, vitreous hemorrhage, and neovascular glaucoma can cause severe and permanent vision loss. Hyperglycemia plays a crucial role in DR development, impacting pathways such as the polyol pathway, protein kinase C activation, advanced glycation end-products (AGEs) formation, and insulin signaling (Jonas et al., 2019).

DR's pathophysiology includes increased vascular flow, leakage, tissue swelling, inflammation, reactive glial cells, inner retinal cell demise, and neovascularization. Mitochondrial dysfunction, oxidative stress, inflammation, and cell apoptosis contribute to its progression. The prevalence of DR rises with worsening diabetes and longer exposure, affecting a substantial global population. Risk factors include poor glycemic control, hypertension, hyperlipidemia, obesity, and genetic factors (Rodríguez et al., 2019).

DR management centers on early detection through regular eye exams, rigorous control of blood glucose and pressure, and effective therapies for existing disease. Pan-retinal laser photocoagulation is a primary treatment for severe NPDR and PDR. Progress in understanding DR's molecular and genetic aspects, coupled with ongoing treatment advancements, is essential to tackle the increasing global burden of diabetic retinopathy (Honasoge et al., 2019).

Motivations and contributions

Existing research highlights a gap in examining the prevalence of DR in individuals with both Type I and Type II diabetes, along with a lack of comparative studies in this field. Motivated by these research gaps, the following presents the key contributions:

- Evaluated the prevalence of DR in individuals with both Type I and Type II diabetes by providing insights into the comparative occurrence of DR in different diabetes subtypes, contributing to a better understanding of the disease burden in diverse diabetic populations.
- Correlated and compared various aspects of Type I and Type II diabetes, such as socio-economic status and glycemic levels, with the severity of DR by uncovering distinct differences in the severity of DR between Type I and Type II diabetes, highlighting the impact of socio-economic factors and glycemic control on the progression of diabetic retinopathy.
- Presented a comparative cross-sectional study design focusing on diabetic patients, emphasizing the importance of DR screening by providing a structured study design for assessing DR prevalence, aiding researchers and healthcare practitioners in planning and conducting similar studies.
- Defined inclusion and exclusion criteria for patient selection and estimate an appropriate sample size for the study by establishing clear guidelines for selecting participants, ensuring a representative sample and robust statistical analysis for meaningful results.

- Identified key variables such as age, gender, and socio-economic status, along with the sampling method used in the study by facilitating a standardized approach to data collection, allowing for effective comparisons between different patient groups and promoting methodological transparency.

Methodology

The paper utilizes a comparative cross-sectional design conducted in the DR screening room at Allied Hospital Faisalabad over a three-month period. The study includes all diabetic individuals in Faisalabad, selected through convenient sampling. Inclusion criteria involve individuals aged 20-65 years, diagnosed with DM, of both genders. Exclusion criteria comprise patients with ocular pathologies unrelated to DM, and those with coexisting diseases like hypertension (HTN) and chronic renal failure (CRF) that could cause DR. Independent variables are age, gender, and socio-economic status categorized into upper, middle-, and lower-income levels. Dependent variables cover aspects of DR such as microaneurysms, retinal hemorrhages, exudates, neovascularization, maculopathy, and cotton wool spots. The sampling method is non-probability convenient sampling, with an estimated sample size of 86 patients (43 in each group) based on an expected percentage of 4% for Type I diabetes mellitus and 1.6% for Type II diabetes mellitus, at a 95% confidence level with 7% absolute precision.

$$n = \frac{z_1^2 - \alpha/2 \, (p_1(1-p_1) + p_2(1-p_2))}{d^2}$$

$z_{1-\alpha/2}$ = confidence level 95%= 1.96

p_1= population proportion I= 4%

p_2= population proportion II= 1.6%

d= absolute precision 7%

The study will utilize various tools for data collection, including a glucometer to assess random blood sugar (RBS) levels and a direct ophthalmoscope for fundoscopy. To ensure proper pupil dilation, mydriatic drops like 1.0% Tropicamide and/or 10% phenylephrine eye drops will be used. Data collection involves checking RBS levels, clinical examinations, and a questionnaire. Informed consent will precede RBS samples and fundoscopy with mydriatic drops. Visual acuity will be assessed before drop installation, followed by fundoscopy with findings recorded on an annexure. This annexure contains concise demographic data obtained through semi-structured questions, covering patient profiles, DM history, and diabetic retinopathy (DR) fundus findings. As no prescribed Performa existed, a self-prepared one was used after a pilot study identified and rectified flaws. The refined Performa, informed by the pre-testing phase, will be employed for actual data collection.

In data analysis, age (quantitative) was presented as mean ± standard deviation (S.D.), while gender (qualitative) was represented by frequency and percentage. A chi-square test compared the two types of diabetes mellitus, considering statistical significance at p-value ≤ 0.05.

Results and Discussions

This comparative study involved 86 diabetic patients, evenly divided between Type I DM and Type II DM

(43 patients each). The average age in Type I Diabetes was 43.98 ± 8.81 years, and in Type II Diabetes, it was 52.30 ± 9.33 years. The majority of Type 1 Diabetes patients (46.5%) fell into the 41-50 age group, while in Type II Diabetes, 32.6% were in the 51-60 age group, as shown in Figure 1.

The patient gender distribution indicated 52 males and 34 females, given in Figure 2. For both Type I (51.2%) and Type II (41.9%) diabetes patients, the most common duration of diabetes was between 5 to 10 years, shown in Figure 3. Oral treatment was the primary treatment regimen in both groups, with 34.9% in Type I and 32.6% in Type II, shown in Figure 4. Control of diabetes revealed good control in 62.8% of Type I patients and 51.2% of Type II patients, shown in Figure 5.

Normal blood pressure (120/80) was reported by 30.2% in Type I and 37.2% in Type II, shown in Figure 6. Regarding changes in vision after diabetes, 51.2% in Type I and 53.5% in Type II patients noticed a difference, shown in Figure 7. The majority of patients in both groups reported a family history of diabetes, particularly from their fathers, shown in Figure 8.

A total of 30 patients (34.9%) had DR, with the proportion of DR higher in Type 2 (46.5%) than in Type 1 (23.3%), shown in Figure 9.

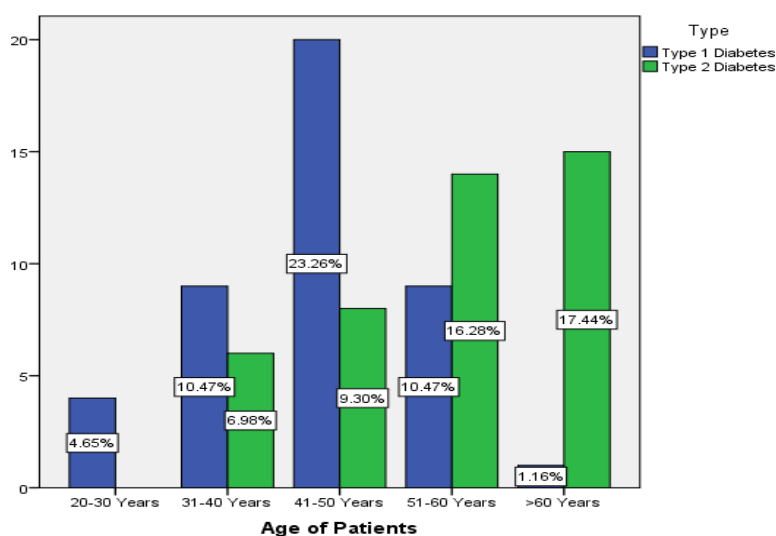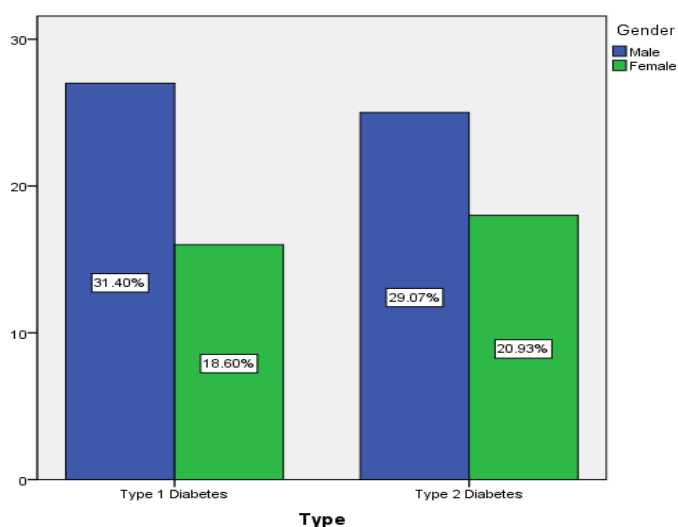Figure 1: Age of patients

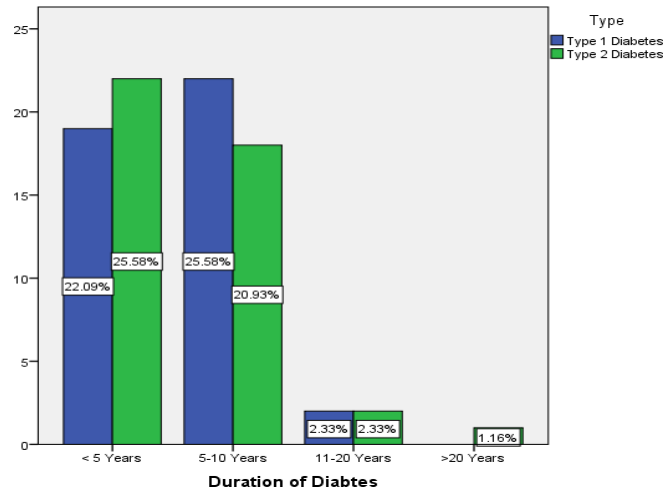Figure 2: Gender of patients

Figure 3: Duration of diabetes
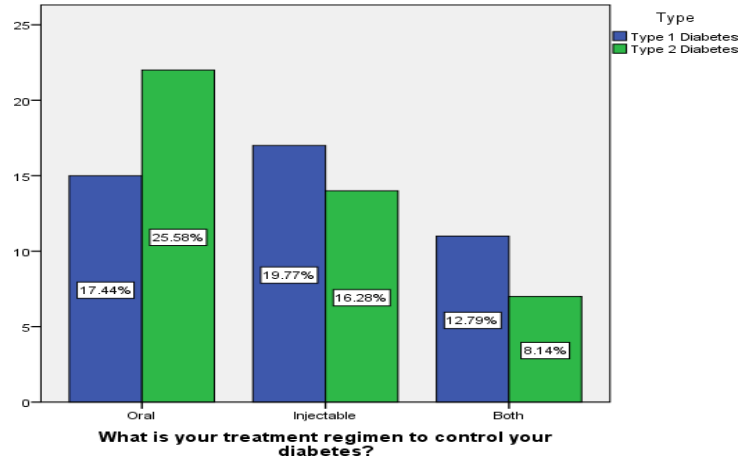
Figure 4: Treatment to control your diabetes
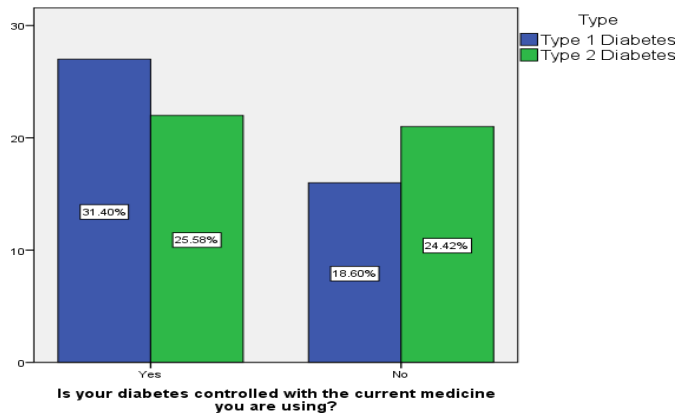
Figure 5: Is diabetes controlled with the current medicine
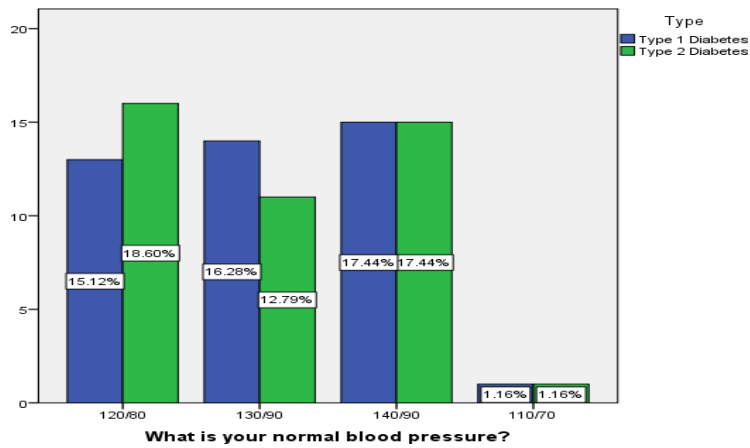
Figure 6: Normal blood pressure

Figure 7: Diabetes affects vision
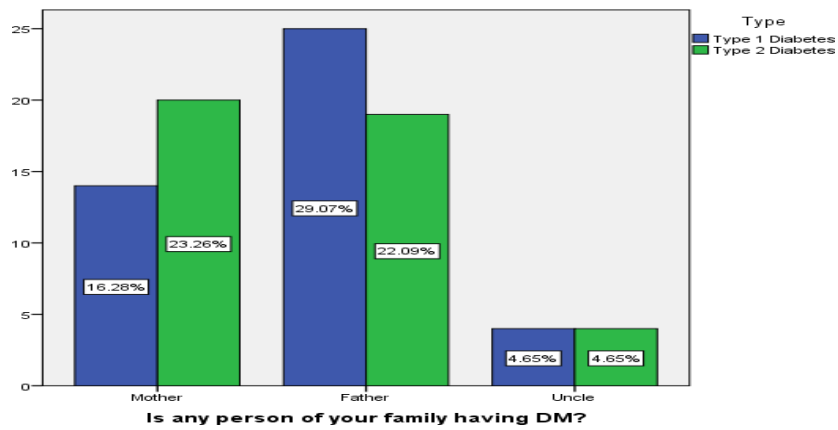
Figure 8: Any family member having DM
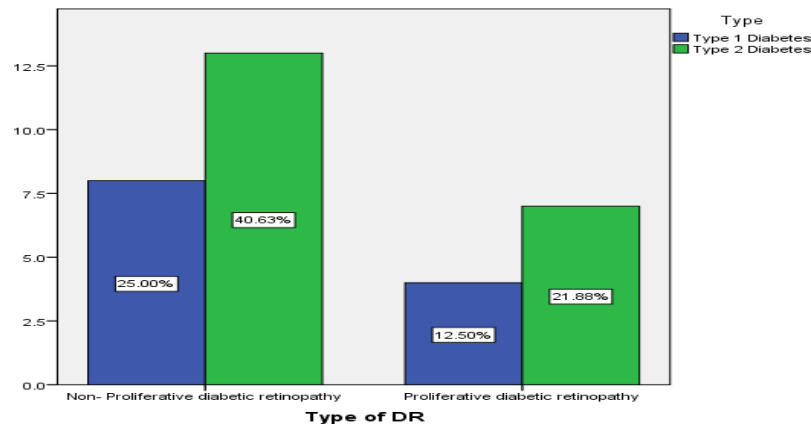
Figure 9: Type of DR

Conclusions

DR is a critical issue arising from arterial problems, adversely affecting the well-being of individuals with diabetes and leading to significant societal costs. This study is the initial examination of the prevalence of DR in type I and type II diabetes mellitus patients at Allied Hospital Faisalabad. The results indicate that DR was found in 34.9% (type I) and 23% (type II) of the cases studied.

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Document Image Enhancement Based on Heuristic Algorithm

Umar Ghafoor[1], Tahreem Ashraf[2], Khawar Ghafoor[2], Khurram Ghafoor[2], and Tasneem Khalid[2]

[1]*National University of Sciences and Technology, Islamabad, Pakistan*
[2]*Government College University, Faisalabad, Pakistan*
E-mail: ch.umar163@gmail.com

Abstract

Preserving the integrity of vital documents by preventing degradation caused by unfavorable storage conditions and inadequate contrast is a significant concern. In this regard, various image enhancement techniques are employed to enhance information clarity for human observers. This paper introduces a novel heuristic algorithm to enhance the document image quality. A comparative analysis based on the structural similarity index measure (SSIM) of the proposed novel heuristic algorithm with the existing image enhancement methods, i.e., histogram equalization (HE), log transformation (LT), and Automated power law transformation (APLT) is presented. The simulation results show that the novel heuristic algorithm is better at enhancing the document image quality compared to the existing algorithms, i.e., HE, LT, and APLT.
Keywords: HE, LT, APLT, Heuristic algorithm, SSIM

Introduction

Image enhancement involves adjusting specific image attributes to align with a particular purpose and observer, necessitating adjustments tailored to the task's unique demands. The effectiveness of this process depends on the specific problem, with techniques suitable for one type of image not necessarily applicable to another. Observer-specific factors, such as human visual perception and expertise, introduce subjectivity in method selection. Typically addressing issues like noise reduction, dark image correction, and object edge accentuation, image enhancement aims to produce an image better suited for specific applications than the original. This is particularly relevant in the context of the increasing digitization of paper documents, as seen in initiatives like the Google Library Project. Such trends highlight the necessity for the development of document image enhancement techniques (Zhou et al., 2023).

Histogram equalization (HE) is an image enhancement method designed to enhance contrast by redistributing pixel intensities, effectively balancing the distribution of values across the available range. This technique adjusts the image's histogram to stretch intensity values across the entire spectrum, making details in both dark and bright areas more pronounced. HE proves particularly beneficial for images with poor contrast or when specific features require enhancement, leading to an overall improved visual representation (Mustafa and Abdul Kader, 2018), (Xiang et al., 2023). The mathematical expression defining this technique is:

$$P(n_k) = \frac{n_k}{n} , k = 0, 1, 2, ..., L-1 \tag{1}$$

where $p(n_k)$ estimates the probability of gray level n_k and n is the total number of pixels in the input image, with L representing the number of discrete gray levels. Log transformation (LT) (West, 2023) serves as an image enhancement method. This technique enhances image quality by adjusting pixel values through logarithmic scaling, achieved by taking the natural logarithm of pixel values. By expanding the image's dynamic range, LT proves valuable for images with a wide range of intensity values. It improves visibility for both low and high contrast details, enhancing image quality in various applications, especially when the original image lacks clarity or when subtle features require emphasis. The transformation is mathematically

defined by the formula:

$$I = C * log (1 + r) \tag{2}$$

where, *I* is the output gray level, *r* is the input gray level, and *C* is a constant. It is assumed that *r* is greater than or equal to 1, and the addition of 1 to each pixel value in the input image prevents issues associated with taking the logarithm of zero. Notably effective for enhancing dark document images, Automated Power-law Transformation (APLT) (Yelmanov and Romanyshyn, 2021) refines image quality through a mathematical operation involving exponentiation applied to pixel values. This technique, akin to LT, adjusts contrast and brightness by raising each pixel value to a specific power, allowing for the enhancement or suppression of specific image features. APLT's versatility proves valuable for customizing images according to specific needs, whether it involves accentuating fine details, reducing noise, or achieving desired visual effects. It differentiates itself from LT by utilizing a power value denoted as γ, and the γ transformation is expressed as:

$$s = vr^{\gamma} \tag{3}$$

where, *s* denotes the output gray level, *v* is a scaling constant, *r* represents the input gray level, and γ regulates the exponent applied to the input gray level. However, choosing a suitable γ value from the image can be challenging, particularly when peak signals are at extremes like 0 or 255, resulting in the entire image appearing excessively dark or white. This challenge can be addressed through pre-processing techniques, such as automated gamma correction. Automated gamma correction determines γ automatically based on the input image's dominant peak signal, as defined by the formula:

$$\gamma = \frac{-1}{\ln \left(\frac{r_{max}}{L-1}\right)} \tag{4}$$

Here, r_{max} signifies the dominant peak signal in the input image, and *L* denotes the number of discrete gray levels. This approach ensures effective contrast enhancement while overcoming challenges posed by extreme peak values, contributing to the effectiveness of the proposed algorithm for document image enhancement. Document image enhancement relies on image quality measures, which fall into two categories. The first category includes mathematically defined measures such as mean squared error (MSE), peak signal-to-noise ratio (PSNR), root mean squared error (RMSE), mean absolute error (MAE), and signal-to-noise ratio (SNR). The second category involves measures that consider human visual system (HVS) characteristics to incorporate perceptual quality. Mathematically defined measures are favored for their ease of calculation, low computational complexity, and independence from viewing conditions and individual observers. In contrast, viewing condition-independent measures, like the structural similarity index measure (SSIM) (Sara et al., 2019), provide a single quality value, offering a general idea of image quality and avoiding issues associated with commonly used PSNR and MSE measures.

 Existing works:

This paper explores the dualistic sub-image histogram equalization (DSIHE) and minimum mean brightness error bi-histogram equalization (MMBEBHE) techniques, examining their combined image fusion using various quality metrics such as blind/reference-less image spatial quality evaluator (BRISQUE) and entropy. Experimental results indicate that the fusion of these methods outperforms individual usage in terms of both contrast enhancement and brightness preservation (Thepade et al., 2022). Another contribution introduces an image enhancement technique based on histogram equalization (HE), fine-tuned using the cuckoo search algorithm (Thakur et al., 2022). Applied to enhance road condition images across four paths using Python, this algorithm's effectiveness is evaluated (Zhang, 2023). Addressing constraints, the study introduces the contrast limited adaptive histogram equalization (CLAHE) algorithm to mitigate

excessive brightness variations by constraining the histogram. Applied to enhance contrast in chest

radiographs, the CLAHE algorithm aims to improve the accuracy of lung disease diagnosis (Lee et al., 2023).

This paper introduces a novel sigmoid function inspired by the contrast sensitivity of human brightness perception. The approach models the contrast sensitivity of the human retina as an exponential function of log-intensity, deriving a transformation function by incorporating the sensitivity model as the exponent in Steven's power law (Park et al., 2019). The study applies this method to a set of low-contrast images captured with the Landsat sensor, employing a multi-step spatial domain image processing approach. Notably, one key step in this process involves the application of the log transformation (LT) (Al-Safar, 2021).

This paper introduces a novel automated image enhancement method called adaptive power-law image intensity transformation (APLIT) (Yelmanov and Romanyshyn, 2021). The approach relies on APLT of the cumulative brightness distribution function, effectively improving image contrast without introducing unwanted artifacts, offering advantages over conventional histogram equalization (Yelmanov et al., 2019). This research aims to enhance image enhancement efficacy using the power-law transformation (PLT) technique, commonly known as gamma correction (Yelmanov and Romanyshyn, 2021). Additionally, the study devises a novel approach to enhance medical images, combining techniques such as Laplacian and Sobel operators, addition and product operations, filtering, and PLT (Islam and Mondal, 2019). In a separate work (Mudeng et al., 2022), SSIM is employed to analyze medical images from various imaging modalities.

Motivations and contributions:

- The preceding section of this comprehensive study concludes that a variety of image quality enhancement measures, including HE, LT, or APLT, are applied in diverse fields such as medicine and beyond.
- However, limited research has been undertaken in the domain of document image enhancement, providing the impetus for our work in this specific area.
- While MSE and PSNR focus on estimating perceived errors, SSIM takes into account image degradation as a perceived alteration in structural information. Structural information revolves around the concept that pixels exhibit strong inter-dependencies, particularly when they are in close spatial proximity. These dependencies convey crucial information about the structure of objects within the visual scene.

We've introduced a heuristic algorithm for enhancing document images, taking into consideration SSIM.

System Model:

Various document images are analyzed for quality enhancement, employing SSIM as a suitable metric to evaluate the similarity between the original and enhanced images. The SSIM measurement system, depicted in Figure 1, evaluates similarity on a scale from 0 to 1. This model takes into account the overall structure of image objects, comparing it with the appropriate structure to yield more validated results. The SSIM metric is computed across various windows of an image, with the measure between two windows x and y of a common size N × N given by:

$$SSIM(x, y) = \frac{(2\mu_x\mu_y+c_1)(2\sigma_{xy}+c_2)}{(\mu_x^2+\mu_y^2+c_1)(\sigma_x^2+\sigma_y^2+c_2)} \tag{5}$$

the average of y, σ^2 the variance of x, σ^2 the variance of y, σ_{xy} the covariance of x and y, $c_1 = (k_1 L)^2$, $c_2 = (k_2 L)^2$ two variables to stabilize the division with weak denominator, L the dynamic range of the pixel values typically this is $2^{(\text{No. of bits per pixel})} - 1$ and $k_1 = 0.01$, $k_2 = 0.03$ by default.
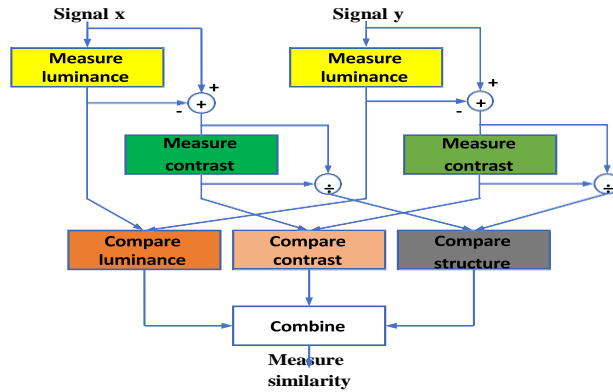
Figure 1: SSIM measurement system

Heuristic algorithm

The heuristic algorithm for improving document image quality follows a series of steps. Initially, in this proposed algorithm, a salt and pepper filter is applied to the original image. Subsequently, APLT with γ correction is employed on the filtered image. Following this, an erosion process is executed, selecting a structuring element for contrast adjustment. The resulting image undergoes visual inspection and is iterated through the initial step involving the salt and pepper filter if deemed unsatisfactory. Finally, a sharpening process is applied to obtain an enhanced document image. The flow diagram of the proposed heuristic algorithm is illustrated in Figure 2, accompanied by the corresponding pseudocode.
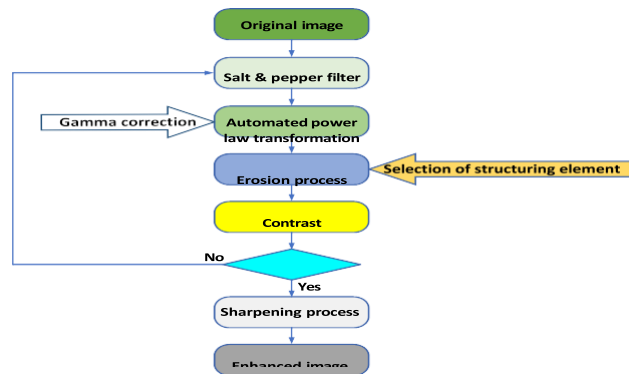
Figure 2: Flow diagram of proposed heuristic algorithm.

Simulation results

We have considered approximately 300 images in jpeg format, comprising 150 camera images and 150 scanned images, assuming γ correction factors ranging from 1.0 to 4.0. The erosion process employed a square structuring element. Our proposed heuristic algorithm was applied to these images for quality enhancement. Additionally, we applied existing algorithms, namely HE, LT, and APLT, to the same set of images for comparison with our novel heuristic algorithm in enhancing document image quality. The assessment of document image quality for all algorithms was conducted using SSIM.

Original image and its histogram

Figure 3 displays both the original image and its corresponding pixel-intensity histogram.
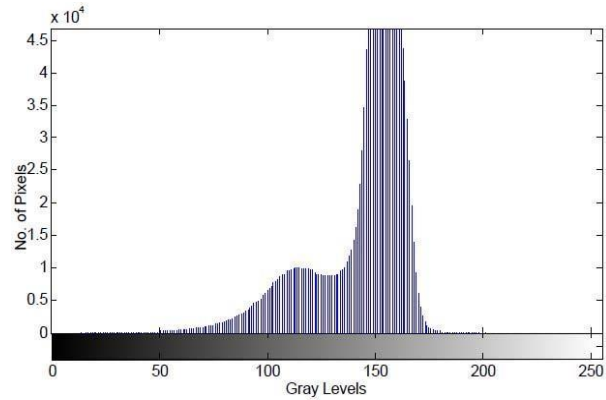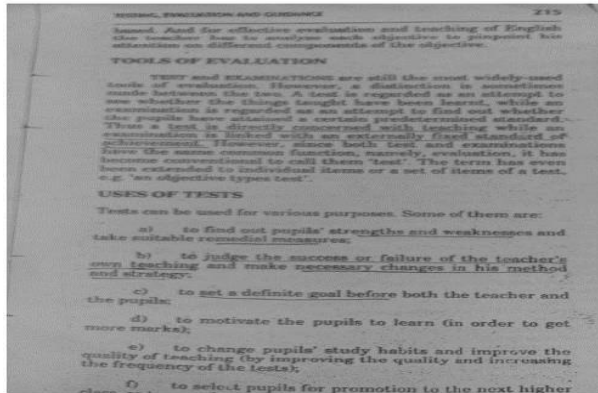
Figure 3: Original image and pixel intensity using histogram.

Enhanced document image quality and pixel-intensity histogram based on heuristic algorithm:

Figure 4 presents the resulting image and its associated pixel-intensity histogram after the application of the heuristic algorithm. The outcomes of our proposed novel heuristic algorithm demonstrate improvement, as the quality of the document image is enhanced.
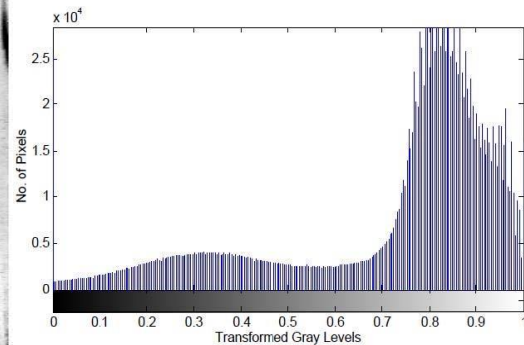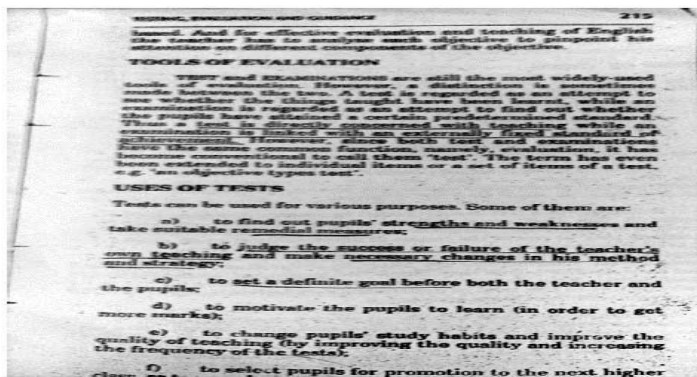
Figure 4: Enhanced document image quality and pixel-intensity histogram based on proposed novel heuristic algorithm.

Comparing our proposed novel heuristic algorithm with existing algorithms, i.e., HE, LT, and APLT for enhancing document image quality:

HE:

Figure 5 illustrates both the resulting image and its corresponding pixel-intensity histogram following the application of the HE technique.

LT:

Figure 6 depicts both the resulting image and its associated pixel-intensity histogram following the

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application of the LT technique.

APLT:

Figure 7 displays both the resulting image and its corresponding pixel-intensity histogram after the application of APLT.
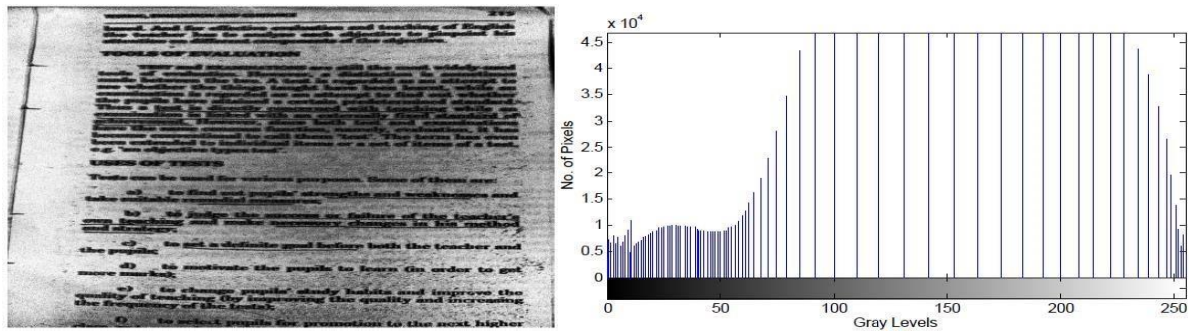
Figure 5. Enhanced document image quality and pixel-intensity histogram based on HE

algorithm.
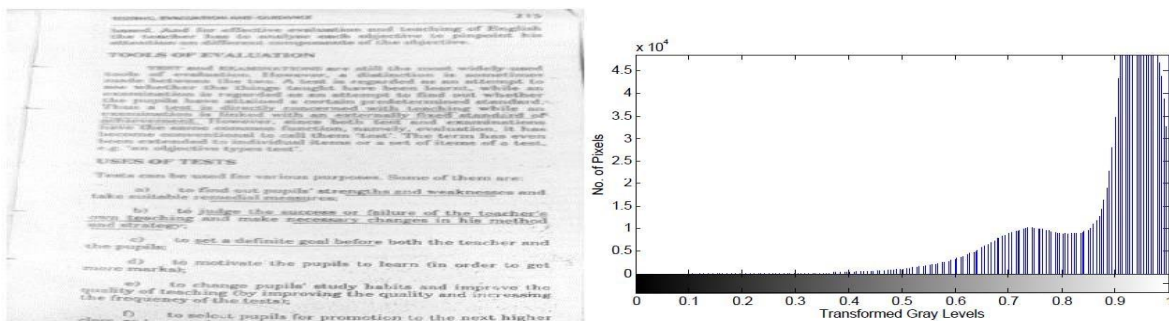
Figure 6. Enhanced document image quality and pixel-intensity histogram based on LT

algorithm.

The comparison between our proposed novel heuristic algorithm and existing techniques (HE, LT, and APLT) reveals that the results from our algorithm, as depicted in Figure 4, are more accurate, precise, and exact. This superiority is attributed to the enhancement of intensity in the foreground and background in opposite directions, yielding a more appropriate outcome. A comparison of Figure 4 with Figure 5 shows a uniform distribution of most gray levels, except at the higher end where a significant number of pixels are concentrated. Figure 7 indicates a sparse presence of pixels for higher gray levels (0.9*255-255).

When comparing Figure 6 with Figure 5, it is evident that a smaller number of pixels correspond to fewer transformed gray levels, which are normalized on a scale based on 255.
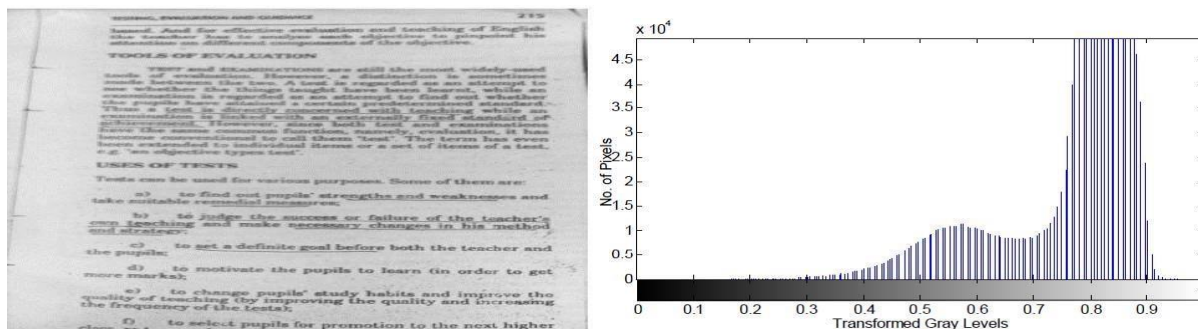
Figure 7. Enhanced document image quality and pixel-intensity histogram based on APLT algorithm.

Upon comparing Figure 6 with Figure 5, it is apparent that a higher number of pixels exhibit uniform gray levels

within the range of 100 to 200.

Performance measure of images using SSIM

The SSIM test is employed to evaluate the performance of our proposed novel heuristic algorithm alongside existing techniques (HE, LT, and APLT), with the results tabulated in Table 1. While in certain instances, the SSIM value may be marginally smaller compared to APLT and LT, the visual assessment indicates superior image quality for our proposed novel heuristic algorithm. Nevertheless, in the majority of cases, a higher SSIM value corresponds to enhanced image quality.

Table 1: Analytical results using SSIM.

Performance measure of images using SSIM				
SSIM of Images	HE	LT	APLT	Proposed technique
1	0.4639	0.9864	0.9957	0.9942
2	0.8412	0.9864	0.9373	0.9356
3	0.8375	0.9342	0.9242	0.9164
4	0.3875	0.9644	0.9732	0.9873

Conclusions and future directions

This paper explores a heuristic algorithm designed for image quality enhancement using SSIM as a metric. Comparative analyses were conducted between our proposed heuristic algorithm and existing methods (HE, LT, and APLT) for document image quality enhancement based on SSIM. The findings indicate that our proposed heuristic algorithm consistently outperforms HE, LT, and APLT in enhancing document image quality, as assessed by SSIM. It was observed that, at times, visually superior document images exhibit lower SSIM values, suggesting the need for refined metrics. Future endeavors could focus on refining image clarity by distinguishing foreground and background pixels, applying diverse filters to reduce noise and ultimately improving readability.

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Molecular Characterization of Mitochondrial tRNA Leucine Gene in Epileptics Patients from District Peshawar, Khyber Pakhtunkhawa

Wali Ur Rehman and Sadiq Noor Khan
The University of Haripur

Abstract

Epilepsy is a neurologic disorder of brain characterized by simultaneous seizers for shorter time affecting of involuntary parts of the body Mitochondrial or genomics DNA genes mutation link to the epilepsy directly affect brain regularities that can lead to epilepsy or to other genetic conditions which can cause seizures. This cross-sectional study was conducted to find out the mutational analysis of mitochondrial transfer tRNA Leucine gene (MT-TL1) in epileptics from district Peshawar Khyber Pakhtunkhwa. Convenient sampling technique was adopted. Questionnaire was filled from patients and three ml blood sample was collected in EDTA tube. Using sample size calculation formula n=p (1-p2) z2/d2 the samples size was calculated by using p (prevalence) =4% (0.04), d (margins of error) =5% (0.05), z; confidence level=95% (1.96) which will provide a sample size of (n=19) gDNA Mini Kit Blood (WizPrep) was used for mitochondrial DNA extraction. Specific primers picked from literature forward and reverse premier were used. The amplified PCR product run on 2% agarose gel electrophoresis. After confirmation of bands the amplified product clean through cleaning process for Sanger sequencing. No mutation was found in all 19 samples of MT-TL1 Leucine tRNA gene ranged from 3212- 3365bp. Our study concludes that epilepsy is common in males as compared to female. Epilepsy is more prevalent at age group of 10 to 20 years. Our study recommend that not just mitochondrial gene but also other genomic DNA should be studied for mutational analysis. Further studies with a larger number of patients are needed to assess the baseline information about mutation analysis of MT-TL1 gene.

Introduction

The International League Against Epilepsy (ILAE) formed an international committee to develop a common definition of epilepsy is the word "epilepsy" is of Greek word "epilambanein" mean to seizer to take hold off or to take attack. The word seizer is of Latin origin from "sacire" and mean to claim (Vos et al., 2020). Epilepsy is a neurologic disorder of brain characterized by seizers for shorter time affecting of involuntary parts of the body (Nazish et al., 2018). Worldwide distribution both males and females of all ages affects by epilepsy the prevalence and the new cases of epilepsy are a bite more in male's individuals as compared to females and the tendency to have high in older ages of population due to more incidences of intellectual's disability diseases, tumors and stroke in this group of ages (Lenaerts et al., 2018). Epilepsy affects 50 to 70 million individuals globally, Accounting for 0.75 percent of the global illness burden. Epilepsy affects around 2.4 million individuals every year. Pakistan is responsible for 1.5 million people suffering with epilepsy, accounting for 3% of the global total. Overall 9.99 per 1000 population estimated prevalence of epilepsy in Pakistan (Ammothumkandy et al., 2022).

Seizure is the characteristics of abnormal brain activity of neurons which lead to disease in the central nervous system that is epilepsy. According to ILAE there are main four types of epilepsy. Generalized epilepsy, Focal epilepsy, idiopathic epilepsy and combination of focal and generalized epilepsy (Zarcone and Corbetta, 2017). Epilepsy is a central nervous system neurological disorder in which brain activity becomes abnormal, causing seizures or periods of unusual behavior, sensations and sometimes loss of awareness. Seizures can affect any process your brain coordinates. Seizure signs and symptoms may include Temporary confusion, Staring spell stiff muscles, Uncontrollable jerking movements of the arms and legs, Loss of consciousness or awareness and psychological symptoms such as fear, anxiety (Subota et al., 2019). Pedigree analysis provide a detailed representation of a family configurations and medical history, pedigree analysis help in identifying patients and their family member who have increased risk for genetic disorders (Al-Rabiaah et al., 2020). Misdiagnosis of epileptic's patients is inappropriately commonly seen in hospitals this percentage is 20% to 30% which increasingly with passage of time and lead to a major public health problems. Many types' seizures of epilepsy are misdiagnosed due to psychogenic non epileptic's attacks in a general neurology department of hospitals. Other convulsive circumstances can also infrequently be   misdiagnosed of neurology problems such as epilepsy (Benbadis et al., 2009). Maternally inherited human mitochondrial DNA mtDNA is the major synthesis site in eukaryotes cell for adenosine triphosphate ATP through the process of oxidative phosphorylation. The genome of mitochondrial DNA mtDNA is 16569 base pairs consist of 22 transfer RNA tRNA genes, 2 ribosomal rRNA genes and 13 proteins shown in (figure1). Replication of mitochondrial DNA controlled uniquely by their own genome copy in a human cell (Saneto, 2017). Mitochondrial DNA mtDNA contains 37 genes (22tRNA genes, 2rRNA genes and 13 proteins) all of mitochondria DNA genes are essential for normal mitochondrial function. The human mitochondrial genome encodes only 13 proteins, 2 ribosomal RNAs (rRNAs) and 22 mitochondrial transfer RNAs (tRNAs) genes (Ros et al., 2020). Respiratory chain complexes I, II, III, IV and V of mitochondria all of the mitochondrial DNA genes need for their normal functioning. Oxidative phosphorylation is a procedure that require oxygen and simple sugar to generate adenosine triphosphate ATP which is the main energy source of the cell. For this process the 13 gene of protein in mitochondria is directly involved. The other remaining genes 22 tRNA and 2 rRNA are chemical cousins of DNA and functioning in assembling of amino acid which is the building blocks of proteins (Rahman and Padavettan, 2012). In human cell mitochondria responsible for making of energy through oxidative phosphorylation twenty two gene of mt-tRNA gene encoded by mitochondrial DNA for this essential part of mt-tRNA gene encoded by mitochondrial DNA for which contain post transcriptional modification controlled by enzymes genomic encoded tRNA modifying gene. Dysfunction of this tRNA post transcriptional continuously result in severe disease significances (Yamakawa et al., 2020). Genomics or mitochondrial DNA genes mutation link to the epilepsy directly affect brain regularities that can lead to epilepsy or to other genetic conditions which can cause seizures. Some people inherit genetic factors. However, certain genetic mutations may also cause epilepsy in people without a family history of the condition (Natale et al., 2022). As per literature there is no study reported from district Peshawar Khyber Pakhtunkhwa. The current study was

designed to check the molecular characterization of mitochondrial tRNA Leucine MT-TL1 gene in epileptic patients from districts Peshawar Khyber Pakhtunkhwa.

Material and Medthods

This cross sectional was performed in district Peshawar, Khyber Pakhtunkhwa Pakistan. All the epileptic patient confirm diagnosed by Electroencephalography (EEG)/ Computed tomography (CT) scan/Magnetic resonance image (MRI) and Positron emission tomography (PET) will be included in this study. Patients having no family history of epilepsy and those with other neurological disorder will be excluded. A total of 19 samples were collected from 10 families using sample size calculation formula n=p (1-p2) z2/d2 was the samples size was calculated by using p (prevalence) =4% (0.04), d (margins of error) =5% (0.05), z; confidence level=95% (1.96) which will provide a sample size of (n=19)**.** Wizep gDNA kit was used for extraction of mitochondrial DNA mt-DNA.

Amplification and gel electrophoresis of the target gene

Specific primers picked from literature were forward primer (5CACCCAAGAA CAGGGTTTGT3) and reverse primer (AGGAATGCCATT GCGATTAG). (Liu *et al.,* 2014) and check through UCSC genome browser. Tm was optimized through gradient PCR with temperature range from 55 ℃ to 65 ℃. The optimized annealing temperature was 58 ℃. Run on 1.8% agarose gel for 50 minutes at 90 voltage. LABTRON made by USA thermal cycle used for primer optimization. The extracted DNA was used as a template for the PCR amplification. The PCR reactions were performed with a 20 µl final volume containing 0.5 µl of each primer, 2 µl template DNA, 2 µl buffer, 1.2 µl MgCl2, 2 µl dNTPs, Taq poly 0.25 µl and 11.55 µl water. The optimum conditions of PCR for genes were as follows An initial-denaturation at 95 ℃ for 4 minutes, followed by amplification by 35x cycles of denaturation at 95 ℃ for 30 seconds, Annealing at 58 ℃ for 30 seconds and elongation at 72 ℃ for 40 seconds, and a final extension at 72 ℃ for 5 minutes.PCR amplified products was run on agarose gel and matched with the DNA ladder under Gel Doc (LABTRON USA).

PCR Product Cleaning

Cleaning of PCR product for Sanger sequencing 4µl of 10M ammonium acetate and 80 µl of absolute ethanol (100%) were added. Shift from strip to eppendrofs for centrifugation. Leave on ice for 20 minutes and then centrifuges for 10 minutes at 14000 rpm. Drain supernatant and place tubes on tissue paper. Wash pellet with 70% chilled ethanol (100 µl) and centrifuges for 10min at 14000rpm. Invert tubes on tissue paper and dry overnight. Resuspend pellet 20 µl with deionized water (Pradelli *et al.,* 2021).

Results and Discussion

As per literature different studies show that epilepsy patients may vary in prevalence and mutation. Survival and disorder progression can be affected by mutation status in mt-DNA and treatment. In the current study 10 epileptic's patient's family were selected from district Peshawar Khyber Pakhtunkhwa. Total nineteen (19) blood samples was collected from epileptic's patient's family.

Gender wise frequency of epilepsy

Out of total 19 epilepsy patients population 13 (68.4%) were males and 6 (31.5%) were females (Figure 1.1). Male was the dominant gender found throughout the study. Epilepsy affects 50 to 70 million people worldwide. Overall 9.99 per 1000 population estimated prevalence of epilepsy in Pakistan (Shah *et al.,* 2021).
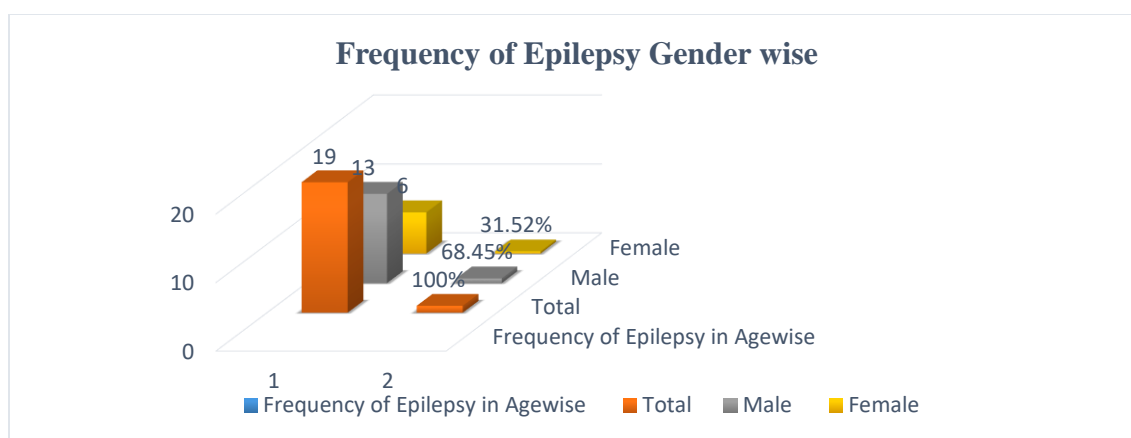
Figure 1.1 Frequency of Epilepsy Gender Wise

Age wise frequency of epilepsy

In the current study total 19 epileptic patients were included and the age wise frequency was distributed into five age groups. First group one to ten year, second group eleven to twenty year, third group is twenty one to thirty year, four group is thirty one to forty year and group five is forty one to fifty year as show in (Figure 1.2
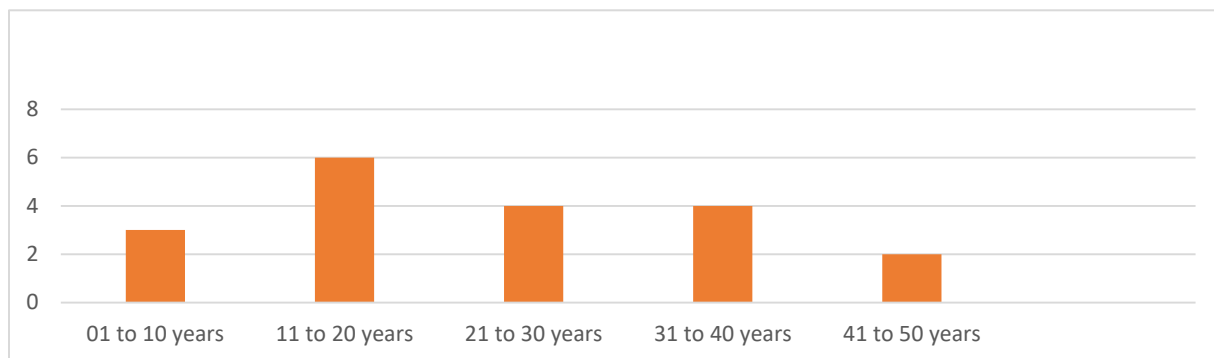
Figure 1.2: Age Wise Frequency of Epilepsy

Epileptics patients have taking antiepileptics drugs

In the current study different anti-epileptics drugs was taken by epileptic patients in which 7 (37%) patients were taking tab Epival, 5 (26 %) were taking both Tab Tegral and Tab Epival antiepileptic's drugs, 4 (21%) were taking only Tegral, 2(11%) were taking clobazam antiepileptic's drug and 1(5%) were taking clonazepam overall of the 19 epileptic patients epileptic as show in (Figure 1.3.)

Patients Have Taking AntiEpileptics Drugs
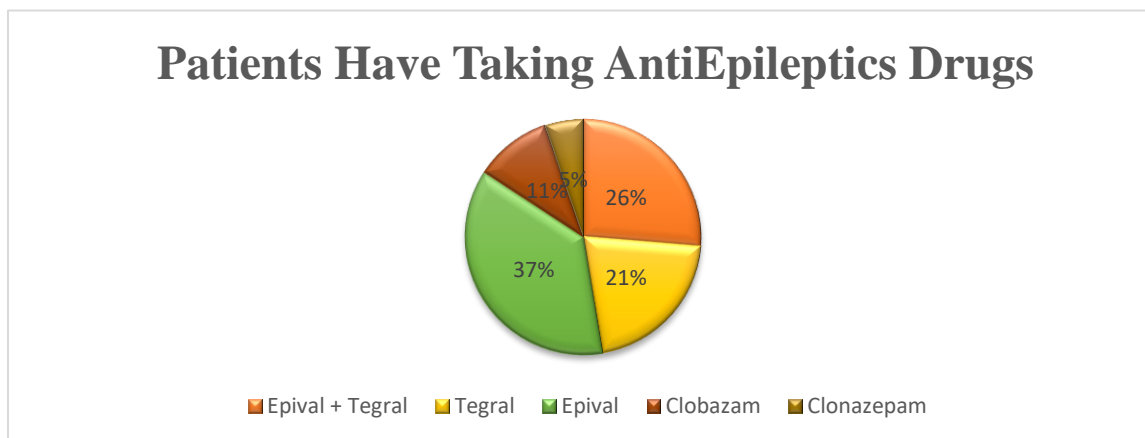
Figure 1.3 Patients Have Taking Anti-epileptics Drugs

Family: 1 Pedigree Analysis

In this case, the patient was male identified with epilepsy having age 18 years suffering from seizures/convulsions. The history of his family revealed that one of the family member blood related were epileptic (died) as show in Figure 1.4.
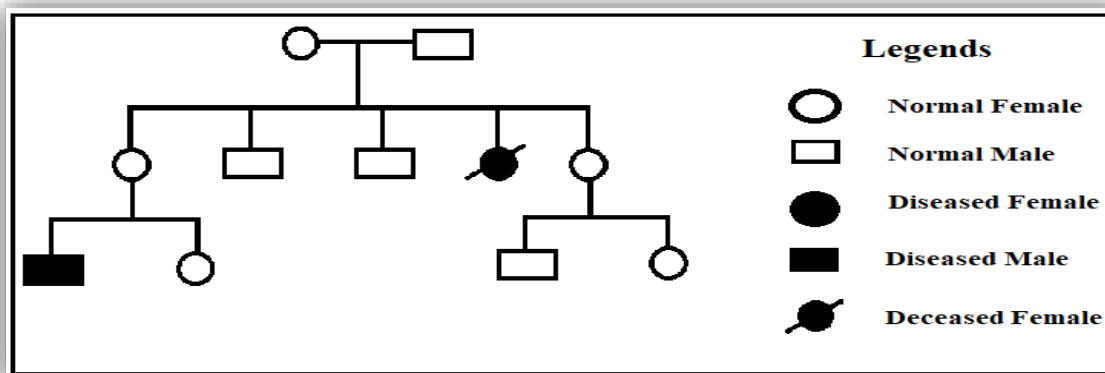
Figure

1.4: Pedigree of sample "F1 S1" with corresponding legends

Nucleotide sequencing analysis of family 1 sample

After cleaning of PCR products proceed for Sanger sequencing IB&GE KRL Hospital Islamabad. There is no mutation in sample S1. The sequence result of specimen-F1 provided by IB&GE KRL Hospital Islamabad as show in Figure 1.5
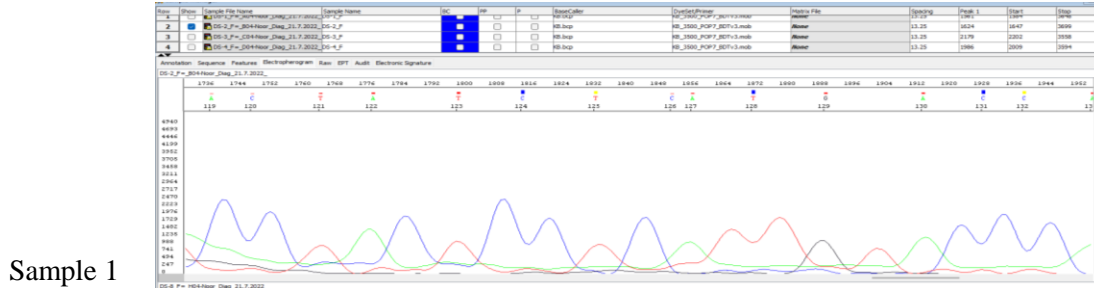
Figure 1.5: Sample 1

Sequence alignment of family 1 sample

Sequence alignment of sample S1 with Reference Sequence accession number ON698208.1. There is no mutation found in the MT-L1 Leu- tRNA gene ranged from 1332- 3365bp. As show in figure 1.6
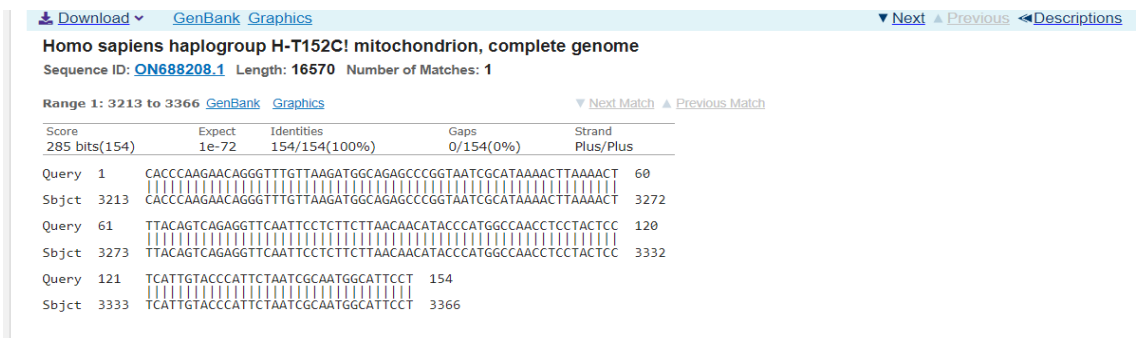
Figure 1.6: Sequence alignment of sample S1

A same study reported from, Turkey of pedigree analysis to our study pedigree helps to identify patients and families who have an increased risk for genetic disorders (Çaksen *et al.,* 2019). On age wise frequency of epilepsy a study reported from New York USA. In the current study nineteen epileptics patients were included age wise frequency show that epilepsy is more common in male as compared to female 68.45% male and 32.55% female (Kwon *et al.,* 2022). A similar to our study reported a number of tRNA gene mutation in mitochondrial DNA involved in a type of epilepsy such as status epileptics are MT-TH, , MT-TV, MT-TW, MT-TF and MT-TL1. Some genes of mitochondrial DNA encoded the subunit of respiratory complexes chain I, II, III and IV gene include as MT-ND6, MT-CO1, MT-ND1, MT-CYB and MT-ND4 (Rahman, 2018).

Conclusion

This study concludes that epilepsy is more common in male's gender as compared to female's gender and also conclude that epilepsy is more prevalent at age of 10 to 20 years of ages.

There is no mutation found in mitochondrial tRNA Leucine gene MT-TL1 ranges from 3212- 3365 bp in all samples.

Recommendation

The current study recommended that the number of specimens increase for better results and to analyze the prevalence of Leucine-tRNA gene. Nuclear genes which are reported in epileptic should also be studied in Pakistani population not only mitochondrial DNA. Studied all the 37 gene of mitochondria not only Leucine MT-TL1 for any mutation in epileptics patients.

The current study also recommended conducting the research on a wider scale to rule out the Leucine-tRNA gene mutation in different ethnicities and geographic distribution in Pakistan. Further studies with a larger number of patients are needed to assess the baseline information about mutation analysis of MT-TL1 gene.

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Crowd Counting an Android Application Based on Neural Network

Shehzad Khan*, Muhammad Tauseef, Zartashia Najaf, Qazi Haseeb Yousaf
City University of Science and Information Technology, Dalazak Rd, Pakha Ghulam Peshawar, Pakistan
shehzadcusit@gmail.com

Abstract

The last few years have witnessed a tremendous increase in population. Given the worrisome rate of population grows it is significant to analyse the patterns of crowds and their conducts as well. The key aimof this study is to compare different crowd counting and crowd labelling Machine learning algorithms, namely Convolution Neural Network, Residual Network, Weakly Supervised Transformer Architecture, and Convolutional Sparse Regression Network. The Convolution Neural Network and Residual Network algorithms have been used for crowd labelling, trained, and tested on a labelled Hajj Footage dataset and Weakly Supervised Transformer Architecture, Convolutional Sparse Regression Network have been used for crowd counting, trained, and tested on un-labelled ShangaiTech dataset. Evaluating the algorithms basedon the evaluation metrics of accuracy, and MAE ensures the highest level of confidence in the results obtained. The findings of the study elaborate that crowd labelling the Resnet model outperforms than CNNand crowd counting the CSRnet model outperforms than WSTA. This study validates that CSRnet outperformed, producing the lowest MAE of about 11.03 on the crowd-counting ShangaiTech dataset. CSRnet was selected for usage in the application as the algorithm with superior efficiency and the lowest error rate after thorough analysis. Conclusively, an application has been developed that offers crowd countinformation.
Keywords: Convolution Neural Network, Crowd Counting, Crowd Labelling, Dataset, Machine Learning

Introduction

A large group of people gathered in one location is referred to as a crowd. The number of people in a crowd can range from a few to thousands or even millions. Crowd counting is significant because of its various applications in a variety of fields, such as business analytic, urban planning, public safety, transit management, and event planning. Through technical advancements, crowd count analysis has improved. Media sources have used applications to examine crowd behaviour. These sources use crowd-related coverage from various events to compile tracking data. The automatic investigation of numerous people's behaviours in one location is referred to as automatic crowd scene analysis (S. R. Musse and D. Thalmann, 2002). According to, (S. Elbishlawi, M. H. Abdelpakey, 2020) automatic sense analysis primarily focuses on a number of people and tracks their movements throughout various marches and gatherings (N. Jarvis and C. Blank, 2011) (J. Drury and R. DaMatta, 2020). This study's main objective is to compare machine learning (ML) algorithms based on Crowd labelling and Crowd Counting. Convolution Neural Network and Residual Network were trained and tested on the Hajj Footage dataset, while for crowd counting, Weakly Supervised Transformer Architecture and Convolutional Sparse Regression Network have been trained and tested on the ShangaiTech dataset.

Problem Statement

For safety and security concerns to analyse patterns of crowd and analyse the crowd many problems happen like crowd control, safety and security concerns. Cameras can also be used in different places where security issues arise like shopping malls, educational campuses and religious gatherings like Hajj, and many other events but it's impossible to keep an eye on larger crowd. As available literature suggests that there is no specific mobile application available for automatic crowd count. For safety and security purposes its dire need to develop mobile application for automatic crowd count.

Objective of the Study

- To suggest an efficient model for the existing model for crowd counting.
- To develop an application for crowd count by using more efficient machine learning algorithm that trained or tested by respective dataset.
- To develop an application that helps the user with time management and their decision to plan early to save time.

Significance of the Study

Crowd counting in different places is considered major contribution for safety security and economic perspectives. This study is major contribution not only for resolving safety and security issues but also make it easy count analysis in so many other places like hospitals banks and other places where number of visitors waiting so by development of this application can reduce waiting time of visitors by providing timely projections and advice on crowded places. And this study also helps policy makers and government organizations to control crowd related issues ensure high level of security and safety, management.

Literature Review

Crowd counting is an essential task in many public places such as parks, subway platforms, and event spaces. In crowd counting single camera is not sufficient to capture all crowd images in large areas. Using Self-Supervision to Improve Cross-Domain Performance Crowd counting is useful in video surveillance and traffic control applications. During the present COVID-19 epidemic, for instance, it has a role to play in monitoring social distancing and reducing disease transmission. Trans Crowd is a cutting-edge approach to weakly-supervised crowd counting, leveraging the power of transformers to reframe the problem as a sequence-to-count task.

Through the strategic use of self-attention mechanisms, Trans Crowd excels at extracting meaningful semantic information from crowded scenes. Rigorous testing on five benchmark datasets has conclusively demonstrated that Trans Crowd surpasses all other CNN-based counting methods designed for weakly-supervised learning, consistently achieving top tier counting results. In our analysis, demonstrate that the attention mechanism has great promise for obtaining semantic crowd knowledge (Liang et al., 2022).

As per (X. Hong et al., 2021) for learning of universal model for cross dataset need crowd counting. For picture resolution and configuration number of problems arises by the help of alignment of closed form solution and it's provided completely new structure of networks. And (Zhang et al., 2022) suggest that SD Net can also be to use for perdition of scale distribution. (W. Liu et al., 2022) have proposed in their study that many cutting edge algorithms used to examine to density of crowd and images and integrate sections to provide people count. For easier understanding in this study use visual framework a step towards introducing a sophisticated deep neural network framework specifically designed for crowd counting from multiple camera views. Using Self-Supervision to Improve Cross-Domain Performance Crowd counting is useful in video surveillance and traffic control applications. (N. Durasov et al., 2021) Suggested in his study that by training of network to learn perspective-aware features on real images and then add 6 it with the ability to utilize these characteristics to predict its unpredictability using a quick type of ensemble modelling to effectively use fake labels for fine-tuning.

As suggested by (W. Liu et al., 2022) that for increased crowd count efficiency use synthetic data and revealed detail data without annotations, and suggested that proposed the technique for merging image- wise and pixel-wise supervision. Our ground-breaking method combines pixel- and image-wise supervision, enhancing crowd-counting accuracy even when only fictitious data and genuine data without

annotations are available. Following the same idea proposed in (W. Liu et al., 2022) Spatial uncertainty aware semi supervised crowd counting provide suggested that surrogate task (binary segmentation)-based semi-supervised solution.

(Y. Liu et al., 2020) have proposed in their study that the student model is more resilient in terms of task-level spatial crowd region consistency due to the built-in regularisation of consistency between the primary task (density regression) and the substitute task (binary segmentation). Demonstrated its ability to reduce annotation efforts while keeping good performance on four challenging crowd-counting datasets. So anticipate that our method will be generally practicable in real life (Y. Meng, et al., 2021).

Crowd counting method proposed in (Z. Yan et al., 2021) study introduce domain-directed channel attention network (DCANet) for teaching multi-domain crowd counting. Three components make up our DCANet: dense map prediction, channel attention-guided mutilation (CAMD), and feature extraction. To train our model, used Adam optimization with a fixed constant momentum of 0.9 and a learning rate of 1e-6. They propose a unique segmentation attention strategy to direct our Seg Crowd Net to focus on the human head regions. Furthermore, the suggested innovative four-loss optimization increases SegCrowdNet's generalization ability (J. Chen and Z. Wang, 2021).

Following the same idea proposed in (J. Chen and Z. Wang, 2021) and (L. Liu et al., 2019) using four major crowd-counting datasets (ShanghaiTech Part A, ShanghaiTech Part B, UCF-CC-50, and World-Expo'10). Comprehensive experimental data show that our suggested strategy outperforms several current methods. As per (Z. Zhao et al., 2020) rather than selecting images at random for annotation, in this study to used framework for active labelling strategy that prioritizes the most valuable images in the dataset. Once the labelling budget is fulfilled during the final cycle, the vast amount of unlabelled data is also utilized. According to study results (O. Sener and S. Savarese, 2017) in a conventional setup, just one sample is chosen in 8 each cycle. For DNNs, this is not achievable since it is not possible to train as many models as there are data points because there are numerous massive amounts relevant real-world problems. Proposed by (W. Liu et al., 2019) Crowd counting using context awareness Modern methods for counting people in crowded spaces depend on deep networks to estimate crowd density. To do this, it is frequently necessaryto train an auxiliary classifier to select the best kernel size from a small range of possibilities for pre-madeimage patches.

Three shallow CNN branches and an attention model make up the AM-CNN that is being shown. To begin, multistate features are extracted using CNN branches with different receptive fields. Then, regardless of graphic difficulty, dispersion non-uniformity, or scale and perspective differences, the attention model is utilized to emphasize head locations. To compensate for Euclidean loss during the training method, the relative deviance loss is also used (Y. Zhang et al., 2019). An effective crowd-counting attention model convolutional neural network (AM-CNN) that makes use of head positions. Through the use of a model of attention to create a likelihood map with higher probability scores in head areas, the layout explicitly prioritizes head locations while suppressing non-head areas. Crowd Counting Using a Deep Hierarchical Scaling Integrated Net Using structural representations of features training and a hierarchical framework for function loss optimization, a novel Deep Structured Scale Integrated Network (DSSINet) for crowd counting tackles people's scale variation. Initially, as a substitute to conventional methods that immediatelycombine numerous characteristics using weighted average or concatenation, to provide a Structured Feature Enhancement Module based on conditional random fields (CRFs) to adjust different scale properties individually via a message-carrying approach. In this module, each scale-specific feature is considered as a continuous random variable, and additional data is given to improve its properties at various scales.

Methodology

Some procedures in this study followed machine learning algorithms for crowd counting and crowd labelling. Datasets were taken from UCF repository that is Hajj Footage and ShagaiTech which contain images for crowd labelling and crowd counting like CNN, CSRnet, etc. To apply pre-processed step on dataset all images fixed at specific size for the easiest understand by machine learning models. After the ML algorithms, WSTA and CSRnet were trained and tested on the ShangaiTech dataset for crowd counting.CNN and Resnet were trained and tested on the Hajj Footage dataset for crowd labelling. The last step is to

evaluate the performance of the algorithm through accuracy and mean absolute error, (L. Liu et al., 2019) as shown in Figure 1.
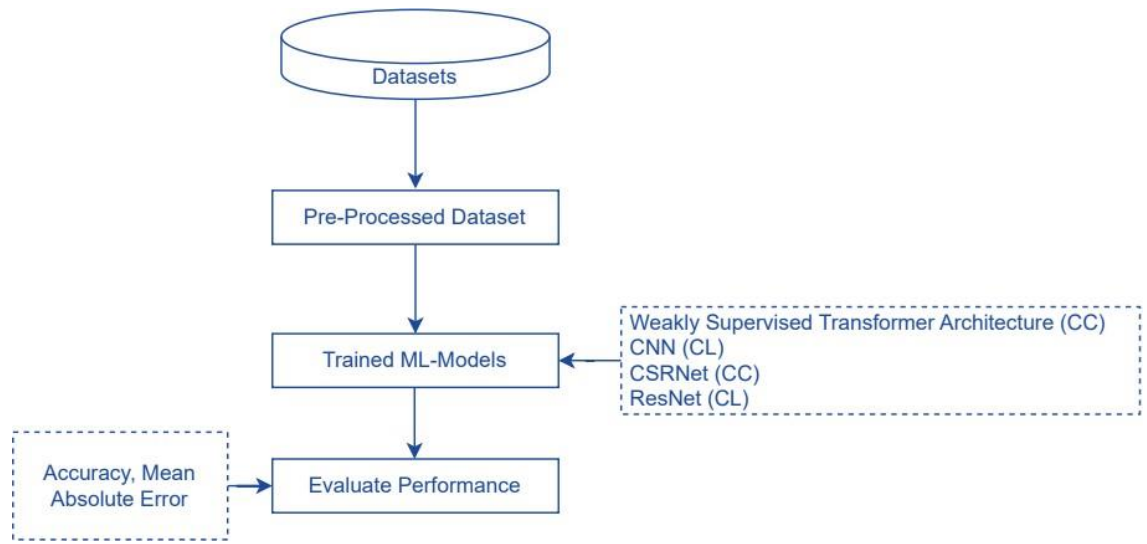
Figure 1: Methodology

Discussion and findings of the study

Using the Hajj footage Dataset from the UCF repository, this study evaluates the effectiveness of two distinct and well-known ML classification techniques, CNN and Resnet. Throughout the examination of the algorithms, the results reveal a variety caused by different approaches and, perhaps most importantly, a spectrum of effective audience percentages. In Figure 2.1 classification algorithms showed accuracy through graph that is Resnet algorithm accuracy is 97.30%, and CNN algorithm accuracy is 91%.
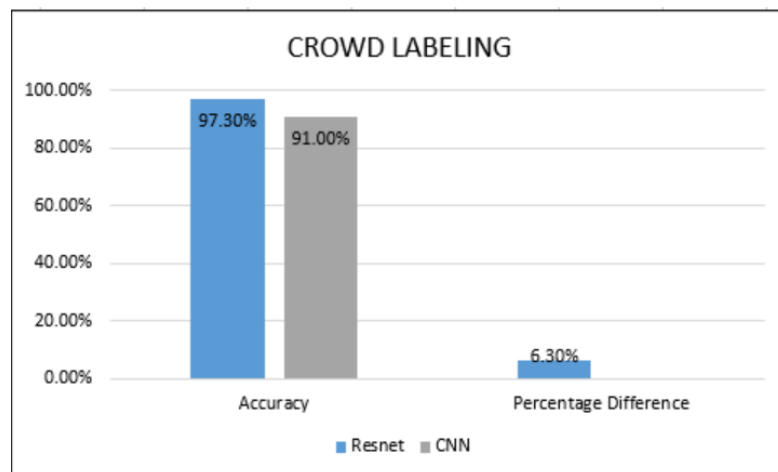
Figure 2.1: Crowd Labelling

Using the ShangaiTech Dataset from the UCF repository, this study evaluates the effectiveness of two distinct and well-known ML regression algorithms, CSRnet and WSTA. Throughout the examination of the algorithms, the results reveal a variety caused by different approaches and, perhaps most importantly, a spectrum of effective audience values. In Figure 2.2 Regression algorithms showed MAE values through

graph that is WSTA algorithm MAE is 18.9, and CSRnet algorithm MAE is 11.03.excel
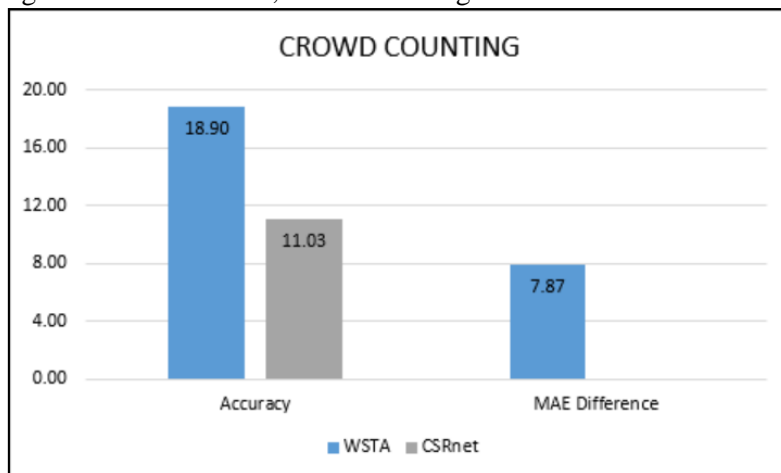
Figure 3.2: Crowd Labelling

By comparing algorithm shows that the CSRnet algorithm MAE value of 11.03 is lower than the WSTA MAE of 18.09 in crowd counting. CSRnet will operate faster and with less error than WSTA, so picked CSRnet. A regression-based model was utilized in the third experiment in to optimize the hyperparameters, several experiments and trials were conducted. To examined the details between multiple algorithms. The dropout layer 0.5 is the optimal hyperparameter for the already developed model, and the optimization algorithm is currently set as adam, with relu as the activation method for the not-visible layer and SoftMaxas the layer that is completely connected. In this work, were employed a density-based hybrid model. First utilize density files for the training model and then use them in layers of the convolutional model rather than initially sending the complete picture for density.

Application Results

The app was tested on crowd images, which reflects the crowd counts, is shown in Figure 3.
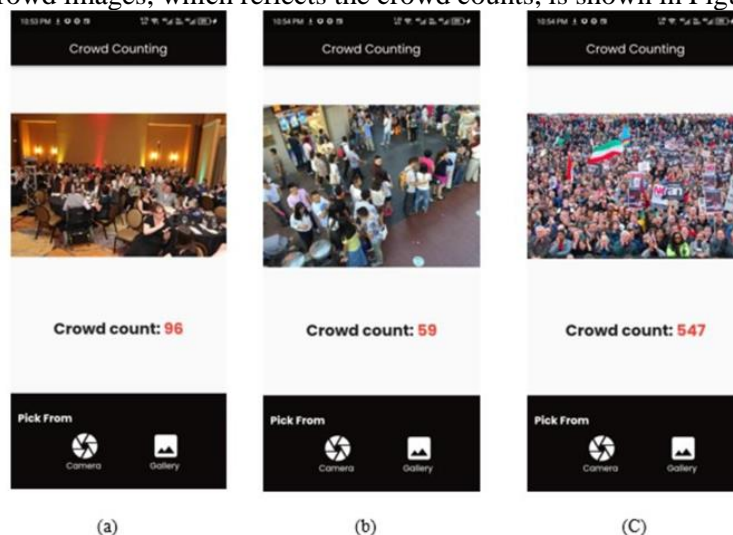
Figure 3: Application Results

Conclusion

Crowd counting means the act of counting the total crowd present in a certain area. The people in a certain area are called a crowd. The most direct method is to actually count each person in the crowd. First, we

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discussed the algorithms, datasets, their comparisons and implementation. The tools and techniques used in the research were also listed. Additionally, methodology, tools, techniques, and requirements for our application have also been discussed. After experimental analysis, it was concluded that the CSRnet has the lowest MAE, which is 11.03 on the Crowd Counting ShangaiTech Part-b Dataset. Resultantly, an App has been created which is likely to show the crowd count.

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Analysis of Oversampling Machine Learning Techniques on Imbalanced Dataset

Muhammad Bilal Babar, Umair Khan, Zartashia Najaf and Wahab Khan
City University of Science and Information Technology, Peshawar, KPK, Pakistan

Abstract

Machine learning frequently faces problems with imbalanced class distribution, especially for text datasets. In order to improve classifier performance on unbalanced text data, this study compares various oversampling techniques. The study focuses on three distinct datasets: Bio-assay, Spam Filtering, and Credit Card Fraud Detection. The implementation and evaluation of several oversampling methods, such as random oversampling, adaptive synthetic, synthetic minority over-sampling for nominal and continuous features, borderline synthetic minority over-sampling technique, support vector machine synthetic minority over-sampling technique, and K-Means synthetic minority over-sampling technique. As a performance metric, accuracy is used to evaluate how well these techniques perform. The experimental findings show that various oversampling strategies can successfully balance unbalanced text datasets. The Support Vector Machine and the Border-line Synthetic Minority Over-Sampling Technique Methods using the Synthetic Minority Over-Sampling Technique routinely perform better in terms of accuracy than other techniques. The dataset's unique properties and the issue at hand, however, determine which oversampling technique should be used.
Keywords: Class Imbalance, Textual Data, SMOTE, Support Vector Machine (SVM), Machine Learning.

Introduction

In an ongoing examination, the class imbalance is a basic issue, one where exceptional imbalanced information represents the additional trouble, as most of the classifiers will show a predisposition towards the larger part class, and in outrageous cases, may dis- regard the minority class. In the class-imbalanced data set, one of its classes has an essentially minimum number of tests compared to the other. It is normal for the classifier to produce better execution on a class having a larger number of tests (Sharma et al., 2022). There are various difficulties in learning such class-imbalanced information. This slanted appropriation of the preparation models makes the standard learning classifiers one-sided, having an inclination toward the majority class, and can't recognize the minority cases. These interesting minority classes might be treated as an endless commotion and erroneously recognized as minority tests. This kind of imbalance issue frequently exists in clinical or fraud identification fields. The quantity of the ordinary examples in the data sets is often more than those of the strange examples, and the hole between the two of them is moderately enormous. The researchers and developers have created various class imbalance techniques and execution assessment measurements to address these challenges (Islam et al., 2022). This research is dealing with the data-level methodology. In data level methodology, we will utilize oversampling procedures, In the oversampling strategies, new samples are made in light of the samples from minority class to arrive at a more adjusted class dispersion of tests while fortifying class limits in this proposed, comparative analysis of the over- sampling techniques on three different data sets, to identify the performance of these techniques on a classifier to find out the better technique in class imbalance problem. By doing this we can have the answer to which oversampling techniques are better for which of the specific domain. The study of deep learning, data science, and advanced analytics on imbalanced classification has inspired this attempt at these techniques with real-life datasets taken as data. Class imbalance problems are common in today's world. An example can be of an oil detection in seas where the information receiver can have the wrong input (Fernández et al., 2018). By utilizing given programming codes and applying them to the data sets we can minimize the wrong input by finding the best technique (He & Garcia, 2009). Having a bit of experience in Python solidified the reason for doing this analysis even more.

Problem Statement

The existing literature has limited studies that comprehensively compare oversampling algorithms for addressing the class imbalance issue in textual datasets, highlighting the need for a more thorough examination of these techniques.

Aim and Objectives

Aim

To address Imbalance classes, ML algorithms, and their outcomes. To assist in the solution of choosing between different ML algorithms. To highlight the relationships between algorithms and imbalanced classes. To establish generalized statements about different sizes of text data sets.

Objectives

• To review and compare different oversampling techniques used to address class imbalance in machine learning.
• To examine and contrast the classification performance of each oversampling technique on the various datasets, using evaluation metrics like accuracy, precision, recall, and F1-score.
• To identify the most effective oversampling technique for each data set based on the evaluation metrics.

Methodology

The methodology is shown in Figure 2 and includes the evaluation of three different datasets that were obtained from trustworthy sources like Kaggle and other trustworthy repositories. The experimental research entails the assessment of seven variants of well-established oversampling methodologies extensively employed for addressing imbalanced datasets. These variants include Random Oversampling (ROS) (Pang et al., 2019), Support Vector Machine (SVM) SMOTE, K-means SMOTE, Borderline SMOTE, Synthetic Minority Over-Sampling Technique (SMOTE), Synthetic Minority Over-Sampling Technique - Nominal Continuous (SMOTE-NC) (Zheng, 2020), and Adaptive Synthetic (ADASYN) (Pristyanto et al., 2022). By employing these techniques on the datasets, a comparative analysis is conducted to determine their efficiency and performance across diverse scenarios. The use of various datasets helps to reduce the impact of dataset-specific biases and ensures the robustness and generalizability of the results. The research aims to provide comprehensive insights into the behavior and efficacy of various oversampling techniques when applied to actual imbalanced datasets through this rigorous approach. Accuracy, precision, recall, and F1-score are just a few of the evaluation metrics that are used to rate the effectiveness of oversampling techniques. These metrics offer a thorough understanding of how well the techniques work to enhance classification results. Accuracy represents the overall correctness of the model's predictions, calculated as the ratio of correctly classified instances to the total number of instances. It provides an overall assessment of the model's performance but may not be informative when dealing with imbalanced datasets. Precision estimates the extent of accurately anticipated positive occasions out of the complete examples anticipated as certain. It evaluates the model's capacity to stay away from false positive expectations and is especially pertinent in situations where false positives have serious outcomes. Recall, otherwise called true positive rate, gauges the extent of accurately anticipated positive occurrences out of the absolute positive sure examples or instances. It demonstrates the model's capacity to recognize every positive case and is significant in circumstances where false negatives are basic. F1-score is the consonant mean of precision and recall. It gives a decent measure that thinks about both precision and recall. F1-score is helpful when there is an uneven distribution between the positive and negative classes
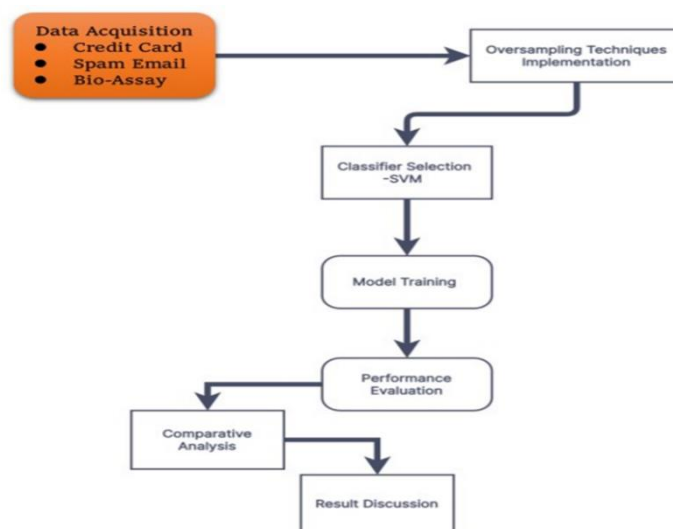
Figure 2 : Methodology WorkFlow

Phases of Research Work

The bioassay, spam email, and credit card datasets were selected for this study due to their applicability, unbalanced class distributions, accessibility, and body of prior re- search. These datasets are frequently used in studies focused on biological studies, email filtering, and fraud detection, respectively. They display unbalanced class distributions, which enables a focused investigation into how well oversampling strategies can address unbalanced class. These datasets have also been extensively used as benchmark datasets in earlier studies and are widely accessible, allowing for comparisons and reproducibility of results. Overall, these datasets were chosen because of their applicability to the research issue, their imbalanced nature, their accessibility, and their well-established usage in the literature.

Datasets

The research utilizes three distinct datasets to assess the adequacy of oversampling techniques on imbalanced text datasets. These datasets consist of, The Credit Card Fraud Detection dataset, the dataset is focused on credit card transactions and aims to detect fraudulent activities. It contains a large number of anonymized credit card transactions. The dataset contains a total of 284807 instances. It aims to identify and prevent fraudulent credit card trans- actions. The Spam Filtering dataset, which is commonly used for spam email classification and filtering. It consists of a collection of the labeled emails as one or the other spam or non-spam. The dataset contains a total of 5730 instances. Bio-assay dataset, which is related to bio-assay experiments and drug discovery. It contains bio-activity data for compounds tested against a specific biological target. The dataset contains a total of 47831 instances. It focuses on categorizing compounds based on their bio-activity levels.

The datasets are separated into training and testing sets to evaluate the performance of oversampling techniques. The training set is utilized to train the SVM classifier (Khan et al., 2022), while the testing set is utilized to assess the effectiveness of the oversampling techniques in improving the classification results.

Several tools are used to facilitate data analysis, model development, and evaluation. Visual Studio code integrated with Jupyter Notebook provides an interactive environment for data exploration, code development, and result visualization. VS code supports various programming languages like Python and frameworks and provides a user-friendly interface, code editing features, and seamless integration with Python libraries, facilitating the development and execution of the code. The classifier used to get the evaluation is the SVM classifier. The reason to choose the SVM classifier is that SVM works well with unstructured and semi-structured (Kurani et al., 2023) data like text which reduces the risk of error in the data.

Results and Discussion

The experimental findings from our study provide insight into the relative effectiveness of these techniques. Surprisingly, the outcomes showed that each method's efficacy varied across the various datasets. While SVM-SMOTE emerged as the best technique for Credit Card Fraud Detection and Bio-assay AID373red, other techniques in the Spam Filtering dataset achieved comparable results. This intriguing result motivates us to investigate the underlying variables affecting the effectiveness of each technique on particular datasets. It emphasizes how crucial dataset properties like class imbalance and feature complexity are in determining the best classification technique. To understand the nuances and intricacies underlying these disparate results, additional analysis and research were required. We make significant contributions to the field of classification techniques and their applicability to real-world datasets through this study. Among the oversampling techniques, SVM SMOTE consistently demonstrated high performance across all three datasets. It consistently achieved accuracy, precision, recall, and F1-scores close to or at 1, indicating its effectiveness in addressing class imbalance and improving classification performance.

Credit Card

All oversampling techniques, including ROS, SMOTE, ADASYN, Borderline SMOTE, K-means SMOTE, and SVM SMOTE, demonstrated high accuracy, precision, recall, and F1-scores in the Credit Card Fraud Detection dataset, as shown in Table 3.1.1. These methods successfully distinguished between fraudulent and legitimate claims, with most evaluation metrics exceeding or close to 1. This suggests that using oversampling techniques can greatly enhance the ability to classify instances of credit card fraud. But it's important to remember that ADASYN performed a little worse than other methods, with an accuracy and recall of 0.9 This implies that ADASYN might be less suitable for handling the class imbalance in this particular dataset, resulting in lower performance in identifying fraudulent claims.

SMOTE-NC is specifically designed to handle datasets that contain both categorical and continuous features (Islahulhaq & Ratih, 2021). However, the Credit Card Fraud Detection dataset used in the analysis consists entirely of continuous features and does not include any categorical features.

Since SMOTE-NC is specifically tailored for datasets with mixed-type features, it may not be appropriate to apply this technique to a dataset that lacks categorical features (Rahmayanti et al., 2021). The algorithm of SMOTE-NC relies on creating synthetic samples by interpolating the feature values of minority instances, which is not applicable in this scenario. As a result, the analysis did not provide specific results for SMOTE-NC on the Credit Card Fraud Detection dataset. It is important to choose the oversampling technique that is best suited for the specific characteristics and requirements of the dataset. In this case, other techniques such as ROS, SMOTE, ADASYN, Borderline SMOTE, K-means SMOTE, and SVM SMOTE were still able to produce valid results and showcase their performance on the dataset. While SMOTE-NC one couldn't be applied on this specific dataset.

Table 3.1.1 : Credit Card

Credit Card				
Algorithm	**Accuracy**	**Precision**	**Recall**	**F1-Score**
ros	0.98	1	0.98	0.99
smote	0.98	1	0.98	0.99
adasyn	0.9	1	0.9	0.94
borderline smote	0.99	1	0.99	1
K-means	0.98	1	0.98	0.99
smote-nc	-	-	-	-
SVM smote	0.99	1	0.99	1

Spam Email

In the Spam Email dataset, similar patterns emerged, with all oversampling techniques achieving high accuracy, precision, recall, and F1 scores. The similarity in results across different oversampling techniques for the Spam Email dataset as shown in Table 3.1.2 could be attributed to the specific characteristics of the dataset itself. It is possible that the dataset has a moderate level of class imbalance, where the minority class (spam) is not significantly under-represented compared to the majority class (non-spam) (Ratadiya & Moorthy, 2019). As a result, the impact of oversampling techniques on the classification performance may be less pronounced, leading to similar results across different techniques (Abid et al., 2022). Notably, compared to other techniques, SMOTE-NC displayed a marginally lower accuracy of 0.97 and recall of 0.97. This implies that it might be because of the unique characteristics of the dataset and the algorithm itself. SMOTE-NC incorporates data from both continuous and categorical features during the oversampling process, making it suitable for handling datasets with both types of features. However, the effectiveness of SMOTE-NC may be diminished if the Spam Email dataset primarily consists of continuous features and has few categorical variables. When there are few categorical features available, the algorithm, which relies on creating synthetic samples based on the nearest neighbors in the feature space, may not be able to fully capture the underlying patterns of the data.

Table 3.1.2 : Spam Email

Spam Email				
Algorithm	Accuracy	Precision	Recall	F1-Score
ros	0.98	0.98	0.98	0.98
smote	0.98	0.98	0.98	0.98
adasyn	0.98	0.98	0.98	0.98
borderline smote	0.98	0.98	0.98	0.98
K-means	0.98	0.98	0.98	0.98
smote-nc	0.97	0.98	0.97	0.97
SVM smote	0.98	0.98	0.98	0.98

Bio-assay

In the Bio-assay dataset, the oversampling techniques displayed varying performances. While most techniques, including ROS, SMOTE, Borderline SMOTE, K-means SMOTE, and SVM SMOTE, achieved high accuracy, precision, recall, and F1-scores, ADASYN exhibited comparatively lower results, with an accuracy of 0.89 and a recall of 0.89 as shown in Figure 3.1.3. This indicates that ADASYN might not be the most effective technique for handling class imbalance in this particular bio-assay dataset.

Table 3.1.3 : Bio-assay

Bio-assay				
Algorithm	Accuracy	Precision	Recall	F1-Score
ros	0.9	1	0.9	0.95
smote	0.9	1	0.9	0.95
adasyn	0.89	1	0.89	0.94
borderline smote	0.96	1	0.96	0.98
K-means	0.97	0.98	0.97	0.97
smote-nc	0.93	1	0.93	0.97
SVM smote	0.97	1	0.97	0.98

Analyzing the performance of each oversampling method separately across the datasets reveals both their advantages and disadvantages. Over the course of the three datasets. ROS consistently produced high accuracy, precision, recall, and F1 scores. It was a trustworthy option for handling unbalanced datasets because it successfully addressed class imbalance and enhanced classification performance. SMOTE, on the other hand, also displayed impressive performance, achieving high accuracy, precision, recall, and F1-scores. It successfully created artificial samples to balance the classes and boost classification precision. Across all three datasets, Borderline SMOTE consistently produced high ac- curacy, precision, recall, and F1-scores. It generated synthetic samples and efficiently identified borderline instances, improving classification performance. K-means SMOTE demonstrated high performance across all datasets, much like Borderline SMOTE. It produced artificial samples and successfully clustered instances, leading to in enhanced classification precision. In the Credit Card Fraud Detection and Bio-assay datasets, ADASYN performed marginally worse than competing methods, with lower accuracy and recall ratings. This implies that ADASYN might not be the best technique for these specific datasets and that different techniques ought to be taken into account. SMOTE-NC displayed a marginally worse performance, scoring lower in accuracy and recall. This suggests that SMOTE-NC may not be the best option for dealing with class imbalance. But across all three datasets, SVM SMOTE consistently demonstrated strong performance, achieving nearly perfect scores for Accuracy, Precision, Recall, and F1. This demonstrates how well SVM SMOTE works to address class imbalance and enhance classification performance across a variety of domains. These perceptions of how well oversampling techniques perform are crucial for guiding researchers and practitioners in selecting the approach that best fits the dataset's characteristics and the specific problem at hand. These observations highlight the benefits and drawbacks of each oversampling method. The class imbalance was successfully ad- dressed by ROS and SMOTE, and high performance was consistently shown by Border- line SMOTE, K-means SMOTE, and SVM SMOTE. SMOTE-NC displayed lower performance, and ADASYN displayed slightly lower performance in some datasets. Based on the unique features of the dataset and the desired classification performance, these findings can help researchers and practitioners choose the best oversampling technique.

Conclusion and Future Work

This study's research has shown that using different oversampling techniques effectively solves the issue of class imbalance in text datasets. Insights into the effectiveness and comparative analysis of these techniques across various datasets, including Credit Card Fraud Detection, Spam Filtering, and Bio-assay, have been provided by the experimental results. The results of this study allow us to draw the conclusion that a combination of oversampling methods, including Random Oversampling (ROS), Adaptive Synthetic (ADASYN), Synthetic Minority Over-Sampling Technique (SMOTE), SMOTE-NC, Borderline SMOTE, Support Vector Machine (SVM) SMOTE, and K-Means SMOTE, can improve classifier performance on unbalanced text datasets. In terms of accuracy, precision, recall, F1-score, these techniques have demonstrated encouraging results. Additionally, the comparison of these techniques has shed light on their ad- vantages and disadvantages. It was found that specific techniques outperform others in particular situations, emphasizing the significance of choosing the best oversampling technique based on the dataset's characteristics and the target class's inherent imbalance. In terms of future work, there are several directions that researchers can explore to further enhance the performance of oversampling techniques in balancing imbalanced text datasets. Some potential areas for future research include. Investigating the effective- ness of combining multiple oversampling techniques with ensemble methods, such as Random Forests or Gradient Boosting, to leverage their complementary strengths and improve overall performance. Exploring more advanced oversampling techniques, such as SMOTE variations with adaptive weighting or incorporating feature selection strategies, to enhance the generation of synthetic samples and diminish the gamble of overfitting. Investigating the application of deep learning models, such as Convolutional Neural Net- works (CNN) or Recurrent Neural Networks (RNN), in handling imbalanced text datasets. Deep learning models have shown guarantee in different natural language processing tasks and may offer superior execution in imbalanced situations. Considering the incorporation of cost-sensitive learning techniques to account for the asymmetric costs associated with misclassification errors in imbalanced text datasets. This can help prioritize the correct classification of the minority class. Conduct experiments and evaluations on larger and more diverse real-world datasets to validate the effectiveness of oversampling techniques in practical applications. Additionally, it explores the challenges and considerations involved in

deploying oversampling techniques in production environments. By focusing on these areas, future researchers can contribute to the advancement of imbalanced text dataset balancing techniques and further improve the performance of classifiers in real-world scenarios. In conclusion, this research has provided valuable insights into the application of oversampling techniques for balancing imbalanced text datasets. The experimental results and comparative analysis have demonstrated the efficacy of various oversampling techniques in improving classifier performance. The findings and recommendations of this study can serve as a foundation for future research and assist practitioners in effectively addressing the class imbalance issue in text data.

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Impact of Fintech on the Financial Performance of Pakistani Banking Sector: A ComparativeStudy of Islamic and Conventional Banks

Arshad Khan

City University of Science and Information Technology, Peshawar, Pakistan.

arshadkhanafridi59@gmail.com

Abstract

FinTech is an emerging technology which fundamentally changed the way of banking. The link between FinTech and banks got the attention of many scholars. In this regard, the purpose of this study is to examine the impact of FinTech on the financial performance of Islamic and conventional banks of Pakistan for a period of five years comprising of 2018 to 2022. Four Islamic banks and all the conventional banks except micro finance banks are chosen as a sample for this study. The analysis of the current study will be based on the independent variable Fintech (Internet banking, Mobile banking and ATM transactions) and dependent variable financial performance (Return on Assets, Return on Equity and Earnings per Share) of both banking systems. The researcher will collect quantitative data as per the quantifiable nature of the study which will be collected from the annual reports of the concerned banks and state bank of Pakistan website. Linear model of panel data regression will be used to derive the empirical results from the analysis of FinTech and banks' financial performance. Moreover, (t-test) will be used to compare the financial performance of Islamic and conventional banks. The outcomes of the current study will contribute updated theoretical information to the existing literature which will be usefulfor future research scholars to use such information as a reference material in future studies. Additionally,this study will shed light on the importance of financial technology from both customers and banks perspectives.

Keywords: FinTech, Financial Performance, Islamic Banking, Conventional Banking, Pakistani Banking Sector.

Introduction

Background of the study

FinTech, short for Financial Technology, is a term that denotes the combination of finance and technology. ‒FinTech is technologically enabled financial innovation that could result in new business models, applications, processes, or products with an associated material effect on financial markets and institutions and the provision of financial services‖ (European Commission, 2018) cited in (Rupeika- apoga & Thalassinos, 2020). The origin of FinTech is associated with Consortium of Financial Services Technology inaugurated in early 1990s by Citigroup (Schueffel, 2016). The innovation in technology leads banks to enter a modern age of digitization, which introduced them with a new tool known as FinTech (Monika et al., 2021). FinTech got recognition due to its wide range of applications as it provides a complete set of banking services to customers including credit facilities, money transfer, payment of bills and investment in stocks by using mobile phones or computers with ease and transparency 24/7. The advancement in financial services brought up by FinTech has shaped financing methods and expectations of the customers.

The digital platform (FinTech) entails a new financial model, whereby technology performs as a provider of several financial services including financing via online platforms, money transfer, bills payments, financial management and cloud computing (Schueffel, 2016). The physical interaction of banks and theircustomers have been declined with the use of innovative computerized mediums specifically during and post COVID-19

pandemic (Feyen et al., 2021). This movement towards the use of technology led customers to increased level of FinTech adoption in terms of internet banking. As a result, customers havechanged the pattern of managing their accounts which pose a significant risk for banks to tackle the shift in customers' preferences (Hassan & Misrina, 2021). Moreover, the experts at Standard and Poor' are of the view that worldwide financial industry could be massively influenced by FinTech adoption, resulting in an immense transformation of old fashioned financial products into digital ones.

The use of FinTech in banking services became common (Medyawati et al., 2021). With FinTech becoming a common tool in banking services, it enable customers to have access to a diversified range of banking services with convenience and security (Abdillah, 2020). Fintech is a composition of financial services and technology that turned around the classic model of business into new-fashioned model. Earlier people used to make payments face to face which require them to carry a large sum of physical cash from one place to another, but now FinTech services enable people to make payments via internet banking (Bank Indonesia, 2018) cited in (Siska, 2022).

Financial technology has two dimensional aspects over performance of banks. Firstly, the widespread use of smartphones facilitates customers with easy access to banking services which leads to enlarge customerbase of banks. Consequently, money is being injected into banks which enhance their liquidity position, deposit base and ultimately results in improving banks' profitability (Ky et al., 2019). Secondly, as per the highly regulated framework of banks, it is challenging to design diversified banking services in integration with technology as it may require banks to take additional measures to incorporate FinTech services into operations of banks. As a result, banks' performance might be negatively affected because provision of innovative services may cause banks to bear higher financial costs (Beccalli, 2007; Jalal- Karim & Hamdan, 2010; Thakor, 2020).

Generally, every activity of everyday life is somehow associated with technology in this modern age of digitization. Similarly, banking operations are going through similar phase. To succeed in these changing circumstances, banks must enhance their technological soundness (Siska, 2022). There exists competitive rivalry for market penetration between conventional and non-conventional banks argued by (Apriyanti, 2018). Consequently, for gaining competitive edge, banks must become technologically equipped enough to meet changing customers' needs through development of innovative banking products and services

Since, this study will be conducted in Pakistani context where both banking systems are operating namely conventional and non-conventional banks. The whole Pakistani banking sector including Islamic and non-Islamic banks will be taken as a population for the current study. Whereas, the selected sample of banks for this study consists of 4 Islamic banks namely Meezan Bank Limited, Dubai Islamic Bank Limited, Al Baraka Bank Limited and Bank Islamic Limited and conventional banks will be taken as a whole except microfinance banks, whereas data will be collected for the past five years ranging from 2018 to 2022. Thecurrent research will examine the influence of digital banking services on the performance of both conventional and non-conventional banks, where financial performance of banks acts as a dependent variable and FinTech as an independent variable.

Problem Statement

Earlier researches (e.g., Ky et al., 2019; El Chaarani & El Abiad, 2018; Bu et al., 2021) measured FinTech services by means of a single parameter, like automated teller machines (ATMs), investment in computer software, mobile banking and Internet banking. Moreover, earlier research studies were more focused on the theoretical aspect while paid less attention to the empirical aspect (Ali et al., 2019). Besides that, a recent conducted in Pakistan which is focused on the performance variations between Islamic and non-Islamic banks during the economic recession period ranging from 2020-2023 (Bhatti et al., 2023), while did not consider role of FinTech on the performance of both banking systems. By considering this fact, the researcher finds the potential gap to conduct study on the impact of FinTech on the financial performance of Pakistani banking sector. This study will be among the emerging studies to be conducted as an empirical FinTech based study on the financial performance Pakistani banking sector. Thus, this study aims to contribute towards the gap in the empirical literature related to the potential impact of FinTech on the performance of conventional banks and their counterparts in the context of Pakistan. The current research will also contribute to the existing literature by examining the variations between Islamic and non-Islamic banks with respect to the influence of FinTech services on the performance of both banking systems.

1. What is the impact of FinTech on the financial performance of Islamic Banks?
2. What is the impact of FinTech on the financial performance of conventional Banks?
3. Does FinTech similarly impact financial performance of Islamic and conventional banks?

Objectives of the study

4. To analyze the impact of FinTech on the financial performance of Islamic banks.
5. To analyze the impact of FinTech on the financial performance of conventional banks.
6. To compare the impact of FinTech on the financial performance of Islamic and conventional banks.

Significance of the Study

The outcomes of the current study will contribute updated theoretical information to the existing literature which will be useful for future research scholars to use such information as a reference material in their future research studies.

Besides that, the primary activity of banks is the provision of financial services to customers. In this modern era of digitalization, investment in technology could be the key priority of almost every bank because their aim is to provide effective digital services to their customers as well as to supersede their opponents in the competitive environment. The outcomes of this study will highlight the importance of retaining customers to banks with facts and figures and will suggest banks to undertake initiatives to retain their existing customers by customer oriented services as the customers' decision to stay or switch can rely on the convenient access to financial services. Furthermore, this study will also suggest the benefits of digital banking to the banking sector. The possible benefits of digital banking include meeting customers' changing requirements effectively, improving profitability of banks as banks deduct charges on transactions conducted through electronic channels. In addition to that, digital banking reduces overheads and service cost of banks by transforming banking practices to paper less environment (Rahimuddin, 2010). Moreover, the level of digital and financial literacy could be one of the key issues and potential opportunities for banks to avail by educating their customers who are unaware or who have little know how of using digital mode of banking. This type of initiatives will be vital for banks to grabthe untapped market and enlarge their customers' base by providing convenience to customers in accessing banking services via digital modes.

Literature Review

Previous studies

A study conducted by Li et al. (2017) which resulted that there is a positive association between the growing activities of FinTech and proceeds generated by stocks of banks. Wang et al. (2021) held a study on the likely impact of FinTech on banks' performance by taking a sample of 113 Chinese banks for a period ranging from 2009-2018. They found that FinTech development have positive influence on banks' risk management, earnings and financial innovation. Moreover, they suggested that performance of commercial banks can be enhanced with the adoption of FinTech. A study designed by Ntwiga (2020) where FinTech adoption and banks performance in terms of technical efficiency were analyzed by taking five banks' sample from Kenyan banking sector for a time span ranging from 2009-2018. A positive association has been revealed by the study between efficiency of banks and FinTech as large scale technical efficiency has been observed with the adoption of FinTech. Moreover, the study reflected that the time span before adoption of FinTech recorded low productivity and technical efficiency.

A research held in Lithuania by Pu et al. (2021) on the association between Fintech and Lithuanian banking industry based on SWOT and PESTEL analysis for a time span consisting of 2003-2019. They deducted results based on regression analysis which reflected that there is a positive affiliation between efficiency of banks and

FinTech services, especially in enhancing level of customer satisfaction and payment services. A study organized by Yang et al. (2017) in Taiwan banking industry to check whether productivity of banks have been influenced by adoption of FinTech. The study was grounded on a sample of twenty five banks taken from Taiwan banking industry for a period comprising of 2010-2015 by using the index of preferred Cost Malmquist. The outcomes reflected that adoption of FinTech has favorable influence on Taiwan's banking industry productivity. A study organized by Manjit Kaur Sidhu (2018) to investigate the correlation between internet banking and Indian banking industry. The outcomes of the study expressed a positive affiliation between internet banking and banks' performance in reference with Return on Assets (ROA) and Return on Equity (ROE). A study organized by Ky et al. (2019) on the impact of mobile money as one of FinTech's aspect on financial performance of banks during 2009-2015.The outcomes of their study demonstrated that there is a positive significant correlation between banks' performance and mobile money, particularly in terms of banks' productivity, stability and profitability.

A study organized by Necla Tunay et al. (2019) on affiliation between banks' performance and technological services in emerging and developed economies. The association between digital banking services and various cost and quality parameters including return on equity and total asset ratio overhead expenses were analyzed. The study resulted in positive correlation between banks' productivity and increased use of digital banking services. El Chaarani and El Abiad (2018) investigated the influence of FinTech services with reference to internet banking, latest softwares and ATMs on banks' performance inLebanon for a period comprising of 2010-2017. The results revealed positive association between banks performance and FinTech services with respect to ATMs and internet banking. According to the study conducted by Alber (2011) in Saudi Arabia for a period ranging from 1998-2007 resulted that there is a positive association between performance of banks and mobile banking. A study conducted by Onay et al.(2008) in turkey during a time span of 1996-2005, which revealed that there is a positive correlation between banks' performance and internet banking. The study of Alber, (2011); Jalal-Karim and Hamdan, (2010) explored the correlation of ATMs which is one aspect of technological services with banks' performance. The outcomes revealed a negative correlation between performance of banks and investment in ATMs. The research of Thakor (2020) resulted in negative correlation between performance of banks and FinTech as it leads banks to cost economies.

A research held in the banking industry of India on the association between profitability and information technology (IT) by using Panel Regression and Correlation models (Sangita Dutta Gupta et al., 2018). Their study outcomes resulted in inconsistency between information technology and profitability of bankswith respect to Return on Equity. A study designed by El Chaarani and El Abiad (2018) on the association between performance of banks and mobile banking. They found that there is a no significant influence of mobile banking on banks' performance. A study organized by Yudaruddin (2022) on the costand level of innovation in banking industry. The outcomes of the research reflected that the level of advancement in Islamic banking is lower than its counterparts. Moreover, Islamic banks face higher costs allied with advisory scholars on Shariah matters than conventional banks. According to Panjwani and Shili (2020) advancement level in terms of technology in conventional banks supersedes Islamic banks. Conventional banks supersede its counterparts in terms of responding level towards the adoption of FinTech (Ali et al., 2019).

Theoretical Framework

The theoretical underpinning of this research is grounded on consumer theory and Technology Acceptance Model (TAM) Model. Consumer theory explains the behavior of people by stating that new innovative services which fulfill their needs are preferred by them over old fashioned services (Aaker & Keller, 1990). In addition to that, TAM Model was designed by Devis in 1989 which states that how various users adopt new technology. Moreover, users consider various factors before adopting new technology (Ajzen&Fishbeai, 1980; Fishben&Ajzen, 1975). TAM explains that two factors are mainly considered by users before adopting new technology which are perceived usefulness and perceived ease of use (Devis, 1989).

Since, FinTech services almost fulfill all the customers' requirements by using internet banking which they can avail in physical setup of a bank. So, banks whether Islamic or conventional which are promoting innovative services could be highly preferable by customers because of convenient access to a full menu of banking services 24/7 through computers and mobile phones as compare to the ones with old fashioned services, which ultimately influence banks financial performance.

Conceptual Framework

Independent Variables   **Dependent Variables**
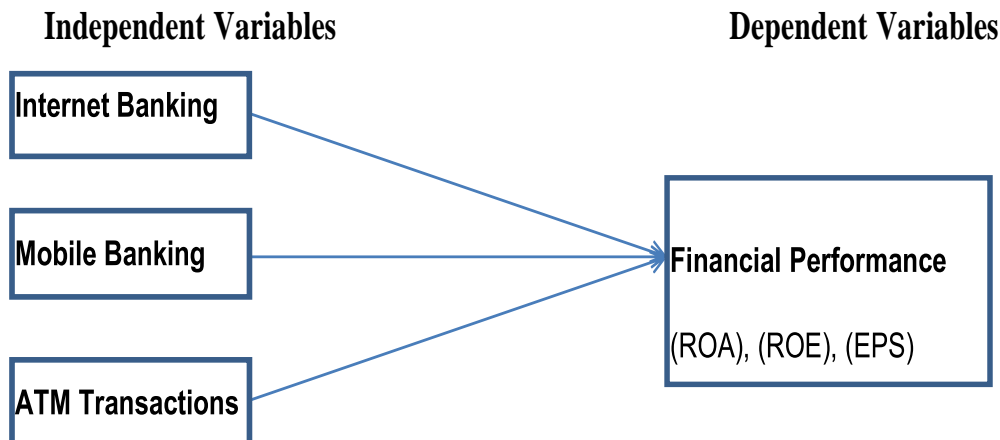
Hypotheses of the study

H1: FinTech has positive significant impact on the financial performance of Islamic banks.

H2: FinTech has positive significant impact on the financial performance of conventional banks.

H3: FinTech has more positive significant impact on the financial performance of Islamic banksas compare to conventional banks.

H4: FinTech has more positive significant impact on the financial performance of conventional banks as compare to Islamic banks.

Research Methodology

The sample of this study includes a panel of all the commercial Pakistani banks excluding microfinance banks: four of which are Islamic banks while the rest are non- Islamic banks. Islamic banks include Meezan Bank Limited, Bank Islami limited, Dubai Islamic Bank limited and Al-Baraka Bank Limited; while non-Islamic banks include Habib Bank Limited, National Bank of Pakistan, United Bank Limited, Muslim Commercial Bank Limited, Allied Bank Limited, Bank Al-Habib Limited, Bank Alfalah Limited,Askari Bank Limited, Bank of Khyber, Bank of Punjab, Faysal Bank Limited, First Women Bank Limited, Habib Metropolitan Bank Limited, JS Bank Limited, Samba Bank Limited, Silk Bank Limited, Sindh Bank Limited, Soneri Bank Limited, Standard Chartered Bank Limited and Summit Bank Limited. The samples of both Islamic and non-Islamic banks are taken as a whole except microfinance banks for the current study until the end of 2022.

Nature of the study

The current research is grounded on secondary panel data because of its quantitative nature.

Philosophy of the study

The researcher will use positivist approach as per the nature of the study, where results will be deducted from the available secondary data of both the banking systems.

Population of the study

Primarily the present study is going to be undertaken in the context of Pakistani banking sector including both Islamic and non-Islamic banks.

Sample & Sampling Procedure

The current study's sample consists of registered Pakistani commercial banks, which is comprised of 4 Islamic banks and 20 non-Islamic banks for a time span of 5 years from 2018-2022.

Data Collection Method

The current research is grounded on secondary panel data as per its quantitative nature. Therefore, data will be taken from the yearly reports of the concerned banks andfrom State Bank of Pakistan website.

Measurement of Variables

The study involves dependent and independent variables. Dependent variable of the current study is the banks' financial performance which will be measured with reference to profitability ratios namely Return on Assets (ROA), Return on Equity (ROE) and Earnings per share (EPS), while the independent variable is financial technology (Fintech) which will be measured in terms of transactions conducted through internet banking, mobile banking and ATM transactions.

Period of the Study

The time period of the present research comprised of previous five years ranging from 2018-2022. In this period of time, the trend of FinTech particularly in banking sector got significant attention due to covid- 19 pandemic.

Statistical Tool

The influence of FinTech on profitability of banks will be examined by using quantitative methods. A technique of Linear Model (panel data regression) will be undertaken for deduction of empirical results and (t-test) will be used to compare conventional and Islamic banks based on their financial performance.

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Risks Identification between the Production Department and Warehouse/Store

Nabeel Haider and Sikandar Bilal Khattak
University of Engineering and Technology, Peshawar, Khyber Pakhtunkhwa, Pakistan

Abstract

In a manufacturing environment, the warehouse is critical in ensuring seamless operations. Industries have automated the interaction through different digital means. However, persistent warehouse and production department issues lead to different quantitative and qualitative risks. These diverse risks can be systematically mitigated once they are identified and quantified. This research investigates and analyzes the risks of receiving and distributing products between storage facilities/warehouses and production departments in a Pakistani manufacturing environment. The research emphasizes preventive and predictive approaches. Supply chain and productive objectives can only be achieved through efficient coordination and collaboration among organizational functions and key processes. The research employs a literature review and questionnaire for data collection. Results include identifying different types of risks primarily associated with warehouse and production interaction. The results lead to recommendations for process improvements. The approach significantly enhances productivity, reduces waste, and improves customer satisfaction.
Keywords: Supply Chain Management, Warehouse Operations, Risk Analysis, Process Improvement, EfficiencyEnhancement.

Introduction

The management of warehouses is a crucial link in the supply chain. The warehouse's continued operation depends on the timely and accurate arrival of the items, which is essential to the entire storage process. Mistakes committed at this stage impact the supply chain and succeeding phases. This research will identify and analyze risks in receiving and distributing products at production from storage facilities and vice versa. Preventive measures for risks of receiving products in the warehouse process are also necessary (Kulińska and Giera 2019).

Effective coordination and strong collaboration among processes and entities play a role in achieving the objectives of supply chain management. The advancements in information technology (IT) have significantly magnified the impact of knowledge sharing on the development and success of supply chains (Tubis and Rohman 2023).

The supply chain cannot function without proper warehouse management. Today, companies are looking for innovative strategies to boost performance by manufacturing quality goods at a significantly higher pace and cheaper costs. Most companies assess performance by considering productivity, cost-effectiveness, quality standards, adaptability, schedule adherence, safety measures, social impact, environmental responsibility, and product lifespan (Hanafiah et al. 2022).

By delivering both items and services alongside them, manufacturers are moving away from the conventional product-centric paradigm toward a service-centric one. Product-Service Systems (PSSs) are the name given to this paradigm. Customization of PSSs comprises two intertwined procedures: service customization and product customization. Customizing products to fit the requirements of various clients entails configuring products with variable degrees of distinctiveness. On the side, service customization refers to enhancing personalized products by incorporating sensors or communication devices that are part of the Internet of Things (IoT) (Esheiba et al. 2022).

Inventory handling is a core process in the supply chain, and its management plays a crucial role in ensuring smooth goods flow. Thus, utilizing digital technologies for real-time information exchange, particularly inventory levels which becomes pivotal. As a result, Industry 4.0 innovations have swiftly penetrated

internal logistics, creating intelligent warehouses, commonly called Warehouse 4.0 (Tubis and Rohman 2023).

In the modern age of industrial economics, warehousing has become a convoluted operation with myriad components and is obliged to contribute actively to the triumph of supply chain management. Consequently, managing warehouse risks is a pivotal matter of dispute to guarantee sustainability within global supply chain procedures to accommodate commendable productivity outcomes. Hence, this investigation strives to scrutinize risk factors that impact warehouse productivity outcomes, aiming to methodically identify essential factors that managers should focus on to perpetuate and enhance warehouse productivity (Hanafiah et al. 2022).

A framework is developed to improve the efficiency of warehousing operations by reducing waste through Lean Six Sigma (LSS) techniques. The results showed an increase in warehouse productivity estimated at 76.9%. This improvement was achieved by implementing tools such as Value Stream Mapping (VSM) Kaizen and other warehouse optimization strategies. Another study focuses on a company in Nigeria and third-party logistics for enhancing productivity using a case study approach to improve productivity by assessing warehouse processes. It allowed for real-time data collection and qualitative analyses through observation (Adeodu et al. 2023).

(Kalisa and Korytárová 2023) implored strategies to mitigate risks within warehouses and production areas. It also includes a cost-benefit analysis and social impact assessment, environmental risk management, identification techniques, assessment approaches, and eliminating measures. It also highlights the importance of surveillance and control in dealing with this step.

(Hanafiah et al. 2022) findings present ten categories and 32 factors associated with warehouse operations, seven categories: human, market, resource, financial, security, and regulatory poses the greatest threats affecting warehouse efficiency. The above study developed a risk matrix model using a combination of a risk-matrix framework, the Board method, and the Analytical Hierarchy Process (AHP) technique.

With a Warehouse Management System (WMS) supply chain managers can track inventory at any point. It enables users to monitor stocks, minimizing the possibility of running dry and thus increasing effectiveness. Through grey DEMATEL and a literature review, the factors associated with digitalization can be identified (Zaman et al. 2023).

(Sooriyakumar et al. 2023) uses a data warehouse-based recommendation system. It helps the customers to choose what type of sensor should be installed at what point for the proper detection. This system collects data concerning product-usage incidents concerning some items customers want to incorporate. To attain this, a quality table is used in the QFD methodology to include "manufacturers required quality for usage" and "user quality expectation".

Methodology

The research methodology starts with an exhaustive literature review for in-depth comprehension of the subject. The statement also leads to a clear problem statement that forms the research's direction and question. Moreover, intensive investigation of literature and field visits take place where other data sources are explored through interviews. After that, the associated factors, issues, and possible challenges are highlighted. A questionnaire is designed, which is relevant, and precise. A pilot study is carried out to test the efficiency of the questionnaire before its dissemination. After being tested, the questionnaire is administered to random people from different industrial backgrounds to confirm its validity. The study ends with results, a discussion of implications, a comparison with the existing literature, a summary of the key findings, a conclusion based on the available evidence, and suggestions for further work/applications. Figure 1 shows the overall methodology adopted for this research.
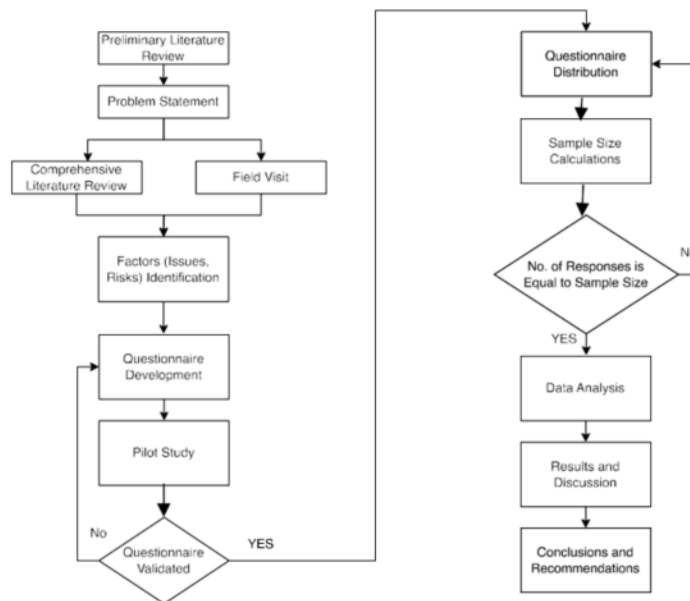
Figure 1: Methodology phasesData Collection and Analysis

In this regard, embarking on a thorough analysis took us through an integrated approach where qualitative and quantitative methods worked hand in hand based on data collected from a diverse sample of 100 people within the industries after conducting site visits and distributing questionnaires. This was progressed over different phases, grouping the answers regarding Warehouse and Store obstacles and production obstacles. Each of these challenges constituted its story waiting for discovery, from disorganized warehousing to communication gaps, storage dilemmas, and possible environment degradation risks connected with raw material sources. On the other hand, Production Challenges echoed with delays, quality control problems, combining of production and store stock, and issues related to the delivery of raw materials. Table 1 lists the different issues highlighted by the respondents.

Table.1: List of identified issues

| Issues No. | Questions | | |
	List the issue faced while interacting for Raw materials with the store/warehouse	List the issue faced while interacting for spares with the store/warehouse.	List the issue faced while interacting for Finish goods with the store/warehouse.
1	Communication gap	Incorrect documentation	Hand covering issue
2	Quality Problems	Quality issue	Storage conditions
3	Stock shortage	Inaccurate inventory record	Order delays
4	Tagging issue	Poorly organized warehouse	Inventory inaccuracies
5	Safety stock issue	Order delays	Counting issue
6	Storage issue	Unavailability of parts	Labeling
7	Transportation issue	Parts Identification	Product tracking
8	Unavailability of parts	Safety stock issue	Stock variation
9		Under specification	Lead times

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The complex inquiry transformed into a thematic analysis, which was not just about seeking out patterns but about feeling the heartbeat of these hurdles. Upon close examination of particular aspects within comments, vital issues that could be utilized for future are discovered. In that regard, quantitative analysis combined the strengths of descriptive statistics by using percentages and averages to measure how often these challenges are observed. These influencing factors originated from a thorough genesis of thought through questionnaires, which were answered intelligently. The results go straight towards more efficient production, optimized warehousing, and increased operational excellence. It captures the underlying fabric that connects warehouses and factories to the pulsating arteries of commerce.

Table 2: Stock shortage frequency

Year	Frequency
2019	15
2020	12
2021	10
2022	8

In Table 2, a quantitative analysis is conducted to examine the frequency of stock shortages over the past few years. This data is obtained through questionnaires distributed to various experts in the industries. By collecting and analyzing numerical data, it gains insights into the occurrences of stock shortages. This quantitative approach allowed us to identify patterns, trends, and potential areas for improvement in inventory management.

Table 3 focused on analyzing the quantity difference in bulk stock issuance over the past few years. By examining the collected data, it becomes evident that there has been a gradual decrease in the quantity difference from 2019 to 2022, indicating improved accuracy and efficiency. These findings provide valuable insights for optimizing stock control, enhancing operation efficiency, and identifying areas for improvements

Table 3: Quantity difference in Bulk Stock Issuance

Year	Quantity Difference
2019	100 units
2020	75 units
2021	90 units
2022	85 units

Results and Discussion

Field visits and expert inputs helped in identifying significant issues related to warehouse and store management, spare parts handling, and everyday operations that must be addressed. In other words, it is akin to unveiling obstacles that makeup impediments in industries. Handling returns becomes a balancing act of logistics and customer satisfaction management. Communication gaps are as stealthy as barriers and difficult for smooth task coordination.

Silent inventory mix-ups often sabotage well-arranged operations. The factory runs into production halts that range from schedule delays impeding the flow of materials, parts, and equipment in strive for perfection. Every warehousing or storage has its issues: disordered raw materials movement lead to supply chain disorder. Spare parts management added twist, as looking for appropriate part in an unorganized warehouse increases machine downtime.

The operational area has its common challenges, including quality setbacks, mix-ups of stocks, and vendor relationships together with purchase orders. These are not just about highlighting issues; they aredirectional markers to change. They give perspectives on the difficulties and the approaches through which issues can be run more smoothly within complex operational environments.

Conclusion

The study identifies, and attempts to mitigate the issues within the production and warehouse. This

research aims to maximize the use of available resources within their limitations, increase inventory effectiveness, simplify processes, and reduce ineffective expenditure. Improving resource utilization reducing stockout and excess inventory through target process improvement. In addition, staff training, development, and an improved communication system cut lead time and ensure high delivery performance. This will enhance the competitiveness as well as customer satisfaction.

It also entails an in-depth assessment of the production and warehouse departments and formulation of measures for solving identified issues. Process changes will apply, training and development opportunities will be provided, and practical implementation evaluation will be conducted. Successful execution will lead to tangible results like better resource use, efficient processes, and superior deliveries outlay.
Essentially, these results will be instrumental in enhancing organizational growth and success in the long run.

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Sustainable Ecosystem Services and Valuation of Artificial Forest

Arbab Khushal khan and Sikandar Bilal Khattak

University of Engineering and Technology, Peshawar, Khyber Pakhtunkhwa, Pakistan

Abstract

Forests provide various services for human society and the environment. Interaction with nature significantly influences the ability to deal with problems like biodiversity loss and climate change. Scientific interest in ecosystem services and human well-being has grown to indicate its essential role in affecting sustainability. There is always a demand for forest resources and ecosystem services, even in times of financial crisis or conflict. However, due to the growing demand for furniture and medium-density fiberboard (MDF) industries, the demand for wood logs cannot be satisfied through natural forests. Such huge demand is satisfied through artificial forests. These artificial forests take 6-7 years, which causes cashflow problems for small farmers. Recent studies show that artificial forests can also be a source of seasonal crops. This study focuses on the district of Charsadda, Khyber Pakhtunkhwa, where artificial forests are in demand. The data regarding the latest trends in artificial forests is collected from a literature review and is coupled with field visits. The available data is scrutinized through different tools. The results provide valuable insights into combining different seasonal products, which can be used in Artificial forests.

Keywords: Artificial Forest, Sustainability, Ecosystem, Forest, Seasonal Products

Introduction

Forests are an essential part of life for various kinds of ecosystem services (ES). It offers unprocessed timber, non-timber goods like resin and medicinal plants, and wild foods like berries, mushrooms, and honey. Additionally, forests control local and global climate, boost biodiversity, increase soil retention and water quality, facilitate pollination, create barriers against natural dangers, and provide recreational and aesthetic benefits in peri-urban and rural areas(Doimo et al., 2020).

 Scientific interest in ecosystem services and human well-being has grown to indicate its essential role in affecting sustainability. However, limit quantitative and illustrative literature on environmental benefits and human well-being exists. Historical development, scientific collaboration, research hotspots, and emerging trends are critical in reviewing the research on ecosystem services and human well-being at an international level. Poverty alleviation, cultural ecosystem service, perception, and green infrastructure are among the most active challenges. The utilization of integrated research on sociocultural and biophysical factors is expected to support policymaking more and more in the future (Wang et al., 2011).

Today, it is widely agreed upon that climate change is a serious issue that results from human-caused greenhouse gas emissions(Kumar, Ranjan and Verma, 2021). Due to the significant effects, specifically extreme weather occurrences, urgent actions are required. Although forests are effective carbon sinks, it is essential to determine how long carbon will remain there because it depends on how the forests are managed.

Pakistan has a deficiency of forests due to its primarily arid and semi-arid climate. Only 4.8 percent of the country's 88 million hectares were covered under natural forests, while 0.12 percent was made up of irrigated plantations, and 32.4 percent was made up of rangelands Saeed, E., & Bhatti, I. (2011). 67 percent rise in forest cover on farmlands despite an annual decrease in the size of natural forests and state-owned plantations. In Pakistan, woods comprise about 5.2 percent of the country's total land area, roughly 87.98 million hectares. With a population of 130.6 million in 1998 and a 2.6% annual growth rate, 33 percent lived in urban areas. When indirect gains are excluded, the forestry sector's contribution to the GNP is 0.3 percent. With 3.5 million cubic meters of annual wood production, domestic industrial demand is satisfied, and jobs are created for over 500,000 people. Forests and rangelands supported forage for 90 million livestock, while the GNP per capita stood at US$450, with an annual GDP growth rate of 3.6 percent (Saeed & Bhatti, 2011).

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Literature Review

More intelligent and practical agricultural farming approaches are required to meet the demands for food and reduce the concerns of declining land use for agriculture. Everyone must know the need for sustainable agriculture to preserve food security. The advancement of new technologies to boost crop yields and promote farming as a respectable profession. Various agricultural technologies, especially the Internet Of Things (IoT),can be used to make agriculture more thoughtful and productive to fulfill future requirements (Dhanaraju et al., 2022)

Forest-based projects generally provide a "health bonus" compared to other efforts conducted in urban settings. In this regard, easily accessible urban and peri-urban wooded areas, such as urban forests, have a meaningful impact on the sustainable development of cities by increasing resilience to climate change, as well as by offering a good setting for energizing the sedentary population, reducing stress, and enhancing general wellbeing. However, bridging knowledge gaps and taking the methodological and data limitations of the available studies is essential (Doimo et al., 2020).

It is well known how forests regulate ecosystem services like clean water, soil protection, and climate regulation, which protect agricultural production(Seidl et al., 2019). However, less is known about how forests and trees meet the rising population's nutritional needs. Consumer trends show a rise in interest in forested food collection, which involves new, culturally solid connections with the natural world and biological processes. Furthermore, growing calls to "re-orient" agricultural production offer opportunities to increase the contributions of forests to food production and reform food systems by including trees and forests (Jansen et al., 2020).

By focusing on the Charsadda district in Khyber Pakhtunkhwa, the research gains a more refined knowledge of regional dynamics through selecting a geographical focus. Through thorough literature reviews and careful on-site field examinations, an information web about complicated interactions of elements, drivers, and trends in artificial forests is captured. The possible integration of different seasonal products inside artificial forests further enhances the dependability and depth of the outcomes. It gives a thorough picture of the district's changing landscape. An all-encompassing strategy seeks to improve ecosystem services and promote sustainable forest management in the local context and the larger conversation.

Methodology

The research methodology begins with a a literature review fostering broad exploration and understanding of the research area. It helped us identify issues, seasonal products and classified crops that can be cultivated for periodic income in an artificial forest. The next step is the identification of product parameters such as (soil, moisture, weight, size, etc.). It is done through field visits. After a suitable site selected for data collection. The data, which includes both quantitative and qualitative data, is collected.

Once an appropriate research site is selected, semi-structured interviews were used to obtain feedback from local farmers and people about artificial forests and large-scale farming. The questions aimed to obtain perspectives from people with actual agricultural expertise. This method guarantees a strong foundation for the research's providing an in- depth examination of the selected site.

The findings and the consequences off different farming techniques are compared and summarized. It also provides an insight into how the study output contributes to the eco-services.
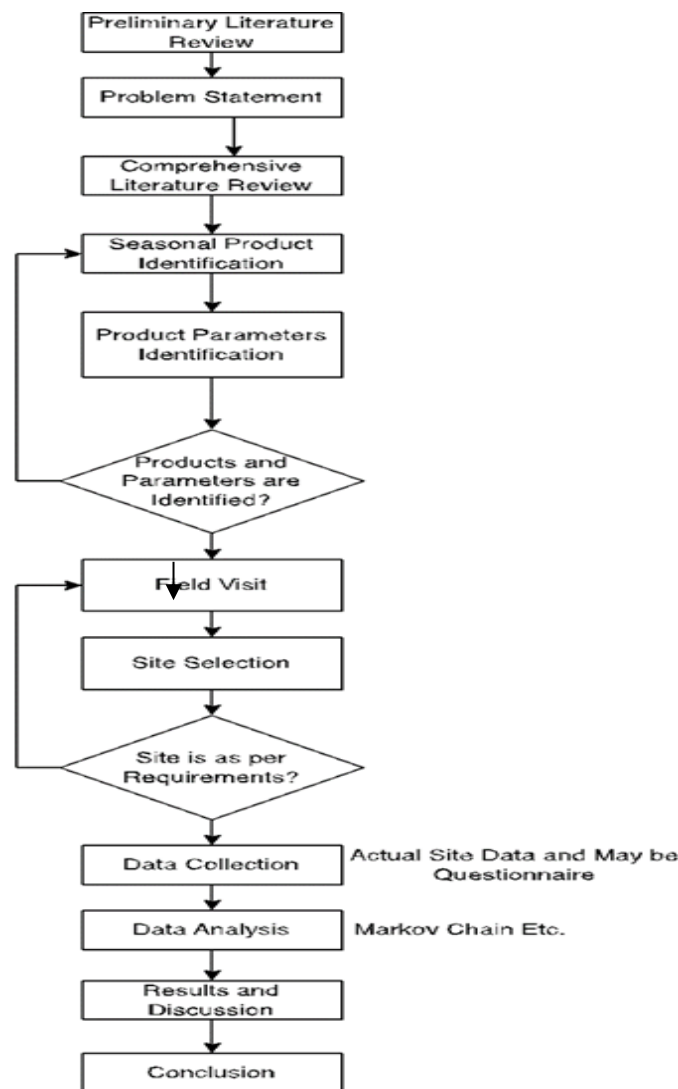
Figure 1: Methodology phases

Data Collection and Analysis

The data in this article relates to planting of Populus deltoides trees in an artificial forest. Populus deltoides are renowned for growing fast; Unlike typical Populus trees, it takes about 5–6 years to mature. Further information about the related expenses and earnings including labor costs, cultivation costs, and other economic factors—is given in (Table 1). The data presented here is the outcome of the field.

As shown in Table 1, one thousand stems are needed.

One hundred stems cost a total of 3,000. Thus 1,000 stems will cost thirty thousand 30000 rupees altogether.

Two people dug out one acre in 5 using a drill machine.

800 PKR is the daily worker wage for each individual.

15 rupees per hole would make 15000

The total labor cost includes 15,000Rs for hole digging and 8,000Rs for wages.

The cost of the tractor machinery is 12,000Rs for two days of leveling.

The total cost mentioned above represents the cost of developing an artificial forest.

2000 per hour for the tractor 12000 rupees for 6 hours.

The yearly cost of taking care would be 15000 per year

for 5 years it will be 75 thousand rupees

The projected profit after six years, following a successful five-year cultivation phase with 600 trees, is 1500000 per acre.

Table 1: Field visit data for artificial forest

Cost of forest stems	Labor cost	Equipment cost	cost for watering, cleaning pesticides etc. by labors per year	Profit After 5 years
30000	23000	12000	50000	1500000

Although Table 1 shows a high profit, this profit takes five years of patience. Whereas small-scale farmers need regular income for daily expenses. Data also taken from a field visit to cultivate ginger and turmeric in an artificial forest. The associated and consideration are as follows

Now for the cultivation of ginger and turmeric in a artificial forest data was also taken from a field visit the associated cost and considerations are as follows

The expense on seed for 1 acre was 40000 rupees

A workforce of 10 individuals is required

The daily wage per labor is 800 rupees.

The total labor cost is 8000 rupees

The tractor is utilized for about 3 hours

The cost for it is 6000 rupees

Pesticides expenses include

One bag of dp (12000Rupees), 1 unit of urea (2000Rupees), 1 unit of zinc(2000Rupees), 1 unit of potassium(2000Rupees)

Total cost of this would be 18000 rupees

Care after harvesting involves processes like cutting extra grass etc.

A workforce of 20 men is required sometimes for maintaining its field 20*800= 16000Rupees

A study suggests that good production can give significant returns:

For turmeric, the investigation indicates a potential output of 8 to 10 tons per acre annually generating a return of 200000-300000 per year if managed efficiently.

Similarly, a production of 8 to 10 tones is achieved for ginger, contributing to the overall income

The information gathered for the study focuses on developments in artificial forestry, explicitly researching the possibility of growing short-term products to increase earnings from both farming and forests. The study analyzes the wide range of crops that can be grown in artificial forests to find opportunities that suit the area's natural characteristics. Data related to economic factors is also collected. A list of other factors is compiled after field visits and analysis by analyzing the relative economic viability of different crops concerning soil characteristics. The things that can be grown in an artificial forest

1. Ginger
2. Turmeric
3. Canola
4. Reddish
5. Spinach
6. Cauliflower
7. Sugarcane
8. Sorghum
9. nypergrass

These are the seasonal products that we can get from inside of artificial forest if we try on it to increase their income and for the betterment of the local community.

Results and Discussion

The information gathered for the study focuses on developments in artificial forestry, explicitly researching the possibility of growing short-term products to increase earnings from both farming and forests. The study analyzes the wide range of crops that can be grown in artificial forests to find opportunities that suit the area's natural characteristics. Data related to economic factors is also collected. A list of other factors is compiled after field visits and analysis by analyzing the relative economic viability of different crops concerning soil characteristics.

The things that can be grown in an artificial forest
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It is important to closely track innovations to keep pushing the efficient production of artificial forests forward. These improvements are essential for optimizing land usage because also ensure that all the land is utilized to its full potential. The goal is to enable farmers to get the most of land while simultaneously improving income. Staying informed of recent advances in artificial forestry methods across developing nations help acquire a significant understanding of ethical methods that maintain a balance between preserving the environment and economic benefits. This approach allows innovation and sensible land use to work together, ultimately providing farmers significant returns while achieving the larger goal of sustainable agriculture development.

The contemporary innovations integrated into artificial forests are.
1. G*E Analysis
2. BLUPP-GGE method
3. Compost leachate method
4. Cloning of the right seed
5. Carbon sponge technique
6. Thinning, lining, spacing
7. Stem cutting

Long term financial analysis shows that artificial forestry methods have the potential to provide a sustainable source of income

Analyzing farmers revenues from artificial forests provides significant information expected cashflow. The gathered data about artificial forests and seasonal products is carefully examined. The farmers whose yearly income is affected due to artificial forestry will have an yearly income, empowering them socio-economically

The findings imply that seasonal products can generate extra and periodic revenue for artificial forest farmers. The findings firms that rely upon forest products can benefit from matching the seasonal changes of artificial forests with innovative operations. Improving operational efficiency and preventing delays can be achieved by changing production schedules. Introducing seasonal crops can offer extra revenue sources, diversifying the activities further and promoting long term viability.

Conclusion

An essential element of sustainable land use and financial growth in artificial forests is choosing the most profitable product combination. The data analysis conducted in this study gives a better understanding of the complicated interactions between an array of elements such as growth cycles, market demands, and soil conditions, that impact profitable forests and crops. This information is vital for helping farmers and owners enhance the balance of goods that maximizes overall financial rewards while satisfying market demands.

This research highlights the vital function of forests in providing various benefits to people and the environment, as well as how important they are in resolving global issues like climate change and biodiversity loss. The study highlights the ongoing demand for ecosystem services and forest resources despite financial crises in political instability requiring creative and long-term solutions. The exploration of artificial forests shows potential as a dual-purpose concept that could provide essential seasonal crops and wood to fulfill the needs**.**

This research enhances a comprehensive understanding of the evolving landscape by combining in-depth literature studies and extensive on field visits.

The study is crucial because it emphasizes the importance of innovative farming in developing nations that aim to optimize land use and improve sustainable agriculture growth. In addition to resolving the challenges facing the Charsadda district, this study adds to the broader discussion on a balance between safeguarding the environment and financial prosperity to create a more sustainable future.

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Consumer Willingness To Pay For Improved Drinking Water In District Buner

Shahid Ali[1], Abdul Ghani[2], Imran Ullah[1], Fasih Ahmad Khan[3] and Zeeshan Ali[4]

[1]Department of Economics University of Buner, Pakistan
[2]School of Civil Engineering, Wuhan University of Technology, China
[3]Department of Civil Engineering, University of Engineering and Technology, Peshawar
[4]National Institute of Transportation, National University of Science and Technology, Pakistan

Abstract

This study investigates households' willingness to pay for better water systems, clean water availability, and water quality in Gadaizi tehsil, District Buner, Pakistan. This research aims to shed light on various aspects of water quality, health impacts, and socioeconomic factors influencing households' ability to pay for superior water services. This research will also look into waterborne infection and water purification methods residents utilize to mitigate the risk of water pollution. Utilizing a mixed-method approach with a structured questionnaire, data from 62 households were collected. SPSS was used for data analysis. Findings reveal awareness of water contamination issues, primarily attributed to marble industries. Most households use untreated water, employing boiling, chemicals, or candle filters. Water purification methods are influenced by media exposure and higher income. Common waterborne diseases, such as typhoid and diarrhea, are treated in private hospitals. Consumer willingness to pay for better water systems depends on income, education, and media exposure, although 76% of households do not use any water purification method. 84% of households are willing to adopt a private sector-provided system. Overall, the study highlights the necessity for public health initiatives and a thorough understanding of socioeconomic issues to guide political choices for better water delivery.

Keywords: Household Income, Source of Water, Water Quality, Willingness to Pay, Waterborne Diseases

Introduction

Clean drinking water is essential for human survival, healthcare, and poverty alleviation (Jain 2012). Inadequate access to clean water not only results in a higher incidence of illnesses and deaths but also leads to elevated healthcare costs and reduced productivity (Hutton and Chase 2016). Almost half of fatalities occur from the consumption of microbiologically contaminated water in Sub-Saharan Africa (Burt et al. 2017). (Ahmad and Sattar 2010) discussed limited water availability leads to heightened rates of sickness, mortality, increased healthcare expenditures, decreased productivity, reduced enrollment in education, and aggravation of poverty. Given its association with severe diseases in less developed regions, access to clean water is crucial in reducing poverty and providing essential healthcare. Furthermore, the World Health Organization (WHO) estimates that polluted drinking water leads to the demise of 485,000 people annually. It is crucial to recognize that an individual's utilization of water at a specific location and time affects other people's access to water and other resources at different locations in subsequent periods (Ward 2009).

In a study conducted by (Ezeh et al. 2014) it was discussed approximately 11.9% of Pakistan's population, equivalent to 20,447,628 individuals, comprises children under the age of five. In Pakistan, inadequate water and sanitation conditions contribute to an annual toll of 97,900 fatalities, with children under five accounting for 54,000 deaths. Furthermore, there was once a perception that water was abundant and easily accessible, although the intrinsic value of water remains debatable (Ward and Michelsen 2002). As a result of swift economic and demographic expansion, water resources have become scarce and polluted. Per capita water availability has declined globally, particularly in Pakistan (Nabi et al. 2019). In 1951, Pakistan had approximately 5000 cubic meters per capita, but by 2005, it had dropped to 1100 cubic meters, just above the recognized inadequacy threshold. Without intervention by 2025, this figure could plummet below 700 cubic meters (WWF Pakistan 2007). The problem is further aggravated due to utilization for industrial applications, agriculture, and the support of our livelihoods; water availability is diminishing rapidly
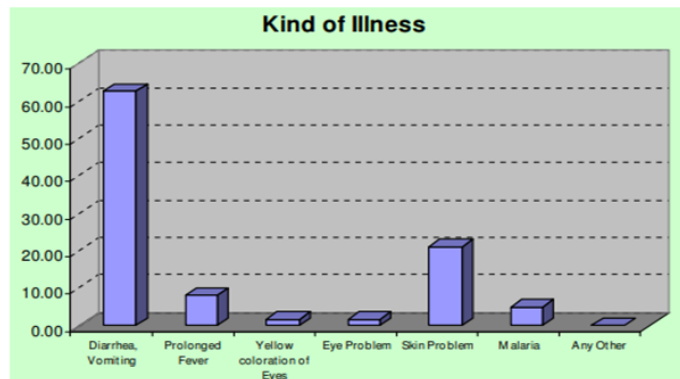
Figure 1. Kind of illness due to contaminated water in Pakistan in 2011

(Orobello and Cirella 2021). Figure 1 shows the illnesses people had during the interview in 2011. (Qureshi, Khan, and Vehra 2011) specified that diarrhea and vomiting were the most prevalent, affecting 62.67% of patients. Skin disorders followed, with a prevalence incidence of 21%. A few people had prolonged fevers, malaria, yellowing of the eyes, and other problems, namely 8, 5, 1,67, and 1.67% of the population

Figure 2 shows the Milky River or Milky Streams in District Buner and focuses on a specific waste material originating in Pakistan, namely waste marble powder (WMP), a byproduct from cutting marble stones within marble factories. Unfortunately, this process harms the environment. Marble particles transported by rivers and streams include calcium carbonate, which the earth eventually absorbs. People who rely on groundwater within a kilometer of these water bodies face a potential threat of developing kidney stones. Consequently, areas near marble factories experience heightened concerns about kidney stone problems (Ghani et al. 2020).

Figure 2. Milky River or Milky Streams of district Buner

In such cases, Descriptive Statistics can be used to (a) elicit people's preferences and (b) estimate their willingness to pay (WTP). The key objective of the current study is to focus on issues and factors affecting WTP in different scenarios. The study's null hypothesis asserts that education, media exposure, and income do not affect willingness to pay for better drinking water. The study's alternate hypothesis proposes that education, media exposure, and income affect willingness to pay for better drinking water. The economic cost of industrial water pollution in rural areas includes the adverse effects on agricultural output, public health, and livestock (Reddy and Behera 2006). Agricultural water pollution is a widespread global issue predicted to worsen as the world's population grows, food demand rises, and eating habits move toward increased protein consumption (Evans et al. 2019). Pesticide use causes water pollution, adversely affecting health outcomes (Lai 2017). About 90 million illnesses arise from 4 billion yearly recreational water activities, with costs ranging from $2.2 billion to $3.7 billion. Roughly 65% of this impact comes from moderate illnesses, costing $1.4 billion to $2.4 billion. Severe illnesses causing hospitalization or death comprise just 8% of the burden, totaling $108 million to $614 million (DeFlorio-Barker et al. 2018). (Raje, Dhobe, and Deshpande 2002) conducted a study in India which used the logistic regression model and stated that various factors influence consumer willingness to pay for municipal-supplied water. (Vásquez and Franceschi 2013) examined that contingent valuation survey was designed to determine how much individuals are willing to pay for access to secure and dependable drinking water in León, Nicaragua. (Pathak 2015) discussed that access to clean water is essential, but polluted water leads to waterborne illnesses, causing economic burdens.

(Ali et al. 2021) conducted a study in which they specified peri-urban households spend more (PKR 1725) on healthcare than urban ones (PKR 1094). In peri-urban and urban areas, expenses range from zero to (PKR 11,100) and (PKR 14,900). 50% to 90% of urban and peri-urban residents are willing to pay 100 to 1000 Pakistani rupees for safe drinking water. (Vásquez et al. 2009) explored households' readiness to pay for safe drinking water in Parral, Mexico. Current water delivery methods lead to strategies like bottled water use and

home treatment. These behaviors highlight a desire for safer water backed by survey data and his study confirms a substantial sensitivity in willingness to pay for water services. In a study by (Soto Montes De Oca and Bateman 2006), families are willing to pay 1.8% to 7.55% of their income, along with existing water bills, for reliable and secure drinking water. (Mulk et al. 2015) specified that spring water in the Buner region is safe to drink per WHO standards. However, it was found contaminated when distributed through pipes, possibly due to leaks and storage in unclean containers. This situation is worrying as local authorities should maximize the use of these resources for safe access. Bottling and selling Buner's spring water and water from Khyber Pakhtunkhwa could aid health in Pakistan's major cities. Insufficient water and sanitation services have diverse direct and indirect impacts. Human and animal waste contaminate groundwater. Poor sanitation causes harmful microorganisms to accumulate in vital food sources, polluting coastal ecosystems. The environment's declining aesthetics harm tourism. Around 35,000 incidents were reported from 2010 to 2012 (Asian Development Bank 2014).

Methodology

Buner is a rural area in the Khyber Pakhtunkhwa province of Pakistan, facing water contamination issues attributed to the disposal of waste materials from marble industries. Despite numerous studies on consumers' willingness to pay for improved water infrastructure, the situation in Buner continues to deteriorate. District Buner, particularly Gadaizi, is significantly affected by water contamination resulting from the extensive marble industry in the region. However, there has been a notable absence of research specifically focusing on Gadaizi. This study aims to fill this gap by investigating the residents' willingness to pay for enhanced water infrastructure. Employing an empirical research methodology, the current study derives its results from primary data. Both quantitative and qualitative approaches were utilized to gather household data on the residents' willingness to invest in better water systems. The research focuses on Gadaizi, and primary data was collected through structured interviews using questionnaires. The data for this research was collected using convenience sampling (Kam, Wilking, and Zechmeister 2007). A significant population in Gadaizi tehsil was conveniently selected from various villages for the study. Personal interviews and questionnaires were employed to gather data from 62 respondents. The research is based on a convenience sampling technique, emphasizing a quantitative approach to assessing willingness to pay for improved water systems. The study surveyed 62 households, having a total of 752 individuals.

Data Analysis

The information for this study was gathered in the district Buner tehsil Gadaizi (Khyber Pakhtunkhwa, Pakistan). The Convenience sampling technique is used to collect the information from 62 households, which consist of 752 household members. Four village councils are selected for data collection of the tehsil Gadaizi.

Table 1 Sample profiles

Village	Number of HHs	HH Members	Average HH Size
Girarai	15	223	14.87
Jowar	19	252	13.26
Bazargai	15	157	10.47
Bampokha	13	120	9.23
Total	62	752	11.96

Table 1 shows the sample profile of village councils, where four village councils of Gadaizi tehsil were selected; 62 households were selected for this study. The selected village councils of Girarai and Bazargai households had 223 and 157 members, respectively, while Jowar and Bampokha had 252 and 123 members, respectively. The average household size of Girarai and Bazargai is 14.87 and 10.47, while Jowar and Bampokha are 13.26 and 9.23, respectively. The average household size in tehsil Gadaizi is 11.96.

Table 2 Household's heads Education, family size monthly income, and willingness to pay Analysis

	N	Mean	Median	Mode	Minimum	Maximum	Standard Deviation
Family Size	62	12.12	11	7	3	35	6.09

Education Level of HH head	62	9.51	10	16	0	18	6.18
Monthly Income	62	103500	72500	150000	13000	350000	80505.52
Willingness to Pay	62	909.67	500	00	00	5000	1153.71

Family Size

The sample's mean (average) family size is approximately 12.12 members. The median (middle value when all values are arranged in ascending order) family size is 11 members. The mode (most frequently occurring value) is seven members. The sample exhibits a minimum family size of 3 members and a maximum family size of 35. The standard deviation is 6.09, indicating moderate variability in family size within the sample.

Education Level of HH Head (Household Head)

The sample's mean education level of household heads is 9.51 years. The median education level is ten years. The model is 16 years of education, suggesting that 16 years is the most common level among household heads in the sample. The minimum education level is 0 years (indicating some respondents may have no formal education), while the maximum is 18 years. The standard deviation is 6.18, indicating a relatively wide range of education levels in the sample.

Monthly Income

The mean monthly income in the sample is PKR 103,500 (Pakistani Rupees). The median monthly income is PKR 72,500. The highest frequency (mode) of monthly income is PKR 150,000. The lowest monthly income in the sample is PKR 13,000, while the highest is PKR 350,000. The standard deviation is PKR 80,505.52, indicating substantial income variability within the sample.

Willingness to Pay
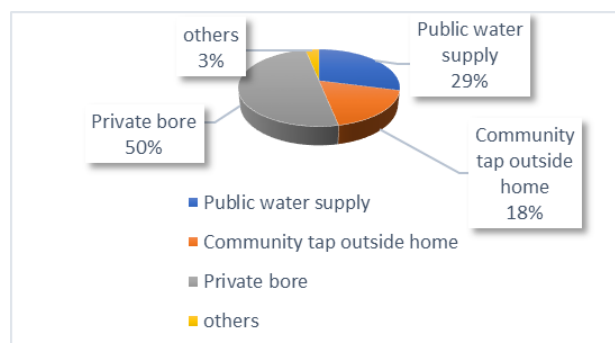
Figure 3 Distribution of HHs by source of drinking water.

The average willingness to pay for a service or product is PKR 909.67. The median willingness to pay is PKR 500, suggesting that many respondents can pay around this amount. The mode is "00," indicating that some respondents may not be willing to pay anything for the service or product. The minimum ability to pay is "00," while the maximum ability to pay is PKR 5,000. The standard deviation is PKR 1,153.71, indicating a considerable variation in the amount respondents are willing and able to pay. These statistics summarize the characteristics and responses of the 62 respondents in the sample for each of the four variables. They offer insights into the data's central tendency, variability, and distribution within the sample.

Drinking water: as a result, out of 62 households, 50% or half of the households in this survey use motor pumps as a drinking water source, 32% use taps, 8% use dug wells, 5% use hand pumps, and 5% use another source of drinking water.
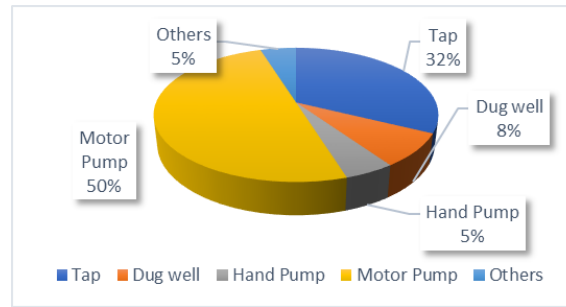
Another question asked from the respondents "*source of drinking water at home",* which is shown in Figure 4. The data reveals that 50% of respondents rely on their own or private bore as the primary source of drinking water at home. The second most prevalent water source is public water supply, constituting 29% of households, followed by 18% of households utilizing a community tap outside the home. In contrast, only 3% of households reported using an alternative drinking water supply at home.

Table 3 Exposure to media of HH head

Media	Yes	Percentage	Cumulative Percent
TV	3	4.8	4.8
Radio	1	1.6	6.5
Social media	11	17.7	24.2
Social institutes	12	19.4	43.5
TV and Social media	9	14.5	58.1
TV and Newspaper	4	6.5	64.5
Newspaper and Social media	15	24.2	88.7
TV, Newspaper, and Social media	7	11.3	100.0
Total	62	100.0	

Table 3 presents information collected from household heads, utilizing the variable "media exposure" to understand where respondents obtain information about water contamination. The highest rate, at 24%, indicates that household heads habitually read newspapers and use social media to gather information about water contamination and treatment. Following closely, the second-highest rate is 19%, signifying that 19% of household heads acquire information without relying on media, obtaining it instead from social institutions. Additionally, 18% of households solely use social media, while 15% of household heads both watch TV and use social media. Furthermore, 11% of household heads engage in both watching TV and using social media, and 5% solely watch TV while using social media.

Table 4 HH's perception of Water contamination

	Contaminated Water		The marble industry creates water pollution		Waste matter creates water pollution.	
	No. of HHs	Percent	No. of HHs	Percent	No. of HHs	Percent
Yes	45	72.6	60	96.8	60	96.8
No	17	27.4	2	3.2	2	3.2
Total	62	100.0	62	100.0	62	100.0

Table 4 summarizes the responses to three questions. Regarding the level of awareness about water contamination in their localities, the responses to water contamination are grouped into three questions:
1. "Is water contaminated in the area?"
2. "Do marble industries create water pollution?"

3. "Does waste matter create water pollution?"

The responses are coded in a binary fashion. 72.6% of households responded that water is contaminated in their area, while 27% of households responded that water is not contaminated in their localities. According to 96.8% of households, marble industries and waste matter cause water pollution, while 3.2% of households believe that marble industries and waste matter did not cause water pollution.

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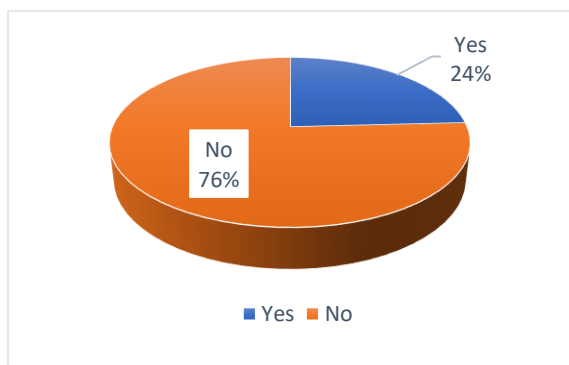
Figure 5. Use of Water Purification
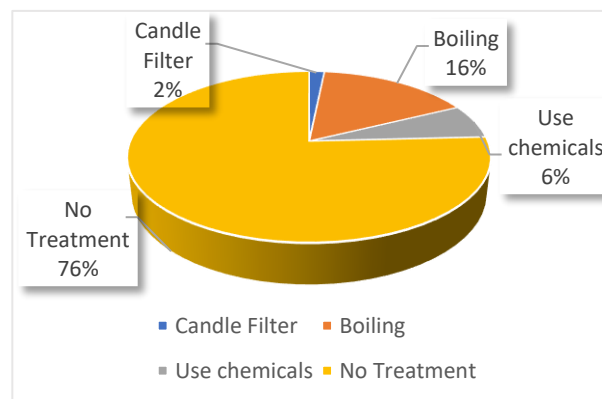
Figure: 6. Water Purification Method

Figure 5 depicts household responses to the question, "Do you use treated water at home?" and responses are coded in a binary fashion. The majority of households, as indicated in the figure, predominantly use untreated water; 76% responded that they do not employ any water purification method. In contrast, 24% of households reported using treated water or employing a water purification method at home. Upon closer examination of this 24%, Figure 6 provides a breakdown of their purification methods. Approximately 16% of households boil their water for purification, 6% use chemicals, and 2% rely on candle filters.

Table 5 Water Purification Methods and HH Head's Media Exposures (%)

	Treatment				
	No Treatment	*Candle Filter*	*Electric Filter*	*Boiling*	*Use Chemicals*
Media Exposure of HH head					
TV	*88.9*	*0.00*	*0.00*	*11.1*	*0.00*
Newspaper	*72.7*	*0.00*	*0.00*	*18.2*	*9.1*
Social Media	*64.3*	*3.6*	*0.00*	*21.4*	*10.7*

Exposure to electronic, print, and social media is an essential indicator of health awareness. We collect information in the questionnaire when household heads watch television, read newspapers, or use social media. Choose the most often used response of the family head. Table 5 shows that of those who watch television habitually, 88.9% do not use any water purification method for safe drinking water, while 11.1% use the boiling method for safe drinking water. Of the household heads who read newspapers, 72.2% of households do not use any water purification methods, 18.2% use boiling, and 9.1% use chemicals for safe drinking water. Of those household heads who use social media, 64.3% of households do not treat water at home, while 3.6% of households use candle filters, 21.4% use boiling and 10.7% use chemicals for safe drinking water.

Table 6 Acceptance for improving water supply systems

	No of HHs	*Percentage*
Yes	*52*	*83.9*
No	*10*	*16.1*
Total	*62*	*100.0*

Table 6 illustrates that a significant majority of the surveyed households, nearly 84%, have expressed their acceptance of better water supply systems. In contrast, a smaller proportion, approximately 16%, have not accepted this proposal. These results provide insights into the level of support or resistance within the surveyed population regarding enhancements to water supply systems.
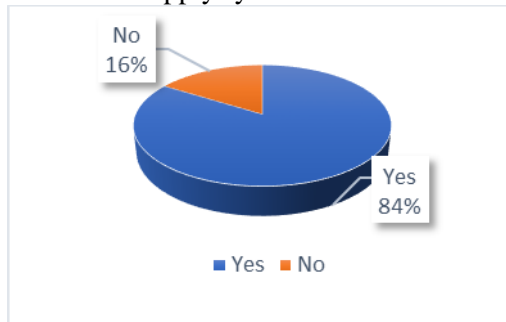
Figure: 7. Consumer Confidence in Private Sector: Readiness for an Upgraded Water System

The study's second objective is to determine how much money households would be willing to pay for good drinking water. The poll questioned respondents about how much they would be willing to pay for better water services and how much they would be willing to pay for improved water service if a private firm offered them water of a higher caliber. Figure 7 and Table 6 illustrate the private company's readiness to embrace an enhanced water system. 84% of 62 households were open to accepting a private company's upgraded water system, compared to 16% who were not. This study demonstrates that consumers have faith and confidence in private businesses.

Table 7 Water Quality Responses

	Yes	Percentage
Taste		
Bitter	0	0.00
Salty	0	0.00
Muddy	9	14.52
Smell		
Odd intensive	0	0.00
Medium	0	0.00
Tolerance	0	0.00
Appearance		
Clean	43	69.35
Muddy	8	12.90
Contains some Matter	2	3.23
Total	62	100.00

Table 7 reveals that a significant portion of respondents perceived their water to have a clean appearance (69.35%), while a smaller proportion mentioned that their water appeared muddy (12.90%) or contained some matter (3.23%). Regarding taste and smell, no respondents reported bitterness, saltiness, odd intensiveness, medium-level odor, or tolerance-level odor in their water. These findings provide insights into how respondents

perceive the quality of their drinking water, particularly in terms of taste, smell, and appearance.
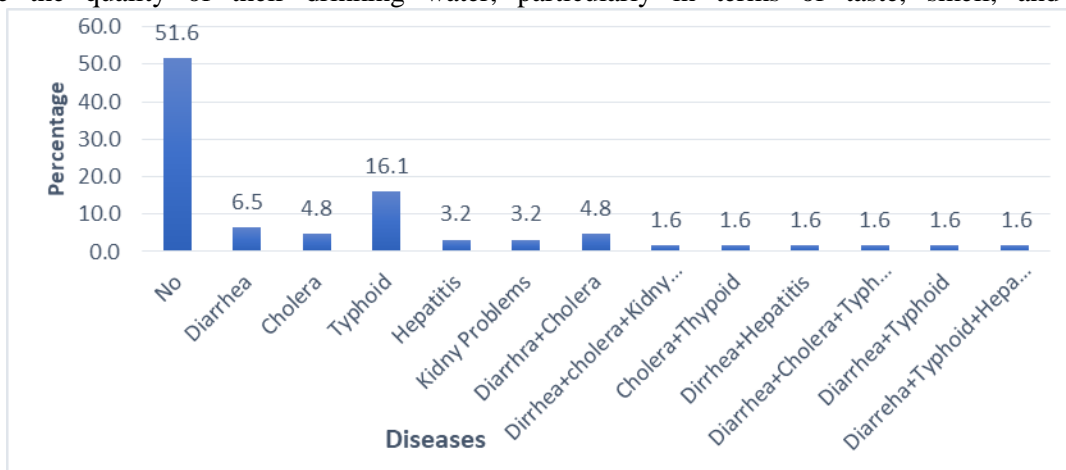
Figure 8. Diseases Occurrence in Households

Figure 8 shows that 51.6% of the respondents have no diseases related to contaminated water or waterborne diseases. 16.1% of households suffer from typhoid, 6.5% of households suffer from diarrhea, 4.8% of households suffer from cholera, 3.2% of households suffer from hepatitis, and 3.2% of households suffer from kidney problems. The remaining 14.6% of households suffer from more than one waterborne disease.
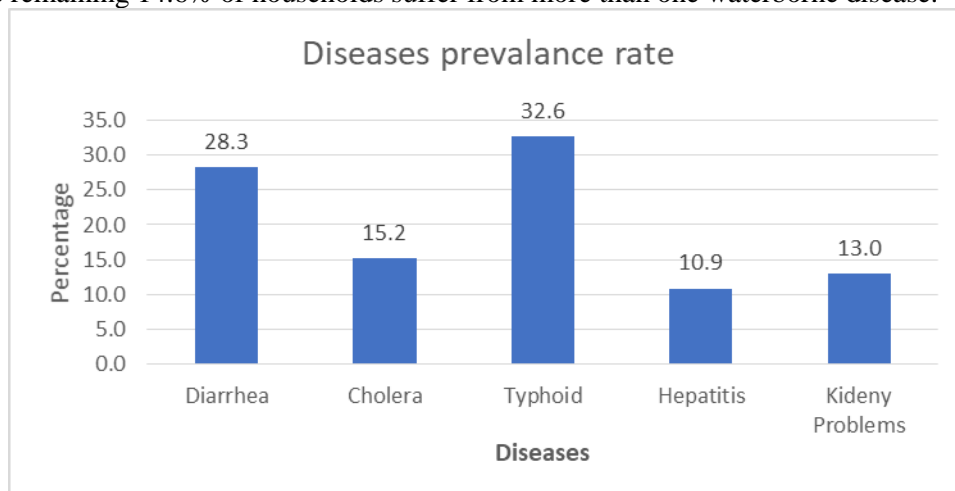
Figure: 9. Diseases Prevalence Rate among HHs

Figure 9 illustrates the most common and dominating waterborne disease, typhoid. i.e., 32.6%. The second highest prevalence rate of waterborne disease diarrhea is 28.3%. Cholera, hepatitis, and kidney problems prevalence rate is 15.2%, 10.9%, and 13%, respectively.
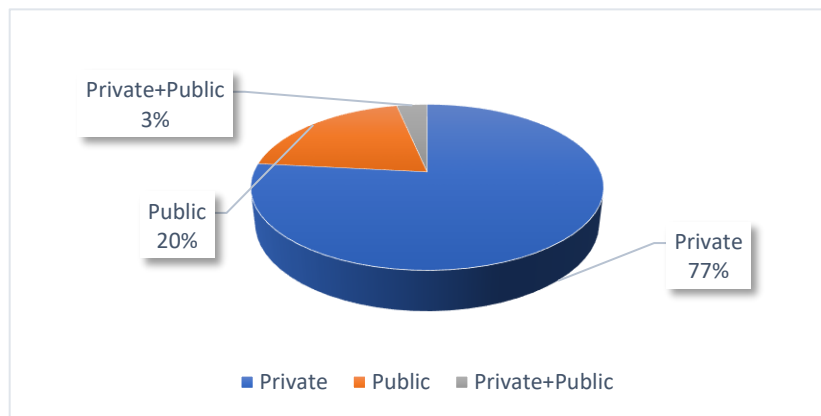
Figure 10. Hospital Treatment of Waterborne Diseases

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Figure 10 shows the response of the homes that suffer from waterborne infections. The respondents were asked which sort of hospital they utilize for the treatment of waterborne infections. The answer is divided into two categories: government hospitals and private hospitals. 77% of households used private hospitals for treatment, and 20% used public hospitals. In contrast, only 3% of households use public and private hospitals to treat waterborne diseases. This considerable amount shows that people believe and trust in a private hospital, so they use it for treatment.

Table 8 provides insights into how the willingness to pay for better water services varies among households with different levels of education. It suggests that households with higher education levels tend to be more willing to pay higher amounts for improved water services. In comparison, those with lower education levels are more likely to opt for lower or no additional payment.

Table 8. Maximum WTP Behavior by HH Head Educational Level (%)

	Pakistani Rupees						
	0	*1-500*	*501 - 1000*	*1001 - 1500*	*1501 – 2000*	*2001 - 2500*	*Above 2500*
No Education	41.7	41.7	8.3	0.00	0.00	0.00	8.3
1 - 8 Years	26.7	40	13.3	0.00	6.7	0.00	13.3
9 - 12 Years	36.4	36.4	18.2	9.1	0.00	0.00	0.00
13 or More years	12.5	20.8	37.5	12.5	8.3	0.00	8.3

Table 9. Maximum WTP Behavior by Media Exposures of HH Heads (%)

	Pakistani Rupees						
	0	*1 - 500*	*501 - 1000*	*1001 - 1500*	*1501 – 2000*	*2001 - 2500*	*Above 2500*
TV habits	22.2	33.3	22.2	11.1	0.00	0.00	11.1
Newspaper habits	0.00	36.4	36.4	9.1	9.1	0.00	9.1
Social media habits	36.8	36.8	10.5	5.3	5.3	0.00	5.3

Table 9 shows how household media exposure patterns affect their willingness to pay across various price points for better water services. Households with TV habits generally exhibit a broad range of willingness to pay, with a significant proportion willing to pay between 1 and 500 Rupees. Those with newspaper habits also display a wide range of willingness to pay, with many willing to pay in the 501 - 1000 Rupees category. Households with social media habits are notable for having a higher percentage (36.8%) unwilling to pay anything for better water services. Overall, the table suggests that media exposure habits can influence households' readiness to pay for enhanced water services, with social media habits being associated with a higher percentage of respondents who are not willing to pay.

Table 10. Maximum WTP Behavior by Monthly Income of HH (%)

|	*Pakistani Rupee*						
Income/month	*0*	*1-500*	*501 - 1000*	*1001 - 1500*	*1501 – 2000*	*2001 - 2500*	*Above 2500*
10k - 50k	61.9	33.3	4.8	0	0	0	0
51k - 100k	13.6	27.3	40.9	13.6	0	0	4.6
101k - 150k	0	42.9	42.9	0	0	0	14.2
151k - 200k	14.3	28.6	14.3	14.3	0	0	28.5
201k - 250k	0	0	0	0	50	0	50
Above 250k	0	50	25	0	25	0	0

Table 10 highlights that willingness to pay (WTP) behavior varies significantly across income groups. Lower-income households are generally less willing to pay, while higher-income households exhibit greater flexibility in their WTP, with some willing to pay substantial amounts. Understanding this variation is crucial when designing pricing strategies or policy interventions for the specified service.

Table 11. Maximum WTP Behavior by Monthly Income of HH (%)

Water Treated	0	1-500	501 - 1000	1001 - 1500	1501 – 2000	2001 - 2500	Above 2500
				Pakistani Rupee			
Yes	14.3	28.6	28.6	7.1	7.1	0	14.3
No	29.2	33.3	20.8	6.3	4.2	0	6.3

Table 11 shows the comparison between those households who use treated water and those who do not use treated water at home; therefore, those households who use treated water at home are more willing to pay for improved drinking water, while those households are less willing to pay for improved drinking water who are not use treated water at home.

Conclusion

This study focuses on the critical issue of water quality, access to clean water, and willingness to pay for improved water systems in a specific region of Pakistan, Gadaizi, Buner. This research shed light on various aspects of water quality, health impacts, and the socioeconomic factors influencing households' ability to pay more for superior water services. Many households in the surveyed area are aware of water contamination issues, with a majority acknowledging that water is contaminated due to marble industries and waste. Many households rely on untreated water for drinking, with most not using water purification methods. Those who purify their water mainly use boiling, chemicals, or candle filters. The Analysis suggests that households with higher exposure to media (TV, newspapers, and social media) are more likely to use water purification methods. The survey indicates that media exposure plays a role in raising awareness about safe drinking water. Waterborne diseases, such as typhoid and diarrhea, are prevalent in the surveyed households, with a notable portion suffering from these illnesses. Private hospitals are the preferred choice for treating waterborne diseases, indicating a higher level of trust in private healthcare facilities among the surveyed population. The willingness to pay for better water services varies significantly based on income, education, and media exposure. Higher-income households are more willing to pay than those with excellent education and media exposure. The study reveals that households with higher income levels are more willing to pay for improved water services. The income-based Analysis highlights the potential for implementing pricing strategies that align with households' financial capabilities. Households that use treated water at home are more willing to pay for better water services.

This study emphasizes the importance of addressing water contamination and improving access to clean drinking water in the Gadaizi region of Pakistan. It highlights the need for public health campaigns to raise awareness about water quality and purification methods. Additionally, understanding the socioeconomic factors affecting willingness to pay can inform policy decisions to provide better water services to the population. This research contributes valuable insights into the complex relationship between the studied area's water quality, health, and socioeconomic factors.

Recommendations

There is a need for comprehensive public health campaigns to raise awareness about water contamination issues and the importance of using water purification methods. These campaigns should utilize various media channels, including TV, newspapers, and social media, to reach a wider audience. Efforts should be made to address the sources of water contamination, particularly those related to marble industries and waste matter. Implementing stricter regulations and waste management practices can help reduce water pollution. Encouraging households to treat their water before consumption is crucial. Education programs can inform people about the benefits of water treatment methods such as boiling, chemical purification, and filters. Initiatives should be undertaken to improve access to clean and treated drinking water. It may involve upgrading water supply systems, ensuring a regular supply of treated water, and repairing leaks in distribution systems. Lower-income households are less willing to pay for improved water services, so policies should be developed to make clean water more affordable for these households. Subsidies or tiered pricing systems could be considered. Private hospitals are the preferred choice for treating waterborne diseases; collaboration between public health authorities and private healthcare providers can help ensure better access to healthcare services for those affected by waterborne illnesses.

Monitoring water quality and the population's health is essential to track improvements and identify new challenges. This data can inform evidence-based policies and interventions. Further research in neighboring areas and regions with similar water quality challenges can provide a broader understanding of the issue and help tailor solutions to specific contexts.

By implementing these recommendations, policymakers, healthcare providers, and local authorities can work together to address water contamination issues, improve access to clean drinking water, and ultimately enhance the well-being of the population in Gadaizi Tehsil and similar regions of District Buner.

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Impact of Cost Management Practices on Firm Performance: A Study of Pakistan's Manufacturing Sector

Umair Ahmed[1], Mohammad Saleem[2], Shah E Yar Qadeem[1], Nisar Khan[1] and Ume Salma[3]
[1]*Qurtuba University of Science & IT, Peshawar Pakistan*
[2]*Alfalah University, Nangarhar, Afghanistan*
[3]*City University of Science & IT, Peshawar Pakistan*

Abstract

Cost management and profitability are the backbone of every organization. Cost management is a common approach used by managers to maximize the shareholder's wealth. It is an important element of overall business success and effective management, which helps the management to accurately forecast the cost before the process. The study aimed to examine the impact of cost management practices on firm performance in the manufacturing sector. Direct material (DM), Direct Labor (DL), Operating expenses (OE), and Factory overhead (FOH) were selected as the independent variable while Return on Assets(ROA) was used as a proxy for performance i.e. dependent variable. Fifteen firms from the manufacturing sector were selected for five years from 2017 to 2021. Panel data was collected through a simple random sampling technique. Results show that direct material and direct labor has a positive significant impact on firm performance. However, operating expenses and Factory overhead were found insignificant. The study concludes that direct labor and direct material are the major cost factors to reduce the cost and a source of profit maximization.
Keywords: Cost Management Practice, Direct Labor, Direct Material, Factory Overhead, Firm performance

Introduction

Cost management is usually referred as cost reduction or cost cutting and it is a common approach which a firm's manager use to get a constant performance. Cost management strategies are very important managerial tools used in decision-making (Stefan & Reka, 2014). Cost management practices are considered as organizational success and include critical factors which aid in increasing profit (Siyanbola, 2017). It is helpful in decision-making and protect you against competitive advantage which provide best resource allocation (Alsoboa, Al-Ghazzawi & Jouden, 2015). Effectiveness of cost management is helpful in managing different task with in limited time and resources. It makes firm valuable just like lows cost per unit, enhance quality of product and manufacturing process and reduce the working capital invested etc. (Sawalhi & Enshassi, 2014).

A corporate objective in the early stage is to succeed it with minimum expenses and it can provide a route for work. This is also a technique through which one can assess the effectiveness of engaged actions of management in the organization (Jayeola, 2012). According to Anand, Sahay & Saha (2004) the main objective of a business is to maximize the shareholder's wealth by increasing profitability however the second objective includes going concern, corporate social responsibility, employee benefits, and growth etc. are the other aims and considered as very much important but profit maximization is considered as a major objective because all the shareholders have an interest in wealth maximization only. This is the reason most of the stakeholders naturally invest prefer in high-profit firms (Hutchings, 2004). For all such reasons, profit can be maximized through enhancing manufacturing of production as well as through cost reduction, but the best solution of such problem is cost reduction which is the result of perfection in the production process.

Cost management practice relates to the analysis and the information which is needed for managers in the decision-making process and controlling an organization efficiently. It is very important in order to achieve the organizational goal effectively. It has great emphasis on accounting system; therefore, deep analysis of a firm's cost management structure is required which enable managers to determine the impact of such costs in favor of firm's profitability.

Literature Review

Oluwagbemiga, Olugbenga, & Zaccheaus (2014) investigated the association between cost management practices and firm's performance of manufacturing organizations. The study suggested a positive significant result by which it can be concluded that there is a relationship between cost management practices and the firm's performance in a manufacturing organization. The main purpose of their study is to find out that cost management and firm's profitability has a significant relationship. They used independent variables such as; direct material cost, direct labor cost, factory overhead cost and operating cost while the dependent variable was profitability of the firm for which return on assets was selected as a proxy.

Etale & Bingilar (2016) selects one brewery company in Nigeria focused on controlling the cost of inventory which should be done by hiring the most efficient workers and this technique of controlling the inventory cost by the use of highly skilled labor and the effect of their performance on the controlling of the inventory cost had given the positive result which was actually evaluated by the help of the statistical software.

According to Adelabu (2015) cost accounting in the manufacturing firms plays an active role to increasing the profitability of firm whereas the companies operating in Nigeria doesn't consider such practice and therefore one survey proved that if the cost is controlled in the manufacturing firms then it will indirectly positively affect the profitability ratio of the company.

Stefan & Reka (2019) argued that at the beginning of 2010 the relationship between customers and management increase rapidly. This relationship will lead the management to achieve their goals. The number of paper increase about this and we found only 8 articles about the relationship of customers and management in 2010 but with the passage of time, the number of articles increases up to 200 plus from 2010 to 2019. The debate of researchers about the relationship between customers and management become more and more after 2019 and this happened in a change of business environment and competition in the global world. The main purpose of the management to control the cost and reduce the wastage of raw material. The work of management is not come out to reduce the wastage of raw material but they also work on using it effectively.

Eluyela, Akomolafe, & Ilogho (2016) observed the behavior of several manufacturing firms operating in Nigeria, it is very effectively noticed that the firms that focus on their cost control in the administrative overhead department and production overhead department was generating a higher amount of profit and this profit of such manufacturing firms operating in Nigeria could be noticed by looking at their balance sheets.

Idogho (2011) study interprets the development of management skills for small-scale business through the introduction of entrepreneurship education in tertiary institutions. 300 final year students were selected as sample and relationship between entrepreneur education and managerial skill development was studied. A positive relationship was observed (r=0.349, p<0.05). Thus the introduction of entrepreneur education effects positively to develop small-scale business among students.

Shah (2016) study focused on the association in firm's profitability and cost management practice in oil companies of Nepal. Study used secondary data for eleven years from 2004 to 2014. Profitability was selected as dependent variable while direct labor, direct materials, selling expenses, administrative expenses and factory overhead was selected as an independent variable. The result shows that there is an overall positive impact of cost management practice on the profitability of firm.

Research Methodology

Population & Sample Size

All the firms in the manufacturing sector from Pakistan Stock Exchange (PSX) were the targeted population of the study. The manufacturing sectors has 32 firms out of which 15 manufacturing firms were selected as a sample using a simple random sampling technique.

Data Collection

Panel Data were collected for 5 years from 2017 to 2021. Data was collected from the Securities Exchange Commission of Pakistan website and annual reports of the respective firm.

3.3 Researcher's Framework
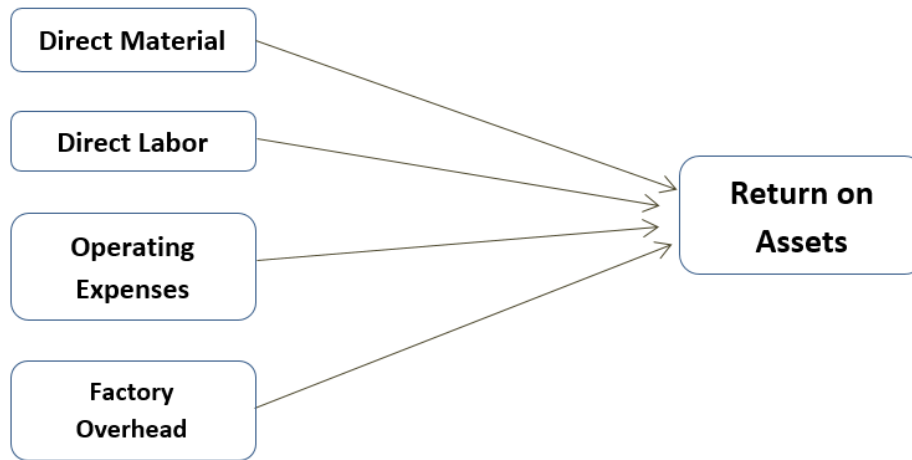
Fig 1 Researcher's Framework

Hypotheses

H1: There is a positive impact of the direct material on firm performance.
H2: There is a positive relationship between direct labor and firm performance.
H3: There is a positive impact of Factory overhead on firm performance.

H4: There is a positive relationship between operating expenses on firm performance.

Econometric Model

Hypotheses of the study tested through the following model:

$$\mathbf{ROA = \beta_0 + \beta_1 \, DM + \beta_2 \, DL + \beta_3 \, OEXP + \beta_4 \, FOH + \ \ ei}$$

The model is explained as:
ROA= Return on Assets
DM= Direct Material
DL= Direct Labor
OPEX= Operating Expenses
FOH= Factory, Overhead
Ei= error term
$\beta_0=$ Constant
$\beta_1=$ Slope of DM
$\beta_2=$ Slope of DL
$\beta_3=$ Slope of OPEX
$\beta_4=$ Slope of FOH

ANALYSIS

Panel Diagnostic Summary

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Table 1 Summary of Panel Diagnostic Test

TESTS	HYPOTHESES	DECISION
Chow's test	H_0 = Pooled OLS model is appropriate	**Fixed** effect model is
	H_1 = Fixed Effect model is appropriate	appropriate
Breusch pagan- Test	H_0 = Pooled OLS model is appropriate	Pooled OLS model is
	H_1 = Random Effect model is appropriate	appropriate
Hausman test	H_0 = Random Effect model is appropriate	**Fixed** effect model is
	H_1 = Fixed Effect model is appropriate	appropriate

Chow's and Hausman Test hypothesis suggested that **fixed effect model** is appropriate for estimation.

Multicollinearity

Table 2: Variance Inflation Factor

	VIF	tolerance
ROA	1.472	0.67889
DM	1.7575	0.56899
DL	1.7016	0.58765
OPEX	1.72	0.5789
FOH	1.167	0.85654
_cons		

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$ level of significance
IM test for Ho: homoscedasticity; Chi(2)=76.20, p=0.0534, Likelihood-ratio
test: sig= 0.04

Durbin-Watson d-statistic(11, 100) = 1.37675

Table 2 suggesting the VIF values of all independent variables and shows that there is no problem of multicollinearity in the model because all the value are less that 10 (Hair et al., 1995).

Autocorrelation

Table 3: Breusch-Godfrey Test

F-statistic	11.214101	Prob. F(3,14)	0.1181
Obs*R-squared	25.214231	Prob. Chi-Square(3)	0.0061

The above table 3 reflects that the p-value is higher than the critical value and chi-square value is less than 5% so, it suggests that the model is free from the problem of autocorrelation.

Regression Analysis

Table 4: Regression Analysis

Variables	Coefficient	Std. Error	t-Stats	P-Value
C	-0.568	0.0879	-6.461	0.0000
DM	0.0861	0.0113	7.6194	0.0108
DL	0.9184	0.0314	29.241	0.0000
OPEX	-0.482	0.0685	-7.036	0.0817
FOH	0.214	0.0314	6.815	0.2146
R-Square: 0.54529		**F-Stats: 23.6769 (P-Value:0.00000)**		

The above table shows that all the independent variables i.e. price earnings; Operating Expenses, Direct Labor, and Leverage are statistically significant at a critical value of 1%. F-stats= 23.68 with a p-value of 0.000 shows that the model as a whole significant at a critical level, while 55% variations were found in the dependent variable due to change in independent variables which are price earnings, Operating Expenses and Direct Labor. Direct Materials and Direct Labor had a positive impact on Return on Assets of the firm; however, Operating Expenses is negatively associated with Return on Assets. Findings suggested that there is a significant impact of Direct Labor, Operating Expenses and Direct Materials on the Return on Assets of a firm. We accept our hypothesis that there is a significant impact of Direct Materials on Return on asset because it is found significant. Direct Labor is also found significant to return on asset therefor study accepts the hypothesis that Direct Labor has a significant impact on Return on asset. Operating Expenses was negatively found with Return on assets however it was significant which shows that a decrease in Operating Expenses will lead to an increase in Return on asset.

Conclusion

Manufacturing firm's operations are concerned with cost management. All manufacturing firms have to examine the great extent of cost management has a direct impact on the firm's financial performance. Increase in such costs may affect the firm financial performance inversely. Therefore it is very important to manage direct cost properly and efficiently. The study aim was to find out the impact of cost management practice on firm performance for which the Manufacturing sector was selected for the time period from 2017 to 2021.

The study found that direct material and direct labor has a positive impact on firm performance because they were found highly significant at p>0.05 level. The results were supported by Alsoboa, Al-Ghazzawi & Joudeh (2015) and Etale & Bingilar (2021). However, operating expenses and Factory overhead were found statistically insignificant due to its higher probability value, as similar to (Eluyela, Akomolafe, & Ilogho, 2016). The study concludes that direct material and direct labor has a significant impact on firm performance hence, study accepts hypothesis H1 and H2. H1 suggest that direct material has a positive impact on firm performance and H2 shows that direct labor has a positive relationship with firm performance.

Implications

- Manager has to manage and regulate its cost system regularly so a cost afloat will remain in the business.
- A proper material management like its utilization, elimination of wastage, proper reduction of quantities of inventories in raw material, work in process and finished goods, minimize the lead time, efficient controlling of overhead,

- Labor can be managed by booking the labor cost correctly, determine the specific labor rate, effective utilization of labor work & initiating incentive wage plans.
- Management should build a system through which expense control culture can be applied in the organization which improves the profitability.

Directions for Future studies

Operating expenses can be further divided into administrative & selling expenses. Return on equity or any other proxy may be used as dependent variable or time span can also be increased.

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The Effect of Corporate Governance on Dividend Pay-Out Policy; (A study of Non–Non-Financial Sectors of Pakistan)

Shah-E-Yar Qadeem1, Umair Ahmed1 and Muhammad Asif2
1*Qurtuba University of Science & IT, Peshawar Pakistan*
2City U*niversity of Science & IT, Peshawar Pakistan*

Abstract

The study aims to evaluate the impact of corporate governance on dividend policy of a firm. Non-Financial sector of Pakistan was selected for the study and forty-two (42) firms all selected from 14 sectors (3 firms from each sector), by convenience-based sampling technique. Dividend payout is used as a proxy for dividend policy which is the dependent variable of the study, while Board size, board Independence, and Director's remuneration were selected as independent variables. Firm size and leverage were the controlled variables of the study. Data was collected from annual reports of every firm and then analyzed on E-views by using the ARDL Regression model. Empirical results show that Board size has a positive and significant relationship with dividend payout; while Directors' remuneration has an inverse effect on the dividend payout ratio and board Independence had no such effect.
Keywords: Board Size, Board Independence, Director's Remuneration, Dividend Policy

Introduction

Corporate governance (CG) normally indicates the rules of business decision making that put on to the center mechanisms of companies. This set of laws has, aided to form the relations between boards of directors (BOD), managers, shareholders, and to resolve agency conflicts. As companies search for regulators and stakeholders that they are entirely clear and responsible, firms have increasingly assured their promise to direct and fair corporate governance principles on an extensive range of business practices (Younas et al., 2017). The basic objective of corporate governance adoption is to defend stakeholders specially shareholders from corporate and executives misconduct. Corporate governance is in fact procedures that are vital to stop frauds in a corporation and possible public and other unlawful liability. These procedures develop status of a company and make it more eye-catching for stakeholders. Securities and Exchange Commission of Pakistan (SECP) has given out the structures for corporate governance for labeled companies i.e. listed companies, public sector companies and insurance companies (Ahmed et al., 2021).

A dividend payout policy has been taken into consideration the more important policy in the corporate policies. Dividend policy has commonly use the set of different procedures that companies use that how to adopt the earnings and how to payout dividend to their shareholders. Some of the investors consider and cannot worry about the dividend policy or dividend payout because they purchase share for capital gains not for the sake of dividend (Chang et al., 2016). In the parlance of finance it is known as Irrelevance theory of dividend. It suggests that dividend announcement has no any impact on the shareholder and also not affect the share price. Most of them were not afraid to a company's dividend payout until they can sell a portion of that portfolio of different equities when they want cash: this is known as the dividend irrelevance theory and it is essential to issue dividends that have low impact on the share Price.

(Hart & Zingales, 2017) suggests that corporate governance is a way of bringing the attraction of stakeholders and to show that the firm is working in a best way. Similarly (Esqueda & O'Connor, 2020) suggested that form the investor's point of view corporate governance is just like an obligation to return a handsome return on capital employed and can show commitment to manage investments to the firm efficiently. The occurrence of Divergent and from time to time differing aims among corporate managers and shareholders has certain rise to the need for corporate governance, as it mainly aims at finding a result to the principal-agent problem. Corporate governance

practices can differ generally even among companies in the same country operating under the same permitted regulations (Yaseen & Dragotă, 2021).

The occurrence of Divergent and from time to time differing aims among corporate managers and shareholders has certain rise to the need for corporate governance, as it mainly aims at finding a result to the principal-agent problem. Corporate governance practices can differ generally even among companies in the same country operating under the same permitted regulations. According to OECD principles a bigger explanation on corporate governance was offered. "Corporate Governance can be applied to private and public both institutions with its own conditions, rules, guidelines and certified business practices. It can order in the direct relationship with the market economy and corporate insiders' i.e. corporate managers and entrepreneurs" (Geiler & Renneboog, 2016).

The purpose of the study is to investigate the relationship of corporate governance with dividend policy on Pakistani Non-Financial sector. It directs the managers towards company's objectives and aim in a way through which they add more value to the company and also give benefit to the stakeholders for long run. From an investor's point of view dividend is the main factor of their consideration. Dividend policy has commonly use the set of different procedures that how companies can adopt the earnings and how to pay-out dividend to their shareholders. The current study can provide an aid to the management in decision making process regarding dividend pay-out policies.

Objectives of the Study

- To investigate that Board size has an effect on dividend payout
- To examine the impact of board independence on dividend payout
- To find out the impact of director's remuneration on dividend payout

Literature Review

Corporate governance has various benefits to the firm, through which a company can perform efficiently. According to (Sumail, 2018) these benefits including enhancement in firm performance, minimization of cost of capital, increase in firm's reputation, justified risk, protection of shareholders right and the main: maximization of shareholder value. Other major advantages are include control over corruption, proper environment for investment, proper growth, support competition and mount the market capitalization.

(Geiler & Renneboog, 2016; Soni & Soni, 2015) suggested that Dividend distribution policy of listed companies decides the method to distribute profit or keep retained reinvested earnings. It affects the companies' cash holding. Dividend policy can be taken as a dependent variable and corporate governance and remuneration committee can be taken as an independent variable. This study selects 150 A-share companies from Shanghai and Shenzhen securities exchange center. All the sample companies paid dividends in 2014. This research mainly studies the impact of corporate governance due to dividend payout ratio empirically, especially the effects of director's remuneration dividend policy in China.

According to (Paranthaman & Ekanayake, 2017) main wisdom of corporate governance is to defense the stakeholder interest, to certify that the directors and managers have to observe with the stakeholders interest which leads to separation of owners and managers. This parting gave rise to the adoption for a number of mechanisms globally for ensuring the going concern assumption of corporate entities that affects business sustainability and survival which directly enhance companies' ability to pay dividend.

According to (Mohammed et al., 2017) corporate governance is a set of different instruments related to company governance, which protect the outside investor from the expropriation by the insider. It settled a way through which confirmation can be done for owners who collect return on capital on the invested money. It deals with the procedures and methods in which suppliers of equity finance can get return in investment in a right way.

According to (Panda & Leepsa, 2017) corporate governance is the larger part of economic context through which firms can operate and include proper policies and procedures. Like Macroeconomic policies and procedures, level of competition in product and market factors. Its framework is depending on the regulations, legal and institutional environment. Additionally, different factors like business ethics and awareness about corporate of the environmental and social interest of the agencies and communities in which companies are operating and working for long run impact for its reputation.

It was parallel to the firms which are governed as a comparison with non-governed firms because firms get high expectations to higher expected returns. A board of directors is a collection of personalities that are selected as, or elected to turn as, representatives of the stockholders to create corporate management connected strategies and to make decisions on major issues of company. It is mandatory for all the public corporations that they have must a group of board of directors (Margaretha, 2017).

Underpinning Theories

Stakeholder's theory

It offers that the firm is consist of stakeholders which functioned structure for which the larger method of the host society offers the lawful need and market structure for its action (Mansel). (Al-Kahmisi & Hassan, 2018) also suggests "stakeholder concept endeavors to report the question of which clusters of stakeholder deserve and attention of management is required.

Stewardship theory

According to (Mansell, 2015)managers assume that a good steward of a company and diligently work to get the highest level of company profit maximization and enhancement of shareholder's return.

Agency theory

It evaluates the problems arising from the separation of ownership and control (Panda & Leepsa, 2017). The relationship between agency and corporate finance can manage many affairs of the firm. According to (Wu & Chen, 2014) the agency relationship is just like a contract in which one and more persons are engaged i.e. principal and agent, to perform desire services on their behalf which include delegation of decision making right to the agent.

Corporate Governance and Dividend policy

Dividend policies address agency problems between corporate insiders and shareholders. Ya & Safari highlighted that dividend payouts ease agency conflicts by reducing the volume of free cash flow accessible to managers, who do not essentially act in the best welfares of shareholders. There are several studies that have found a significant and positive relationship among dividend policy and corporate governance, (Muntahanah et al., 2021).

(Al-Kahmisi & Hassan, 2018) investigate the effect of corporate governance on dividend payout ratio by taking 300 listed firms as a sample from MSE (Malaysian Stock Exchange). Findings supports the high growth of companies reduce the interest payment and association between investment opportunities. Dividend policy was found weaker with larger board size. Overall it was found that there was a negative and significant relationship between board size dividend policy composition and Growth opportunity.

According to (Margaretha, 2017)Thai firms are very concentrated and many of these retained by organizations. These organizations are analyzed in two ways which are: Decision to pay dividend or not, and how much will be pay as dividend. analyzed results shows that profitability, Firm Size and Retain earnings-to-Book Equity ratio is found positively effecting the decision of company to pay divided and how many dividend are to pay. At the beginning 421 Non-Financial firms were taken as a study sample from SET, for the period of nine (9) years from 2009-2017. But due to unavailability of data 287 firms were the final sample. Data was collected from the annual reports published by SET.

Dividends constitutes another significant area which plays a vital role in controlling possible agency problems between block shareholders and marginal shareholders.at the time of distribution , a pro-rata

distribution can be curtained to all stockholders and bounds corporate wealth from block shareholders' control Dividends can also be utilized by controlling shareholders to counter set the marginal shareholders' concern in a situation where expropriation by governing shareholders conquers (Paranthaman & Ekanayake, 2017).

Dividend policy

Dividend payout was used as a proxy for dividend policy and it can be calculated by dividing net income on total dividend paid to shareholders. It can be defined as ratio of total dividends to total earnings" (Chang et al., 2016). It is found as the main aspect of a firm progress and success. It is used as a proxy for dividend policy(Yuwono & Aurelia, 2021).

Corporate governence

i. Board Size

It can be determined by the members included in the board. It shows the total number of board members in a company (Ahmed et al., 2021). (Asif et al., 2017) mentioned that large board size will always needs high administration expenditure, but a smaller board less expensive and has a rapid decision making process. (Younas et al., 2017) explained that larger boards allow directors to specialize.

ii. Board Independence

An independent board of a corporate which has majority of outside directors who are directly associated with top executives and less participation in business dealings. According to (Younas et al., 2017) an independent board is a board of a company which has majority of outside directors which has unusual dealings with company and also with the top executives.

iii. Directors Remuneration

It is the remuneration as payment or compensation given for the services rendered and includes basic salary, bonuses and any other benefit to executives during employment. (Younas et al., 2017) suggested that managers and firm profits were significant. (Geiler & Renneboog, 2016) found that director's remuneration had a significant and inverse relationship with Dividend payout.

Research Methodology

Sources of Data

Data for the study extracted from the annual reports of the respective sample companies. For extracting data from annual reports at Pakistan Stock Exchange (PSX) and State bank of Pakistan (SBP) web data was used. This is a secondary study which is based on secondary data.

Sampling Design

All the non-financial firms listed at PSX were the universe of the study. There are 14 Non-Financial sectors listed in PSX and 396 firms were found in these 14 sectors. Three (3) firms were select from each sector. So total sample size of the study was 42 Non-Financial firms and the time period for the sample was from 2017 to 2021 (5 Years). Sample was selected on convenience based sampling technique. According to (Saunders et al., 2007) this is a sampling technique used widely, bias and influences is prone to beyond your control, so in this case you can select sample of your ease.

Hypotheses to be tested

H_1: Board size and dividend payout has a significant relationship.

H[2]: Board Independence and dividend payout has a significant relationship.
H[3]: Directors Remuneration and dividend payout has a significant relationship.
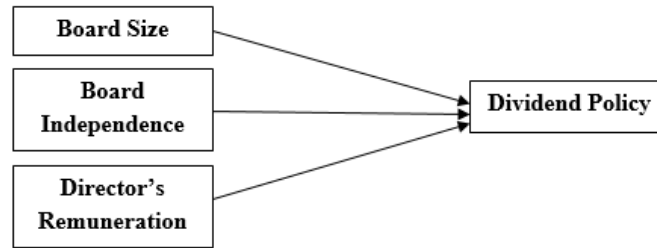
Figure 1: Conceptual Framework

Econometric Model

Hypotheses were tested on the basis of following model:

$$DP = \beta_O + \beta_1 BS + \beta_2 BI + \beta_3 DR + \beta_4 LNFS + \beta_5 LNLEV + et$$

Model is explained as:
DP= Dividend policy; BS= Board size; BI= Board independence; DR=Director's Remuneration
LNFS= natural log of Firm size; LNLEV= natural log of leverage of firm; et= Error term; β_o= intercept; $(\beta_1, \beta_2, \beta_3, \beta_4, \beta_5)$ = Slopes

Analysis

ARDL (Regression Model)

To estimate long run relationship for consideration or bound procedure Auto Regressive Distributed Lag (ADRL) approach can be used, irrespective of considering that value are stationary or non-stationary or combination of both. In the situation when data is found mix i.e. I (0) or I (1), ARDL give the most realistic and efficient results of estimation. In such estimation each variable stands a long run relationship (Margaretha, 2017; Ghazali, 2014).

Table 1: ARDL (Regression) Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.298623	0.034070	8.764868	0.0000
LNTA	0.007141	0.000871	3.874124	0.0015
LNLEV	0.041419	0.000212	1.975822	0.0621
BI	1.121182	0.000191	0.953160	0.3519
BS	5.321419	0.000212	5.692101	0.0000
DR	-0.021257	0.000142	-1.812058	0.0287

R-squared	0.234878	Mean dependent var		0.341504
Adjusted R-squared	0.120110	S.D. dependent var		0.028781
S.E. of regression	0.026997	Akaike info criterion		-4.235142
Sum squared resid	0.014577	Schwarz criterion		-4.038800
Log likelihood	54.82171	Hannan-Quinncriter.		-4.183052
F-statistic	17.046545	Durbin-Watson stat		1.100746
Prob(F-statistic)	0.000000			

Source: (Eviews Results)

F-stats is 17.0465 and its p-value is less than 0.05 it suggests that the model is statistically good fit and 23.48 percent variations were found in the dependent variable which has been explained by the change in the explanatory variables. However if individual independent variables are concerned, Size of the firm, Board Size and Directors Remuneration are statistically significant at $\alpha < 0.05$, while Board Independence and Leverage has turned out statistically insignificant.

In the above empirical result it is found that the model is good fit due to it F-statistics at a critical value and 23% variations were found due to change in the explanatory variables which are Board Independence, Board Size and Directors Remuneration. As for as individual variable is concerned it was observed that coefficient of Board independence is 1.21 but due to its negative p-value it should be turned to the insignificant variable of corporate governance and its impact on Dividend policy. It suggests that board independence has no impact on dividend policy simply it cannot be affected with board independence. The other variable is board size and its coefficient is 5.32 and having a high significant value at critical level. It reflects that there is a positive and significant relationship between Board size and dividend policy. Each increase in board size will contribute 5.32 units in dividend payout (proxy of dividend policy). It further shows that the higher the board size higher will be the dividend payout. As far as director's remuneration is concerned a negative relationship is found between dividend policy and director's remuneration; but this relationship is significant at critical value. This revels that dividend policy can be inversely affected by director's remuneration. But the magnitude is too low i.e. 0.02. Higher the director's remuneration will decrease the dividend payout by 0.02 per unit. In the light of above results is concluded that corporate governance has and overall significant impact on dividend policy.

Conclusion

Corporate governance is an emerging field of finance, it is a system which is used for controlling and directing companies matters. It is an important element of every corporate because it influence on every activity of the organization. The study is conducted to investigate the impact of corporate governance on dividend policy. The study concludes that there is a significant impact of corporate governance on dividend payout. Dividend payout effected with board size and directors remuneration. If board size is increased so it will increase the dividend payout because a more members in a board may make a better dividend policy. Ultimately it can increase the shareholders' wealth and their interest towards company. The results also demonstrate that the firms which are paying high remuneration to directors may pay lower dividends because there is an inverse relationship was found between director's remuneration and dividend payout. Board independence has no influence on dividend policy; it shows that if a company has independent director or not it will not affect the dividend policy.

Recommendations

As it is discussed in the findings that corporate governance has a significant impact on dividend policy, therefore:
- Corporations have to focus on the implementation or improve corporate governance.
- Board size to be increased up to a specific number through which dividend payout will be increase.
- Director's remuneration decreases the dividend therefore it should be controlled and minimized.
- From investors point of view this study will provide an aid who wants better dividends.
- For academic sectors it is also helpful to find different gaps.

Limitations of the Study

The study covers the period from 2017 to 2021 for five years. Lack of prior researches related to Directors Remuneration due to which it takes more time. Due to time limit selected sample size is not very huge.

Direction for Future Researchers

- In future other can change the dependent variable by using different performance indicators, assets management tools etc.

- One can add more explanatory variables like CEO ownership, CEO employment level etc.
- In the study there are 42 firms one can take more firms for better results. In this study all sectors have been taken one can do the same study on only one sector or on more than one.

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The comparison between Islamic and capitalistic Concept of Economy and Market: A conceptual study

Salim Khan, Iftikahar Ahmad, Said Akbar

Riphah school of Leadership, Faculty of Management Sciences, Riphah International University (Malakand

Campus), 18800, Chakdara, Pakistan

Abstract

Amid adverse economic crises around the globe specifically in developing countries, it is obligated for practitioners and scholars to work extensively on different economic systems prevailing in the world to uncover their pros and cons. Accordingly, this paper is designed to compare the Islamic and capitalistic view of market and economy to highlight the weaknesses in the prevailing capitalist economic system and how the Islamic economic system can help to overcome such weaknesses. This paper is based on logical arguments supported by literature to compare the two economic systems in terms of comparing the foundational factors of economic system including capital mobilization, risk sharing, resource accumulation and distribution, information asymmetry, and governance system etc. The main differences between the two economic systems include regulation, valuation, information asymmetry, and consideration of risks. This paper is more feasible from a practical perspective and suggests the policy makers to consider Islamic economic system as an alternate of Capitalism.
Keywords: Market, Capitalism, Islamic economic system, profit Maximization

Introduction

A market is a place where buyers and sellers meet to carry out economic transactions. A market transaction involves not only the exchange of goods and services between the parties but also the information, currency, or a combination of all of these (Franjić 2023). There are several sellers and buyers in a market and at least two parties are required to make an economic transaction (Yang, Zhang et al. 2022). The earlier view of a market is that it exists in the physical form only but nowadays the concept of the market has become wide and exists in varied forms such as financial markets, auction markets, stock markets, virtual markets, etc. (Berndt, Peck et al. 2020). A Market also refers to a set of consumers (actual or potential) who are interested in a particular product and have the resources to acquire the product (Mankell and Hvenmark 2020). The market is also used in the sense of demand. i.e., the demand for a particular product is referred to as the product's market (Tomlinson, Walsh et al. 2002).

A market should be effective to leash out its maximum benefits for all the stakeholders involved. The efficient market is the one that fulfills the following conditions.

1. Efficient Capital Mobilization
2. Equal Risk Sharing
3. Effective Resource accumulation and Distribution
4. Fair and Efficient Contracting
5. Information Symmetry
6. Fairness in Price Settlement
7. Effective Governance and Control
8. Operational Efficiency

The above factors will be considered in the description of both markets individually as well as in their comparison (O'Neill, Sotkiewicz et al. 2005, Yang, Zhang et al. 2022).

Islamic Concept of market

In Islamic, market is the one which is regulated by the Laws and values defined by Islamic. The market is not a

free entity and rather is regulated by the laws and teachings of Islam. Following are its main features (Al Amin, Marliyah et al. 2021).

Quality Products and Services

The products and service should be of high quality and meet the needs and demand of consumers. The ancient Muslim traders and industrialists relied on the continuous innovation and creativity and would modify their products, services, and business procedures accordingly (Abbas, Nisar et al. 2020). The quality of product is attained by the continuous research and development. Such products and services have the potential of giving maximum utility to the consumers with the least disadvantages (Abbas, Nisar et al. 2020). The other reason for emphasizing quality product and services is the deterrence of imitation and copyright violation. The continuous research and development may encourage the firms to rely on their creative skills in products and business procedures rather than stealing from others (Saifudin 2022). Another reason is that a quality product builds a good reputation among the consumers, and could capture a larger share of the market, thereby branding a product (Pratama, Hanan et al. 2021).

Benefits of Goods for all stakeholders

In Islam, the market is the one where the exchange of such goods and service take place that benefit all the stakeholders involved rather than just a few (Aman and Systems 2020). The sellers should not be the only person who takes the maximum benefit in the form of earning high profit, rather all the stakeholders including consumers, agents, employees of the selling firms, and even the community near a market gain the benefits (Aman and Systems 2020). The consumers may take benefits in the form of acquiring quality product and services, the employees such as salespersons in the form of fair compensation, and the community by less suffering from the harmful effects of the products (Ashmawy and Management 2015).

Fair Distribution of Products and Services

Islam encourages the fair distribution of products and services to all consumers in a given market regardless of their religion, race, ethnicity etc. unlike the conventional market(Aman and Systems 2020). The example is the COVID-19 vaccines which were politicized by the Western Countries and would be distributed to only those nations that were the close allies of the West or would be supplied to the rich nations, and the poor countries would be left at the mercy of Allah (Abbas 2022, O'Regan 2023). The Islamic concept of market follows the principles of equality and justice in the distribution of good and service (Hasan, Hasan et al. 2020). The Muslim merchants used to deliver goods to the far-flung areas in order to fulfill the demands and needs of those who were deprived of such goods. They delivered the products through mutual exchange system that would control the shortfall of goods in a particular area (Sadia and Ahmed 2020).

Cost Effective Product

It is the basic principle of Islamic concept of market that the available products should be cost effective and affordable (Abbas, Nisar et al. 2020). The best example is the introduction of paper by the Muslim merchants that replaced the expensive raw material of papyrus and Parchment. A market should make available the products to the consumers at affordable prices so that all of them could buy it rather than the conventional markets where just the elite class could buy the products (Syafril and Hadziq 2021).

Fair Pricing

Pricing the commodity is often used as a tool of profit maximization and the exploitation of the basic rights of the consumers. Islam directs its followers to fix the price of a commodity based on its utility and real value (Abbas, Nisar et al. 2020). Often the products are priced based on its packaging, the location, attraction etc. that is unfair and unjustified (Hosen, 2021). In addition, in the monopolistic markets, sellers while pricing the

products at a high rate in order to earn the maximum profit is above the real worth of the products (Li and Shuai 2019). In the same way, a restaurant, cope shop, bookshop etc. offering the product at high price based on the decoration and attraction of the place rather than the actual worth of the product is against the principles of fair pricing(Li and Shuai 2019).

Information Symmetry

Market is not only the place of exchanging goods and services but that of information as well. Both sellers and buyers have the right to have the accurate and all the required information rather than just a single party (Li, 2019). Buyers along with the sellers should know the information related to market mechanisms, operational procedures, products, price etc. (Ijaz 2022). The rationale behind this is the principle of fairness. Just like the sellers who spend resources to manufacture and sell a product, consumers also spend resources in the form of money to acquire the product (Ahmed and Rahman 2015). Therefore, both have the same rights of having all the required information. In conventional market, often the seller is much aware of the product and the buyer has very few information, thereby the buyer often makes faulty decisions in buying the product. (Halim, How et al. 2020)

Fair Contracting

A market is often operated by the contracts between the parties. The contract between the sellers and buyer, the employees and the employers, the community and the sellers is a routine activity and takes place implicitly if not explicitly (Aman, 2020). In the Islamic view of market, all the parties are bound to their corresponding promises in a given contract. For instance, a seller is bound to the quality, fair price, guarantee, delivery etc. of a product; buyer to pay the price, return what was bought; and employees to the fair rules and regulations of the employers (Rokan 2020). Islam emphasizes the equality and respect of individuals' rights, forbids the breaking of words, and sticking to the promises. Therefore, an efficient market should be the one that considers the contractual rights and responsibilities of all the parties involved (Bakar, Yasin et al. 2020).

Western Concept of market

Western concept of market is largely operated on capitalism. The following are the features of capitalist market.

Profit Maximization

Capitalist markets largely operate on the concept of profit maximization. The sellers tend to maximize the profit at the cost of violating ethical norms (Ullah, Adams et al. 2021). Although, it motivates the sellers to earn maximum profit by providing quality products, yet it violates the basic rights of consumers when the sellers start monopolizing their product (Kuch 2020). The profit maximization motive forces the sellers to compromise on the quality of the product, misrepresenting the products, and to engage in several others deceptive practices (Hermann 2021). Profit maximization has made the industrialists blind towards their societal responsibilities. Such products and services are introduced on a daily basis that are beneficial in the short term but have a harmful effect in the long terms in the form of pollution, human health, societal norms etc. The profit maximization has motivated the business community to install inexpensive plants in the industries that are causing severe pollution, and avoid environment-friendly installation that requires huge capital (Mustafa, Long et al. 2023). Another disadvantage of profit maximization is the stimulation of unfair competition among the sellers in the market. All the sellers tend to earn maximum profit by acting against the interests of each other. The quality of good is compromised since profit maximization is the driver of reducing the cost unethically (Ferrante, Fontana et al. 2021).

Supply and Demand as the determinant of price

The price of product and service is largely determined by the forces of supply and demand in a market. The high

demand and low supply cause a surge in the prices of a commodity whereas more supply and less demand lead to drop in the commodity prices (Inoua and Smith 2023). This mechanism of price is an automatic and does not require intervention from the regulators. However, this has seriously violated the norms of a market and has exploited basic rights of the consumers. The best example is the monopoly in which the big sellers control the supply and demand of the commodities (Al Mamun, Hassan et al. 2022). The sugar industry in Pakistan is an example of monopolistic market where the few people control the supply of the sugar. Besides, the demand and supply mechanism of price has largely become a matter of politics and the countries develop such mechanism as the tool of politics against each other (Razzaq, Liu et al. 2022). The oil producers reduce the supply of oil leading to high prices that mostly suffer the poor nations. In short, the demand and supply procedure of setting up the prices of commodity is an unregulated procedure and causing serious violations of market norms and exploitation of basic rights (Razzaq, Liu et al. 2022).

Unequal Distribution

The products in the capitalist markets are often unequally distributed. The products such as medicines, weapons, machineries, and other precious commodities are distributed among the nations based on the political interests of the producers(Ranaldi and Milanović 2022). The best example is the life-saving drugs such as COVID-19 vaccines distributed to those countries that were the closed allies of the producing countries(Kalocsányiová, Essex et al. 2023). Similarly, the oil and food distribution is not uniform and often the poor nations are exploited (D'Odorico, Carr et al. 2019).

Money as a medium Exchange

In the capitalist market, money is the medium of exchange and the commodities are fixed according to the value of the money (Howden 2023). The consumers have to pay money while buying the commodities. Yet, the major disadvantage of money is that it does not truly reflects the actual value of a commodity and the price is either overestimated or underestimated. For instance, the price of good includes all the necessary and un-necessary costs that makes the commodity as less worthy than its actual use (Ingrao, Ruggeri et al. 2022).

Pricing based on Speculation

Often the price of some commodities such as stocks, oil, gold etc. is priced according to their speculated value rather than its actual value (Howden 2023). The major drawback of this mechanism is such value reflects the future worthiness rather than the existing one. The future is always uncertain and involves uncalculated risk. For instance, if the stock of a company is sold expensive today based on the reason that the stock price will be high in the future, it involves a high level of risk (Simsek 2021). What if the company faces some crises, which will result in dropping its prices, and the investor may bear huge loss. In the same way, the real estate business is completely operating on the speculations and the investors are attracted based on the future worthiness of a project which is not the correct way of pricing as the current value is far less than its future value (Humphrey and Society 2020).

Comparison between Islamic and western Market

Taking insights from the previous section, the two markets are differentiated by the following factors.

Regulation

Islam largely encourages the regulation of market and is against to let the market free. In a regulated market, the rights of all the stakeholders are preserved and few powerful people do not control all the resources (Murphy, Smolarski et al. 2020). On the other hand, unregulated market allows the powerful actors to exercise their control over the marker and they control prices, supply, product choice etc. (Cohen 2023). This results in the violation of basic rights of the weaker actors. Capitalist market is mostly unregulated that results in its instability in the

prices, supply, and other economic and social costs (Abbas, Nisar et al. 2020).

Valuation of Goods

Markets based on Islamic teachings encourage the exchange of good that are valued based on their actual value rather than its valuation in monetary terms (Kader 2021). Capitalist markets often value the goods in terms of money that mostly is not the accurate valuation and may include unrealistic costs that cannot be justified (Nelson 2002).

Information Asymmetry

There exists information asymmetry in the capitalist market. Often the sellers have more information about the price, quality, cost of goods sold, uncertainty involved etc. than the sellers. Besides, the salespeople manipulate, hide, and withdraw information about a product resulting the consumers to know very little about the product (Hallunovi 2020). On the other hand, Islamic concept of market encourages information symmetry that results to discourage a number of deceptive practices in the market (Adada 2019).

Consideration of Risk

The capitalist market often involves the uncalculated risk and is bear by a single party. The pricing mechanism based on speculation and in term of money results in the accumulation of risk just in the hands of a single person rather than equally distributed by all the parties involved (Hirota, Huber et al. 2022). The capitalist market often involves the uncalculated risk and is bear by a single party (Akram, Khan et al. 2022, Guo, Long et al. 2022). The pricing mechanism based on speculation and in term of money results in the accumulation of risk just in the hands of a single person rather than equally distributed by all the parties involved in conclusion, the market conceptualized on Islamic teachings is more in line with the real based situation than the capitalist market (Guo, Long et al. 2022).

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Comparison of live load distribution factors for the design of simple spanhighway bridges in Pakistan.

Osama Wali, Muhammad Suliman, Muhammad Sunaid, Muhammad Musa Jan, Hasnain Ahmad
[1]*Department of Civil Engineering, University of Engineering and Technology Peshawar, Pakistan,*

Abstract

The "S/D" Method used for the Distribution Factor (DF) of Moment & Shear was introduced in the 1930s inthe AASHTO LRFD Specifications. However, when applied using the Finite Element Method (FEM), it hasbeen found to be unrealistic and uneconomical for our design purposes. In response to this issue, AASHTOLRFD 1994 developed new Load Distribution Factor (LDF) equations as a result of the NCHRP 1226 projects. These equations are based on detailed studies using the Finite Element Method (FEM) and providea more accurate representation of the real conditions in our bridge design. On the other hand, WPCPHB 1967uses Live Load Modals taken from a British code (1937), which shows that each girder cannot have the sameportion of load effect with increasing span, making it unsafe for realistic bridge design. Additionally, the WPCPHB (1937) loading condition is lower than all the loads, which does not represent truck loading in Pakistan, making it an unsafe method for the realistic design of short span length bridges. Over time, trafficflow and traffic loads have changed, and the same applies to AASHTO LRFD, which also does not representthe actual truck loading condition in Pakistan, as it uses HL-93 loading. The highway loading modal-93 (HL-93) is too conservative for simple span highway bridges in Pakistan. Consequently, utilizing these codes in Pakistan for simple span highway bridge construction leads to losses in the country's economy due to uneconomical projects and overdesign, both during construction and later in maintenance.
Keywords: Distribution Factor, Finite Element Method, Load Distribution Factor , Bridge design.

Introduction

This section provides an overview of the current state of Live Load Factors that Influence Distribution (LLDF). These considerations have been incorporated into the American bridge codes. Since the first edition of the AASHO Standard Specifications was published, the American Association for the Advancement of Science and Technology (AASHO) was founded in 1931. The current Specifications(AASHTO, 1996) continue to contain the original Distribution Factors, which were computed in HL-93 with just minimal changes. In the year 1994, the LRFD Bridge Design Specifications were adopted by AASHTO (1996). These new requirements featured a new type of Distribution Factors, which was the firstsignificant change since 1931. These equations have been used, and details of these Distribution Factors contained in these two design Bridge codes of practice and their historical development are presented in this section.

Research Methodology

The research methodology encompasses data acquisition from diverse consultancies and departments, including the National Health Agency. It involves computing moments and shear values through methods such as AASHTO LRFD, Corbouns method, and WPCPHB 1967 for different loading circumstances like HL 93, Class A, and Class AA. The approach integrates the NHA Bridge Girders Standardization Manualto obtain girder sections for various lengths, elucidates techniques for determining moment and shear valuesfor new bridge sections across different spans, and discusses the utilization of Finite Element Analysis software for precise calculations.

Obtaining Data

Data for the project, obtained from NHA websites, includes details on four selected bridges, encompassingvarious

parameters like span length, girder information, diaphragm dimensions, piers, piles, bridge dimensions, abutment data, and concrete and reinforcement properties. This comprehensive dataset forms the basis for the project's analysis and design considerations.

Different Sections and Span Length

The NHA Bridge Girders Standardization Manual was employed to establish consistent section values forvarious span lengths, specifically ranging from 12 to 40 meters. This manual offered standardized section values, particularly beneficial for spans within and exceeding this specified range.

Moment of Inertia:

The moment of inertia, which is essential for obtaining moment and share, was manually calculated for allof these and additional parts. The cross-section changes with each span length, i.e., 12 to 15 meters, resulting in a change in moment of inertia. As a result, the new section's moment of inertia was estimated as well.

Moments and Shear Values:

For each scenario, equations were utilized to calculate the values for moments and shear values. The Absolute maximum theorem was used to find Shear and Moment values for AASHTO LRFD, HL-93 truckloading. Shear values calculations of S/D class A Truck are used for WPCPHB 1967.

Distribution Factor:

For each scenario, the Distribution factor for Shear and Distribution factor for Moments were calculated using the values of moments and shear for each span length and cross section. The LRFD Lever rule was used by AASHTO.

Distributed Moments and Distributed Shear:

To get distributed shear, the maximum values of shear were multiplied by a distribution factor. To getdistributed moments, maximum values of moments were multiplied by the distribution factor.inite Element Analysis:
The Ghazi Ghat bridge was planned and studied using FEA (Finite Element Analysis) and the finite element approach (CSI Bridge software). CSI Bridge was chosen to design and study the Ghazi Ghat Bridge. Valuesof shear and moments were discovered using FEA. These variables were used to calculate the values of theMoments and Shear Distribution Factors.

Design and Analysis of Bridge:

In CSI Software, the Ghazi Ghat Bridge was designed with its original size. The planned bridge was then examined. The Hsn-44, an AASHTO Vehicle class vehicle, was used for live load analysis. The analytical findings provided values for moments and shear.
These values include,
1. Moment values for each girder i.e.,1,2 and 3
2. Moment values for all girders
3. Moment values for right and left exterior girder.
4. Shear values for each girder i.e., girder 1,2 and 3
5. Shear values for all girders
6. Shear values for right and left exterior girders.

Shear and Moment distribution factors:

The sum of all girders' moment and shear values were divided by the moment and shear value of each girder to find the moment and shear distribution factors for each girder. The sum of all girder shear values divided by the shear value of each girder. And the sum of all girders' moment values divided by each girder's moment value. Then, for each increment of span, i.e., 12-15, moment and shear were divided by that maximum moment and maximum shear to obtain moment and shear distribution factors, respectively.

Table 1. Bridges Data

Bridge Name	Lahore Bridge	Ghazi Ghat Bridge	Fly Over on Lahore Sialkot (M)	Layyah With Taunsa Bridge
No of Lanes	1	2	3	4
No of Girders	4	5	6	9
Roadway Width(m)	10.3	10	14.5	21.2
Girder Spacing(m)	2.7	2.4	3.65	2.6
Slab Thickness(inch)	8.8	8	8	9
Rail Width(m)	0.4	0.4	0.4	0.4
Asphalt Thickness (inch)	50	50	50	50
Skew Angle	0	0	0	0
Area of Girder Used (inch^2)	911.0	1571.52	1771.36	1726
N.A of Girder (inch)	30.6	53.43	98.72	53.19
MOI (inch^4)	398330.3	1995644.5	7409477.5	2348932.32

Table 2. Calculated Area, MOI and Yt asper NHA Bridge Girders

Span(m)	Y_t (Inch)	A(inch2)	MOI(inch4)
12-15	24.5	693.6	163548.10
16-18	26.26	722.16	206821.60
19-21	29	765.36	266482.22
22-24	30.4	783.84	407904.47
25-27	36.16	1029.28	606081.60
28-30	41.10	1121.76	845225
31-33	44	1245.76	511006.21
34-36	48.40	1374.08	141169.05
c37-40	51.40	1566.36	1940016.44

Comparison of D.F from AASHTO LRFD, S/D and FEA:

Distribution Factors from AASHTO LRFD, S/D, and FEA were contrasted by graphing these distribution factors visually with varied spans of girders, ranging from 12 to 40 meters.

2.8 Results from Comparison Graphs of Distribution factors for AASHTO, S/D and FEA:

DF values from AASHTO LRFD and FEA were put on graphs, followed by S/D and FEA for DF for Moments and Shear, respectively. Also plotted were graphs showing the difference of Moment and Shear DF for AASHTO LRFD and FEA, as well as S/D and FEA, to highlight the comparison of the differences between the two.

Data and Calculations

The plans and technical details for the bridges were gathered from the NHA website. Four bridges were selected for this namely,

1. Flyover on Lahore to Sialkot Motorway
2. Lahore Bridge
3. Bridge on Layyah to Taunsa road
4. Ghazi ghat bridge

Bridges Data:

.Data Obtained from FEM (CSI Bridge) of Bridge:

Moment and Shear values for Interior Girder 1,2 and 3

Table 4. Interior Girder 1

Span(m)	Moment	Shear
12	1703	109743
16	11031	21039
19	114473	69243
22	37666	95366
25	47436	17152
28	1077278	17683
31	1010194	6503
34	209727	1019
37	33	19606
40	1235389	46365
Total	866,4438	563,127

Table 5. Interior Girder 2

Span	Moment	Shear
12	79.80	51.328
16	60.13	31.534
19	61.062	33.211
22	28.64	46.38
25	28.76	46.40
28	63.383	32.321
31	62.080	32.250
34	28.488	46
37	27.80	42
40	60.80	24.256
Total	500.943	385.68

Table 6. Interior Girder 3

Span	Moment	Shear
12	156	102
16	109	65.90
19	111	66.213
22	52.85	103
25	44.22	92
28	117	67.21
31	116	65.774
34	39.98	93.56
37	53.68	100.73
40	118	40.50
Total	917.73	796.887

Moment and Shear values for Exterior Girder 1 and 2:

Table 7. Exterior Girder 1

Span(m)	Moment	Shear
12	52.07	36.15
16	71.01	28.50
19	72.065	27.763
22	43.5684	34.25
25	42.6608	28.095
28	74.0907	77.815
31	74.08	27.66
34	42.177	32.666
37	42.87	34.168
40	78.1149	16.233
Total	**592.7068**	**343.30**

Table 8. Exterior Girder 1

Span(m)	Moment	Shear
12	70.52	42.354
16	66.09	27.193
19	66.66	29.261
22	40.57	34.930
25	41.3458	36.980
28	64.190	27.83
31	61.430	27.99
34	39.821	37.56
37	40.94	32.813
40	73.01	18.628
Total	**564.5768**	**315.539**

Ghazi Ghat Bridge designed model in CSI bridge:
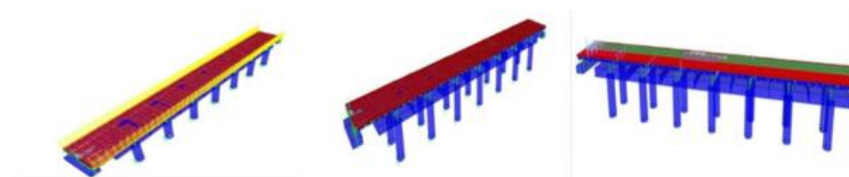
Bridge Model in CSI Bridge:

Figure 2: Bridge model after application of different loads

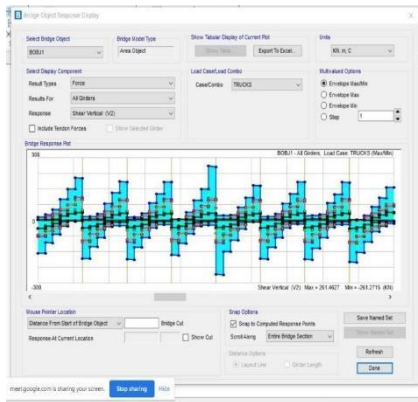## 3.5 Ghazi Ghat Bridge model, All and interior Girders Shear:
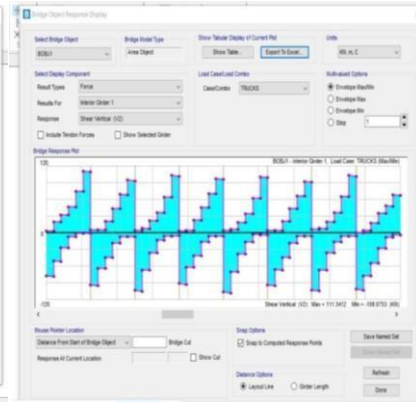

<table>
<tr><td>Figure 3: All girders shear</td><td>Figure 4: Interior girders shear</td></tr>
</table>

Results

Moment Distribution Factor for Ghazi Ghat Bridge

Table 9. Moment distribution factors   Table 10. Shear Distribution factors

Moment									
Specs.	SR.NO	Bridge Name	Span Length(m)	Spacing(m)					M (KN.m)
				2.1	2.2	2.3	2.4	2.5	
LRFD	1	Ghazi Ghat Bridge	12	0.725	0.749	0.773	0.798	0.822	969
	2		16	0.682	0.705	0.727	0.750	0.772	1526
	3		19	0.665	0.687	0.710	0.731	0.753	1970
	4		22	0.651	0.673	0.694	0.715	0.737	2436
	5		25	0.659	0.681	0.703	0.725	0.746	2923
	6		28	0.658	0.680	0.702	0.723	0.745	3431
	7		31	0.645	0.667	0.688	0.709	0.730	3960
	8		34	0.637	0.659	0.680	0.701	0.722	4510
	9		37	0.654	0.676	0.698	0.719	0.741	5081

SHEAR									
Specs.	SR. NO	Bridge name	Span Length (m)	Spacing(m)					V(KN)
				2.1	2.2	2.3	2.4	2.5	
LRFD	1	Ghazi Ghat Bridge	12	0.735	0.759	0.78	0.805	0.829	386
	2		16	0.735	0.759	0.78	0.805	0.829	430
	3		19	0.735	0.759	0.78	0.805	0.829	456
	4		22	0.735	0.759	0.78	0.805	0.829	479
	5		25	0.735	0.759	0.78	0.805	0.829	499
	6		28	0.735	0.759	0.78	0.805	0.829	519
	7		31	0.735	0.759	0.78	0.805	0.829	537
	8		34	0.735	0.759	0.78	0.805	0.829	554
	9		37	0.735	0.759	0.78	0.805	0.829	517

Table 9. Moment distribution factors   Table 10. Shear Distribution factors

CLASS A										
Specs.	Sr.No	Bridge Name	Span Length (m)	Spacing(m)					M(KN.m)	V(KN)
				2.1	2.2	2.3	2.4	2.5		
S/D	1	Ghazi Ghat Bridge	12	0.63	0.66	0.69	0.75	0.78	645	227
	2		16	0.63	0.66	0.69	0.75	0.78	956	283
	3		19	0.63	0.66	0.69	0.75	0.78	1208	302
	4		22	0.63	0.66	0.69	0.75	0.78	1494	316
	5		25	0.63	0.66	0.69	0.75	0.78	1793	323
	6		28	0.63	0.66	0.69	0.75	0.78	2112	330
	7		31	0.63	0.66	0.69	0.75	0.78	2430	334
	8		34	0.63	0.66	0.69	0.75	0.78	2746	338
	9		37	0.63	0.66	0.69	0.75	0.78	3060	341

CLASS AA										
Specs.	SR. NO	Bridge Name		Spacing(m)					M (KN/m)	V (KN)
				2.1	2.2	2.3	2.4	2.5		
COURBONS	1	Ghazi Ghat Bridge	12	0.35	0.34	0.34	0.33	0.33	1958	653
	2		16	0.35	0.34	0.34	0.33	0.33	2728	682
	3		19	0.35	0.34	0.34	0.33	0.33	3305	696
	4		22	0.35	0.34	0.34	0.33	0.33	3883	706
	5		25	0.35	0.34	0.34	0.33	0.33	4460	714
	6		28	0.35	0.34	0.34	0.33	0.33	5038	720
	7		31	0.35	0.34	0.34	0.33	0.33	5615	725
	8		34	0.35	0.34	0.34	0.33	0.33	6193	729
	9		37	0.35	0.34	0.34	0.33	0.33	6770	732

Moment and shear Distribution Factor for Girders:

Table 11: Moment Distribution Factor for Girders

Total Moment for All Girders	342.4566 KN/m
DF Interior Girder 1	0.25167
DF Interior Girder 2	0.1455
DF Interior Girder 3	0.26659
DF Right Exterior Girder	0.1772
DF Left Exterior Girder	0.164

Table 12: Shear Distribution Factor for Girders

Total Shear for all girders	3945.26 KN
DF Interior Girder 1	0.1427
DF Interior Girder 2	0.097
DF Interior Girder 3	0.2019
DF Right Exterior Girder	0.0799
DF Left Exterior Girder	0.08701

D. F for Different Span of Girder from LRFD, S/D and FEM and graph of DF for moment:

Table 13: D.F for different span of girder from LRFD, S/D and FEM   Figure 5: Graph of DF for Moment

Span (m)	DF	DFM (LRFD)	FEM DM	S/D	DFV (LRFD)	FEM DFV
12	0	0.798	0.17	0.75	0.805	0.128
16	0.1	0.75	0.119	0.75	0.805	0.083
19	0.2	0.731	0.121	0.75	0.805	0.083
22	0.3	0.715	0.057	0.75	0.805	0.129
25	0.4	0.725	0.048	0.75	0.805	0.115
28	0.5	0.723	0.127	0.75	0.805	0.084
31	0.6	0.709	0.126	0.75	0.805	0.083
34	0.7	0.701	0.043	0.75	0.805	0.117
37	0.8	0.719	0.058	0.75	0.805	0.126

Figure 5: Graph of DF for Moment
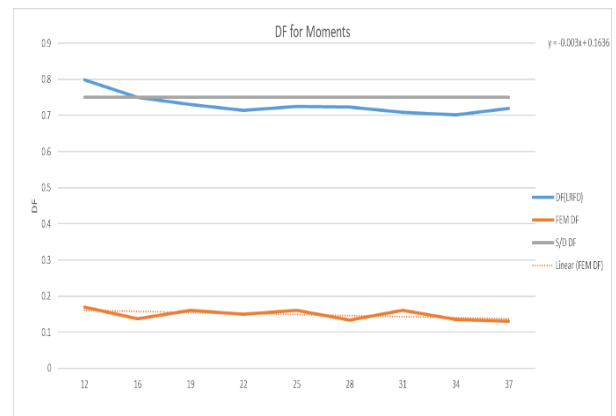
According to the graph in Figure 5, the distribution factor for moments calculated using the AASHTO LRFD and WPCPHB 1967 techniques is significantly larger than that calculated using the Finite Element Method (FEM) CSI Bridge. Therefore, when developing short-span bridges or evaluating existing ones with spans between 12 and 37 meters, it is advised to use the distribution factor for moment of the FEM approach. We have developed an equation to determine this component, and by multiplying it by the actualmoment, we can quickly acquire the dispersed moment for upcoming bridge designs. Subsequent design phases can employ this simplified procedure.

Percentage Difference of DF for Moments and shear:
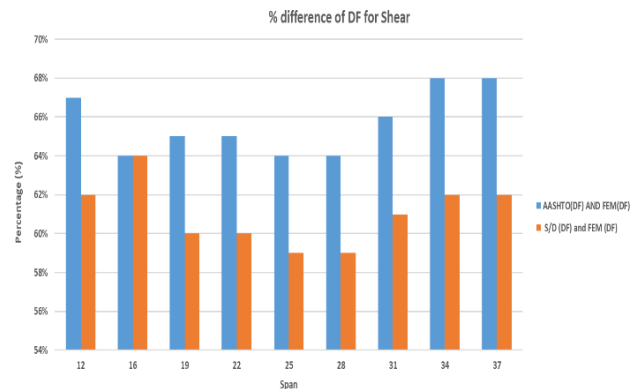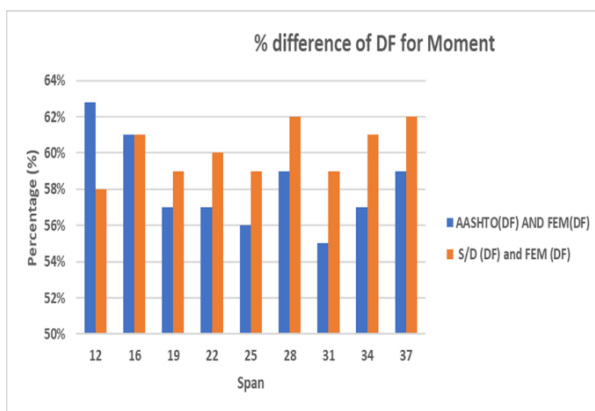
Conclusions

This study compared the live load distribution variables used in Pakistan to build basic span highway bridges. From the findings, the following conclusions have been drawn:

According to the data in the table of distribution factors (DF), the DF values produced using the AASHTO LRFD and WPCPHB methodologies are too cautious. For the design of new bridges and the assessment of existing ones, these approaches recommend very high DF values.

The DF values obtained by Finite Element Analysis (FEM), especially with the aid of the CSI Bridge program, are, in contrast, significantly lower.

These results show that the AASHTO LRFD and WPCPHB methodologies for designing simple span highway bridges in Pakistan are economically inefficient. On the other hand, using FEM, like CSI Bridge, proven to be a more cost-effective method of bridge design in this situation.

These findings highlight the significance of choosing the proper approach for calculating the live load distribution factor when constructing and evaluating small span highway bridges in Pakistan, with FEM methods showing promise for more economically sound designs.

Acknowledgements

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To Investigate and Compare the Marshall Properties of Two Sources of Aggregate Using Asphalt Penetration Grade 60/70

Osama Wali, Muhammad Suliman, Hamzah Muhammad Ali Shamsan Zaid, Hasnain Ahmad
University of Engineering and Technology Peshawar, Pakistan,

Abstract

The increasing global traffic volume and harsh environment are leading to pavement deterioration, particularly in areas with congested traffic. The use of weak aggregate in road construction has resulted in increased stress levels on the bitumen surface, leading to common issues like fatigue cracking and permanent deformation. Flexible pavements are being built worldwide, but the cost of assessing and rehabilitating them affects pavement life. This challenge urges experts and researchers to enhance pavement efficiency. To understand pavement failure mechanisms in heavily congested traffic areas, standard experiments were conducted on HMA samples using Margalla Hills Islamabad and Palai Malakand aggregates. Conventional samples with Margalla Hills aggregate percentages ranging from 3.5% to 5.5% were prepared, and Marshall Properties were tested. Modified samples, incorporating Malakand Palai aggregate, were also tested with the same percentage range. Comparing Marshall Properties, it was observed that Margalla Hills aggregate outperformed Palai aggregate. The comparison involved Marshall Stability, Flow, Bulk Specific Gravity, Theoretical Specific Gravity, Air Voids, Voids in Mineral Aggregate, and Voids Filled with Asphalt. To address Rutting (Permanent deformation), the use of strong and durable aggregate is recommended. All laboratory tests were performed according to AASHTO, ASTM, and BS standards.
Keywords: HMA, Rutting, Marshall Mix Design, Deformation

Introduction

Essential to road construction, the careful selection of aggregates shapes the integrity of bituminous and concrete surfacing, influencing the strength of road structures. Coarse aggregates, known for their cost-effectiveness, are vital components in this process. While international standards guide aggregate use, in Pakistan, the properties of selected aggregates often exceed global requirements. However, the use of aggregates with undesirable properties poses a risk to construction strength. This research delves into the properties of Hot Mix Asphalt (HMA) using 60/70 grade bitumen and aggregates sourced from Margalla Hills and Palai Malakand quarries. By varying bitumen percentages, the study assesses their impact on HMA properties. In response to challenges such as fatigue cracking and permanent deformation in road networks, the research aims to optimize asphalt-aggregate bonding, determine optimal bitumen content, and evaluate stability characteristics using aggregates from different sources.
Centered on Margalla Hills and Palai Malakand aggregates, the study follows ASTM D-1559 Marshall Mix Design. The results not only establish standards for pavement construction but also provide valuable insights to enhance construction practices in Pakistan.

Research Methodology

The research methodology adopted for this study employs a systematic three-stage approach to address the limitations associated with traditional bituminous materials and enhance the volumetric properties of Hot Mix Asphalt (HMA).

Stage 1: Selection and Characterization of Materials

Stage 2: Utilization of Aggregates with Bitumen

Stage 3: Checking Volumetric Properties

Figure 1 shows the Research Methodology shows flow chart for the experimental study, on the base of which we have carried out this Research.

Figure 1: Flowchart of Research Methodology

Material Characterization

Flexible pavement, a vital element of road infrastructure, consists of two key materials: aggregate and binder. The binder, commonly bitumen with a grade of 60/70, significantly influences pavement performance. This research focuses on studying aggregate properties from different sources, specifically Margalla Hills in Islamabad and Palai Malakand in Pakistan. The experiment ensures consistency by exclusively investigating and comparing Marshall Properties throughout the research process. These selected aggregate sources are essential considerations, contributing to the research. Additionally, the binder used is virgin bitumen sourced from Attock Refinery Ltd in Pakistan. Understanding the characteristics of these materials is crucial for optimizing flexible pavement construction, ensuring long-term durability and efficiency.

Physical Properties of Aggregates

The research ensures consistency by employing 1.2 kg trial samples, aiming for 63.5 ± 1.27 mm high compacted specimens, with adjustments made using the formula Modified aggregate mass = 63.5 * (mass of aggregate used) / sample height (mm) collected.
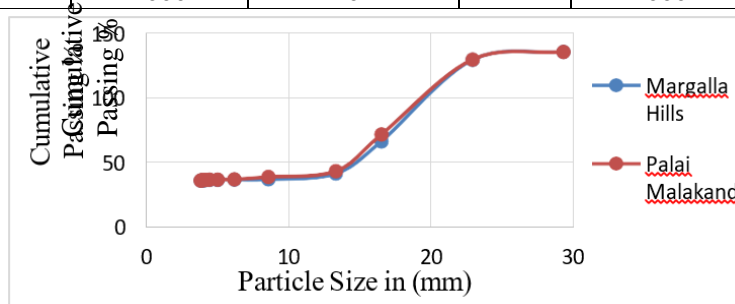
Sieve analysis test

Reference: (AASHTO T27/ASTM D448-03). Weight of Sample = 2000 gm

Table 1: Sieve Analysis

Margalla Hills	Palai Malakand

Sieve Size	Wt. Retain	Cumulative wt. Retain	Cumulative %	Wt. Retain	Cumulative wt. Retain	Cumulative %
(Inches)	(gm)	(gm)	Passing	(gm)	(gm)	Passing
1	0	0	100	0	0	100
3/4	124	124	93.8	118	118	94.1
1/2	1266	1390	30.5	1166	1284	35.8
3/8	502	1892	5.4	568	1852	7.4
#4	90	1982	0.9	90	1942	2.9
#8	4	1986	0.7	38	1980	1
#16	2	1988	0.6	3	1983	0.85
#30	2	1990	0.5	4	1987	0.65
#50	2	1992	0.4	2	1989	0.55
#100	4	1996	0.2	2	1991	0.45
#200	2	1998	0.1	5	1996	0.2
Pan	2	2000	0	4	2000	0

Graph 1: Comparative Graph of Sieve Analysis

Los Angeles abrasion test

Reference: (ASTM C 535 & AASHTO T-96). NHA Specification: 40% & ASTM Specification: 45%. The setup includes 5000g aggregates, 11 steel balls, and milling at 30 RPM for 500 revolutions.

Table 2: LAA Values

S. No.	Sources	LAA Value %
01	Margalla Hills	23.28 %
02	Palai Malakand	28.44 %

Specific gravity test

Reference: (AASHTO T84 & T85/ ASTM C127-88).

Table 3: Specific Gravity Test Values

S. No.	Sources	Apparent S.G (G_{sa})	Bulk S.G (O.D) G_{sb}	Bulk S.G (S.S.D) G_{sb}
01	Margalla Hills	1.683	1.678	1.681
02	Palai Malakand	1.67	1.65	1.66

Water absorption test

Reference: (AASHTO T84 & T85/ ASTM C127-88).

Table 4 No text of specified style in document.: Water Absorptions Test Values

S. No.	Sources	Water Absorption %
01	Margalla Hills	0.2 %
02	Palai Malakand	0.61 %

Crushing strength test

Table 5: Crushing Strength Test Values

S. No.	Sources	Crushing Value %
01	Margalla Hills	19.5 %
02	Palai Malakand	24.1 %

Impact value test

Table 6: Impact Test Values

S. No.	Sources	Impact Value %
01	Margalla Hills	17.25 1.87%
02	Palai Malakand	21.2 %

Flakiness & Elongation test

Table 7: Shape Test Values

S. No.	Source	Flakiness Index	Elongation Index
01	Margalla Hills	1.66 %	17.9 %
02	Palai Malakand	1.45 %	16.95 %

Physical Properties of Bitumen

The study evaluates the physical properties of binders using AASHTO/ASTM standard procedures. The bitumen used in this study is of the 60/70 penetration grade.

Penetration test

Table 8: Penetration Test on 60/70 grade Bitumen

S. No.	Penetration in 10th of (mm)			Grade
	Readings	Readings	Readings	
01	67	64	68	60/70
02	65	68	62	
03	68	61	64	

Softening point test

Table 9: Softening Point Test on Pure Bitumen

S. No.	Rate of Heating Temperature (^{0}C)
1	64
2	62

Safety tests

Table 10: Safety Tests on Bitumen

Test Properties	Test Numbers			Mean
	1	**2**	**3**	
Flash Point	271 ^{0}C	269 ^{0}C	272 ^{0}C	270.6 ^{0}C
Fire Point	274 ^{0}C	273 ^{0}C	275 ^{0}C	274 ^{0}C

Specific gravity test

Specific gravity of bituminous material at 25°C is 1.054.

Ductility test

Table 11: Ductility Test for Bitumen

Tests	Specimen Numbers			Mean
	1	2	3	
Ductility (cm)	107	101	112	106.67

Marshall Tests

The experimental mix design includes the preparation of 15 samples each for Margalla Hills and Palai Malakand, incorporating varying binder percentages of 3.5, 4, 4.5, 5, and 5.5.

Figure 2: Marshall Mix Asphalt Samples

Results and Discussions

Marshall Mix Design

Table 12: Volumetric Test Results

Source	% Bitumen	G_{mb} (%)	G_{mm} (%)	Flow (mm)	Stability (Kg)	VA (%)	VMA (%)	VFA (%)
Margalla Hills	3.5%	2.33	2.252	2.5	1404	7.75	17.35	55.252
Palai Malakand		2.37	2.524	2.5	1348	4.3	17	60.19
Margalla Hills	4%	2.35	2.507	2.5	1513	6.1	17.35	55.252
Palai Malakand		2.39	2.518	2.8	1445	5	16.25	67.63
Margalla Hills	4.5%	2.37	2.477	3	1477	4.29	16.76	74.48
Palai Malakand		2.37	2.509	3	1408	5.25	16	67.07
Margalla Hills	5%	2.37	2.466	3.3	1420	3.71	17.05	78.23
Palai Malakand		2.39	2.509	3.3	1356	5.45	16.25	71.07
Margalla Hills	5.5%	2.36	2.462	3.65	1307	4.08	17.96	77.32
Palai Malakand		2.37	2.508	3.65	1319	4.6	17.65	68.98

Bulk Specific Gravity (G_{mb}), Theoretical Specific Gravity (G_{mm}), Air Voids (AV), Voids in Mineral Aggregates (VMA), and Voids Filled with Asphalt (VFA).
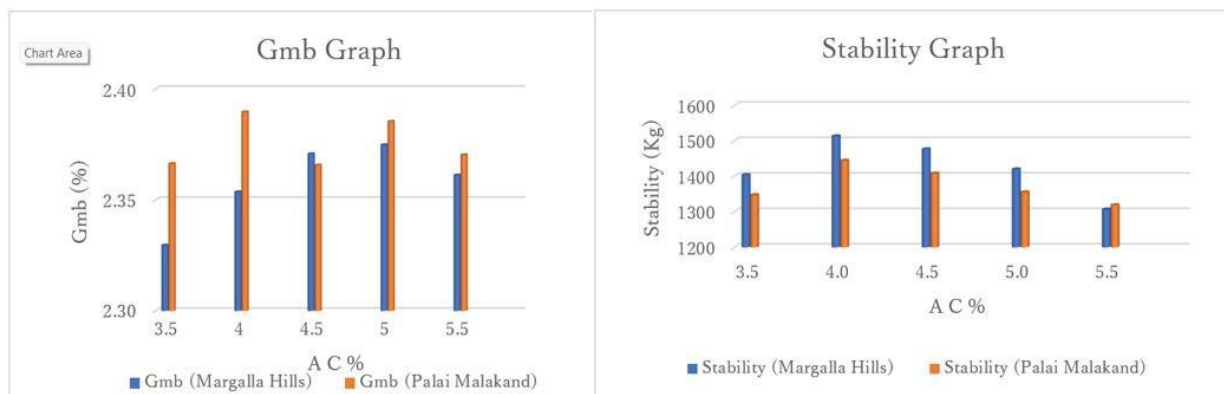
Comparison of Volumetric Properties

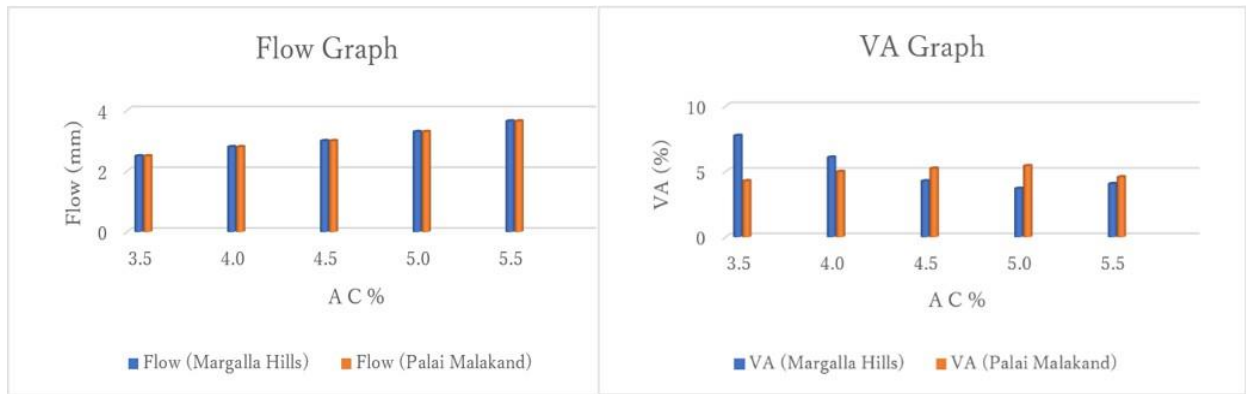Figure 3: Comparative Graphs of Gmb & Stability
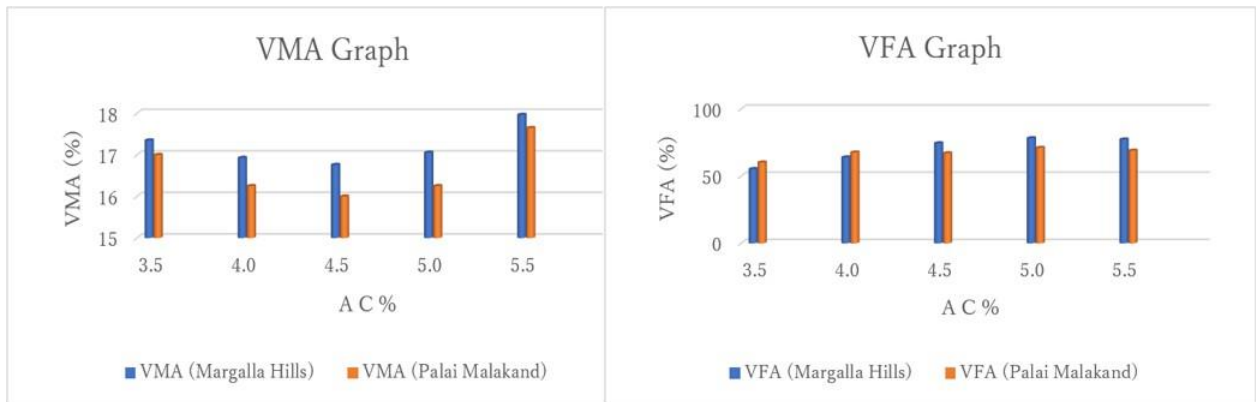
Figure 4: Comparative Graphs of Flow & Air Voids

Figure 4: Comparative Graphs of Voids in Mineral Aggregates & Voids Filled With Asphalt

Conclusion

The study examines aggregate properties and bitumen properties from Margalla Hills, Islamabad and Palai Malakand to set new standards for Pakistan. It evaluates the efficiency of mixed bituminous road mixes and compares volumetric properties. The study suggests using limestone aggregate from Margalla Hills to strengthen pavement materials and improve durability. Tests on compacted mixtures with traditional and modified bitumen from waste plastic showed Margalla Hills source mixtures have superior stability, stiffness, fatigue resistance, and deformation resistance. The optimum binder content is 5.0%, and the patterns and shapes are like those from Palai Malakand.

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Model study of Cable Stayed Retaining Wall

Osama Wali, Fayyaz Ullah, Hamzah Mohammd Ali Shamsan Zaid, Muhammad Suliman

University of Engineering and Technology Peshawar, Pakistan,

Abstract

Retaining walls are unit engineering structures used to maintain soil and facilitate traffic flow between locations. They require transportation of raw materials but can be fabricated as hinged cable stayed RCC panels. In this study, a 450mm x 450mm steel box is fabricated with one side hinged, and sand backfill is applied to apply active lateral earth pressure. The reaction at the top of the wall is measured using a proving ring. The height of the wall or backfill is determined using a surcharge load in four steps of 25kg, 50kg, 75kg, and 100kg. The theoretical active thrust and reaction at the top of the wall for cable tension are formulated. A steel structure app called "Frame" is used to analyze the reaction and tension in the cable in the wall.

Keywords Retaining Wall, fabrication, backfill, proving ring, RCC.

Introduction

A wall that keeps back soil or water on one side is called a retaining wall. Retaining walls are vertical or almost vertical structures that are used above ground to level off sloped lands to maximize building space, to build terraces for infrastructure to run down slopes, and to add support to unstable natural slopes. In towns and cities, they are also utilized to build the walls of metro stations, underground parking garages, and basements.

The convectional structure of retaining wall consumes a lot of money and resources. In situ construction is required, which is time consuming. Transportation of raw materials are problematic in some areas.

Cable-stayed RCC slabs are a pre-fabricated, reusable alternative to conventional retaining walls, allowing construction anywhere and ensuring soil retention.

Types of Retaining Walls

Retaining walls are engineering structures used to block roads or fall in trending areas like basements. They can be restricted by quartz, anchored by wise, or cantilever RCC with a base entrenched in the soil for passive resistance and bearing.

Retaining walls can be classified into three types: gravity, cantilevered, and sheet pile. Gravity walls are designed to resist pressure from behind and are often made of segmental concrete units or mortar less stone. They don't require a rigid base and can be dry-stacked. Cantilevered walls use a steel-reinforced internal stem of cast-in-place concrete or mortared masonry to transfer horizontal pressures behind the wall into vertical pressures on the ground below. They can be buttressed or have counter forts on the back.

Sheet pile walls are commonly used in soft soil and confined places. They are buried in the ground and require a wrap anchor, or "dead man," to be connected to the wall. Bored pile retaining walls are created by assembling a series of bored piles and excavating the leftover dirt. They may include earth anchors, reinforcing beams, soil enhancement techniques, and a shotcrete reinforcement layer. Anchored retaining walls are created using cables or stays fastened to the soil or rock behind the wall. Anchors are often bored into the material and enlarged mechanically or frequently by injecting pressurized concrete. These types of retaining walls are useful when significant loads are anticipated, or the wall must be thin to avoid

beingtoo weak.

Research Methodology

Sample Collection:

Sand samples are obtained from stock material, requiring 200kg of local material, and stored in polythene bags to maintain water content. Tests are conducted accordingly.

Determination of water content of Sand:

Table 1: Determination of Water content

Sample number	1
Number of the water can and lid	15
MC = Masses of a clean, empty can plus a lid (grams)	7.83
Mass of that can, lid, and wet soil (MCMS) (grams)	13.43
Mass of can, cover, and dry soil (MCDS) (grams)	12.69
SS = Soil Solids Mass (grams)	4.86
Weight of pore water is MW (grams)	0.74
W% is the water content.	**15.2**

Unit Weight of Sand:

Table 2:Determination of unit weight of sand and its average

Test no.	1	2	3	4
Weight of mould (W1)	W1	W1	W1	W1
Weight of mould + dry sand (W2)	W2	W2	W2	W2
Weight of sand (W)	W	W	W	W
Sand Unit weight $\gamma = \frac{W}{V}$	$\frac{W}{V}$	$\frac{W}{V}$	$\frac{W}{V}$	$\frac{W}{V}$
Average γ	$\gamma_1 + \gamma_1 + \gamma_1 + \gamma_1$			

Specific Gravity:

The density of a substance is determined by its ratio to another substance's density, such as purewater. Gravity is calculated by dividing the concentration of a liquid sample by its density. Thedensity of soil solids is determined by dividing its volume by its mass.

Table 3: Specific Gravity of Soil Solids

Item	Test no		
	6	8	9
Volumetric flask No.	6	8	9
Mass of flask + water filled to mark, W_1 (g)	666.0	674.0	652.0
Mass of flask + soil + water filled to mark, W_2 (g)	722.0	738.3	709.93
Mass of dry soil, W_s (g)	99.0	103.0	92.0
Mass of equal volume of water as the soil solids, $W_w(g) = (W_1 + W_s) - W_2$	37.0	38.7	34.07
$G_{s\,(T_1C)} = W_s/W_w$	2.68	2.66	2.70
$G_{s(20C)} = G_{s(T_1\,C)}\, xA$	2.68	2.66	2.70

Sieve Analysis:

Sieve analysis is a technique used to determine the distribution of grain sizes in soil for engineering applications. It involves braiding wires with square apertures to form sieves, withthe No. 200 sieve being the most used filter. The process involves gathering a sample of oven-dried dirt, breaking it into separate particles, determining the sample's mass, setting up a pile of sieves, pouring the dirt into the sieve stack, shaking the stack, and calculating the dirt weight.If clay or silty soil is retained, it must be cleaned and dried.

Table 4: Typical sieve analysis calculation.

No Sieve	Size(mm)	Retained Weight (g)	Cumulative (%) Weight Retained	Total Retained Percentage (%)	Passing Rate (%)
#4	4.75	0	0	0	100
#8	2.36	0	0	0	100
#16	1.18	66	66	6.6	93.4
#30	0.6	286	352	35.2	64.8
#50	0.3	396	748	74.8	25.2
#100	0.15	236	984	98.4	1.6
#200	0.08	16	1000	100	0
Pan		0	1000		
Total		1000		315	

Direct Shear Test:

The direct shear test apparatus is a strain-controlled device used to test soil specimens. It consists of a shear box, a proving ring, dial gauge dials, a yoke, and a soil specimen. The process involves disassembling the shear box, filling it with sand, determining the soilspecimen's dimensions, and applying the desired normal load. The device then measures soil deformation using dial gauges and a proving ring gauge. The test ensures a maximum and constant reading.

Results and Discussions:

Water Content of Sand:

Moisture content in sand samples affects soil engineering properties, particularly clayey soil.Test results show moisture content as a percentage of solid weight.

Table 5: Observation and calculation of water content

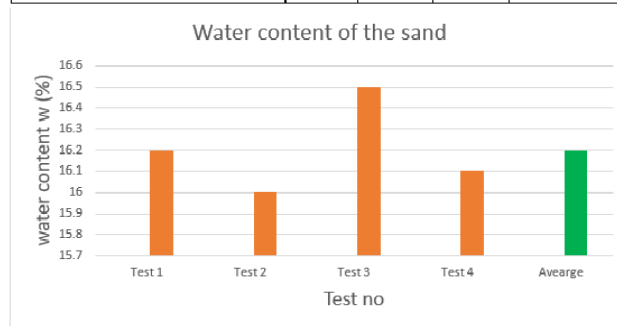| Item	Test No			Average
Can no.	42	31	54	43
Mass of can, W_1 (g)	17.31	18.92	16.07	17.32
Mass of can + wet soil, W_2 (g)	43.52	52.19	39.43	44
Mass of can + dry soil, W_3 (g)	39.86	47.61	36.13	40
Mass of moisture, $W_2 - W_3$ (g)	3.66	4.58	3.30	3.56
Mass of dry soil $W_3 - W_1$ (g)	22.55	28.69	20.06	22.8
Moisture content, $w(\%) = \frac{W_2 - W_3}{W_3 - W_1} \times 100$	16.2	16.0	16.5	16.2

Figure 1: Water Content of Sand

Specific Gravity

Table 6: Observation and calculation

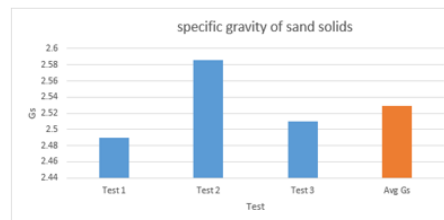| S.no	Specific Gravity (SSD)	Bulk Specific Gravity
1	2.49	2.531
2	2.586	2.587
3	2.51	2.531

Figure 2: Specific Gravity

Unit Weight of Sand

This study tests sand unit weight, a property crucial for soil shear strength, slope stability, and bearing capacity, with an average value of 18.5 kN/m^3.

Sand Gradation

Table 7: Observations and Calculations:

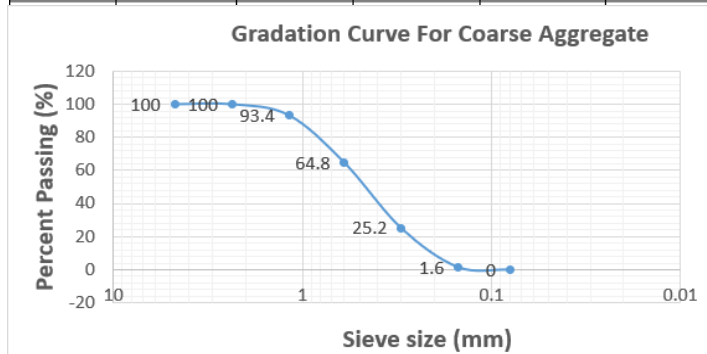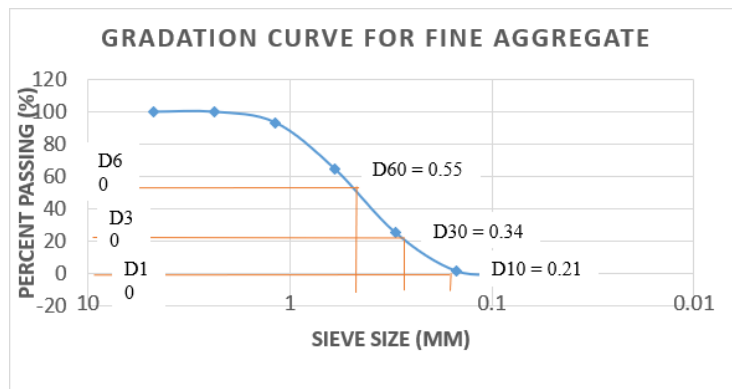| No Sieve	Size(mm)	Retained Weight (g)	Cumulative (%) Weight Retained	Total Retained Percentage (%)	Passing Rate (%)
#4	4.75	0	0	0	100
#8	2.36	0	0	0	100
#16	1.18	66	66	6.6	93.4
#30	0.6	286	352	35.2	64.8

Figure 3: Coarse Aggregates

Figure 4: Fine Aggregates

Sand Shear Strength Parameters

This study conducted direct shear tests at Abasyn Soil lab to determine the shear strength parameter of sand, revealing a 30° angle of internal friction.
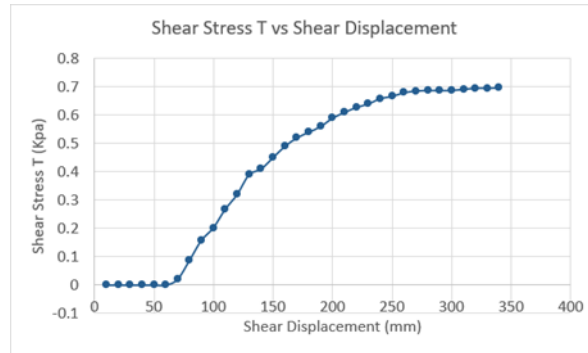
Normal Load of 2.54 kg

Figure 5:Shear Stress vs Displacement Graph for Normal load 0f 2.54 kg
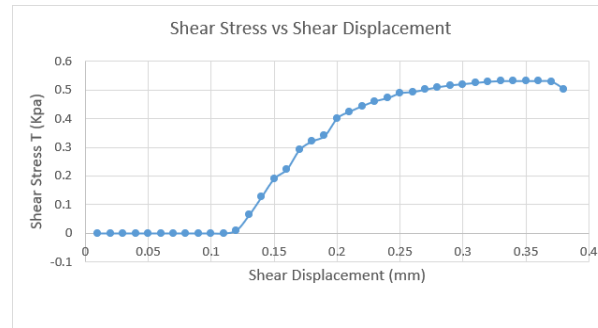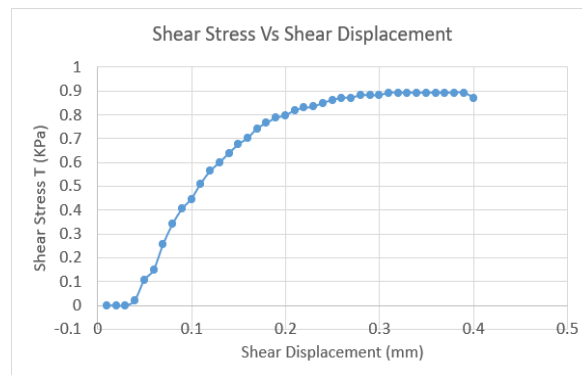
Normal Load Of 4.46 Kg

Figure 6:Shear Stress vs Displacement Graph for Normal load 0f 4.46 kg

Normal Load of 7.007 kg

Graph 7:Shear Stress vs Displacement Graph for Normal load 0f 7.01 kg

Calibration of Proving Ring

Table 8: Observations

Reading	Weight
0	0
20	1.275
32	1.9
42	2.5
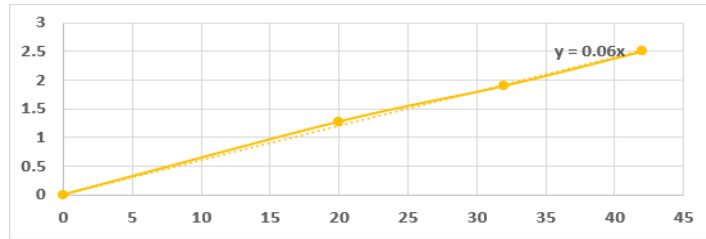
Graph 8: Graphical Representation

Calibration factor of proving ring = 0.06

Results of Direct Shear Test

Table 9: Results OF DST

Weight (kg)	W*12 (kg)	AREA (m)	SIGMA N (kpa)	T MAX
0	0	0.0036	0	0
2.54	30.48	0.0036	1.065734266	0.5307
4.46	53.52	0.0036	1.871328671	0.8917
7.007	84.084	0.0036	2.94	1.47983
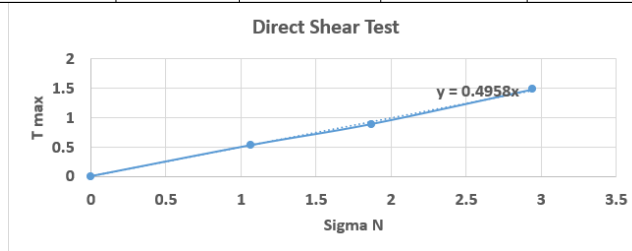
Figure 9: Graphical representation

Table 10: Observations and Calculations

Load (kg)	Dimension N (mm)	R
O	0	0
25	30	1.8
50	57	3.43
75	108	6.48
100	173	10.83
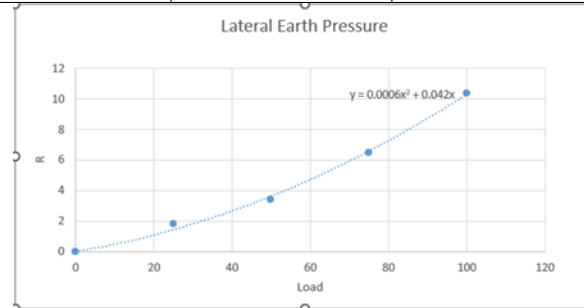
Graph 10: Graphical representation

Pa= 2.74 KPa per running meter. It means that total 2.74 surcharge acting from the back fill onthe retaining wall.

Conclusions

A new method for cable stayed and hinged RCC soil retaining is proposed, using a soil retainingwall model at Abasyn University Soil Mechanics Lab. Normal load is applied, and tension in the cable follows theoretical trends, with slight variations due to test quality.

This study examines the effect of lateral earth pressure on a hinged steel box with a poorly graded Sand backfill. The tension in the cable at the top is measured using a proving ring. Theheight of the wall and the sand backfill are analyzed using surcharge loads in four steps. The theoretical top reaction per unit wall width is compared with the actual reaction. The study finds a compatible trend of parabolic variation between the cable tension and the wall/backfillheight.

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Empowering Academia: The Impact of disclosure Stigmatized Identity on Performance of Academia, mediated by Psychological Empowerment and Perceived Organizational Support as a moderator

Adeeba Khan

FMH&SS, University of Poonch, Rawalakot

Abstract

This study explores the intricate connection that exists in the academic domain between psychological empowerment, academic performance, disclosure of a stigmatized identity, and the moderating effect of perceived organisational support. This empirical study explores the dynamics of identity disclosure and provides information about how it affects academic performance.Utilizing a broad sample of academic staff and faculty members from different universities, the study uses a methodology to gather quantitative data.The empirical findings reveal a multifaceted relationship between stigmatized identity disclosure, psychological empowerment, and academic performance.The study's results demonstrate that stigmatized identity disclosure significantly impacts academic performance. Individuals who disclose stigmatized aspects of their identity experience both positive and negative effects on their performance. For some, disclosure can be a catalyst for growth and empowerment, it may lead to increased academic performance. These effects are partially mediated by psychological empowerment, suggesting that how individuals perceive and internalize their disclosed identity plays a pivotal role in shaping their academic outcomes.Furthermore, the moderating effect of perceived organizational support is a critical dimension of this research. The study uncovers that the level of support perceived from the academic institution can exacerbate the impact the relationship between psychological empowerment on performance. Higher levels of perceived organizational support mitigate the negative consequences of identity disclosure, promoting psychological empowerment and ultimately enhancing academic performance. These findings have significant implications for academic institutions, suggesting that fostering an inclusive and supportive environment can empower individuals to thrive academically, regardless of their stigmatized identities.

Keywords: Disclosure Stigma, Psychological empowerment, Perceived organizational support and Academic performance.

Introduction

It's not easy to disclose stigmatised identities or "mental" distress at work. It might be helpful and allow people to get support, adjustments, and care (Zamir, Tickel, & Sabin-Farrell, 2021), but it might also run the risk of stigma and discrimination.While the UK Equality Act 2010 and the Americans with Disabilities Act 1990 forbid employers from discriminating against people experiencing MHPs, not all people who are distressed may characterize their distress as "mental impairment," as defined by these laws (Irvine, 2011), leaving them unprotected from disability discrimination. Additionally, employers can only make modifications if they are aware of the "impairment." As such, people who are in distress might want to think twice before disclosing information. Early research revealed a relationship between stigmatised people's beliefs and their attitudes, both positive and negative. Employees who receive support from others at work become more confident and share with others (Khan, 2019). According to our research, the participants' top concern when determining whether to disclose was how their actions might influence other

people's opinions at work. Most participants only disclosed information selectively, but more than one-third disclosed information to everyone.

During the application process or after beginning work, many participants made the decision to disclose; however, this happened very infrequently during the interview phase. Many also disclosed (also known as retrospective disclosure) following problems they encountered at work. A little more than one-third of participants thought that telling coworkers and supervisors had a positive effect. From the past findings , approximately 73% of participants who had personal experience , challenges chose to disclose these issues to their managers (Dewa et al.,2021). It means employees disclose their identities when they feel more empowered psychology but past research studies did not considered that disclosure of identities positively associated with employees empowerment.

At workplace employees who perceive that they have managers and their positive support encourage them to disclose their identities and become more productive as compared to those who concealed their identities with co-workers(Evans-Lacko & Knapp , 2016). At workplace employees with stigmatized identities , try to disclose their identities for better outcome and adjustment of his/ her position with other (Brouwers et al., 2020), empowering employees as well as performance of organization.Consistent with prior research, the results imply that deliberate disclosure can reduce stigma and discrimination (Toth, 2022). When workers believe they are psychologically empowered, they reveal their identities at work. Studies have shown that empowering employees can help businesses gain and maintain a competitive edge in their marketplaces (Kim et al., 2018, p. 257). The relationship between task performance and structural empowerment was partially mediated by psychological empowerment (Amor, Xanthopoulou, Calvo & Pablo Abeal Vazquez, 2020).

Businesses looked at psychological empowerment as a performance- and engagement-boosting management strategy (Boamah & Laschinger, 2015). Employees' intrinsic motivation is increased, which encourages them to reveal their identities at work in order to keep up their performance. Academic institutions ought to acknowledge the significance of psychological empowerment and establish a nurturing atmosphere to foster the professional growth of their faculty members, thereby contributing to higher productivity levels.

Employees' intrinsic motivation is increased, which encourages them to reveal their identities at work in order to keep up their performance. Academic institutions ought to acknowledge the significance of psychological empowerment and establish a nurturing atmosphere to foster the professional growth of their faculty members. This, in turn, can enhance universities' performance. According to earlier research, psychological empowerment can effectively increase people's motivation for their jobs and foster an improvement in job performance (Meng & Sun, 2019). "Intrinsic task motivation reflecting a sense of self-control in relation to one's work and an active engagement with one's work role" is what psychological empowerment is defined as. (Al-Tobasi, Moinuddin, and Omar, 2016) Positive organisational outcomes can be predicted in large part by empowerment (Seung, Gaeun, Seung & Dong, 2016).

It is the perception that workers have of having control over their working circumstances (Matsuo, 2019). However, people behave differently in social and individual contexts. They analyse and appraise their relationship with their organisation on an ongoing basis (Brown, 2017). When individuals have a deep emotional connection to a specific group, their social identities become more apparent (Becker & Barreto, 2019; Chas, Fontela & Neira, 2019). When workers feel more psychologically empowered, they reveal their identities more frequently at work, which improves organisational performance overall. This study sheds light on the need for more research on

contextual variables related to organisations. Academic performance and disclosure stigma are mediated by psychological empowerment.

Additionally, research indicates that psychological empowerment is sustained when workers perceive support from their organisations or supervisors.People's POS increases their responsibilities to organisations so they can return the favour (Maan, 2020). They also wish to integrate organisational affiliation into their social identity and fulfil their socioemotional needs. Furthermore, research to date has demonstrated that people's POS improves both in-role performance, such as performance (Walumbwa et al., 2017).Furthermore, according to Wang et al. (2017), POS encourages favourable results like increased job satisfaction and improved performance. POS can increase people's confidence and trust that the company recognizes their abilities and gives them the appropriate authority (Astuty,, & Udin, 2020).

Theoretical Framework
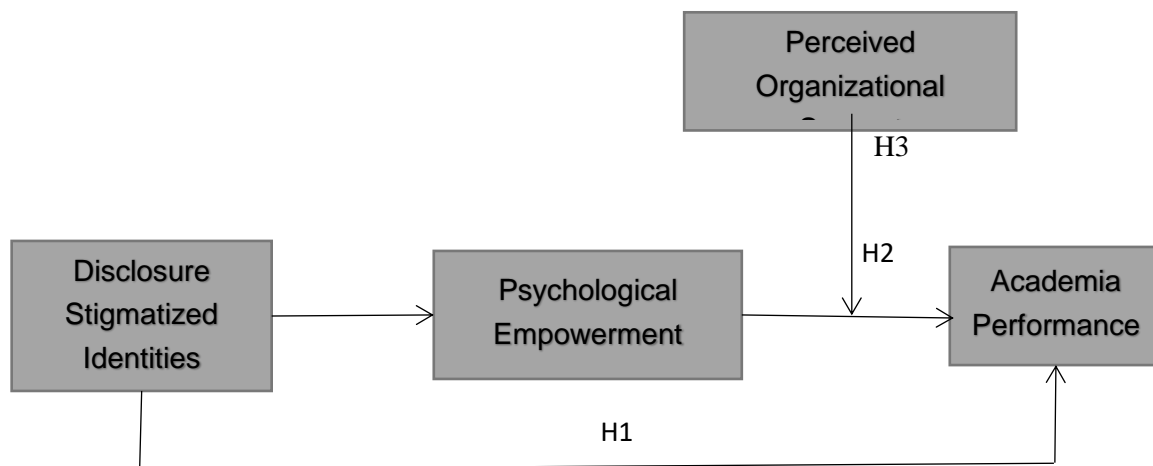
Research Approach

This particular section details the approach and tools utilized to ascertain the connections between disclosure stigmatised workers in the workplace, using perceived organisational support as a moderating variable and psychological empowerment as a mediating mechanism. The current study uses a time-lagged survey design to gather data from the target population.

Time-Lagged Study Framework

This study emphasizes the design of time-lag surveys. Two time lags were used to collect the data. Data was collected for disclosure stigma and PE in the first time lag. In fact, academic performance and point-of-sale data were collected at a later date. 300 questionnaires were sent out during the initial time lag, and 280 replies were received. The remaining answers were eliminated because there was insufficient information in them. Likewise, during time lag 2, the writer disseminated 200 surveys and obtained 250 responses. Because 50 responses were disregarded because their answers were missing from the data, the final sample size was 250. both the population and the sample A centre for contacting people was established in several public and private Higher Education Institutions (HEIs) in Azad Jammu between June 2023 and September2023.

Study Findings and Outcomes

The primary data collection and analysis methods and techniques used in this study were quantitative research methods and techniques. Does the disclosure stigma effect make it harder for employees to perform well enough to meet the study's objectives and provide the desired answer? Additionally, statistical analysis was employed to determine the role psychological empowerment as a mediator. And POS as a moderator in the relationship between psychological empowerment and academia's performance.

Additionally, data for the state of Azad Kashmir was obtained using a sample size of 250. Assess the consistency of the data and all study variables using a reliability test. When all latent and observed variables have alpha values, they are all consistent.

After utilizing a self-administrative questionnaire to evaluate the internal consistency of the data, current study also looked at the validity of a few chosen instruments. The structure and validity of the data factor analysis (CFA) have been investigated through the application of confirmatory factor analysis. Four research variables were used in this study: an independent, a dependent, a mediator, and a moderating variable.

T1: Confirmatory Factor Analysis

	Chi-Square	df	CMIN/Df	RMSEA	IFI	TLI	CFI
Initial model	3661.787	1675	1.686	0.050	0.910	0.874	0.931
Modified model	3455.554	1660	1.579	0.047	0.881	0.899	0.876

The initial model's values are displayed in the above table according to several criteria, including RMSEA.050, IFI.910, TLI.874, and CFI. 931. There were few opportunities to obtain new values even after multiple adjustments were made to achieve the goodness of model fit. The model's validity for hypothesis testing is increased because all of the adjusted values meet the threshold condition (Hair, Ringle & Sarstedt, 2013). Following model execution, the model's fitness was determined by the RMSEA =.047, which is less than.05. Additionally, the model's fitness for hypothesis testing was determined by the IFI =.881, TLI =.89, and CFI =.8, all of which met the threshold values.

Correlation Analysis

T2. Correlation Analysis

Sr#	Variables	Disclosure Stigma	Psychological Empowerment	Perceived Organizational Support	Academia Performance
1	DS	1			
1	PE	.52*	1		
3	POS	.663**	.344*	1	
4	AP	.45*	.470*	.633**	1

*Note: * p < 0.05; ** p < 0.01*

The aforementioned table established a statistically significant negative correlation (r=.52, p <.05) between academic performance and disclosure stigma. P and disclosure stigma had a significant correlation (r=-.663, p<.01). According to the available data, there is a significant correlation (r=.45,p<.01) between disclosure stigma and POS.

Testing Hypothesis

Hypothesis 1: Disclosing stigmatized identities at workplace is positively related with academic performance.

T3: un-standardized co-efficient for Structural Path

Structural Path	β	S.E	P-Value	***
DS ———— ACA	.452	.087	.001	=

p<.001, *β= (Un-standardized Beta), SE= standard error*

The table mentioned above illustrates the significant and positive relationship between an employee's disclosure of stigmatised identities and their academic performance (β =.45, p =.001). The statistical findings indicated that there is a positive correlation between higher DS and higher performance in both the public and private academic sectors. Therefore, hypothesis 1 has been accepted.

Hypothesis 2. Employees psychological empowerment mediates in the relationship between their stigmatized identities and performance of HEIs.

T4: Mediation Analysis

H2	Direct path	B	P-value		
	DS ⟶ AP	.452	.001		
	Specific Indirect effect				
	DS ⟶ PE ⟶ AP	0.314	.023		
	Total Effect			UL	LL
	DS ⟶ AP	0.839	.000	.011	.234

Result showed that there is a partial mediation and H2 is accepted.

Hypothesis 3.   Perceived organizational support moderates the relationship between (high) employees' psychological empowerment and performance. The greater the POS the lower negativity between SE and performance

T5: Moderation Analysis

Structural path	Co-efficient	P-value
PE ———— AP	.39	P<.001
POS ———— AP	.33	P<.001
Int_Term1 (POSX PE)	.42	P<.05

H3 is accepted because the interaction term results (β=.42, p=.05) demonstrated that POS had a highly positive impact on the relationship between high PE and performance.

Conclusion

According to the current research study, academic performance improves when workers reveal their stigmatised identities at work. Employees who are stigmatised in Pakistan's academic sector have studied the reasons behind the obstacles and difficulties they encounter when trying to advance to high positions. Many management science studies have examined career growth and adaptability in the past, but the barriers that keep workers—especially those who are stigmatized—from rising to the top have received less attention.Developing nations deal with these problems and make an effort to control labour force participation in businesses. This study looks at the stigma, which is still an imperceptible obstacle that hinders success. Additionally, the research backs up the idea that workers who have a high degree of

psychological empowerment find it difficult to take advantage of opportunities.There are various ways to empower employees and lessen negativity in the workplace. To find out where and how much middle-level employees—including administrative and non-administrative staff—face these challenges, data was gathered from them using statistical tools.

Implications of the research

The results of the study hold significance for policymakers, organisations, human resource personnel, researchers, administrators, academia, and other relevant stakeholders in Pakistan who are keen on enhancing the career prospects of women. Organisations need to comprehend employees' habits and attitudes in order to keep them on staff and sustain productivity. Consider developing new strategic approaches to ensure that stigmatised employees receive equal treatment in light of the study's findings. This study helps the business understand that handling stigmatised workers calls for a special approach. They ought to be given the opportunity to advance, and their full potential must be realized.
Their job satisfaction and organisational commitment will increase if this problem is fixed, which will help the business flourish and become more profitable. Additionally, having a successful career and seeing their professional status rise gives them a sense of psychological empowerment that ultimately results in happiness. Therefore, these reforms might give the labour force more negotiating leverage in the business and public sectors, as well as the opportunity to work as second-income earners, which would support academic achievement in the home.

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Complexities of Directional Surveys in Drilling: A Data-Driven Investigation

Haseeb Raza, Sikandar Bilal
University of Engineering and Technology Peshawar,Khyber PakhtunKhwa, Pakistan.

Abstract

The significance of directional drilling operations in the real-time decision-making process during drilling necessitates a comprehensive grasp of multiple drilling parameters. This research aims to devise an approach for optimizing drilling in real-time by establishing correlations between drilling and MWD (Measurement While Drilling) parameters. Utilizing machine learning techniques on historical drilling data, this study observes and indicates the independent factors effect on dependent variables such as the inclination of the well. The outcome is expected to facilitate precise trajectory control, enhancing well-completion efficiency. This innovative approach has the potential to transform directional drilling practices, resulting in cost savings, reduced drilling times, and heightened accuracy, thereby contributing to the overall success of oil and gas operations.
Keywords: Machine Learning, Measurement While Drilling, Decision-making, management and operations.

Introduction

Directional drilling is vital in exploring and extracting oil and gas resources. It involves steering the wellbore along a planned trajectory to maximize reservoir access and productivity. However, the complexity of directional drilling operations, coupled with uncertainties and various factors, often leads to suboptimal decision-making, resulting in costly drilling inefficiencies, reduced productivity, and increased risks. Therefore, there is a critical need to improve the decision-making process in directional drilling (Torkildsen et al., 2004).

Three categories of parameters exist drilling parameters, hydraulic parameters, and MWD survey parameters, which govern the comprehensive drilling operation and facilitate the successful advancement of the borehole into the desired target section. These parameters are skillfully adjusted by their concern specialists, considering various factors such as alterations in formation composition, transition zones, and downhole negative pressure. Within these parameters, a distinction is made between dependent and independent variables. The Measurement While Drilling Survey is dependent upon drilling and mud parameters. The MWD survey signal is transmitted through the mud medium, generated by a pulser that responds to directional sensor data by emitting pulses. This complex relationship of parameters and factors creates a network of direct and indirect relationships that collectively influence the drilling process (Desbrandes & Clayton, 1994)

In the pursuit of refining drilling operations, this study employs Artificial Intelligence as a potent analytical tool. By investigating the dynamic relationship between crucial drilling parameters such as RPM, mud viscosity, mud pressure, stem vibrations, and weight on bit, this analysis seeks to illuminate the delicate relationships that shape drilling Measurement While Drilling Survey. Through this focused exploration, valuable insights emerge, bridging the gap between academic inquiry and practical advancements in engineering management.

Literature Review

Artificial intelligence (AI) systems are recognized for their ability to address complex, ambiguous problems by learning from data, handling noisy and incomplete information, tackling non-linear issues, and swiftly making predictions and generalizations. Different fields such as Control system, robotics, pattern recognition, medicine applications have been innovated and emphasize AI technique's significant role in modeling and predicting combustion processes' performance and control across various disciplines within ignition systems, demonstrating AI's potential as a valuable design tool (Tunkiel et al., 2021),(Gharbi & Mansoori, 2005).

Supervised learning (SL) uses techniques such as Linear Regression (LR), Support Vector Machines (SVMs), Decision Trees (DT), and Random Forests (RF). Machine learning is a broad discipline that includes several subfields. Principal Component Analysis (PCA) and K-means clustering are two methods used in unsupervised learning (UL). Semi-supervised learning is exemplified by techniques such as propagation and label spreading (SSL). Last but not least, Q-learning and deep Q network (DQN) techniques define reinforcement learning (RL). These many subfields of machine learning provide useful tools and approaches for problem-solving and data analysis in a variety of fields. (Radwan et al., 2022), (Wei et al., 2021).

Shaygan and Jamshidi's study examines the effects of cutting journey and weight on the bit (WOB) on the rate of penetration (ROP) in drilling operations using random forest regression modelling and multilayer perceptron (MLP) neural networks. Statistical measures and K-fold cross-validation is used to validate the models, and the results show satisfactory performance. (Shaygan & Jamshidi, 2023).

Critical analysis of the significant literature items reveals their significance in drilling operations and engineering management. The studies by (Shaygan & Jamshidi, 2023), (Gabdrakhmanova et al., 2021),(Niu et al., 2021), and (AL-Bahadly, 2023) all employ different statistical techniques to investigate the impact of various drilling parameters on critical outcomes like rate of penetration (ROP), oil production, and shale gas well recovery. Even though each research offers insightful information, it's clear that the study focused on comprehending the intricate connections between these factors and drilling success. The robustness of these results is increased by the use of several approaches and validation procedures, which makes them applicable to both practical drilling industry applications and scholarly development. There is a need for more research, though, especially in terms of how these discoveries might be applied to improve operational and engineering management.

(Gabdrakhmanova et al., 2021) Utilizes multiple regression analysis to examine the relationship between natural resources and production potential indicators and oil production. The research employs Fisher's F-test for validation and finds a strong, positive correlation between the variables studied. Within the existing literature, there is a noticeable gap in the comprehensive exploration of the intricate relationships between drilling parameters and directional Pulses while considering engineering management aspects. While previous studies have examined individual parameters and their impacts, there is a need for a holistic approach that integrates these factors and provides actionable insights for informed decision-making in drilling operations. This gap highlights the opportunity for our research to contribute to a more comprehensive understanding of the field, filling the void in current knowledge and approaches (Gabdrakhmanova et al., 2021).

Table 8: Dependent and independent variables in directional drilling with satisfactory results from past studies.

Reference	Independent Variable	Dependent Variable	Results
(Shaygan & Jamshidi, 2023)	weight on the bit (WOB) and cutting transport	ROP	Satisfactory ROP
(Gabdrakhmanova et al., 2021)	natural resource and production potential indicators	Oil production	Impacts of factors on oil production
(Niu et al., 2021)	19 geological and engineering factors	Ultimate recovery of shale gas wells	Improved the Production efficiency
(Saihati et al., 2021)	Drilling parameters	Surface drilling torque	Detected downhole abnormalities
(Halafawi & Avram, 2019)	horizontal profile, Kick-off point (KOP), horizontal turn trajectory, vertical turn determination, and mud weight	long radius horizontal well	Optimized wellbore profile
(Koryabkin et al., 2019)	mechanical parameters of drilling, tool-face data, MWD/LWD data, etc.	Drilling bit position and direction determination	Accuracy in Well trajectory
(Tunkiel et al., 2021)	Sensors data	Inclination	Accurate result after 180m training data
(Li et al., 2018)	drilling data of earlier drilled wells	lost circulation	Accurate prediction model of lost circulation

A study investigates the ultimate recovery of shale gas wells by employing multiple regression methods. Research comprises 19 geological and engineering factors and demonstrates that the approach improves efficiency in estimating shale gas well recovery (Niu et al., 2021). In the proposed work, AL-Bahadly uses statistical calculation and regression analysis to analyze the influence of parameters such as weight on the bit (WOB), revolutions per minute (RPM), hardness-specific index (HSI), and torque on the rate of penetration (ROP) in drilling operations. The study yields a high coefficient of determination (R^2) of 0.842 and a low root-mean-square error (RMSE) of 0.74, indicating the effectiveness of his models (AL-Bahadly, 2023). There is much research aiming at the effects of MWD Pulses. In the research work, Andrzej T. Tunkiel has taken only inclination data of the single well data, and found accurate results after preprocessing 180m drilling (Tunkiel et al., 2021).

This research proposal significantly contributes to the existing literature by addressing a critical gap in the field. While the literature reviews offered valuable insights into various aspects of drilling operations and

analysis techniques, none specifically delve into the intricate relationships between drilling parameters and directional Pulses while emphasizing the role of engineering management in decision-making.

Methodology

In this research methodology date of a directional well has been collected and the well type was S-type Which means the results and outcomes will be only applicable to the S-type directional wells. The data was collected from one of the OGDCL National Rig, all of the MWD service are collected in the section in which degree was build to 12 degrees and then drop to 0 degree approximately. From daily morning report of drilling there are different variables that were collected such as an independent variables like Drilling parameter and mud parameters Is with age dependent variable such as MWD survey outcomes like inclination.

Directional driller confronts a lot of complexities while performing the task, so all those parameters are considered to be analyzed to find the regression on dependent variable inclination of each independent variable. A simple regression approach is Adopted to find the r square value and the P value, By this analysis it will be calculated that which of the variable has the most Significance and the variation change in inclination.
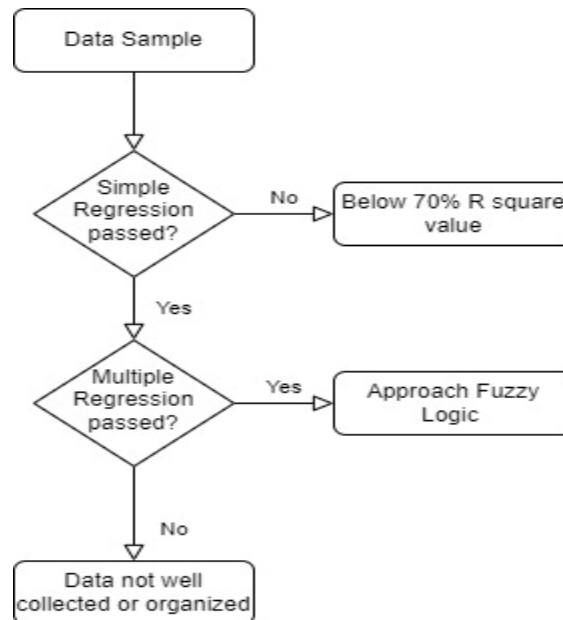

Figure 1: Methodology flowchart diagram

Methodology flowchart diagram shows the study working process, data sample has been processed by simple regression and below 70% R-square variables that have weak effect on inclination are excluded for next round of analysis. Multiple regression has been performed on those with more than 70% R-square values and are considered to be processed further for fuzzy logic analysis. Failing multiple regression analysis is declared as weak data collection or disorganized data sample.

Data Collection and Analysis

Data is gathered from an oil and gas OGDCL rig, it was a directional section data which was build to 12 degrees then drop vertical, well was S-type. Multiple parameters were gathered for analysis from daily drilling report, covering both dependent and independent variables, include average weight on bit (ave

WOB), RPM, GPM, average torque, pressure, viscosity, density, measured depth, inclination, and azimuth. These variables are critical considerations in directional drilling operations. The collected parameters were then categorized into dependent and independent variables.

Table 9: Data Collected from a directional well.

Ave WOB (tons)	RPM	GPM	Pressure (Psi)	Viscosity	Density	Measured depth	Inclination	Azimuth
4	144	624	1950	60	1.3	781	1.4	220.4
4	144	624	1950	60	1.3	838	3.1	128
4	144	624	1960	58	1.32	896	7.3	109.1
4	144	624	1960	58	1.32	925	8.1	108.3
4	144	624	2000	58	1.33	1011	11.5	106.1
4	144	624	2000	58	1.33	1040	12	107.9
4	157	676	2270	55	1.37	1068	12.2	108.2
4	157	676	2270	55	1.37	1094	12.1	108.3
4	154	624	2150	57	1.4	1153	12.7	108.5
4	154	624	2150	57	1.4	1182	12.5	108.7
6	154	624	2200	59	1.4	1211	12.4	108
6	154	624	2200	59	1.4	1239	12.3	108.2
4	137	583	2050	58	1.4	1296	11.9	108.4
4	137	583	2050	58	1.4	1327	11.7	107.9
5.5	142	583	2100	59	1.4	1348	11.8	107.8
5.5	136	546	2100	58	1.4	1381	12.4	109.5
4.5	141	546	2120	59	1.4	1411	12.4	110.4
4.5	141	546	2120	59	1.4	1440	12.5	110.5
4.4	141	546	2100	56	1.4	1468	12.4	112.5
4.4	141	546	2100	56	1.4	1497	12.4	110.9
4	155	603	2330	58	1.4	1553	12.7	110.2
4	155	603	2330	58	1.4	1582	11.6	112.9
5	155	603	2350	61	1.44	1610	10.4	114.4
5	155	603	2350	61	1.44	1640	8.5	113.6
5	164	624	2450	60	1.47	1668	7.1	116
5	164	624	2450	60	1.47	1696	4.7	122.5
5	164	624	2600	62	1.47	1725	3.4	128.4
5	164	624	2600	62	1.47	1754	2.3	138.4
5	164	624	2600	60	1.47	1782	1.8	150.2
5	164	624	2600	62	1.47	1811	1.1	159.1
2.5	169	600	2600	62	1.47	1840	1.6	159.5
2.5	174	624	2600	60	1.47	1869	1.9	170.5
2.5	174	624	2600	62	1.47	1898	2.5	170.3
2.5	174	624	2600	62	1.47	1927	2.4	170
2.5	174	624	2600	62	1.47	1956	2.2	170.1
2.5	169	624	2600	61	1.47	1985	2.1	179.3
2.5	160	572	2600	62	1.5	2027	1.9	165.5

Results and Discussion

Managing inclination-dependent variable during drilling proves challenging when considering independent variables. However, implementing a system programmed to process real-time data inputs rapidly would be a commendable initiative within the oil and gas industry. simple regression method is employed to assess the significance and variation between the variables with the response variable Y to transition this analysis into a practical approach.

Table 10: Simple regression analysis of the variables to the response variable

X Variable	P Value<	R Square	Y Variable
Density	0.001	87.65	Inclination
Pressure (Psi)	0.001	86.73	Inclination
Azimuth	0.001	86.2	Inclination
Measured depth	0.001	79.92	Inclination
Viscosity	0.001	68.27	Inclination
RPM+MOTOR	0.001	46.48	Inclination
Ave WOB (tons)	0.003	29.7	Inclination
GPM	0.015	21.91	Inclination

A multiple regression analysis is conducted to establish a higher degree of significance by selecting the most impactful four variables concerning the response variable. Density with 87.65% variation, Pressure with 86.73% variation, Azimuth with 86.2% variation, and Measured depth with 79.92% variation are represented by each Xs in Y. Viscosity. RPM, Ave WOB, and GPM are excluded because these variables do not explain additional variation in the Y variable. These four variables were accepted to further analyze the multiple regression approach, which results showing 97.64% variation explained by the regression model shown in the figure below. This study indicates the factor that can be considered to make some more in-depth experience of other directional well data to cross the results. Once verified, it will be an excellent opportunity to opt for a fuzzy logic approach to enhance decision-making in real-time while drilling. The data will be of S-type well because the data used in this study is of S-type well, so it will better explain the same type of well only.

By the multiple regression equation, the inclination's future value can be predicted, providing the X variables. This approach is used for a single well, single section data where the angle builds to 12 degrees and then drops back to approach 0 degrees. These relations can be used to analyze data in a Fuzzy logic approach, leading to making a possible decision in real time while drilling.
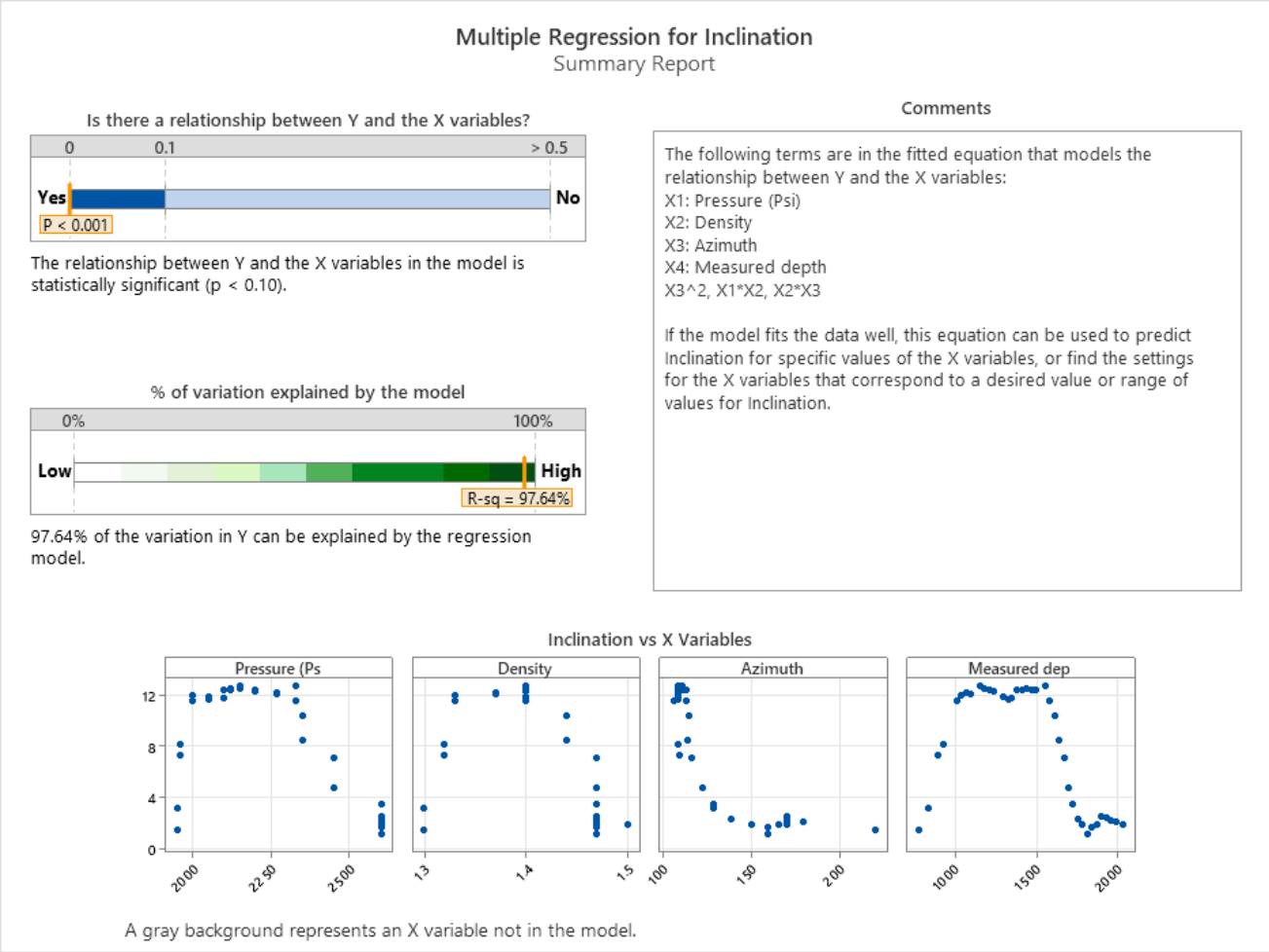
Figure 2: Multiple Regression of the most important factors to the response variable.

Conclusion

In conclusion, the comprehensive research methodology employed in this study successfully addressed the identified knowledge gaps in directional drilling operations. Combining theoretical insights from an extensive literature review and practical observations from field visits facilitated a well-rounded analysis. The collected data, encompassing critical parameters in directional drilling, underwent thorough analysis using simple and multiple linear regression approaches. The significance of various independent variables to the response variable, Inclination, was explored, with Density, Pressure (Psi), Azimuth, and Measured depth emerging as the most influential factors. Adopting a multiple regression analysis further enhanced the model's predictive capabilities. Integrating fuzzy logic approaches presents a promising avenue for refining the predictive accuracy in real-time drilling scenarios. The dynamic and complex nature of drilling operations could benefit from the adaptability and nuanced decision-making essential in fuzzy logic systems, suggesting a valuable direction for future research and application in the oil and gas industry.

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Free Convection MHD Flow of Fractional Nanofluids Through a Porous Medium with Uniform Heat Source and Heat Flux

Muhammad Adnan, Sami Ul Haq, Asad Khan*

Department of Mathematics, Islamia College Peshawar, Peshawar 25000, Pakistan

*Corresponding author email: asadkhan.mathicp@gmail.com

Abstract

In this article, the free convection flow of nanofluids taking into consideration the MHD effect over a vertical infinite plate and through a porous medium is examined. The ambient external agent did not affect the system, i.e., the heat source is uniform and constant. Boussinesq approximation, momentum, and continuity equations formulate the governing equations. The developed governing equations are solved with the use of the Caputo-Fabrizio fractional operator and the technique of Laplace. Nanofluids' velocity and temperature are set in precise form. Such solutions fulfill all initial and boundary requirements. The impact of fractional parameters on heat transmission and fluid movement is highlighted and debated graphically. Compared to ordinary nanofluids, the increase in heat transfer in these flows for fractional nanofluids is greater. In addition, using fractional models, we can select the fractional parameters to achieve a good consensus on both experimental and theoretical findings. The results obtained are represented in terms of physical parameters to give physical significance to the provided governing equations. Moreover, when the strength of the magnetic field and the permeability of the porous medium number turn zero in this paper, the general solution obtained reduces the literature to special cases.

Keywords: Porosity, MHD, Laplace transformation, Nanofluids, Caputo-Fabrizio.

Introduction

The transfer of heat is mainly related to cooling applications [1]. Fluids like ethylene, oils, glycol and water have been used as cooling agents, but they do not have a more effective and thermal conductivity. In the past, the field of heat exchange increasing by increasing in heat transfer fluids to increase the heat dissipation, but it was expensive and thermal management was needed. Rapid growth and demand in power station, comprising chemical production, microelectronics and modern technology a new sort of fluids are needed that should be therapeutically efficient and that meet heating/cooling requirements, Choi [2] has implemented the nanofluid technology for the first time. Nanofluid consists of particles in nanometer format known as nanoparticles, usually coming from Al_2O_3 (oxides), AlN, SiN (nitrides) or non-metallic elements (graphite, carbon nanotubes) and metallic elements (Al, Cu) a fluid called base fluid like. ethylene, oil, glycol, water, and bio fluid polymers. The nano particle sizes are between 1nm-100nm. Nanofluids include 5 percent volume fractions of nanoparticles for excellent thermal transfer improvements. Nanofluids are used extensively in fuel cells, engines of hybrid-powered, pharmaceutical processes, including microelectronics in engineering equipment for ship-sand in boiler flue gas temperature decrease and in space, defense, nuclear reactor, in machining, heat exchanger in grinding, chiller, engine vehicle, domestic refrigerator and cooling/thermal management. Nanofluids are also very compatible and don't have other

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problems such as further pressure reduction, erosion or sedimentation [3-4]. In view of its practical use and wide range of applications for cooling and heat transfer, numerous scientists have focused on thermal characteristics of nanofluid in recent decades. Couple fractional nanofluids which contain CuO and the Ag water nanoparticles, are analytically and graphically studied Fetecau et al [5] with a uniform temperature and thermal radiation on an infinite vertical plate closed form of solution for dimensional velocity, Nusselt number, temperature and coefficient of skin friction using a time derivative of Caputo and Laplace transformation. Ellahi et al [6] examined the transparent, thin film of metallic tactile nanoparticles covering the surface of a spinning disk. A smooth, hydrodynamic particle access for numerical reproduction of nanofluid flows was discussed by Nasiri et al [7]. An exact heat and mass transfer analysis passing a vertical oscillating plate with Newtonian heating by using integral transform technique received by Hussanan et al [8]. Moreover, they obtained Skin friction, Sherwood and Nusselt numbers and displayed in tabular forms. Also they analyzed that raising the Newtonian heating parameter improves the distribution of velocity and temperature, while skin friction reduces and heat transfer rates boost. Turkilmazgolu [9] discussed the impact of unstable flow and heat transfer of certain nanofluids which move upon a vertical surface. Ellahi et al [10] examined the Jeffrey peristaltic fluid beneath the results of porosity and slip beneath the constraints of the low number of Reynolds and long wavelengths. The combination of nanofluid and heat transfer inserts was discussed by Rashidi et al [11].

Magnetohydrodynamics (MHD) are known as the flow of fluid in a magnetic area. Magnetic fields influence natural as well as man-made flows. It is possible to view the implementation of the magnetic field in energy generation [12] in industry to stir, to pump and to levitate liquid metals. Molten metals that produce the magnetic field called terristal magnet field are found in the earth's core, the solar magnets and the sun spot generate solar magnets. Due to its practical application the combined study on MHD is very critical with heat transfer. The combined impacts of heat transfer flow of magnetohydrodynamics (MHD) beneath the impact of a slip over a moving flat plate was studied by Ellahi et al [13]. Khan et al [14] used the technique of Laplace to find out the accurate solutions for velocity as well as temperature of Sodium MHD flow Alginate based nanofuid sort Casson heaving Newtonian heating over a porous medium. Ellahi et al [15] analytically conducted the study of thermal conductivity with temperature variation and magnetic field with angle of inclination on a steady plane Poiseuille flow with equal flat wall temperature and suction / injection. The evolution of organic matter and the combustion kinetics of Tarfaya and Timahdit oil shales were investigated with thermogravimetry (TG) and differential thermal analysis (DTA) by Barkia et al [16]. Magnetohydrodynamics (MHD) impact of on a non-Newtonian peristaltic type flow of Carreau fluid in a rectangular cross section uniform duct was studied by Ellahi et al [17]. A creative strategy is proposed to increase the heat generation in the peristalsis nanofluids flux under the effect of MHD in asymmetrical channel by Khan et al [18]. Khan and Khan [19] used technique of Laplace to find out the analytical solution of viscous abatement of Darcy flow under the effect of MHD upon the inclusion of heat transfer and copper nanoparticles of an incompressible Newtonian nanofluids EG-Cu and water-Cu above a flat sheet through a porous medium. Khan et al [20] used Fourier transformation to get exact solutions for velocity as well as shear stress of Brinkman type fluid has MHD impact on infinite plate and enclosed in a channel. The numerical solution of Entropy generation of nanofluid among strectching angular discs influenced by the MHD and thermal radiation investigate by Hosseinzadeh et al [21] through Runge Kutta method. Alsagri et al [22] discussed the significance of MHD nanofluid in the existence of viscous dissipation. They reduced partial differential equation by similarity transformation into ordinary differential equation, and

resolved by ADM (Adomian Decomposition Method). It is found from the literature survey that the exact solution of the free convection flow with the participation of constant flux and heat sources under the effect of magnetohydrodynamics of some nanofluids on the porous medium is not investigated. The exact solution of a fractional Casson fluid upon the nanoparticles of MoS_2 with the definition of Atangana–Baleanu fractional time derivative by technique of Laplace was studied by Saqib et al [23].

Problem Formulation

Suppose there is an electrically conducting and non-compressible, free convection flow of nanofluids upon a moving perpendicular infinite plate in the xz-plane having a fixed system of cartesian co-ordinates x, y and z. The fluid and the plate are at the constant ambient temperature $T_{1\infty}$ at the initial t = 0. After this moment the plate that slids in the x-direction of its plane at speed $U_o(1 - e^{-\gamma_1 t})$ is subject to a boundary condition of isoflux. The non-Darcian model is implemented, and viscous dissipation is disregarded in the energy equation as it is small size. This hypothesis, generally in free convection flows, small velocities can explain. The robust efficiency of nanofluids varying at a flow rate can be severely limited. In fact, the distribution to a basic fluid of nanoparticles is followed by a dynamic viscosity development that significantly reduces (or decreases) velocity rate. Thus, nanoparticles can't be suspended by random in such a fluid. It must be monitored or even optimized. Since the plate is infinite, the heat transfer is characterized by all the measurable numbers and the functions of fluid motion are y and t only. Nanofluids here consist of water and nanoparticles [as a base fluid] CuO, Cu or Ag, TiO_2, Al_2O_3. Table 1 shows the physical and thermal characteristics of particles.

Table1. Thermo-physical characteristics of nanoparticles and water [20].

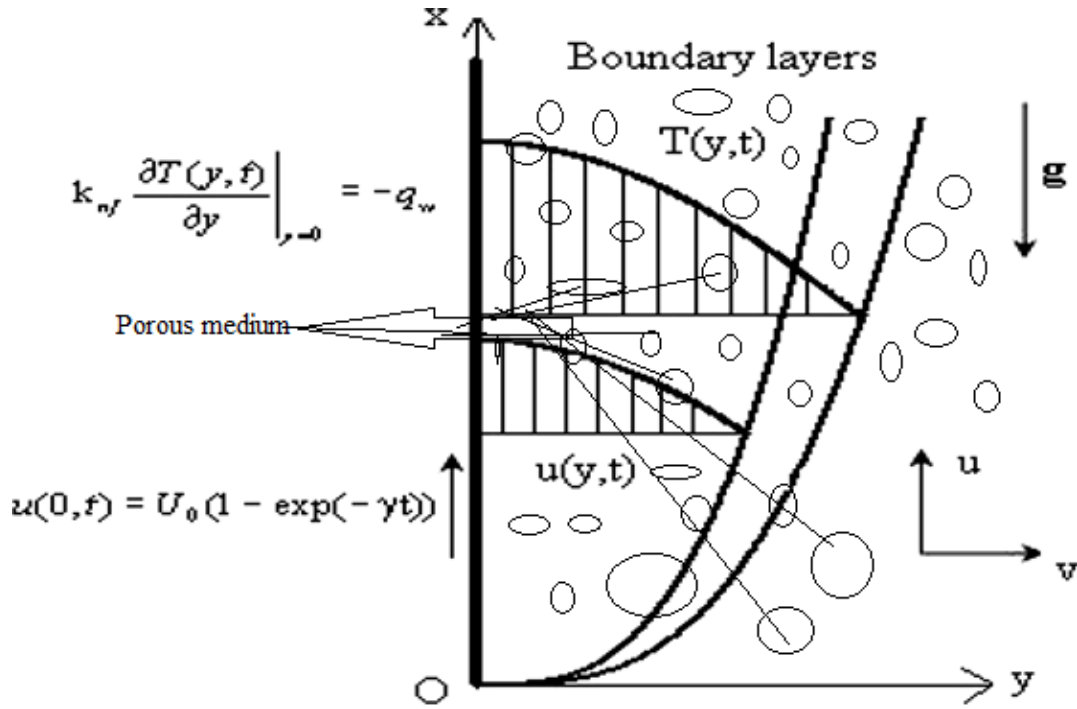|	ρ(kg/m^3)	C_p(J/kg K)	k(W/mK)	$\beta \times 10^5$(/K)
Silver (Ag)	10500	235	429	1.89
Alumina (Al$_2$O$_3$)	3970	765	40	0.85
Copper Oxide (CuO)	6320	531.8	76.5	1.8
Copper (Cu)	8933	385	401	1.67
Pure Water	997.1	4179	0.613	21
Titanium Oxide (TiO$_2$)	4250	686.2	8.9538	0.9

Figure.1 Water-based nanofluid geometry that flows across a vertical plate.

he Boussinesq general approximation provides the relevant nanofluid governing equations;

$$\rho_{1nf} \frac{\partial u_1(y,t)}{\partial t} = \mu_{1nf} \frac{\partial^2 u_1(y,t)}{\partial y^2} - \sigma_{1nf} B_{10}^2 u_1(y,t) - \frac{\mu_{1nf}}{K_1} u_1(y,t) + g_1 (\rho\beta)_{1nf} [T_1(y,t) - T_{1\infty}]$$

$y, t > 0$ (1)

$$(\rho c_{1p})_{1nf} \frac{\partial u_1(y,t)}{\partial t} = k_{1nf} \frac{\partial^2 u_1(y,t)}{\partial y^2} - Q_1 [T_1(y,t) - T_{1\infty}], \quad y, t > 0 \tag{2}$$

here $\rho_{1nf}, k_{1nf}, \mu_{1nf}, \beta_{1nf}, \sigma_{1nf}, B_{1o}, K_1, g_1, Q_1$ and $T_1(y,t)$, represent the density, the thermal conductivity, the dynamic viscosity, the thermal expansion coefficient, the electrical conductivity, the magnetic field strength, permeability of the porous medium, the acceleration gravity, the coefficient of heat absorption or generation and temperature of the nanofluids respectively.

The expressions of ρ_{1nf}, $(\rho\beta)_{1nf}$ and $(\rho c_{1p})_{1nf}$ can be seen in [20]

$$\begin{cases} \rho_{1nf} = \phi_1 \rho_{1s} + (1-\phi_1)\rho_{1f} \\ (\rho\beta)_{1nf} = (1-\phi_1)(\rho\beta)_{1f} + \phi_1(\rho\beta)_{1s} \\ (\rho c_{1p})_{1nf} = (1-\phi_1)(\rho c_{1p})_{1f} + \phi_1(\rho c_{1p})_{1s} \end{cases}, \tag{3}$$

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here ϕ_1 denotes the nanoparticle volume fraction, ρ_{1f} denotes the fluid's density base, ρ_{1s} denotes the density of solid particle's and c_{1p} denotes the determined heat at a constant pressure. The equation for thermal conductivity efficient of the nanofluids also known as Hamilton and Crosser model is defined by [9] and is given as;

$$\frac{\kappa_{1nf}}{\kappa_{1f}} = \frac{\kappa_{1s} + (b-1)\kappa_{1f} - (b-1)\phi_1(\kappa_{1f} - \kappa_{1s})}{\kappa_{1s} + (b-1)\kappa_{1f}\phi_1(\kappa_{1f} - \kappa_{1s})}$$

(4)

where κ_{1nf} are nanofluids thermal conductivity, κ_{1f} are the base fluid, κ_{1s} are the solid particle thermal conductivity and b are nanoparticulate shape respectively. The values p=3 and p=3/2 for spherical nanoparticles and cylindrical nanoparticles respectively.

Loganathan *et al.* [20] defined the inter conversion of efficient, nanofluid and base fluid dynamic viscosity.

$$\mu_{1nf} = \mu_{1f}\, g(\phi_1)$$

(5)

$$g(\phi_1) = \frac{1}{(1-\phi_1)^{2.5}}$$

$$g(\phi_1) = 123\phi_1^2 + 7.3\phi_1 + 1$$

(6)

The associated boundary conditions and initial condition for the defined pdes [Eq.1 and Eq.2] are given as;

$$u_1(y,t) = 0 , \quad T_1(y,t) = T_{1\infty}, \qquad \text{at } t=0, \quad \text{and} \quad y \geq 0$$

(7)

$$u_1(y,t) = U_o\left\{1 - e^{-\alpha_1 t}\right\}, \text{ at } y=0, \ \alpha_1 \geq 0, \ \ k_{1nf}\left.\frac{\partial T_1(y,t)}{\partial y}\right|_{y=0} = -f_w, \quad t > 0$$

(8)

$$u_1(y,t) \to 0, \quad T_1(y,t) \to T_{1\infty} \text{ as } y \to \infty$$

(9)

f_w indicates heat that passes from wall surface.

By putting the following dimensionless parameters as well as functions

$$y^* = \frac{y}{L_0}, \ u_1^* = \frac{L_0}{v_{1f}}u_1, t^* = \frac{v_{1f}}{L_0^2}t, \ \varphi_1 = \frac{k_{1f}}{b_w}(T_1 - T_{1\infty}), \ L_0 = \left(\frac{k_{1f}v_{1f}^2}{g_1\beta_{1f}f_w}\right)^{\frac{1}{4}},$$

$$U_o = \frac{v_{1f}}{L_0}, \ \alpha_1^* = \frac{\alpha_1 L_0^2}{v_{1f}}, \ M^2 = \frac{\sigma_{1f}B_{1o}^2 L_0^2}{\rho_{1f}v_{1f}}, \ K_{1p} = \frac{L_0^2}{K_1}$$

(10)

and delete asterisk symbols, we get;

$$l_1 \frac{\partial u_1(y,t)}{\partial t} = \frac{\partial^2 u_1(y,t)}{\partial y^2} - l_5 u_1(y,t) - l_6 u_1(y,t) + l_2 \varphi_1(y,t), \quad y,t \geq 0 \tag{11}$$

$$l_3 \frac{\partial \varphi_1(y,t)}{\partial t} = \frac{\partial^2 \varphi_1(y,t)}{\partial y^2} - l_4 \varphi_1(y,t), \quad y,t \geq 0 \tag{12}$$

$$u_1(y,t) = 0, \ t=0, \ \alpha_1 \geq 0, \ \varphi_1(y,t) = -0, \ t = 0 \ \text{and} \ y > 0 \tag{13}$$

$$u_1(y,t) = U_o\{1 - e^{-\alpha 1 t}\}, \ f(p, \varphi_1) \frac{\partial \varphi_1(y,t)}{\partial y}\Big|_{y=0} = -1, \ y=0 \ \text{and} \ t > 0 \tag{14}$$

$$u_1(y,t) \to 0, \ \varphi_1(y,t) \to 0 \ \text{as} \ y \to \infty \tag{15}$$

l_1, l_2, l_5, l_6, l_3 ,and l_4 are some constants used on the equations above and could be described as;

$$\left[\begin{array}{l} l_1 = \frac{1}{g(\phi_1)}\left[(1-\phi_1) + \phi_1 \frac{\rho_{1s}}{\rho_{1f}}\right], \ l_2 = \frac{1}{g(\phi_1)}\left[(1-\phi_1) + \phi_1 \frac{(\rho\beta)_{1s}}{(\rho\beta)_{1f}}\right], \\[4mm] l_3 = \frac{\text{Pr}}{f(p,\phi_1)}\left[(1-\phi_1) + \phi_1 \frac{(\rho c_{1p})_{1s}}{(\rho c_{1p})_{1f}}\right], \ l_4 = \frac{v_{1f} Q_1}{f(p,\phi_1)\sqrt{g_1 \beta_{1f} k_{1f} f_w}}, \\[4mm] l_5 = \frac{\sigma_{1f} B_{1o}^2 L_0^2}{\rho_{1f} v_{1f} \ f(\phi_1)} = \frac{M^2}{g(\phi_1)}, \ l_6 = \frac{L_0^2}{K_1} = K_{1p}, \ \text{Pr} = \frac{(\mu c_{1p})_{1f}}{k_{1f}} \end{array} \right] \tag{16}$$

in the above relations $\textbf{Pr}, M$ and K_{1p} denote Prandtl number, magnetic parameter and inverse permeability respectively.

For nanofluids, take a fractional model and thus.

$$l_1 \ ^{CF}D_t^{\beta_1} u_1(y,t) = \frac{\partial^2 u_1(y,t)}{\partial y^2} - l_5 u_1(y,t) - l_4 u_1(y,t) + l_2 \varphi_1(y,t), \ 0 < \beta_1 \leq 1, \ \text{for} \ y,t \geq 0 \tag{17}$$

$$l_3 \ ^{CF}D_t^{\gamma_1} \varphi_1(y,t) = \frac{\partial^2 \varphi_1(y,t)}{\partial y^2} - l_4 \varphi_1(y,t), \ 0 < \gamma_1 \leq 1, \ \text{for} \ y,t \geq 0 \tag{18}$$

In addition to the specified imposed conditions Eq. [(13), (14) and (15)]

Now using Laplace transforms over Eq. (18) and using imposed conditions, we get

$$l_3\left(\frac{s\overline{\varphi_1}(y,s)-\overline{\varphi_1}(y,0)}{(1-\gamma_1)s+\gamma_1}\right)=\frac{\partial^2\overline{\varphi_1}(y,s)}{\partial y^2}-l_4\overline{\varphi_1}(y,s)\ . \tag{19}$$

The simplified form of Eq.(19), is

$$\frac{\partial^2\overline{\varphi_1}(y,s)}{\partial y^2}=\overline{\varphi_1}(y,s)\left[\frac{l_3 f}{(1-\gamma_1)s+\gamma_1}+l_4\right], \tag{20}$$

$$\frac{\partial^2\overline{\varphi_1}(y,s)}{\partial y^2}=\overline{\varphi_1}(y,s)\left[\frac{a_1 s+a_2}{s+a_3}\right], \tag{21}$$

where

$$a_1=\frac{l_3}{(1-\gamma)}+l_4,\ a_2=\frac{l_4\gamma}{1-\gamma},\ a_3=\frac{\gamma}{1-\gamma},\ \gamma\in(0,1)$$

The Laplace inversion of Eq.(14) and Eq.(15) are;

$$\frac{\partial\overline{\varphi_1}(y,s)}{\partial y}\Big|_{y=0}=\frac{-1}{f(p,\phi_1)s},\ \ \overline{\varphi_1}(y,s)\to 0\ \text{as}\ y\to\infty \tag{22}$$

Put Eq. (22) in Eq. (21) and solve we get;

$$\overline{\varphi_1}(p,s)=\frac{1}{f(p,\phi_1)}\frac{1}{s}\overline{v_1}(y,s;a_1,a_2,a_3) \tag{23}$$

Where $\overline{v_1}$ is defined as;

$$\overline{v_1}(y,s;a_1,a_2,a_3)=\frac{1}{s}\sqrt{\frac{s+a_3}{a_1 s+a_2}}\,e^{-y\sqrt{\frac{a_1 s+a_2}{s+a_3}}}=\frac{1}{s}\frac{1}{\sqrt{w_{1\gamma}(s)}}e^{-y\sqrt{w_\gamma(s)}}$$

here

$$w_{1\gamma}(s)=\frac{a_1 s+a_2}{s+a_3}=\frac{\left[l_3+(1-\gamma_1)l_4\right]+l_4\gamma_1}{(1-\gamma_1)s+l_4} \tag{24}$$

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Now let's find out $\overline{\psi}$, what's solved by means of Laplace inversion, but the function given above is not a simpler one, this feature is compound and could be described as;

Let the Laplace inversion of $F_1(s)$ is $f_1(t)$ so that, $f_1(t) = L^{-1}\{F_1(s)\}$, then Laplace inversion of compound function $F_1(w_1(s))$, could be described as;

$$L^{-1}\{F_1(w_1(s))\} = \int_0^\infty F_1(u_1)f_1(u_1,t)du_1 \quad \text{and}$$

$$f_1(u_1,t) = L^{-1}\left\{\exp\left(-u_1 w_1(s)\right)\right\} \tag{25}$$

In the Appendix (A) you can find the significant outcomes and formula.

The Laplace inverse of Eq.(24) gives

[where $F_1(s) = \left(\dfrac{1}{\sqrt{s}}\right) e^{-y\sqrt{s}}$ and $w_1(s) = w_{1\gamma}(s)$], and using the relation defined in appendix (A1),

we obtain $v_1(y,t;a,b,c)$ which is Laplace inversion of $\overline{v_1}(y,s;a_1,a_2,a_3)$ as:

$$v_1\left(y,t;a_1,a_2,a_3\right) = \left\{ \begin{array}{l} \dfrac{1}{\sqrt{\pi}} H_1(t)\displaystyle\int_0^\infty \dfrac{1}{\sqrt{\pi}}\exp\left(\dfrac{-y^2}{4u_1} - a_1 u_1\right)du_1 + \\[3mm] \sqrt{\dfrac{a_1 a_3 - a_2}{\pi}}\displaystyle\int_0^\infty \exp\left(\dfrac{-y^2}{4u_1} - a_1 u_1\right)\times \\[3mm] \displaystyle\int_0^\infty \dfrac{e^{-a_3 s}}{\sqrt{s}} I_1\left(2\sqrt{(a_1 a_3 - a_2)us}\right)dsdu_1 \end{array} \right\}, \tag{26}$$

Here, $H(t)$ (Heaviside unit step function) and $I_1(.)$ (modified Bessel function of the first kind of order one). The simplified form of Eq.(26) is:

$$v_1\left(y,t;a_1,a_2,a_3\right) = \dfrac{1}{\sqrt{a_1}} H_1(t)e^{-y\sqrt{a_1}} + \sqrt{\dfrac{a_1 a_3 - a_2}{\pi}}\int_0^\infty \exp\left(\dfrac{-y^2}{4u_1} - a_1 u_1\right)\times\int_0^t \dfrac{e^{-a_3 s}}{\sqrt{s}} I_1\left(2\sqrt{(a_1 a_3 - a_2)u_1 s}\right)dsdu_1, \tag{27}$$

which is obtained by using formula given in appendix (A).

The Laplace inversion of Eq. (23), is

$$\varphi_1(y,t) = \frac{1}{f(p,\phi_1)} \frac{1}{s} v_1(y,t;a_1,a_2,a_3) \tag{28}$$

$v_1(y,t;a_1,a_2,a_3)$ is defined by Eq.(27). By computation Eq.(28) fulfills the imposed conditions.[(13),(14) and (15)].

From Ref. 20, we noted that the Nusselt number is

$$Nu_1 = \frac{L_0 f_w}{k_{1f}(T_{1w}-T_{1\infty})} = \frac{1}{\varphi_1(y,t)}\Big|_{y=0} = \frac{1}{L^{-1}\{\overline{\varphi_1}(0,s)\}} \tag{29}$$

$$Nu_1 = \frac{f(p,\phi_1)}{v_1(0,t;a_1,a_2,a_3)} \tag{30}$$

We find $v_1(0,t;a_1,a_2,a_3)$ by using

$$v_1(0,t;a_1,a_2,a_3) = L^{-1}\left\{ \begin{array}{l} \dfrac{1}{s}\sqrt{\dfrac{s+a_3}{a_1 s+a_2}} = \dfrac{1}{\sqrt{a_1}}\exp\left(\dfrac{-(a_1 a_3 + a_2)t}{2a_1}\right)\times I_o\left(\dfrac{-(a_1 a_3 + a_2)t}{2a_1}\right)H_1(t)+ \\[4mm] \dfrac{a_3}{\sqrt{a_1}}\times\displaystyle\int_0^t \exp\left(\dfrac{-(a_1 a_3 + a_2)\tau_1}{2a_1}\right)I_o\left(\dfrac{-(a_1 a_3 + a_2)\tau_1}{2a_1}\right)d\tau_1 \end{array} \right\} \tag{31}$$

where $I_0(.)$ (modified first kind of Bessel function of order zero).

For finding the thickness of non-dimensional of thermal boundary layer take the form of a differential fractional equation. We used the integration from $y=0$ to $y=\infty$ of thermal layer [Eq. (18)]

$$\eta_{1T}(t) = \int_0^{\eta_{1T}} \varphi_1(y,t)dy \tag{32}$$

Eq. (32) becomes by using Eqs. (14) and (15) ;

$$l_3 {}^{CF}D_t^{\gamma_1}\eta_{1T}(t) + l_4 {}^{CF}D_t^{\gamma_1}\eta_{1T}(t) = \frac{1}{f(p,\phi_1)} \tag{33}$$

To address Eq. (33) and using the conditions imposed, we shall obtain;

$$\eta_{1T}(t) = \frac{1}{l_4\, f(p,\phi_1)}\left[1 - \frac{l_3}{l_3 + (1-\gamma_1)l_4}\exp\left(\frac{-l_4\gamma_1 t}{l_3 + (1-\gamma_1)l_4}\right)\right] \tag{34}$$

Now to find non-dimensional velocity and the coefficient of skin friction, we use Laplace transform,

Eq. (17) become as;

$$\frac{\partial^2 \overline{u}_1(y,s)}{\partial y^2} = \frac{l_1 s \overline{u}_1(y,s)}{(1-\beta_1)s + \beta_1} + l_5\overline{u}_1(y,s) + l_6\overline{u}_1(y,s) - l_2\overline{\varphi}_1(y,s) \tag{35}$$

From Eq. (22)

$$\frac{\partial^2 \overline{u}_1(y,s)}{\partial y^2} = \frac{m_1 s \overline{u}_1(y,s)}{s + m_2} + l_5\overline{u}_1(y,s) + l_6\overline{u}_1(y,s) - l_2\frac{1}{f(p,\phi_1)s}\sqrt{\frac{s+a_3}{a_1 s + a_2}}\exp\sqrt{\frac{a_1 s + a_2}{s + a_3}}$$

(36)

$$m_1 = \frac{l_1}{1-\beta_1} \quad \text{and} \quad m_2 = \frac{\beta_1}{1-\beta_1}$$

After simplification and using initial and boundary conditions, Eq. (36) becomes,

$$\overline{u}_1(y,s) = \left[\begin{array}{c}\dfrac{\alpha_1}{s(s+\alpha_1)}\overline{\theta}_1(y,s;m_1,m_2,l_5,l_6) + l_2\overline{A}_1(s)\overline{\varphi}_1(y,s) \\[2mm] -l_2\overline{\varphi}_1(0,s)\overline{A}_1(s)\overline{\theta}_1(y,s;m_1,m_2,l_5,l_6)\end{array}\right] \tag{37}$$

where

$$\overline{\theta}_1(y,s;m_1,m_2,l_5,l_6) = \exp(-y\sqrt{V_{\alpha 1}(s)} = \frac{l_1 s}{(1-\beta_1)s + \beta_1} + l_5 + l_6, \tag{38}$$

and

$$\overline{A}_1(s) = \begin{cases} \dfrac{(s+a_3)(s+m_2)}{(m_1+l_5+l_6-a_1)s^2 - s(a_1m_2+a_2-m_1a_3-l_5a_3+l_6-a_3l_5m_2-l_6m_2)-(a_2m_2-l_5m_2a_3-l_6a_3m_2)} \\[4mm] \dfrac{1}{m_1-a_1}\left(1+\dfrac{g_1}{s-s_1}-\dfrac{g_2}{s-s_2}\right), \quad m_1 \neq a_1 \end{cases}$$

(39)

with

$$g_1 = \frac{(s_1+a_3)(s_1+m_2)}{s_1-s_2}, \quad g_2 = \frac{(s_2+a_3)(s_2+m_2)}{s_1-s_2}$$

(40)

and

$$s_{1,2} = \frac{\left[\begin{array}{c} a_1m_2+a_2-m_1a_3-l_5a_3-l_6a_3-l_5m_2-l_6m_2 \pm \\[2mm] \sqrt{(a_1m_2+a_2-m_1a_3-l_5a_3-l_6a_3-l_5m_2-l_6m_2)^2+4(a_2m_2-l_5m_2a_3-l_6m_2a_3)(m_1+l_5+l_6-a_1)} \end{array}\right]}{2(m_1+l_5+l_6-a_1)}$$

(41)

are the roots polynomial of

$$p(s) = (m_1+l_5+l_6-a_1)^2 - s(a_1m_2+a_2-m_1a_3-l_5a_3+l_6-a_3l_5m_2-l_6m_2)-(a_2m_2-l_5m_2a_3-l_6m_2a_3)$$

By applying Laplace inversion on Eq. (38) and using Eq.(25)

[with $G(s) = \exp(-y\sqrt{s})$ and $w(s) = v_\alpha(s)$] and using the relation given in (A6), we get;

$$\theta_1(y,t;m_1,m_2,l_5,l_6) = \delta_1(t)e^{-y\sqrt{m_1+l_5+l_6}} + \theta_o(y,t;m_1,m_2,l_5,l_6)$$

(42)

Where

$$\theta_o(y,t;m_1,m_2,l_5,l_6) = \frac{y\sqrt{m_1m_2}\,e^{-m_2t}}{2\sqrt{\pi t}}\int_0^\infty \frac{e^{(\frac{-y^2}{4u_1}-u(m_1+l_5+l_6))}}{u} \times I_1(2\sqrt{m_1m_2u_1t})\,du_1$$

(43)

where $\delta_1(.)$ (dirac delta function). The Laplace inversion of $\overline{A}_1(q)$, is;

$$A_1(t) = \frac{1}{m_1-a_1}\left(\delta_1(t)+g_1e^{s_1t}-g_2e^{s_2t}\right)$$

(44)

By taking Laplace inversion of Eq. (37) and used convolution theorem, we get

$$u_1(y,t) = \left\{1 - e^{-\alpha_1 t}\right\} e^{-y\sqrt{m_1 + l_5 + l_6}} + l_2 \int_0^t \left\{1 - e^{-\alpha_1(t-s)}\right\} \theta_o(y,s;m_1,m_2,l_5,l_6) ds + l_2 \int_0^t A_1(t-s)\varphi_1(y,s) ds$$

$$-l_2 \int_0^t \int_0^s \theta_1(0,t-s) A_1(s-\tau)\theta_o(y,\tau;m_1,m_2,l_5,l_6) d\tau ds$$

(45)

Clearly Eq. (45) fulfills the imposed conditions (initial and boundary) [(13), (14), and (15)].

A new amount of physical interest is the coefficient of skin friction specified by [20].

$$C_{1f} = \left\{ \begin{array}{l} \dfrac{\tau_{1w}}{\rho_{1f}(V_{1f}/L_0)^2} = g(\phi_1)\dfrac{\partial \overline{u}_1(y,q)}{\partial y}\Big|_{y=0} = g(\phi_1)L^{-1}\left\{\dfrac{\partial \overline{u}_1(y,s)}{\partial y}\Big|_{y=0}\right\} \\[4mm] = g(\phi_1)L^{-1}\left\{l_2 \overline{\varphi}_1(0,s)\overline{A}_1(s)\overline{A}_2(s) - \dfrac{l_2}{g(p,\phi_1)}\dfrac{1}{s}\overline{A}_1(s) - \dfrac{\alpha}{s(s+\alpha)}\overline{A}_2(s)\right\} \end{array} \right\}$$

(46)

Noted that

$$\overline{A}_2(s) = \sqrt{\dfrac{m_1 s}{s+m_2} + l_5 + l_6}$$

(47)

The coefficient of skin friction may be defined as;

$$C_{1f} = g(\phi_1)\left\{l_2 \int_0^t \int_0^s A_1(s-\tau)\varphi_1(0,t-s)A_2(\tau) d\tau ds - \dfrac{l_2}{f(p,\theta_1)} \times \int_0^t A_1(s) ds - \int_0^t A_2(s)\left\{1 - e^{-\alpha_1(t-s)}\right\} ds\right\}$$

(48)

also

$$B_1(t) = \sqrt{a_1}\left[\dfrac{a_1 m_2 - a_2}{2a_1} I_o(\dfrac{a_1 m_2 - a_2}{2a_1} t) + \delta_1(t)\right]\exp(\dfrac{-a_1 m_2 + a_2}{2a_1} t) + \dfrac{a_2 - a_1 m_2}{2\sqrt{a_1}} I_o(\dfrac{a_1 m_2 - a_2}{2a_1} t)\exp(\dfrac{a_2 - a_1 m_2}{2a_1}) t$$

(49)

4   Special Cases

When $B_o = 0$ and $K = 0$ the solution of Eq. (45) becomes

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$$u_1(y,t) = e^{-y\sqrt{m_1}}\left\{1 - e^{-\alpha 1t}\right\} + l_2 \int_0^t \left\{1 - e^{-\alpha 1(t-s)}\right\}\theta_o(y,s;m_1,m_2)ds + l_2 \int_0^t A_1(t-s)\varphi_1(y,s)ds$$

$$- l_2 \int_0^t \int_0^s \varphi_1(0,t-s)A_1(s-\tau)\theta_o(y,\tau;m_1,m_2)d\tau ds$$

(50)

this expressions for velocity is similar to Azhar et al [28].

Numerical Results and Discussions

This paper focuses on the transfer of heat in nanofluids that flows in a moving vertical surface/ plate across a permeable medium. The heat transfer took place in free convection mode at constant heat source and heat flux under the presence of a magnetic field. The exact solutions for the non-dimensional velocity and temperature equations were obtained by the Laplace transformation technique. The impacts of certain physical parameters i.e. fractional parameters, magnetic parameters, inverse permeability, nanoparticle volume fraction, the coefficient of skin friction, Nusselt number are disused. With the help of Mathcad software we have plotted the graph. The impact of fractional parameters on the heat transfer, thickness of thermal layer, nanofluids motions, velocity, Nusselt number, skin friction coefficient are debated in Eqs. 28, 30,45 and 4 and plotted.

The behavior of non-dimensional temperature $\varphi_1(y,t)$ is shown in figure.2 and figure.3 under fractional parameter γ_1 influence, in which particles made from copper $\left[Cu\right]$ of cylindrical having value $\left(p = \frac{3}{2}\right)$ and the spherical form $(p = 3)$ were they taken into account. With $t = 5$, $Q_1 = 25$, $\phi_1 = 0.1$ and $f_w = 0.008$, could be noted that the temperature of the fluids decreases by increasing γ. Therefore nanofluids have a high heat transfer relative to ordinary nanofluids. It is also clear from these figures that the same conditions apply to of t, Q_1 and f_w but with different values of ϕ_1 i.e. $\phi_1 = 0.2$ the temperature decreases. So the volume fraction of nanoparticles is conversely associated with temperature profile $\varphi_1(y,t)$. Cylindrical particles have a high thermal conductivity relative to spherical nanoparticles. Shown in figures. 4 and 5 that copper of different form factor, i.e. circular and cylindrical. It displays the relation between thermal layer thickness and time. The values in respect of $f_w = 0.008$, $Q_1 = 25$ and $\phi_1 = 0.1$. Figure.4 and figure.5 are related to factor in spherical shape with $(p = 3)$ and cylindrical shape with $\left(p = \frac{3}{2}\right)$. From the graphs it's clear that thickness of thermal layer $\eta_{1t}(t)$ is narrower about nanofluids fractional and bigger for ordinary nanofluids. The labels reveal the differing fractional

parameter values γ_1. It's likewise clear that $\eta_{1t}(t)$ is thicker to look for nanoparticles shape of spherical copper than for nanoparticles shape of cylindrical copper. That does say the shape of nanoparticles also influences the temperature of nanofluids. Figures.6 and 7 displays heat generation $[Q_1 < 0]$ and heat absorption effect $[Q_1 > 0]$ on temperature. The plot is drawn by taking $t = 5$, $\phi_1 = 0.1$, $Q_1 = 25$, $f_w = 0.008$, $\gamma_1 = 0.5$ and $\gamma_1 = 0.99 \cong 1$. Figure.6 and figure.7 are related to the shape of nanoparticles of spherical as well as cylindrical copper. From these figures this is clear that temperature decreases for ordinary and nanofluids in order to increase the values of Q_1 in the heat absorption process.

Figure.8 indicates the effect of the moving platform's α_1 initial dimensionless velocity profile with $t = 5$, $Q_1 = 25$, $K_{1p} = 0.1, \beta_1 = 0.1, \gamma_1 = 0.5, M = 0.2$ and $f_w = 0.008$. It's cleared from figure.8 that the velocity increases with increasing the initial velocity of the moving platform's α_1.

Illustration. 9 repots the effect of M (magnetic parameter) on the non-dimensional $u_1(y, t)$ (velocity profile) of copper-containing water-based nanofluids as nanoparticles. At set permeability inverse values $t = 5, K_{1p} = 0.1, \alpha_1 = 0.25, Q_1 = 25, \beta_1 = 0.1, f_w = 0.008$ and $\gamma_1 = 0.5$. It is evident that the relation of magnetic parameter with velocity is inversely. Owing to the heavy magnetic effect of the fluids the velocity decreases.

Figure.10 sets out the effect of permeability inverse K_{1p} on non-dimensional velocity with $\alpha_1 = 0.25, t = 5, Q_1 = 25, \beta_1 = 0.1, \gamma_1 = 0.5, f_w = 0.008$ and $M = 0.2$. Velocity decreases as permeability inverse K_{1p} increases. Even fluids in a high porosity medium have high velocity.

Figure.11 indicates the dimensionless velocity profile $u_1(y, t)$ underneath fractional parameter impact β_1 of based nanofluids copper with $\gamma_1 = 0.99$, particulate spherical shape of copper bear in mind along $\phi_1 = 0.1$ inverse permeability $K_{1p} = 0.1$, $M = 0.2$, $t = 5, \alpha_1 = 0.25, Q_1 = 25$ and $f_w = 0.008$. This is cleared that the velocity $u_1(y, t)$ is increasing by increases fractional parameters β_1 which means that velocity is an increasing function. In ordinary nanofluids the thickness of the boundary layer is higher than that of fractional nanofluids.

Figure.12 provides the dimensionless velocity $u_1(y, t)$ at the edge of fractional parameter β influence based nanofluids of copper along $\beta_1 = 0.1$, particles of the shape of spherical bear in mind along $\phi_1 = 0.1$ inverse permeability $K_{1p} = 0.1, M = 0.2$, $t = 5$, $\alpha_1 = 0.25, Q_1 = 25$ and $f_w = 0.008$. It is clear

that the fractional parameter γ_1 has a lesser effect on the velocity.

Figure.13 provides the dimensionless velocity $u_1(y,t)$ underneath varying conditions of volume fraction values ϕ_1 based nanofluids of copper along $\beta_1 = 0.1$, particles of the shape of spherical bear in mind along $\gamma_1 = 0.5$, $M = 0.2$, $t = 5$, $\gamma_1 = 0.25$, $f_w = 0.008$ and $Q_1 = 25$. this is obvious that fraction volume ϕ_1 is conversely tied to velocity.

From figure.14 it is observed that the dimensionless velocity $u_1(y,t)$ at the edge of fractional parameter β_1 of copper based nanofluids at $\gamma_1 = 0.5$, particles of the shape of spherical bear in mind along $\phi_1 = 0.1$, inverse permeability $K_{1p} = 0.1$, $M = 0.2$, $t = 5$, $\alpha_1 = 0.25$, $Q_1 = 25$ and $f_w = 0.008$. We noted from this figure that velocity is an increasing function of fractional parameter β_1. In ordinary nanofluids the thickness of the boundary layer is higher than that of fractional nanofluids.
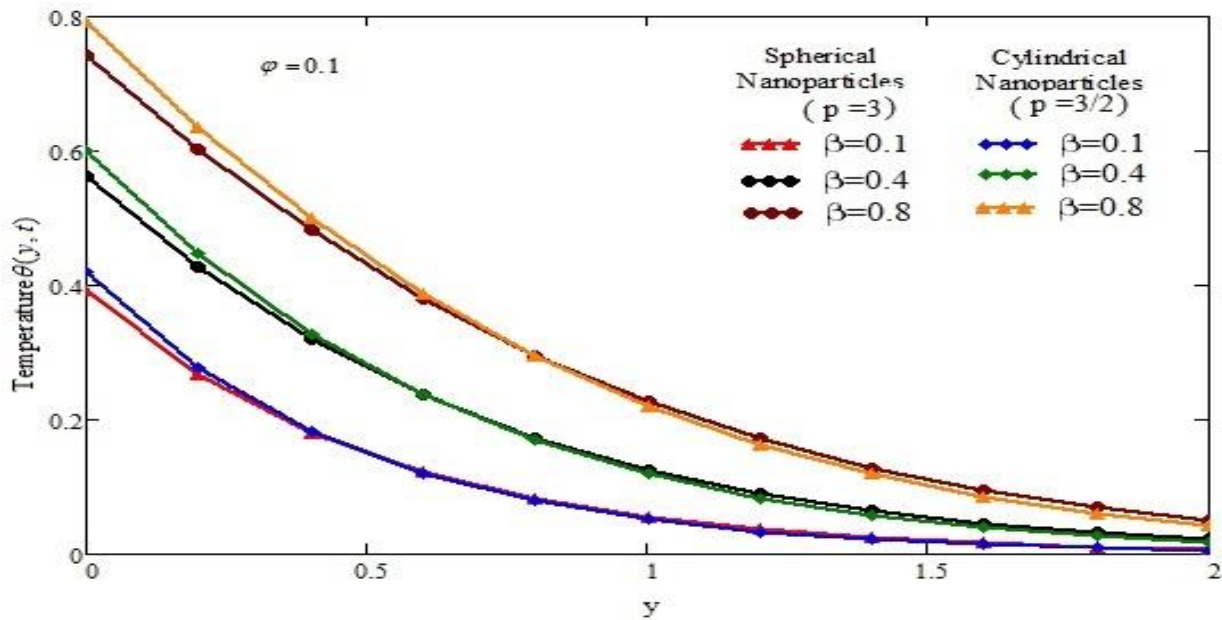

Figure.2. Dimensionless temperature profile $\varphi_1(y,t)$ consisting of spherical as well as cylindrical

nanoparticles of copper water-based nanofluids with $t=5, Q_1=25, \phi_1=0.1,$ and $f_w=0.008$
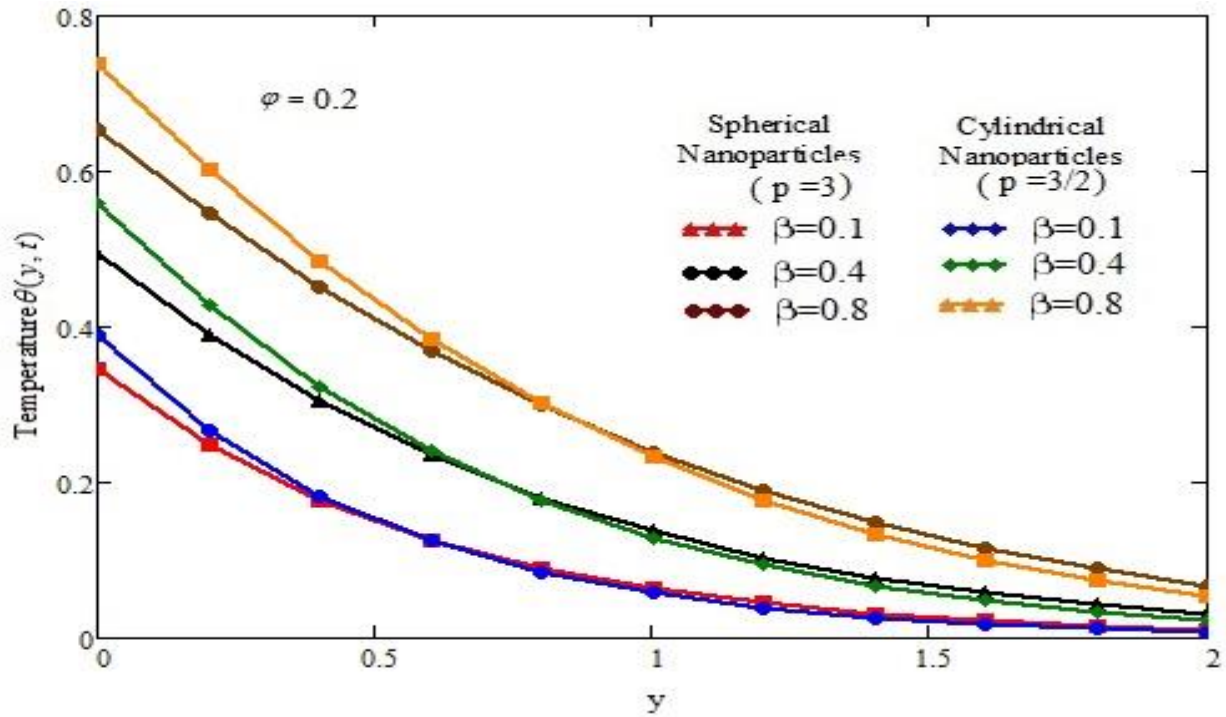

Figure.3. Dimensionless temperature profile $\varphi_1(y,t)$ consisting of spherical as well as cylindrical nanoparticles of copper water-based nanofluids with $t=5$, $Q_1=25$, $\phi_1=0.2$ and $f_w=0.008$

Figure.4. Thickness of Thermal Layers $\eta_{1T}(t)$ consisting of spherical nanoparticles of copper water-based nanofluids with $t=5$, $Q_1=25$, $\phi_1=0.1$ and $f_w=0.008$ having different fractional parameter γ_1.
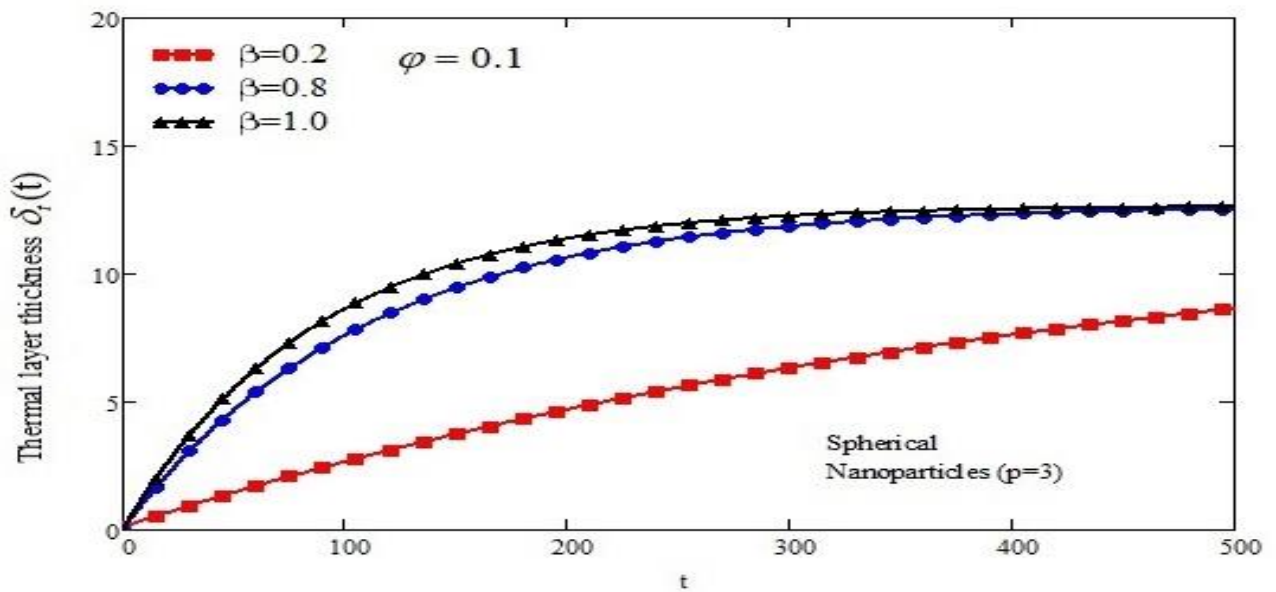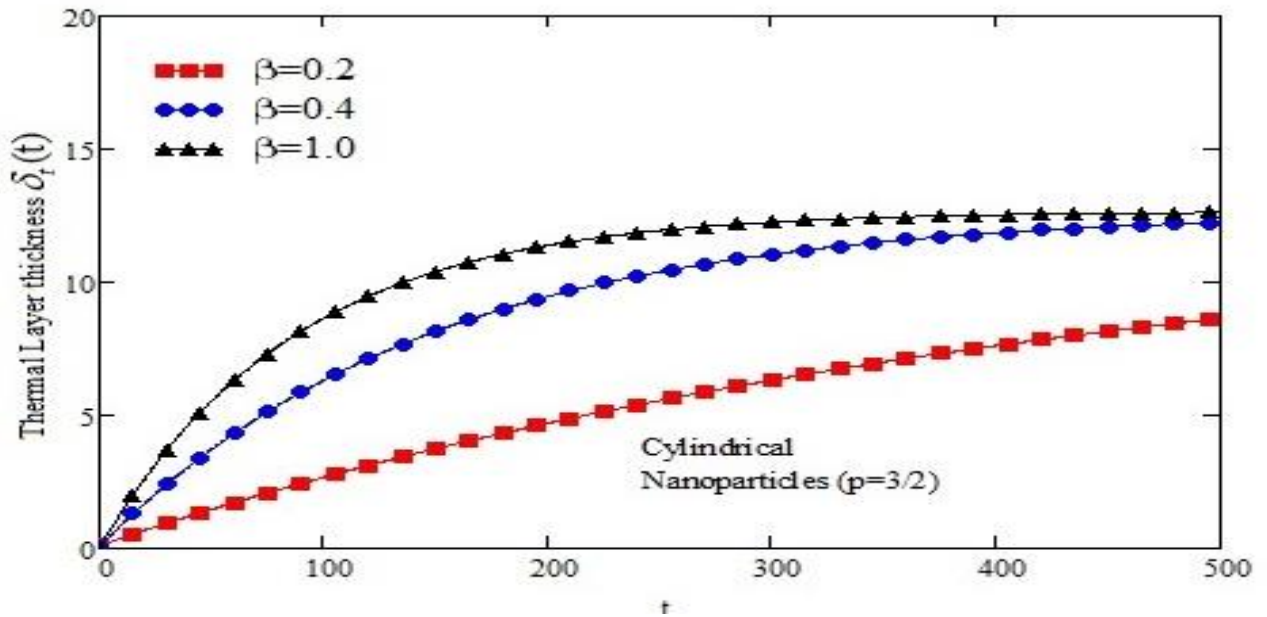
250

Figure.5. Thickness of Thermal Layers $\eta_{1T}(t)$ consisting of spherical nanoparticles of copper water-based nanofluids with $t=5$, $Q_1 = 25$, $\phi_1 = 0.1$ and $f_w = 0.008$ having different fractional parameter γ_1.

Figure.6. Dimensionless temperature profile $\varphi_1(y,t)$ consisting of spherical nanoparticles of copper water-based nanofluids with $f_w = 0.008$, $t=5$, $\gamma_1 = 0.5$ and $\gamma_1 = 1$, with numerous values of Q_1.
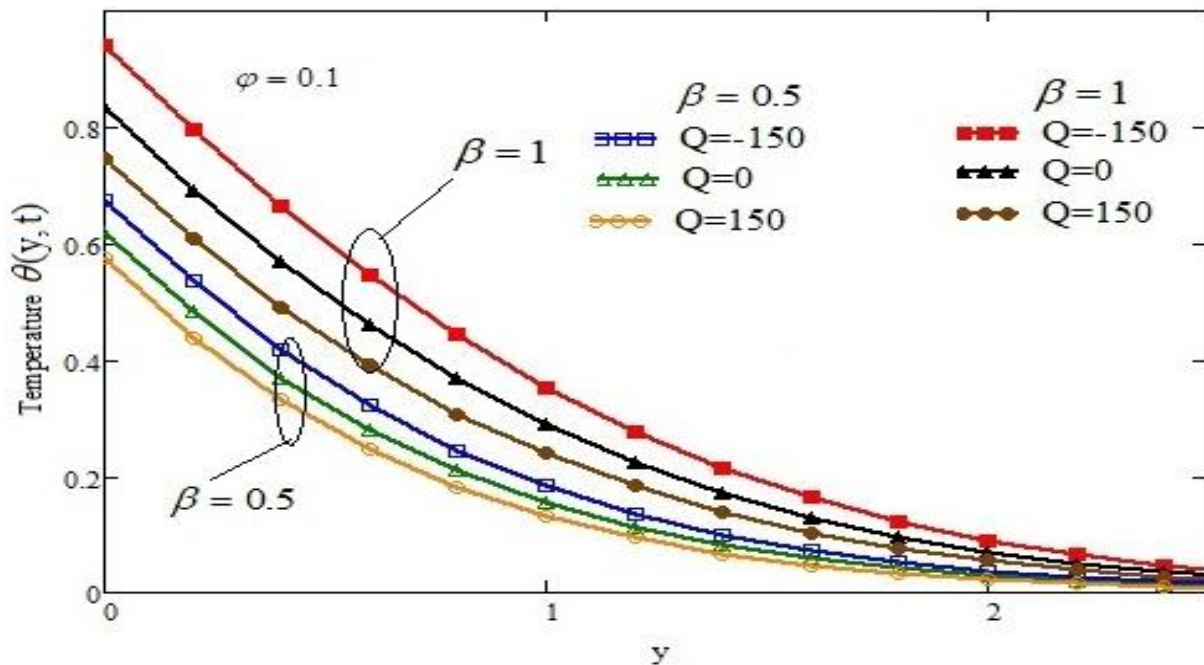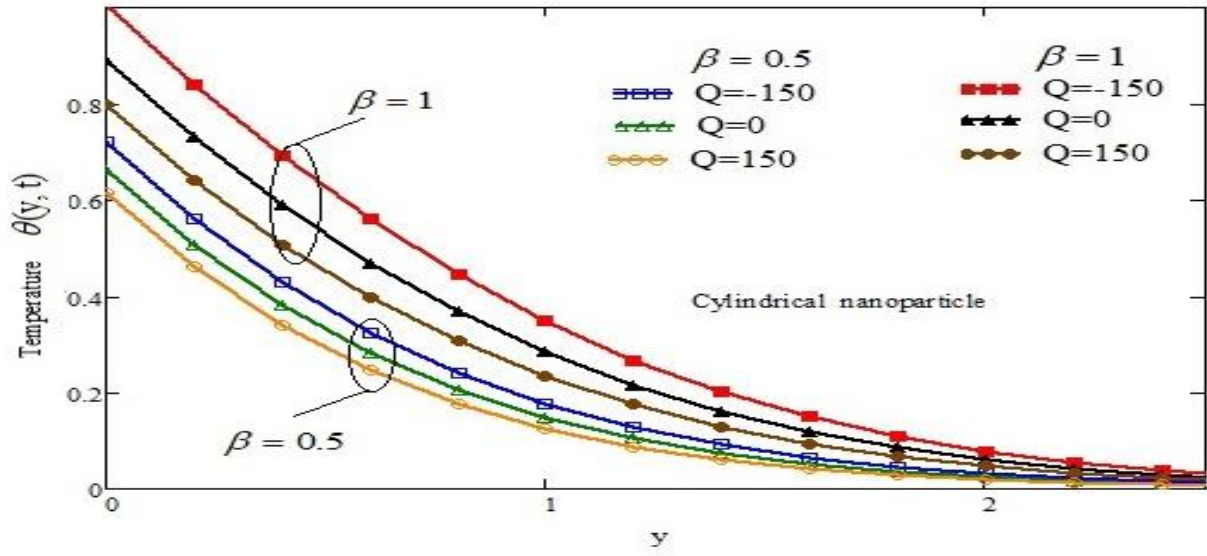
Figure.7. Dimensionless temperature profile $\varphi_1(y,t)$ consisting of spherical nanoparticles of copper water-based nanofluids with $f_w = 0.008$, $t = 5$, $\gamma_1 = 0.5$ and $\gamma_1 = 1$, with numerous values of Q_1.

Figure.8. Dimensionless velocity profile $u_1(y, t)$ consisting of spherical nanoparticles of copper water-based nanofluids with $t = 5$, $Q_1 = 25$, $\phi_1 = 0.1$, $f_w = 0.008$, $K_{1p} = 0.1$ and $M = 0.2$ having numerous values of α_1.

Figure.9. Dimensionless velocity profile $u_1(y, t)$ consisting of spherical nanoparticles of copper water-based nanofluids with $t = 5$, $Q_1 = 25$, $\phi = 0.1$, $f_w = 0.008$, $K_{1p} = 0.1$ and $M = 0.2$ having numerous values of α_1.

Figure.10. Dimensionless velocity profile $u_1(y, t)$ consisting of nanoparticles of copper water-based nanofluids with $t = 5$, $Q_1 = 25$, $\phi = 0.1$, $f_w = 0.008$ and $M = 0.2$ having numerous values of K_{1p}.

Figure.11 Dimensionless velocity profile $u_1(y,t)$ consisting of nanoparticles of copper water-based nanofluids with $t=5$, $Q_1=25$, $\phi=0.1$, $f_w=0.008$, $K_{1p}=0.1$ and $M=0.2$ having diverse values of α_1.
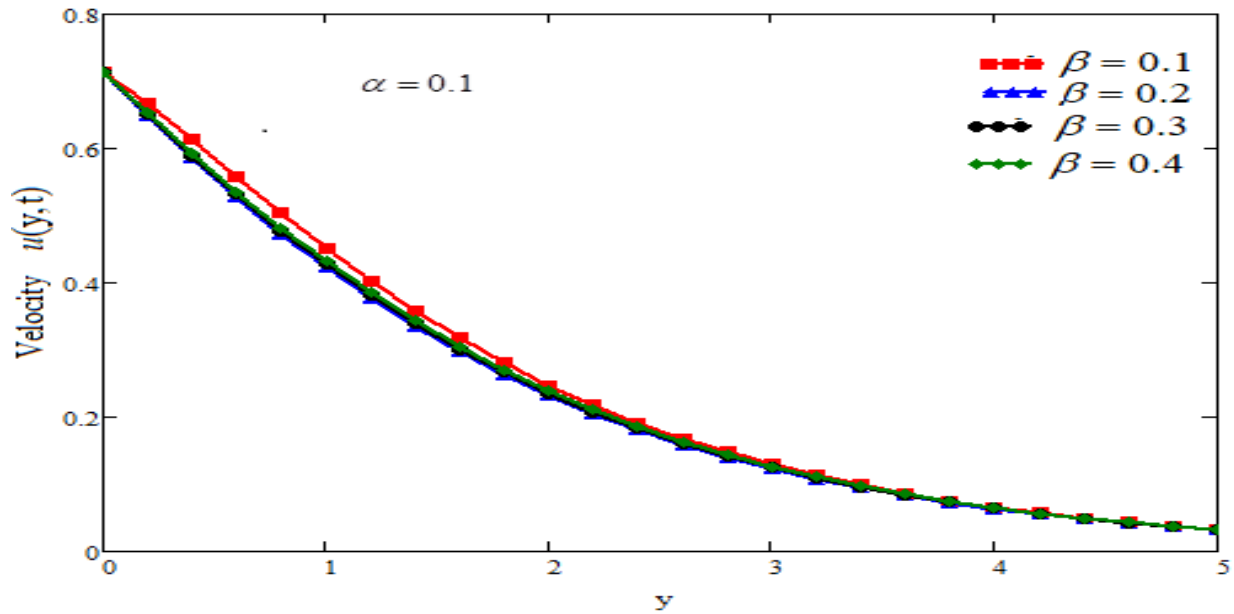
Figure.12. Dimensionless velocity profile $u_1(y,t)$ consisting of nanoparticles of copper water-based nanofluids with $t=5$, $Q_1=25$, $\phi_1=0.1$, $f_w=0.008$, $K_{1p}=0.1$ and $M=0.2$ having diverse values of γ_1.
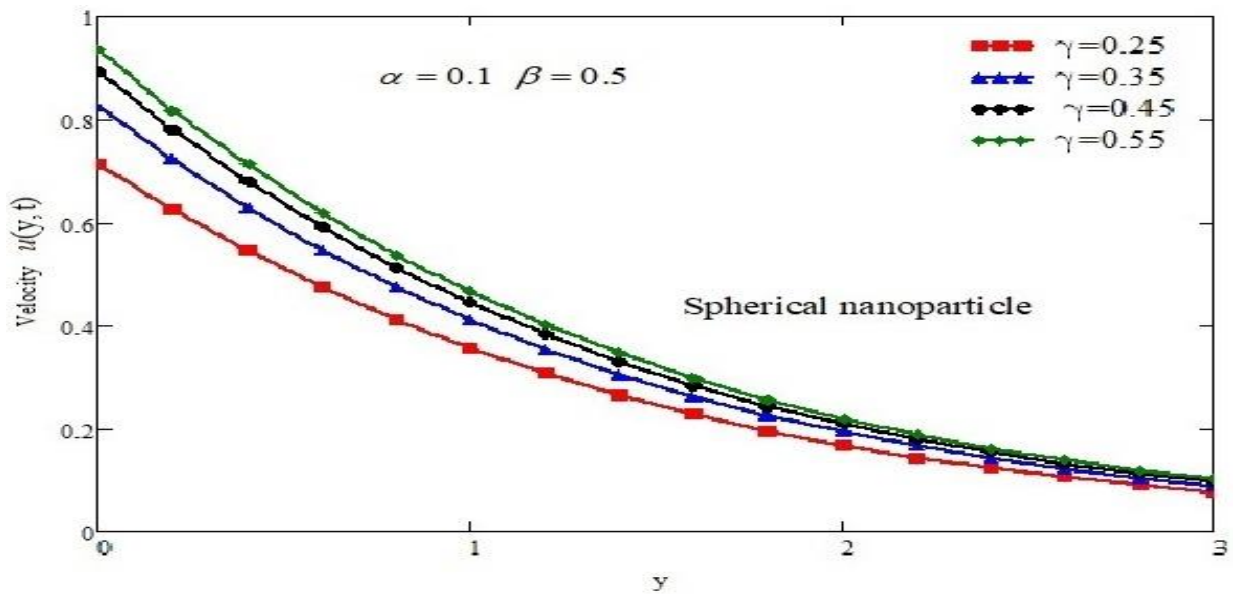
Figure.13. Dimensionless velocity profile $u_1(y,t)$ consisting of nanoparticles of copper water-based nanofluids with $t=5$, $Q_1=25$, $\phi_1=0.1$, $f_w=0.008$, $K_{1p}=0.1$ and $M=0.2$ having numerous values of the volume fraction ϕ_1.
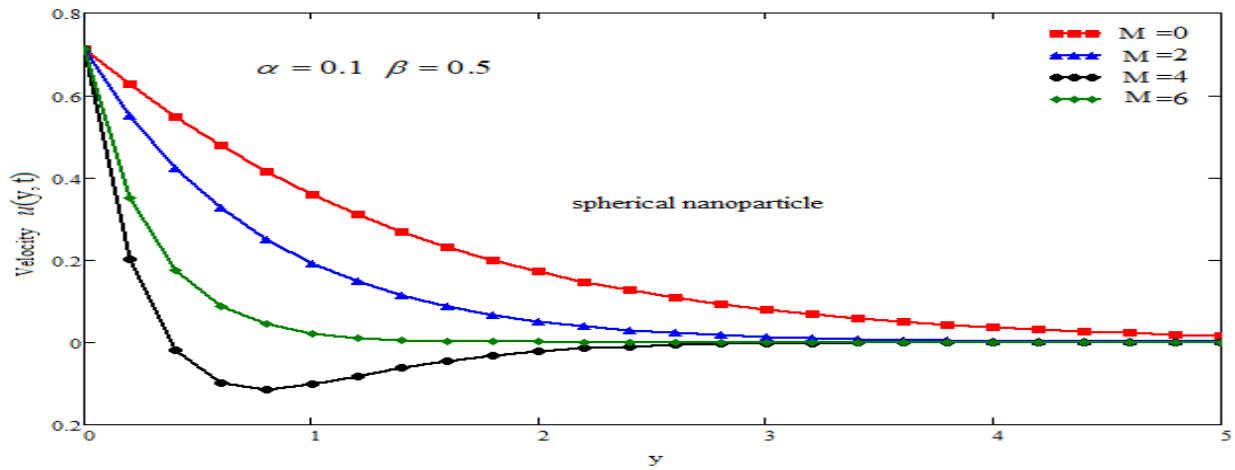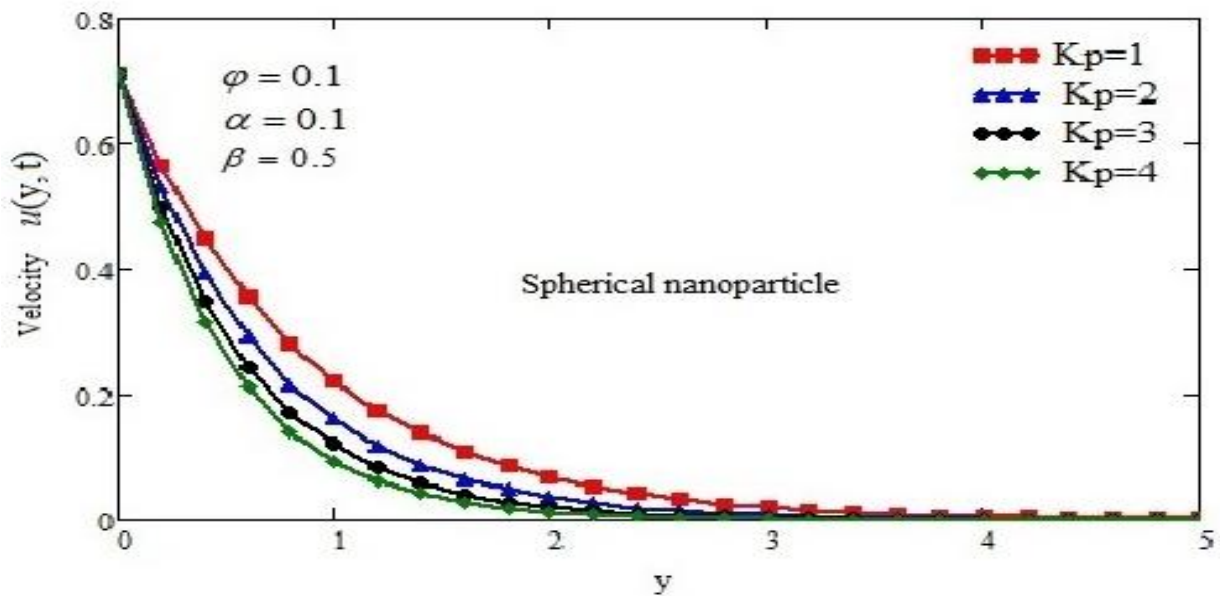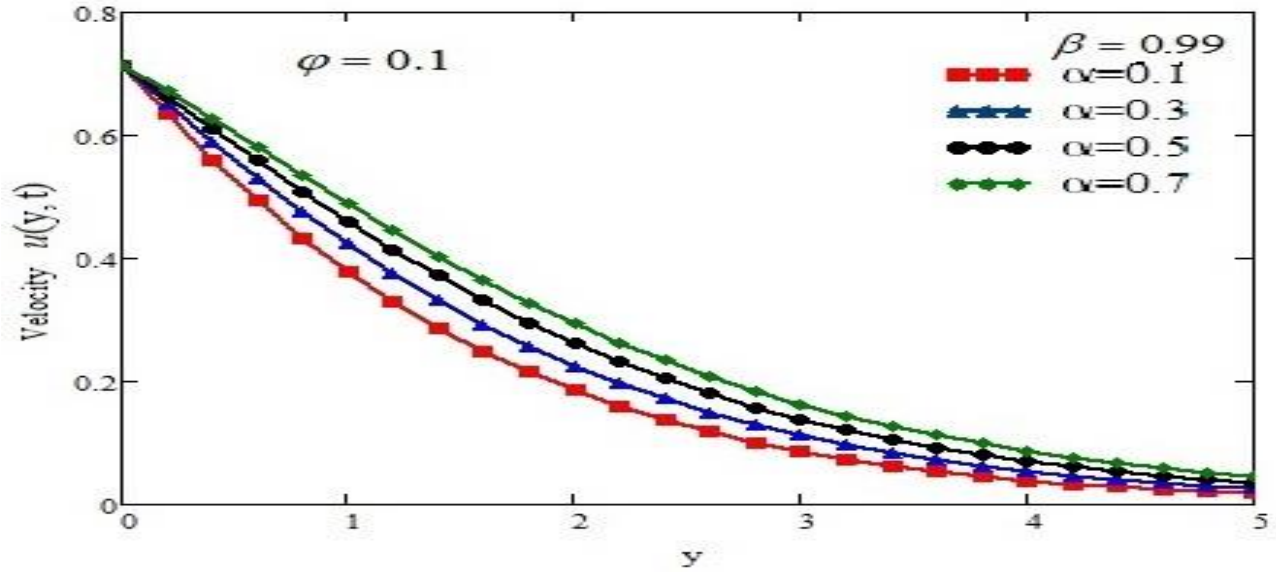

Figure.14. Dimensionless velocity profile $u_1(y,t)$ consisting of spherical nanoparticles of copper water-based nanofluids with $t=5$, $Q_1=25$, $\phi_1=0.1$, $f_w=0.008$, $K_{1p}=0.1$ and $M=0.2$ having diverse values of β_1
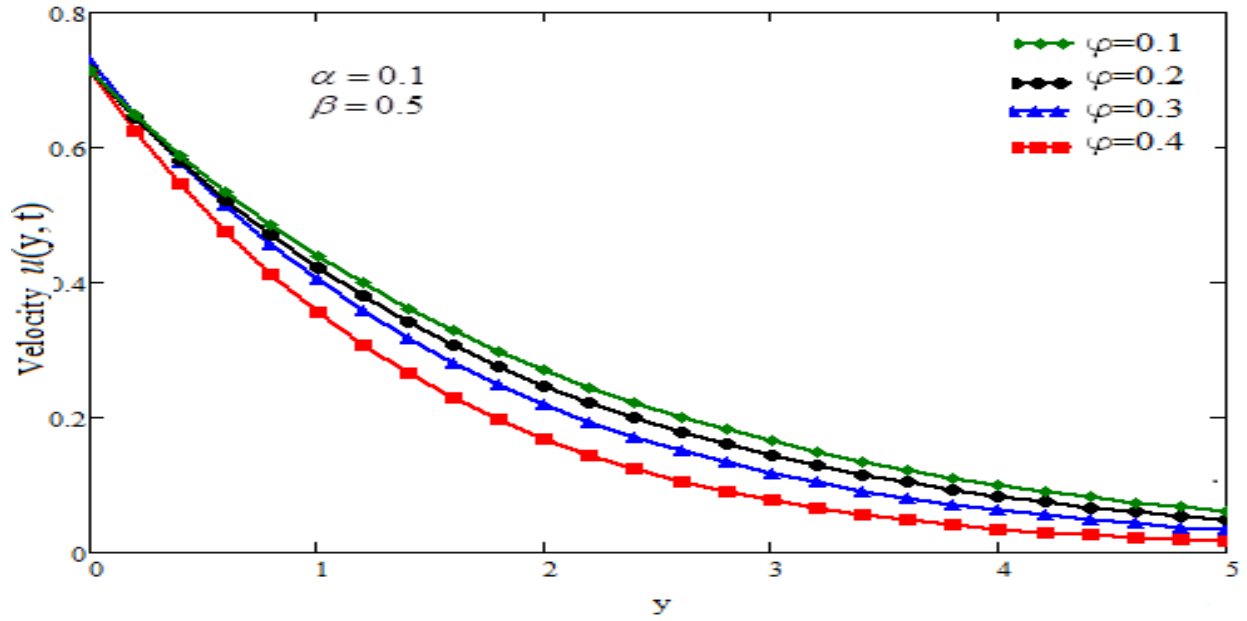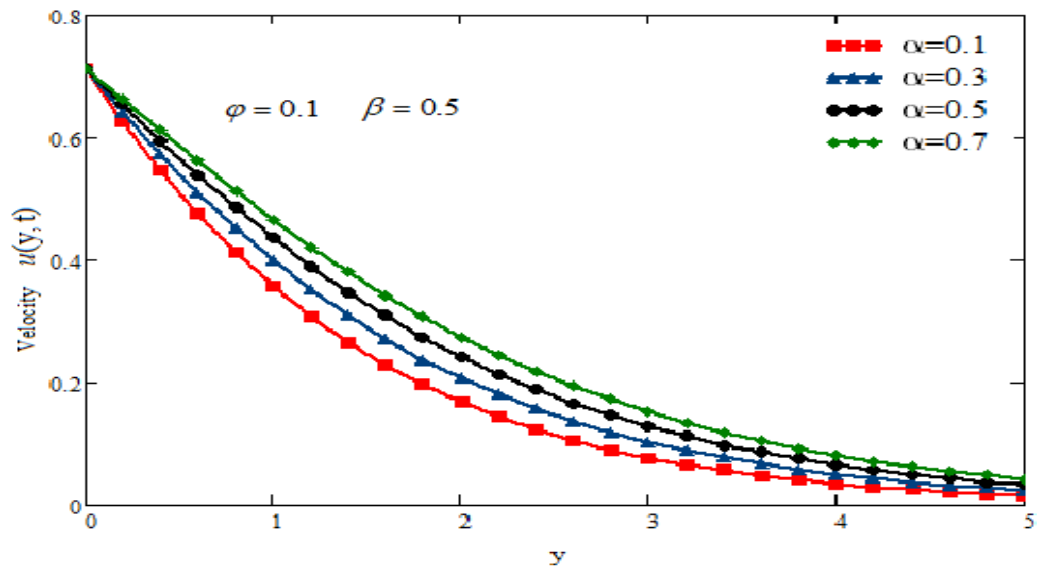
Conclusion

The MHD free convection flow is analytically and graphically analyzed in a porous medium of five water, spherical or cylindrical fractional nanofluids across an elevated plate which is vertical with a homogeneous heat source and flux. Precise solutions for dimensionless velocity as well as temperature, thickness of thermal boundary, Nusselt numbers and coefficient of skin friction are introduced in the form integral of the first kind of modified Bessel functions. The technique of Laplace is used to solve the fractional differential equations for velocity and temperature. The following are the most significant results:

- Fluid temperature increases with rising β_1.
- Particulate cylindrical shape has a thermal conductivity which is high related to nanoparticles in the shape of spherical.
- The thickness of the thermal layer for nanofluids fractional is narrower and nanofluids of ordinary type is greater.
- Magnetic parameter decreases the motion of the fluid.
- The motion of the fluid is decreasing as the inverse permeability increases.
- The fractional parameter increases the motion of the fluid.
- The volume fraction is in inverse relation to the velocity profile.

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APPENDIX - A

Some basic Mathematical formulas

$$L^{-1}\left[\frac{1}{\sqrt{s}}e^{-y/\sqrt{s}}\right] = \frac{1}{\sqrt{\pi t}}e^{\left(-\frac{y^2}{4t}\right)} \tag{A1}$$

$$L^{-1}\left[e^{a_1/s} - 1\right] = \sqrt{\frac{a_1}{t}}I_1(2\sqrt{a_1 t}) \tag{A2}$$

$$\int_0^\infty \exp\left(-a_1^2 u_1^2 - \frac{a_2^2}{4u_1^2}\right) du_1 = \frac{\sqrt{\pi}}{2a_1} e^{-a_1 a_2}, a_1 \neq 0 \tag{A3}$$

$$L^{-1}\left[\frac{1}{\sqrt{s^2 - a_1^2}}\right] = I_0(a_1 t) \tag{A4}$$

$$L^{-1}\left[\frac{s}{\sqrt{s^2 - a_1^2}}\right] = a_1 I_1(a_1 t) + \delta(t) \tag{A5}$$

$$\int_0^t \left(\frac{1}{\sqrt{s}} e^{\left(-\frac{a_1 y^2}{4s}\right)}\right) ds = 2\sqrt{t} \exp\left(-\frac{a_1 y^2}{4t}\right) ds - y\sqrt{a_1 \pi}\, erfc\left[\frac{y\sqrt{a_1}}{2\sqrt{t}}\right] \tag{A6}$$

$$L^{-1}\left(\frac{1}{s - a_1} e^{(-y/\sqrt{s})}\right) = \frac{e^{-a_1 t}}{2}\left[e^{(-y\sqrt{a_1})} erfc\left(\frac{y}{2\sqrt{t}} + \sqrt{a_1 t}\right) + e^{(-y\sqrt{a_1})} erfc\left(\frac{y}{2\sqrt{t}} - \sqrt{a_1 t}\right)\right] \tag{A7}$$

$$L^{-1}\left(\frac{1}{(s - a_1)\sqrt{s + a_2}}\right) = \frac{e^{a_1 t}}{2\sqrt{s + a_2}}\left[erfc\left(-\sqrt{(a_1 + a_2)t}\right) - erfc\left(\sqrt{(a_1 + a_2)t}\right)\right]$$

(A8)

$$2\int_0^t \left(\sqrt{(t - s)}\, erfc\left(\frac{y\sqrt{a_1}}{2\sqrt{s}}\right)\right) ds = \frac{a_1 y^2 + 4t}{3}\sqrt{t} \exp\left(-\frac{a_1 y^2}{4t}\right) ds - y\sqrt{a_1 \pi}\,\frac{a_1 y^2 + 6t}{6}\, erfc\left[\frac{y\sqrt{a_1}}{2\sqrt{t}}\right]$$

(A9)

Evaluation of Trip Generation in Single Gated Community in Urban Area using Trip Generation Models.

Abu Bakar Bin Arif, Imran Hafeez
University of Engineering & Technology, Taxila, Pakistan

Abstract

Single gated communities in urban areas for safe living have limited outdoor access that requires forecasting of future traffic for its smooth operations. During peak hour, vehicle trips should be forecasted, which is to be used to study the congestion analysis at the provided gate. The objective of this study is to forecast future traffic by estimating trip generation in a single gated community. Trip generation models such as linear regression and poisson regression models have been used for forecasting trips during the peak hour. Three types of trips such as work based trips, shopping trips, social/recreational trips models were considered to predict number of trips. Work based trips depend on the workers departing in peak hour and it doesn't depend on household size or income level, whereas shopping trips and social/recreational trips depend on household size and income level. Analysis carried out in the study area indicated that number of trips are influenced by influenced family size, income level. In case of linear regression model, increase in household size from 2 to 8 people, the number of shopping trips are increased by 40%, social/recreational trips are increased by 17.8% and increase in income from 75 thousand to 5 lacs, number of shopping trips are increased by 675%, social/recreational trips are increased by 234%. In case of poisson regression model, increase in household size from 2 to 8 people, number of shopping trips are increased by 4.4%, social/recreational trips are increased by 9.29% and increase in income from 75 thousand to 5 lacs, number of shopping trips are increased by 19%, social/recreational trips are increased by 104%. So, greater the number of people in the house and higher income level , more number of trips will be generated.
Keywords: Trip generation, Single gated community, Linear Regression Model, Poisson Regression Model.

Introduction

Development of transportation networks plays an important role in transportation planning. Travel demand forecasting is the main component in transportation planning. Trip generation in first step in four step urban travel demand analysis (Rahman, 2011). It forecasts the number of trips that originate in or are destined for a particular zone in urban areas. Trip generation depends on various characteristics of land use in residential areas such as socioeconomic and demographic factors affecting the number of trips generated from a residential urban area. The household survey are conducted in residential areas to obtain trip details and socioeconomic factors (Leena and Padmini, 2013).

The number of trips are influenced by household's size, income level, population, workers in urban area (Bijoy et al., 2017). Linear Regression and category analyses are the representative methodologies for trip generation and shown an acceptable performance from planning perspective (Justin et al., 2014). Poisson Regression model were used with different dependent variables to predict number of trips (Ma and Goulias, 1999). Linear regression equations evaluate the number of generated trips that attract study area (dependent variable) from independent variables (Zenina et al., 2013).

Various methods are available to study trip generation in urban area. In this study, two regression models are used to study trip generation in community. Linear and poisson regression models are used to predict the number of trips during peak hours. The forecasting begins with variables such as household size, car ownership, income level, workers departing, employment in neighborhood. In this study, trips have been classified into three categories, shopping trips, social/recreational and work-based trips. Shopping trips

usually occur on Saturday and Sunday. Likewise, social/recreational trips occur mostly on Saturday and Sunday. But work-based trips are on working days from Monday to Friday. The models used in this research study predict these three categories of trips.

The study area selected for this research study as shown in Figure 1 is single gated community, Top City-I which is located in capital city of Pakistan, Islamabad at intersection of M1 and M2 motorway. The total area of the Top city is 9081 Kanal, and it is planned for nearly half a million population. Top city has limited access due to its single gate. The main problem in single gate community is congestion at gates due to limited access. The population of the study area is increasing day by day. In urban areas, a zone with a greater number of household size and good socioeconomic condition of people will generate a greater number of trips. To forecast the future trip generation, it must be considered that the society is fully populated and developed. For this purpose, the master plan of the society is used to collect the data of number of houses along with size. For convenience, a total of seven types of houses have been taken in account to study trip generation.
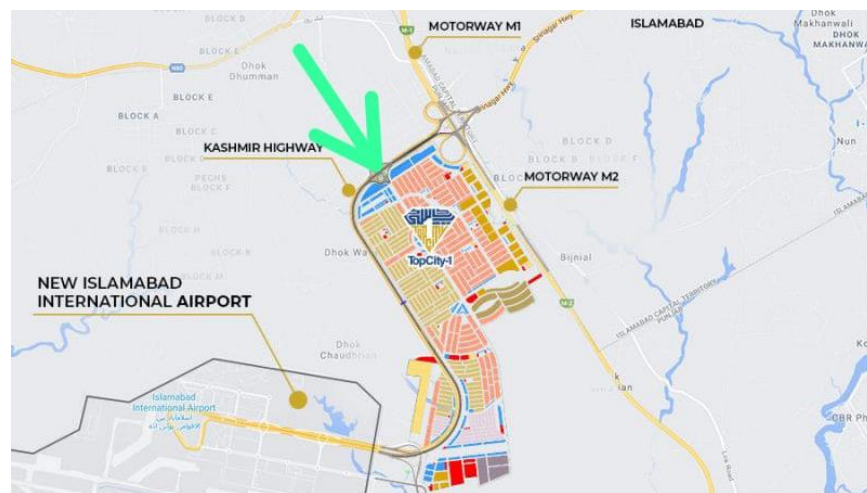
Figure 3: Location of Top City-I, Islamabad

Following are the main objectives of the research study.
1. To determine trip generation in single gated community using trip generation models.
2. To study the effect of income level on trip generation.
3. To study the effect of household size on trip generation.

Methodology

To accomplish the study objectives a three-phase research study was planned. In Phase I, layout plan details were assessed, and composition of society was synthesized. All categories of dwellers, commercials operational and service providers were counted, and data developed as an input for forecasting trip generation. In Phase II, the regression models have been used to study trip generation. Two regression models, linear and poisson regression models were used to forecast the number of trips in a single gated community. In Phase III, two variables (household size and income level) were used to analyze the influence on trip generation. Firstly, household size was considered as a constant, to study the effect of income level on number of trips. Secondly, the income level is kept constant, to study the effect of household size on number of trips generated from the models used.

To forecast the data for trip generation, master plan of study area is used. For a community in urban areas, different types of plots are available according to their size. From master plan the plot size have been taken. A total of seven types of plots have been considered to achieve the objectives of this study. For trip generation total number of houses and plots have been taken which will be the traffic flow during peak hour. For studying the effect of household size and income level on trip generation a sample of 500 houses

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from each type of houses were used to achieve the objectives of this study. The forecasting begins with the variables such as household size, car ownership, income level, workers departing. Average household size has been taken according to size of houses and plots, larger house may have larger number of people as compared to smaller sizes of houses and plots. Income level also depends on size of house, so it is shown in Table 1. Employment in the neighborhood is assumed to be 205 retail employees, workers departing will be one from each house, remaining will be non-workers. For analysis purpose firstly household size is considered as constant for all seven types of houses, and income level has been taken according to size of house, to study the effect of income level on trip generation. Secondly, the income level is assumed to be constant for all types of houses and household size is considered as variable to study the effect of household size on trip generation.

Table 11: Houses Size with estimated variables

Type of Houses	Category	Size	Total Units	Sample Size	Average Monthly Income (in Lacs)	Average Household size
Type 1	Houses	10 Marla	1712	500	2	5
Type 2	Houses	1 Kanal	1609	500	5	8
Type 3	Commercials and Apartments	<1000 sq yds	1350	500	0.75	2
Type 4	Commercials and Apartments	1000-2999 sq yds	3605	500	1	3
Type 5	Commercials and Apartments	3000-5999 sq yds	1080	500	1.5	4
Type 6	Commercials and Apartments	6000-8999 sq yds	810	500	2	5
Type 7	Commercials and Apartments	>13000 sq yds	700	500	3	6

Table 1 shows different types of houses which have considered in this research paper, with the variable considered in this study, estimated average household size, income level, sample size and total number of houses in community.

Models used in Research Study

I. Data used for input variables of models used in this study are estimated because the study area is not fully developed, so for the purpose of forecasting trip generation in single gated community, the average household size is estimated according to size of houses taken from master plan of community. The income level also depends on how large the size of house is. These values are also estimated on basis of data collected from similar community in Islamabad their current socio-economic conditions are evaluated to get average values of these variable such as household size and income level. Data collected from the survey in similar societies includes average household size, income level have been taken into account for these types of houses which are mentioned in Table 1. Employement in neighborhood is assumed to be 205 on basis of employment in such societies. It is assumed , that atleast one person from each house must go for work purpose on working days. Linear regression models asssumes a linear form in which number of trips

depends on various factors such as household size, income level, employment in neighbourhood etc. , whereas poisson model uses a log linear relationship not a linear relationship between variables (Fred & Scott). Table 2 shows the two different regression models used in this study, with two types of trips such as Shopping-trips and social/recreational trips. During peak hours of working days the work based trips are included which will be vehicle bases trips. The work based trips are calculated by simply multiplying number of workers departing from house into the total number of houses. Here, one worker is assumed to be departed from each house and multiplied with total number of houses considered.

Table 12: Types of Models used for Trip Generation

Types of Trips	Linear Regression Model	Poisson Regression Model
Shopping-trip generation	$Number\ of\ trips\ in\ peak\ hour =$ $0.12 + 0.009(X_1) +$ $0.011(X_2) - 0.15(X_3)$	$BZ_i = -0.45 + 0.002(X_1)$ $+ 0.003(X_2)$ $- 0.10(X_3)$ $Number\ of\ trips\ in\ peak\ hour$ $= e^{BZi}$
Social/Recreational trip generation	$Number\ of\ trips\ in\ peak\ hour$ $= 0.04$ $+ 0.018(X_1)$ $+ 0.009(X_2)$ $- 0.16(X_4)$	$BZ_i = -0.9 + 0.015(X_1) +$ $0.006(X_2) - 0.05(X_4)$ $Number\ of\ trips\ in\ peak\ hour$ $= e^{BZi}$

Where;
$X_1 = Household\ Size$
$X_2 = Annual\ household\ income\ in\ thousands\ of\ dollars$
$X_3 = employment\ in\ the\ household's\ neighborhood\ in\ hundreds$
$X_4 = Number\ of\ non-working\ household\ members$

Work based trips

$Number\ of\ trips\ in\ peak\ hour = nX_5$
Where;
$X_5 = Number\ of\ Workers\ Departing\ from\ each\ house$
$n = number\ of\ houses$

Results and Discussion

Trip generation results obtained from linear and poisson regression models, have been shown in Table 2 and Table 3. The input values of models have been taken from Table 1 and after using in equations of models the resulting value gave percentage of trips which was then converted into number by multiplying total number of each type of houses to their respective percentage, the following values have obtained. The total number of each type of trip is also shown in Table 3 and Table 4. Work based trips were the same for both models because it only depends on the number of workers departing per house. The models used in this study forecasted the total number of trips during peak hour.

Table 13: Number of Trips obtained from Linear Regression Model

Types of Houses	Shopping Trips	Social/Recreational Trips	Work Based Trips
Type 1	600	1442	1712
Type 2	1105	1529	1609
Type 3	64	1027	1350
Type 4	535	2841	3605
Type 5	281	890	1080
Type 6	302	697	3996
Type 7	339	627	700
Total	3226	9052	14052

Table 14: Number of Trips obtained from Poisson Model

Types of Houses	Shopping Trips	Social/Recreational Trips	Work Based Trips
Type 1	613	1457	1712
Type 2	1120	1549	1609
Type 3	85	1041	1350
Type 4	552	2873	3605
Type 5	305	897	1080
Type 6	316	701	3996
Type 7	356	631	700
Total	3347	9148	14052

It may be noted from Table 3 and Table 4, are the number of vehicle-based trips generated from the total number of seven types of houses. It didn't predict the influence of income level and household size on trip generation, because the number of houses is not same for all types. To achieve remaining two objectives of this study, a sample size of 500 has been taken, firstly the income level is kept constant for all types and secondly the household size is kept constant for all types of houses to study their effect on trip generation. But work-based trips are 500, because one person will depart from home for work purposes, so one car will contribute to work-based trip, from each house.

Effect of Income Level on Trip Generation

Figure 2 shows the effect of income level on shopping and social/recreational trips using linear regression model and Figure 3 shows the effect of income level on shopping and social/recreational trips using poisson regression model. The highest income is 5 lacs Rupees, for which the number of trips is greater than other income levels.

Figure 4: Effect of Income Level on Trips Generated from Linear Regression Model
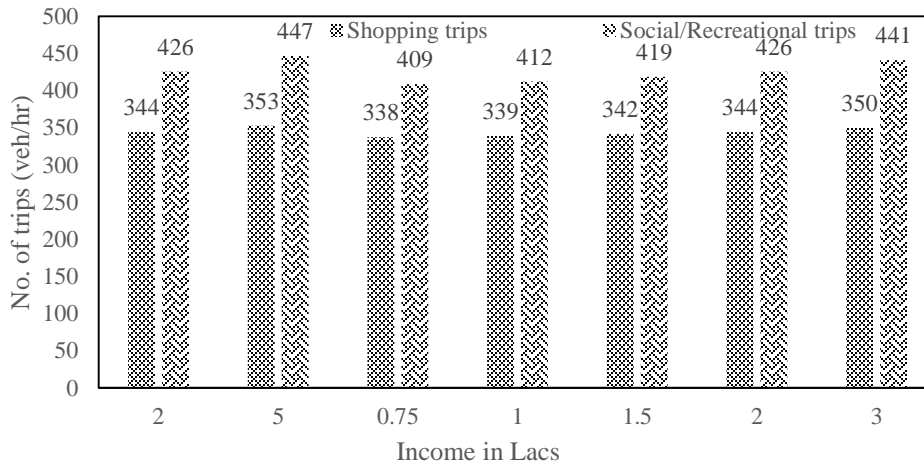
Figure 3: Effect of Income Level on Trips Generated from Poisson Regression Model

Effect of Household Size on Trip Generation

Figure 4 shows the effect of household size on shopping and social/recreational trips using linear regression model and Figure 5 shows the effect of income level on shopping and social/recreational trips using poisson regression model. The highest household size is 8, for which the number of trips is greater than other size of households.
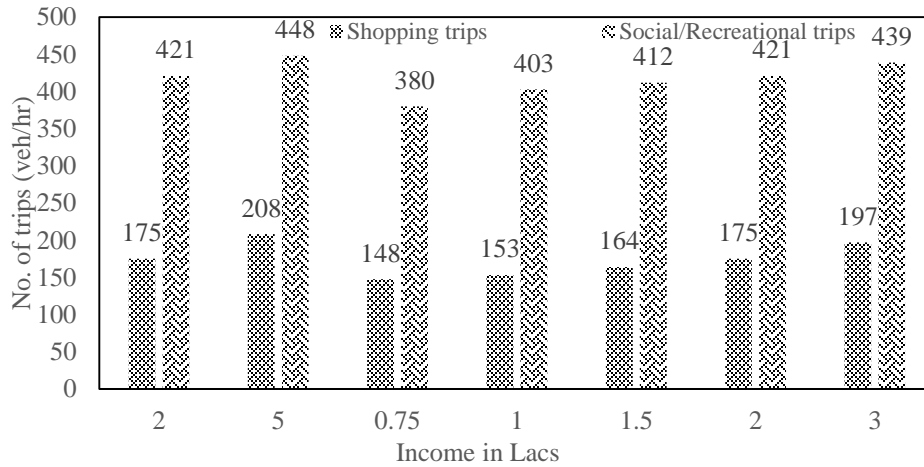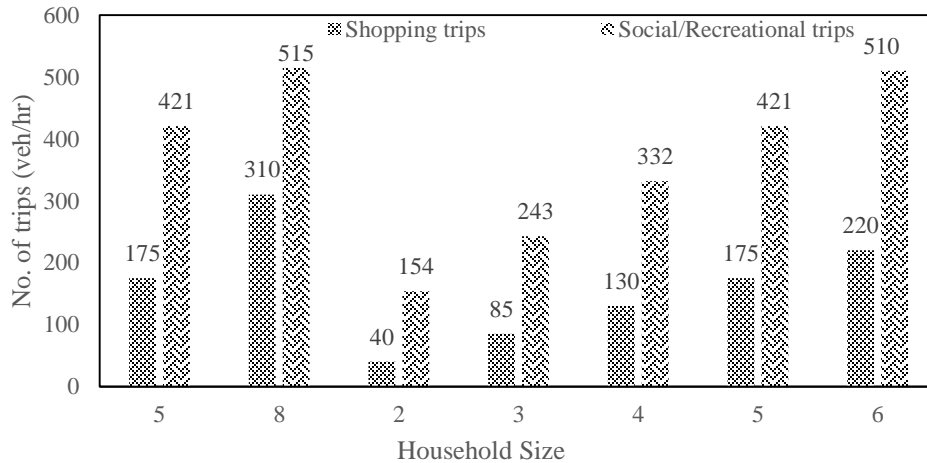
Figure 4: Effect of Household Size on Trips Generated from Linear Regression Model
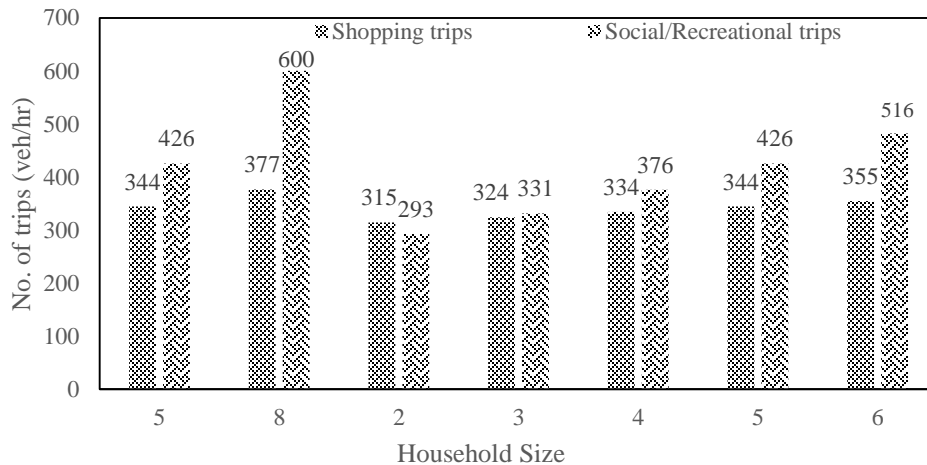
Figure 5: Effect of Household Size on Trips Generated from Poisson Regression Model

Conculsion

The research study was mainly conducted to determine trip generation in single gated community using two regression models and to investigate the effect of household size and income level on these two regression models. Regression models used in this study were linear and poisson regression model. The study has shown the trips generated in a single gated community using two regression models with various input variables. Various variables were used in this study in which income level and household were the main factors which were considered to study effect on trip generation.
The following conclusions have been drawn from this research study.

- Trip generation in a single gated community is determined using two regression models. In the case of shopping trips, poisson model predicted 3.75% more number of trips than linear regression model. In the case of social/recreational trips, poisson model predicted 1.06% more number of trips than linear regression model. The work-based trips depend on the person departing per house using his own vehicle during peak hour.

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- With an increase in household size the number of shopping and social/recreational trips also increases. In case of linear regression model, increase in household size from 2 to 8 people, the number of shopping trips are increased by 40%, social/recreational trips are increased by 17.8% . Whereas, in case of poisson regression model, increase in household size from 2 to 8 people, number of shopping trips are increased by 4.4%, social/recreational trips are increased by 9.29%.
- Houses with more income, generated more number of shopping and social/recreational trips.In case of linear regression model, increase in income from 75 thousand to 5 lacs, number of shopping trips are increased by 675%, social/recreational trips are increased by 234%.Whereas, in case of poisson regression model, increase in income from 75 thousand to 5 lacs, number of shopping trips are increased by 19%, social/recreational trips are increased by 104%. This shows that the linear regression model varies linearly and a drastic change in trip generation whereas poisson model has a log linear relationship between the coefficients of equation.

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Model Paper For Conference Proceedings Icetems-2023 (Implementation of Lean Six Sigma In The Textile Spinning Sector)

Qaiser Raza[1], Sikandar Bilal Khattak[1], Asfandyar Khan[2]
[1]University of Engineering and Technology, Peshawar, KPK, Pakistan
[2]National Textile University Karachi, Sindh, Pakistan

Abstract

The textile industry is a crucial component of global manufacturing and faces increasing pressure to improve operational efficiency. Implementing Lean Six Sigma (LSS) methodologies has the potential to minimize waste, enhance product quality, and bolster competitiveness. This research includes a comprehensive literature review on LSS, identification of critical processes in the textile spinning sector, and assessment of current practices. The ultimate goal is to provide valuable insights that assist textile spinning companies in optimizing operations and reducing waste. Key objectives encompass examining the principles and methodologies of Lean Six Sigma and their applicability to the textile spinning industry. Data collection and analysis identify bottlenecks, thus paving the way for implementing LSS strategies. By drawing on successful LSS implementations across different sectors, this research extract lessons and best practices to fit the needs of textile spinning companies. The expected benefits of LSS implementation, such as cost savings and waste reduction, are quantified, providing concrete incentives for the industry to embrace these methodologies. Ultimately, this research aspires to be a catalyst for transformation within the textile spinning sector, empowering companies to survive and thrive in an increasingly competitive global market and contribute to broader sustainability goals through waste reduction.
Keywords: Textile industry, Lean Six Sigma (LSS), Operational efficiency, Waste reduction, Spinning Industry.

Introduction

The textile spinning industry stands as a vital cornerstone within the intricate web of the global textile and apparel supply chain. Its significance reverberates throughout the production process, as it plays a pivotal role in crafting yarns. The yarns, meticulously spun from various fibre types, form the bedrock upon which the entire textile and apparel industry stands. It is the raw materials from which fabrics, garments, and an extensive array of textile products spring forth (Mahmood, 2020).

The textile spinning sector is a complex and challenging industry. It requires high competition, constant innovation, and a focus on quality and efficiency. Spinning companies are increasingly using Lean Six Sigma to improve their operations to remain competitive. This industry operates at the intersection of tradition and modernity, where age-old techniques meet cutting-edge technology. Amidst this dynamic backdrop, it faces the relentless pressures of competition locally and globally. The quest for market dominance and the need to satisfy ever-discerning consumers require a delicate balancing act that mandates the preservation of heritage and a continuous drive for innovation (Nedra et al. 2022).

This research focuses on implementing Lean Six Sigma specifically in the textile spinning sector. Systematically exploring LSS principles, identifying critical processes within the industry, and assessing existing practices. Additionally, it draw inspiration from successful LSS implementations in various sectors, tailoring the insights gained to suit the unique needs and challenges of the spinning sector. By doing so, this research empower companies to survive and thrive in a fiercely competitive global market while contributing to sustainability objectives through waste reduction and process optimization. (Adikorley R.D, 2017). Implementing Lean Six Sigma in the textile spinning sector addresses the challenges and

considerations of the principles and methodologies, identification of waste and defects that exist, and the best practices for textile spinners seeking to implement Lean Six Sigma.

Literature Review

Six Sigma has revolutionized the business world while setting new customer satisfaction and quality standards. In today's competitive marketplace, textile companies must continuously improve quality and reduce defects to remain competitive. Lean tools are well-known for managing and reducing waste in apparel manufacturing, which can lead to significant cost savings and improved efficiency (Hibarkah Kurnia1, 2021).

Six Sigma is a powerful tool for improving quality and reducing costs in industries, including the textile industry. It identifies and eliminates the root causes of defects in fabric production, such as uneven weave, dye defects, and tears, significantly improving product quality and customer satisfaction thus reducing energy consumption. Many textile companies worldwide have successfully implemented Six Sigma to improve their quality, efficiency, and profitability. For example, one textile company used Six Sigma to reduce the defect rate in its fabric production process by 50% (Abbes Nedra, 2022). Another textile company used Six Sigma to reduce the lead time for its garment manufacturing process by 25% (Abbes Nedra, 2022).Some people have argued that Lean and ISO 9001 have shown a way to combine them so that organizations can be certified without needing any extra documentation. However, no previously published studies explore how Lean Six Sigma (LSS) tools and methodologies meet ISO 9001 requirements in textile companies (Mahmood, 2020).

It serves as an exceedingly valuable and indispensable tool in the realm of process optimization, meticulously delineating both the current operational state and the envisioned future state, all with the overarching goal of expeditiously and effectively eliminating inefficiencies through the judicious application of lean principles and practices. Moreover, while its primary function is to act as a potent communication tool, Value stream Maping (VSM) which is integral part of lean philosophy, transcends its foundational purpose and extends its influence into strategic planning and change management, offering invaluable insights and strategic guidance. In the detailed VSM, one can find a thorough account of activities, starting from opening bales and ending with careful yarn packaging on cones (Sivakumar Annamalai, 2020).

There is a significant disparity in the execution of housekeeping procedures within the studied organizational framework. Notably, it reveals the absence of established protocols for the efficient management and conservation of essential resources, while also identifying shortcomings in the cleanliness standards maintained on the shop floor. Implementing specific strategies to enhance housekeeping practices within the organization, drawing inspiration from the fundamental principles of the Toyota Production System (TPS) is highly recommended. These strategies include delineating defined floor spaces for various activities, fostering an organizational culture prioritizing housecleaning activities, and emphasizing how these efforts align with achieving lean and efficient operations (S. Karthi, 2013).

Green Lean Six Sigma GLSS is introduced alongside Lean and Lean Six Sigma, highlighting their prominence as unified improvement methodologies in manufacturing systems. It underscores the growing popularity of combining these approaches into GLSS and references studies that have substantiated the effectiveness of this amalgamation. This lays the foundation by emphasizing the integration of Green Lean and Six Sigma principles. GLSS can lead to the betterment of a company's environmental performance through the reduction of waste and pollution. Simultaneously, it elaborates on enhancing operational performance by boosting efficiency and productivity. GLSS is pivotal in motivating and encouraging businesses to improve profitability and competitiveness. It is a holistic approach that aligns with environmental goals and drives operational excellence (Hamid Gholami, 2020).

Methodology

Textile production involves the transformation of fibers into fabric by employing various manufacturing techniques. Spinning is the procedure for converting fibers or filaments into yarn, which can be accomplished through multiple methods. Among the well-known techniques are Ring spinning and Open-end spinning, each with advantages and disadvantages.

Spinning process comprises of various stages from the blow room to the ring frame. In the blow room, fibers undergo proper opening and are transformed into a lap/sheet. Subsequently, in the carding process (which involves reducing the entangled mass of fibers to a filmy web by working them between two closely spaced, relatively moving surfaces closed with sharp points), the lap is converted into a sliver. A flow chart depicting the process of Ring spinning is illustrated in Figure 1.

Figure 1: Flow Chart Ring Spinning Process

Combing is another crucial step, which eliminates the remaining proportion of short fibers, neps, and impurities such as vegetable matter and seed coat fragments in cotton that have already undergone carding. In the Drawing process, slivers are blended, doubled, leveled, and drafted by passing them through a series of pairs of rollers. They then proceed through a simplex/roving/speed frame, where fibers are transformed into a low-twist lea known as roving. In the Ring frame, roving is further converted into yarn. Throughout these processes, various types of waste are generated. As shown in Figure 2, a four stages methodology is adopted for this research.

Data Analysis Techniques

A time analysis, as its name suggests, delves into the temporal constraints associated with each phase of the organizational processes. It precisely illustrates the time allocated to individual steps, highlighting any significant inactivity periods.

While conducting a time analysis can be somewhat taxing for specific individuals within an organization, including its leaders, its invaluable results can significantly reduce the time required to complete various components of the overall process. However, there is a risk of some managers exploiting this information to an extreme extent, pressuring employees to work harder until they are pushed to their limits.

Conversely, when executed correctly, a time analysis can unveil valuable insights about the organization, fostering deeper collaboration among different departments. Mastering this technique requires experience, and if you lack confidence in your ability to conduct a thorough time analysis, hiring an external party for the task is a viable option.

Task sampling, a technique linked to time analysis, provides specific insights into the timing of individual organizational processes. By sampling the workflow, you can determine the average time a worker needs

for tasks such as setting up their workspace, completing their current assignment, and preparing the workstation for the following user.

A crucial aspect of task sampling is the need for many samples, especially in processes with volatile timing. Sufficient data points are essential to draw meaningful conclusions, preventing the collection of results that lack helpful information.

Additionally, adjusting your sampling for a larger workforce is important when necessary. Sampling an individual worker's performance differs significantly from sampling a large team, and variations in results may require different problem-solving approaches. Consistently adapting your task sampling to the organization's current state ensures practical long-term time analysis.

In more complex sampling situations, introducing an element of randomness can be beneficial. It may not be necessary to follow every step of process closely, instead of randomly checking the status of different departments or adjusting the randomness factor based on past issues can enhance the efficiency of the sampling process.
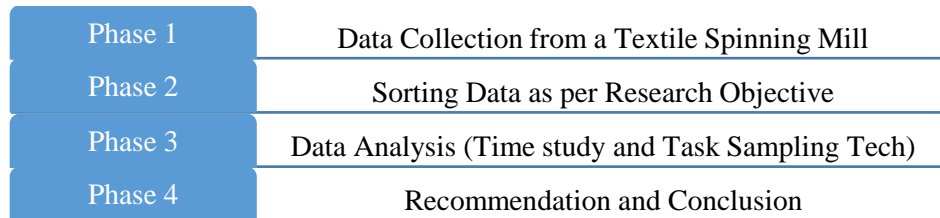
Phase 1	Data Collection from a Textile Spinning Mill
Phase 2	Sorting Data as per Research Objective
Phase 3	Data Analysis (Time study and Task Sampling Tech)
Phase 4	Recommendation and Conclusion

Figure 2: Methodology Adopted for this Research

Data Collection and Analysis

A textile spinning mill was frequently visited. A comprehensive floor plan was drawn and time study for 10 successive repetitions was averaged out. Data was critically analyzed to identify the non-value-added time and bottlenecks in the system. Complete process was manually simulated to see the time gap between processes.

Blow Room states that "Pneumatic means for the supply of reduced air pressure near the fiber destination are used for transferring fibers from one machine to another". Raw cotton produces a variety of different impurities, the first department is called "blow room" in the spinning process. These impurities are found under established seeds and fragments in cotton, such as sand, dirt, dust, whole seeds, broken seeds. Dust and trash extraction depend on how much fibers are collected through fiber processing. Most of the impurities are removed and others in the next one is removed. The time data of the Blow room is given in Table 1.

Table 1: Time Data of Blow Room

Section	Operation	Time (minutes) / Sample									
		1	2	3	4	5	6	7	8	9	10
Blow Room	Opening	26.82	29.53	26.37	27.05	28.5	24.42	31.12	28.76	27.13	27.7
Total average		**27.74**									

The Blow room process involves the separation of cotton packs into small tufts and the removal of 75% of the waste in the cotton. Additionally, the cotton must be opened to each fiber and cleared of impurities and debris to the greatest extent possible. The card machine meticulously opens up the fibers, to achieve this, ensuring complete waste elimination. Consequently, the carding mechanism holds a crucial role in the spinning process and is aptly referred to as the heart of spinning, embodying the principles of "Half carded, half spun" and "Well Carded, well spun". Table 2 shows the Carding data.

Table 2: Time Data of Carding

Section	Machines	Time(minutes) / Sample									
		1	2	3	4	5	6	7	8	9	10
Carding	1	57.35	58.24	57.55	56.7	57.52	58.45	56.56	57.22	58	58.1
	2	57.42	57.54	57.11	57.22	56.34	56.44	57.12	56.1	57.14	57.55
	3	58.25	58.26	59.11	58.24	59.09	59.32	58.46	58.12	58.07	57.27
	4	58.11	56.29	57.25	57.54	59.12	59.33	56.21	57.14	56.02	58.4
	Average per Machine	57.8	57.6	57.8	57.4	58.0	58.4	57.1	57.1	57.3	57.8
Total average		57.6									

Findings from Result

In carding section the major problem is the delayed transportation of material and the reduced capability of the card itself which causes the drawing machines to be idle. If AGVs or Conveyor belts are used, it reduce the transportation time by 33% to 15 minutes. The contemporary landscape of global manufacturing is witnessing a proliferation in the production of Automated Guided Vehicles (AGVs). Notably, within the context of a spinning mill, the transportation infrastructure linking the card and draw frame is poised for enhancement. Presently, a conveyor belt with housing tailored to the dimensions of the drum is under consideration for installation. This system is designed to seamlessly facilitate the movement of materials between these key processing units, thereby optimizing operational efficiency.

The incorporation of AGVs into this transportation framework presents a strategic avenue for automation. Various options are commercially accessible in the market, providing a spectrum of choices that can be calibrated according to the specific layout and spatial constraints inherent to the inter-process zones. To ensure the efficacy of this automation, meticulous attention must be devoted to AGV path planning. The intricacies of the production floor, combined with the dynamic nature of manufacturing processes, necessitate a comprehensive strategy for AGV trajectory optimization. Such a meticulous approach is imperative to guarantee a smooth, synchronized, and responsive conveyance system, aligning seamlessly with the overarching objectives of enhanced efficiency and automation within the spinning mill environment.

Comparative timeshare of the three processes can be analyzed in the Figure 3. It can be interpreted that carding section has maximum share while completing the production cycle. As per time study, it has been evaluated that two additional carding machines must be installed, coupled with material handling system to increase productivity and eliminate idleness of other processes.
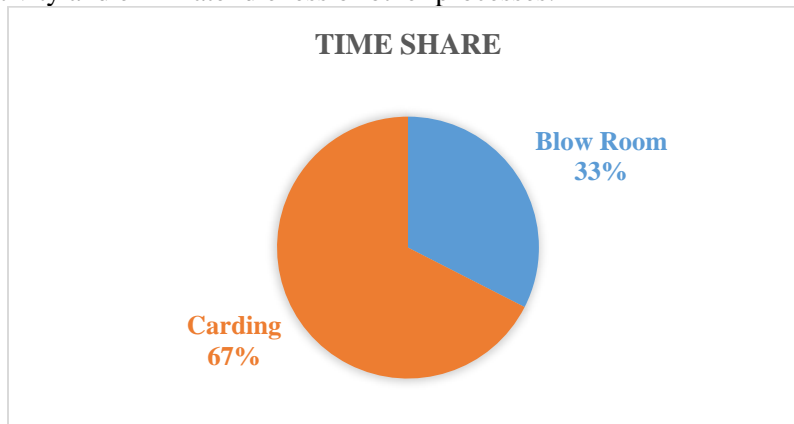

Figure 3: Time share Percentages

Conclusion

This research signifies the implementation of Lean Six Sigma (LSS) methodologies in the textile spinning sector to address operational challenges, enhance efficiency, and contribute to sustainability goals. The textile spinning industry, situated at the intersection of tradition and modernity, faces intense competition, technological advancements, and the imperative to balance heritage preservation with innovation. Lean Six Sigma emerges as a strategic tool to navigate these complexities, offering a systematic approach to process improvement.

An in-depth analysis of the carding and simplex sections, identifies specific challenges, such as delayed material transportation and excessive yarn breakage. This research proposes practical solutions, such as the implementing AGVs or conveyor belts to reduce transportation time and the installation of additional carding machines to enhance productivity.

Ultimately, the implementing Lean Six Sigma in the textile spinning sector is depicted as a catalyst for transformation. By optimizing operations, reducing waste, and improving product quality, companies can achieve economic benefits and contribute to broader sustainability objectives. This research aims to empower textile spinning companies to adapt to the evolving industry landscape, combining tradition with innovation, and fostering a resilient and competitive presence in the global market.

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Critical Factors Affecting Labour Productivity in Construction Industry

Husnain Ajmal[1], Abdul Qadeer[2]

[1]*Industrial Engineering Department, University of Engineering and Technology, Peshawar, Pakistan.*

[2]*Civil Engineering Department, University Of Engineering and Technology, Taxila, Pakistan.*

Abstract

Construction industry is one of the most crucial and challenging industry in world. It directly affect the economy of the country. Labour productivity play an important role in completion of any construction project within budget and time limit .Construction projects are engaged with the risk poor labour productivity. Hence it is important to identify the factors affecting labour productivity in order to ensure success of the project. The research paper aim to find essential factors that affect labour productivity and rank them according to their effect on project efficiency. A questionnaire survey was done in which 115 respondents and 5 sites were visited to collect data. The data is statically analyzed by SPSS and weighted average is used. The results show material shortage, large crew size, poor site management, design changes, are the top key factors that affect the productivity. Stakeholder can consider this study for productivity improvement. It is recommended that material should be provided on time, there should be less changes in design at the time of execution, and labour should be paid on time in order to achieve significant productivity.

Keywords: Labour productivity, Productivity improvement, Efficiency

Introduction

Construction industry is the most demanding and challenging industry which effect the economy of developing as well as the developed country .Construction industry provide infrastructure and generates good revenue. In Pakistan it is one of the biggest industry which account 2.53% of GDP.CEPEC boost the construction industry in Pakistan with projects like highway, power plants, dams etc.it produce 7.61% Job vaccines in Pakistan (Pakistan Economic Survey).construction industry plays important role in economic growth of the country therefore it is necessary to complete construction projects within in time and budget. There are several factors which effect the construction project but the main factor is manpower. Poor labour productivity is a major cause of which construction project faces uncertain delays. It is important to complete construction project in given deadline and resources. Labour productivity play a vital role in project completion .labour productivity directly affect the cost of project. In Pakistan it is reducing day by day. Labour and equipment productivity determined and there cost is included in initial phase of the project. If the productivity decrease at any stage of project to increases it there must be addition of extra labour and equipment which increase the overall cost of the project otherwise increases time to complete the project.it is important to identify the factors affecting labour productivity to carry out project activities and completion of project in required time. There is no standard definition of labour productivity but mostly used is the ratio of output to the labour cost

$$\text{Productivity} = \text{Outcome/Labour cost}$$

Labour cost accounts about 30% to 50% of the total cost of the construction projects. (Hanna *et al*., 2002)It is important to know the critical factors that are affecting the labour productivity as it has directly relation with the quality of work done by the labour.

Literature review

Labour plays a key and vital role in continues success and growth of the construction industry, by improving the labor productivity and efficiency the overall cost of the project can be minimized, improvement in quality of work and time management. (Nguyen Van Tam, 2021) The perception of respondents may be different on factors affecting productivity as they are working on different activities and environment (Perera *et al*., 2014). Profit oriented companies focus on improving labour productivity to achieve better output and enhance overall profit (Wilcox *et al*., 2000). It was suggested that overtime decrease the productivity because of unavailability of equipment, material and guidance at that instant time (Ginther, 1993) Some major factors affecting labour productivity are material shortage, inefficient Equipment, Lack of experience labour, working overtime, accidents as a result of poor site safety program, sequence of work, storage locations, delay in payment, (Ismail Abdul Rahman *et al*., 2001).

Methodology

To achieve the aim of study questionnaire was developed and distributed among the stakeholder. For the identification of factors previous studies were considered .Questionnaire was disturbed among 385 stakeholder which consists of 36 factors .The respondent required to mark each factor on the basis of its effect on productivity according to the scale
Scale 1= Not Applicable
Scale 2= Extremely Low
Scale 3= Low
Scale 4= Moderate
Scale 5= High
Scale 6= Extremely High
The data is collected from the questionnaire survey and on site interviews in statistically analyzed by SPSS software. To rank the each factors relative importance index technique is used. It is calculated by the formula

$$RII = \frac{\sum W}{(A * N)}$$

Where:
w = Weight given to each factor by the respondents and ranges from 1 to 6
A = Highest weight
N = Total number of respondents

Data analysis

Data analysis is to transform the data into useful information. To analyze data and rank factors questionnaire was distributed among stakeholders. The data collected from the questionnaire and on site interviews is examine statically by SPSS software. The total of 115 forms were taken into consideration. Total 36 factors were considered and ranked on the basis of RII.
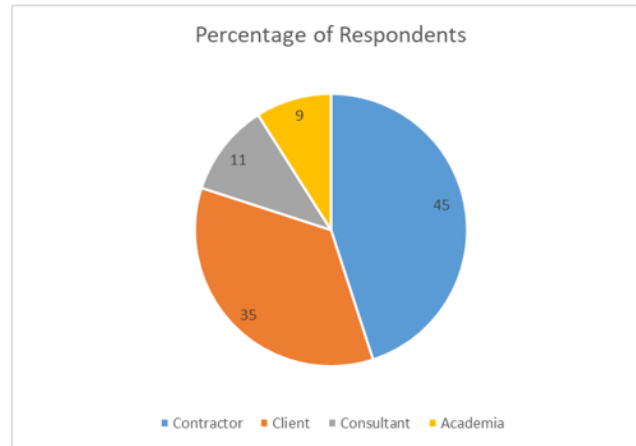
Figure 1: Percentage of Respondents

The factors are ranked according to their RII in following given tables:

Table 1: Labour Group

Sr.NO	Factors	RII
1.	Large crew size	0.799
2.	Lack of Teamwork	0.777
3.	Age of worker	0.744
4.	Training of Labour	0.743
5.	Labour low wages	0.642
6.	Labor personal problems	0.601
7.	Overtime	0.601
8.	Unscheduled Work	0.599
9.	Language difference	0.566
10.	Cultural Differences	0.563
11.	Willingness to wear PPE	0.551
12.	Drug Abuse	0.548

Table 2: Managerial group

Sr.No	Factors	RII
1.	Design Change	0.795
2.	Poor site management	0.787
3.	Rework due to changes	0.763
4.	Lack of communication between labour and management	0.743
5.	Lack of Meetings between labour and management	0.726
6.	Execution of Plan	0.703
7.	Payment Delays	0.668
8.	Lack of supervisor's experience	0.633
9.	Inspection delay	0.613
10.	Lack of motivation	0.600
11.	Lack of training sessions	0.591
12.	Incompetence Supervision	0.586

Table 3: External factors

Sr.No	Factors	RII
1.	Material Shortage	0.785
2.	Lack of Equipment	0.765
3.	Project Size	0.754
4.	Working in confined Space	0.717
5.	Inaccurate Design	0.685
6.	Working at Height	0.675
7.	Type of Activities in Project	0.644
8.	Site Conditions	0.622
9.	Low quality of Raw Materials	0.610
10.	Residence of Labour	0.599
11.	Unforeseen disaster	0.595
12.	Regime Change	0.588

Table 4: Overall ranking of critical factors

Sr.No	Factors	RII
1.	Large crew size	0.799
2.	Design Change	0.795
3.	Poor site management	0.787
4.	Material Shortage	0.785
5.	Lack of Teamwork	0.777
6.	Lack of Equipment	0.765
7.	Rework due to changes	0.763
8.	Project Size	0.754
9.	Age of worker	0.744
10.	Lack of communication between labour and management	0.743
11.	Training of Labour	0.743
12.	Lack of Meetings between labour and management	0.726
13.	Working in confined Space	0.717
14.	Execution of Plan	0.703
15.	Inaccurate Design	0.685
16.	Working at Height	0.675
17.	Payment Delays	0.668
18.	Type of Activities in Project	0.644
19.	Labour low wages	0.642
20.	Lack of supervisor's experience	0.633
21.	Site Conditions	0.622
22.	Inspection delay	0.613
23.	Low quality of Raw Materials	0.610
24.	Labor personal problems	0.601
25.	Overtime	0.601
26.	Lack of motivation	0.600
27.	Unscheduled Work	0.599
28.	Residence of Labour	0.599
29.	Unforeseen disaster	0.595
30.	Lack of training sessions	0.591
31.	Regime Change	0.588
32.	Incompetence Supervision	0.586

33.	Language difference	0.566
34.	Cultural Differences	0.563
35.	Willingness to wear PPE	0.551
36.	Drug Abuse	0.548

Conclusions

The study is carried out to identify the critical factors affecting labour productivity. For this purpose a questionnaire was formed and divided into 3 group's i-e labour group, managerial group and other critical factors .the questionnaire is floated among different people working in construction industry. After the data is collected it is analyze statically and factors are ranked according to their RII values. In labour group large crew size with RII value .799.In managerial group design change with RII value.795.In other critical factor group material shortage with RII value .785 affect the most. Large crew size, Design Change, Poor site management, Material Shortage Lack of Teamwork, Lack of Equipment are the overall key factors affecting labour productivity

Recommendations

1. Productivity can be increased with providing labour with good health and safety conditions on sites.
2. To minimize the gap between activities material should be stock according to the requirement of the project.
3. Skilled labour can add value to the quality of work.
4. All the set of drawings are approved by the regulation authorities at the initial phase of the project so design changed can be minimized at the time of execution.
5. Labour should be provided with bonus on achieving required milestone.
6. There should be proper meeting before the executing plan.
7. Labour should get payments on time to meet their financial need.
8. Daily wage is selected on the basis of labour skill.
9. Training sessions should be arranged for managers to improve their managerial skills.
10. To ensure the availability of tool and equipment on project site. Equipment should be in good condition.
11. Crew size should be according the scope and quantity of the work.

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Evaluation of Trip Generation in Single Gated Community in Urban Area using Trip Generation Models.

Abu Bakar Bin Arif, Imran Hafeez
University of Engineering & Technology, Taxila, Pakistan

Abstract

Single gated communities in urban areas for safe living have limited outdoor access that requires forecasting of future traffic for its smooth operations. During the peak hour, vehicle trips should be forecasted, which is to be used to study the congestion analysis at the provided gate. The objective of this study is to forecast future traffic by estimating trip generation in a single gated community. Trip generation models such as linear regression and poisson regression models have been used for forecasting trips during the peak hour. Three types of trips such as work based trips, shopping trips, social/recreational trips models were considered to predict number of trips. Work based trips depend on the workers departing in peak hour and it doesn't depend on household size or income level, whereas shopping trips and social/recreational trips depend on household size and income level. Analysis carried out in the study area indicated that number of trips are influenced by influenced family size, income level. In case of linear regression model, increase in household size from 2 to 8 people, the number of shopping trips are increased by 40%, social/recreational trips are increased by 17.8% and increase in income from 75 thousand to 5 lacs, number of shopping trips are increased by 675%, social/recreational trips are increased by 234%. In case of poisson regression model, increase in household size from 2 to 8 people, number of shopping trips are increased by 4.4%, social/recreational trips are increased by 9.29% and increase in income from 75 thousand to 5 lacs, number of shopping trips are increased by 19%, social/recreational trips are increased by 104%. So, greater the number of people in the house and higher income level , more number of trips will be generated.
Keywords: Trip generation, Single gated community, Linear Regression Model, Poisson Regression Model.

Introduction

Development of transportation networks plays an important role in transportation planning. Travel demand forecasting is the main component in transportation planning. Trip generation in first step in four step urban travel demand analysis (Rahman, 2011). It forecasts the number of trips that originate in or are destined for a particular zone in urban areas. Trip generation depends on various characteristics of land use in residential areas such as socioeconomic and demographic factors affecting the number of trips generated from a residential urban area. The household survey are conducted in residential areas to obtain trip details and socioeconomic factors (Leena and Padmini, 2013).

The number of trips are influenced by household's size, income level, population,workers in urban arae (Bijoy et al., 2017). Linear Regression and category analyses are the reprsentative methodologies for trip generation and shown an acceptable performance from planning perspective (Justin et al., 2014). Poisson Regression model were used with with different dependent variables to predict number of trips (Ma and Goulias, 1999). Linear regression equations evaluate the number of generated trips that attract study area (dependent variable) from independent variables (Zenina et al., 2013).

Various methods are available to study trip generation in urban area. In this study, two regression models are used to study trip generation in community. Linear and poisson regression models are used to predict the number of trips during peak hours. The forecasting begins with variables such as household size, car ownership, income level, workers departing, employment in neighborhood. In this study, trips have been classified into three categories, shopping trips, social/recreational and work-based trips. Shopping trips

usually occur on Saturday and Sunday. Likewise, social/recreational trips occur mostly on Saturday and Sunday. But work-based trips are on working days from Monday to Friday. The models used in this research study predict these three categories of trips.

The study area selected for this research study as shown in Figure 1 is single gated community, Top City-I which is located in capital city of Pakistan, Islamabad at intersection of M1 and M2 motorway. The total area of the Top city is 9081 Kanal, and it is planned for nearly half a million population. Top city has limited access due to its single gate. The main problem in single gate community is congestion at gates due to limited access. The population of the study area is increasing day by day. In urban areas, a zone with a greater number of household size and good socioeconomic condition of people will generate more number of trips.To forecast the future trip generation, it must be considered that the society is fully populated and developed. For this purpose, the master plan of the society is used to collect the data of number of houses along with size. For convenience, a total of seven types of houses have been taken in account to study trip generation.

Figure 6: Location of Top City-I, Islamabad

Following are the main objectives of the research study.

4. To determine trip generation in single gated community using trip generation models.
5. To study the effect of income level on trip generation.
6. To study the effect of household size on trip generation.

Methodology

To accomplish the study objectives a three-phase research study was planned. In Phase I, layout plan details were assessed, and composition of society was synthesized. All categories of dwellers, commercials operational and service providers were counted, and data developed as an input for forecasting trip generation. In Phase II, the regression models have been used to study trip generation. Two regression models, linear and poisson regression models were used to forecast the number of trips in single gated community. In Phase III, two variables (household size and income level) were used to analyze the influence on trip generation. Firstly, household size was considered as a constant, to study the effect of income level on number of trips. Secondly, the income level is kept constant, to study the effect of household size on number of trips generated from the models used.

To forecast the data for trip generation, master plan of study area is used. For a community in urban areas, different types of plots are available according to their size. From master plan the plot size have been taken. A total of seven types of plots have been taken into account to achieve the objectives of this study. For trip generation total number of houses and plots have been taken which will be the traffic flow during peak hour. For studying the effect of household size and income level on trip generation a sample of 500 houses from each type of houses were used to achieve the objectives of this study. The forecasting begins with the variables such as household size, car ownership, income level, workers departing. Average household size has taken according to size of houses and plots, larger house may have larger number of people as compared to smaller sizes of houses and plots. Income level also depends on size of house, so it is shown in Table 1.

Employment in the neighborhood is assumed to be 205 retail employees, workers departing will be one from each house, remaining will be non-workers. For analysis purpose firstly household size is considered as constant for all seven types of houses, and income level has taken according to size of house, to study the effect of income level on trip generation. Secondly the income level is assumed to be constant for all types of houses and household size is considered as variable to study the effect of household size on trip generation.

Table 15: Houses Size with estimated variables

Type of Houses	Category	Size	Total Units	Sample Size	Average Monthly Income (in Lacs)	Average Household size
Type 1	Houses	10 Marla	1712	500	2	5
	Houses			500		
Type 2		1 Kanal	1609		5	8
	Commercials and	<1000 sq yds				
Type 3	Apartments		1350	500	0.75	2
	Commercials and	1000-2999 sq yds				
Type 4	Apartments		3605	500	1	3
	Commercials and	3000-5999 sq yds				
Type 5	Apartments		1080	500	1.5	4
	Commercials and	6000-8999 sq yds				
Type 6	Apartments		810	500	2	5
	Commercials and	>13000 sq yds				
Type 7	Apartments		700	500	3	6

Table 1 shows different types of houses which have considered in this research paper, with the variable considered in this study, estimated average household size, income level, sample size and total number of houses in community.

Models used in Research Study

II. Data used for input variables of models used in this study are estimated because the study area is not fully developed, so for the purpose of forecasting trip generation in single gated community, the average household size is estimated according to size of houses taken from master plan of community. The income level also depends on how large the size of house is. These values are also estimated on basis of data collected from similar community in Islamabad their current socio-economic conditions are evaluated to get average values of these variable such as household size and income level. Data collected from the survey in similar societies includes average household size, income level have been taken into account for these types of houses which are mentioned in Table 1. Employement in neighborhood is assumed to be 205 on basis of employment in sych societies. It is assumed , that atleast one person from each house must go for work purpose on working days. Linear regression models asssumes a linear form in which number of trips depends on various factors such as household size, income level, employment in neighbourhood etc. , whereas poisson model uses a log linear relationship not a linear relationship between variables (Fred & Scott). Table 2 shows the two different regression models used in thus study, with two types of trips such as Shopping-trips and social/recreational trips. During peak hours of working days the work based trips are included which will be vehicle bases trips. The work based trips are calculated by simply multiplying

number of workers departing from house into the total number of houses. Here, one worker is assumed to be departed from each house and multiplied with total number of houses considered.

Table 16: Types of Models used for Trip Generation

Types of Trips	Linear Regression Model	Poisson Regression Model
Shopping-trip generation	$Number\ of\ trips\ in\ peak\ hour =$ $0.12 + 0.009(X_1) +$ $0.011(X_2) - 0.15(X_3)$	$BZ_i = -0.45 + 0.002(X_1)$ $+ 0.003(X_2)$ $- 0.10(X_3)$ $$Number\ of\ trips\ in\ peak\ hour = e^{BZi}$$
Social/Recreational trip generation	$Number\ of\ trips\ in\ peak\ hour$ $= 0.04$ $+ 0.018(X_1)$ $+ 0.009(X_2)$ $- 0.16(X_4)$	$BZ_i = -0.9 + 0.015(X_1) +$ $0.006(X_2) - 0.05(X_4)$ $$Number\ of\ trips\ in\ peak\ hour = e^{BZi}$$

Where;
$X_1 = Household\ Size$
$X_2 = Annual\ household\ income\ in\ thousands\ of\ dollars$
$X_3 = employment\ in\ the\ household's\ neighborhood\ in\ hundreds$
$X_4 = Number\ of\ non - working\ household\ members$

Work based trips

$Number\ of\ trips\ in\ peak\ hour = nX_5$
Where;
$X_5 = Number\ of\ Workers\ Departing\ from\ each\ house$
$n = number\ of\ houses$

Results and Discussion

Trip generation results obtained from linear and poisson regression models, have been shown in Table 2 and Table 3. The input values of models have been taken from Table 1 and after using in equations of models the resulting value gave percentage of trips which was then converted into number by multiplying total number of each type of houses to their respective percentage, the following values have obtained. The total number of each type of trip is also shown in Table 3 and Table 4. Work based trips were the same for both models because it only depends on the number of workers departing per house. The models used in this study, forecasted the total number of trips during peak hour from both models.

Table 17: Number of Trips obtained from Linear Regression Model

Types of Houses	Shopping Trips	Social/Recreational Trips	Work Based Trips
Type 1	600	1442	1712
Type 2	1105	1529	1609
Type 3	64	1027	1350
Type 4	535	2841	3605
Type 5	281	890	1080
Type 6	302	697	3996
Type 7	339	627	700
Total	3226	9052	14052

Table 18: Number of Trips obtained from Poisson Model

Types of Houses	Shopping Trips	Social/Recreational Trips	Work Based Trips
Type 1	613	1457	1712
Type 2	1120	1549	1609
Type 3	85	1041	1350
Type 4	552	2873	3605
Type 5	305	897	1080
Type 6	316	701	3996
Type 7	356	631	700
Total	3347	9148	14052

It may be noted from Table 3 and Table 4, are the number of vehicle-based trips generated from the total number of seven types of houses. It didn't predict the influence of income level and household size on trip generation, because the number of houses is not same for all types. To achieve remaining two objectives of this study, a sample size of 500 has been taken, firstly the income level is kept constant for all types and secondly the household size is kept constant for all types of houses to study their effect on trip generation. But work-based trips are 500, because one person will depart from home for work purposes, so one car will contribute to work-based trip, from each house.

Effect of Income Level on Trip Generation

Figure 2 shows the effect of income level on shopping and social/recreational trips using linear regression model and Figure 3 shows the effect of income level on shopping and social/recreational trips using poisson regression model. The highest income is 5 lacs Rupees, for which the number of trips is greater than other income levels.
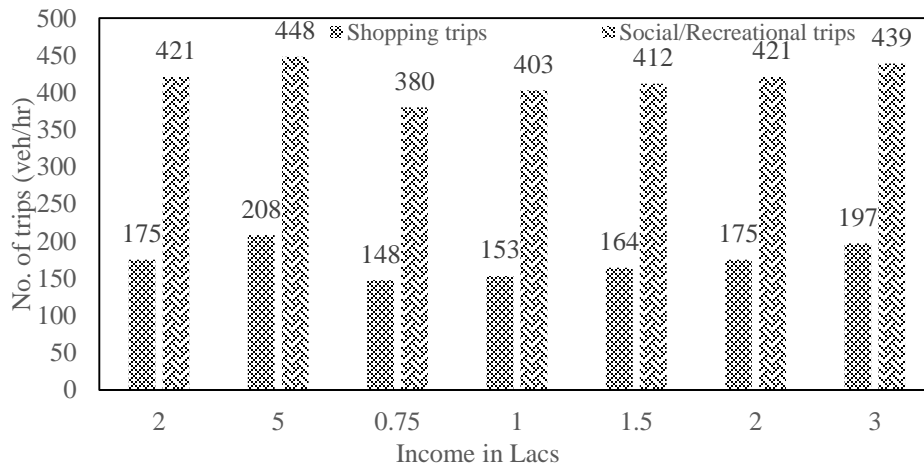

Figure 7: Effect of Income Level on Trips Generated from Linear Regression Model
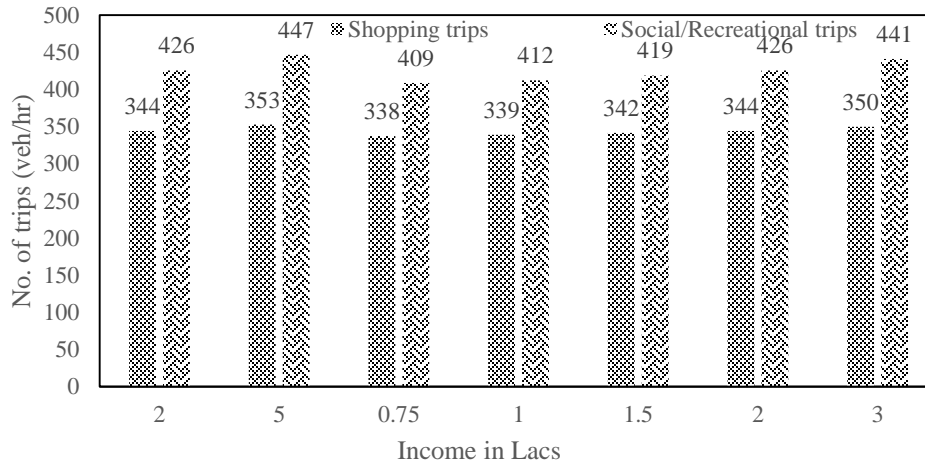
Figure 3: Effect of Income Level on Trips Generated from Poisson Regression Model

Effect of Household Size on Trip Generation

Figure 4 shows the effect of household size on shopping and social/recreational trips using linear regression model and Figure 5 shows the effect of income level on shopping and social/recreational trips using poisson regression model. The highest household size is 8, for which the number of trips is greater than other size of households.
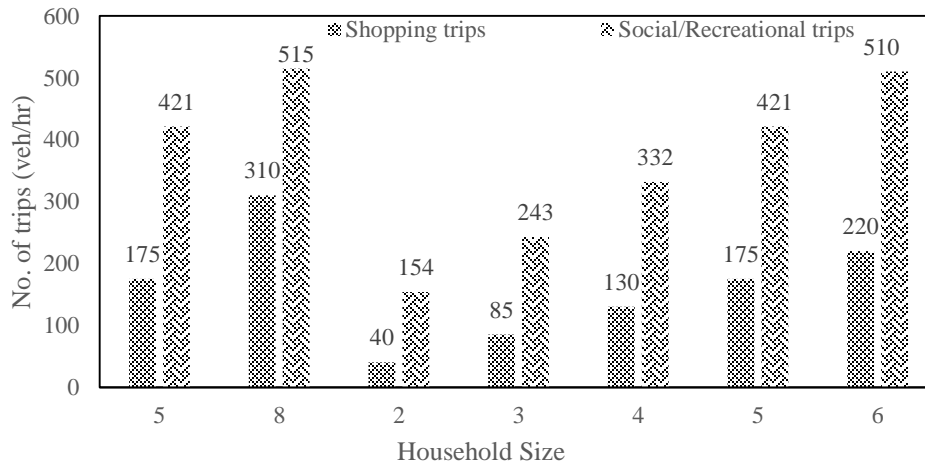

Figure 4: Effect of Household Size on Trips Generated from Linear Regression Model

Figure 8: Effect of Household Size on Trips Generated from Poisson Regression Model

Conculsion

The research study was mainly conducted to determine trip generation in single gated community using two regression models and to investigate the effect of household size and income level on these two regression models. Regression models used in this study were linear and poisson regression model. The study has shown the trips generated in a single gated community using two regression models with various input variables. Various variables were used in this study in which income level and household were the main factors which were considered to study effect on trip generation.

Following conclusion have been drawn from this research study.

- Trip generation in a single gated community is determined using two regression models.. In case of shopping trips, poisson model predicted 3.75% more number of trips than linear regression model. In case of social/recreational trips, poisson model predicted 1.06% more number of trips than linear regression model. The work-based trips depend on the person departing per house using his own vehicle during peak hour.

- With an increase in household size the number of shopping and social/recreational trips also increases. In case of linear regression model, increase in household size from 2 to 8 people, the number of shopping trips are increased by 40%, social/recreational trips are increased by 17.8% .Whereas, in case of poisson regression model, increase in household size from 2 to 8 people, number of shopping trips are increased by 4.4%, social/recreational trips are increased by 9.29%.

- Houses with more income, generated more number of shopping and social/recreational trips.In case of linear regression model, increase in income from 75 thousand to 5 lacs, number of shopping trips are increased by 675%, social/recreational trips are increased by 234%.Whereas, in case of poisson regression model, increase in income from 75 thousand to 5 lacs, number of shopping trips are increased by 19%, social/recreational trips are increased by 104%. This shows that the linear regression model varies linearly and a drastic change in trip generation whereas poisson model has a log linear relationship between the coefficients of equation.

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Advocate of Racism: American Newspapers and the Reporting of Black Murders

Anila Rahman[1], Shumaila Ashee[2], Hoor Shamail Khattak[3]
[1]City University of Science and Information Technology, Peshawar
[2]Shaheed Benazir Bhutto Women University, Peshawar

Abstract

The present study is a rigorous exploration of the inherent ideologies of newspaper discourse and the subjugation of readers to the said ideologies. The American newspapers: The New York Times, USA Today and Washington Post are used to select 30 articles, 10 per newspaper, for creating three corpora of 25,561 words in total. The software AntConc 3.5.9 is used to generate the wordlist, N-Grams and concords of the corpora. LancsBox 6.0 is used to annotate the corpora to mark it for all the parts of speech using Whelk. The articles collected are on incidents of black murders committed by white police officials in the years 2014-2021. These articles are analyzed in light of Critical Discourse Analysis and the Ideological Square Model proposed by Van Dijk in which he defines two distinctions "US" and "THEM" and how they are achieved through discourse. In the findings, it is uncovered that certain lexical items play a significant role in the construction of a desired discourse. These include nouns, verbs and adjectives. They abet the discourse in manipulation of the news. The deliberate omission of the ethnic identity of the victims in Washington Post and use of neutral verb "die" for naturalizing the crime makes it a racist and partial reporter of crimes, specifically black murders in white the perpetrators are white police officials. New York Times and USA Today incline more towards pro-black discourse.
Keywords: corpus-based analysis, ideology, racism, CDA, ideological square

Introduction

News media serve as a source of information for the masses. They claim to be pursuers of neutral and objective reporting. However, Egelhofer and Lecheler (2019) revealed that lately there has been a substantial rise in circulation of fake news. Strömbäck et al. (2020) stated that the trust in news agencies has dropped to 32% in 2016 worldwide and reportedly, 12% people have blind faith in news media. Media in the modern world is highly in demand as a tool for achieving hidden agendas. Downey, Titley, and Toynbee (2014) have observed that the increasing polarity in mass media is concealed by inculpating the lower social classes.

Destutt de Tracy coined the term ideology (idéologie) towards the end of 18th Century. It was explored by Van Dijk (2019) to ascertain how it was related to discourse and racism to find out the relationship they shared. Van Dijk (2000) stated that racist ideologies are often expressed through discourse, and display the inherent ethnic prejudices. He clarified that racist ideologies are more commonly observed in the West. He further explained that the disparities in the representation of various social groups in newspaper discourse are what lead to the dichotomy of "US" and "THEM". Minkenberg (2013) specified the class of ideologies to which racism belonged. This ideology operated on a notion of exclusion. Besides racism, he identified xenophobia and ethnocentrism among other types. He defined racism as ill-treatment of the "other" owing to their biological traits.

The study at hand evaluates the nature of news reporting by three American newspapers namely New York Times, USA Today and Washington Post. It aims at identifying the ideologies which are advocated by each newspaper and to ascertain the lexical tools which are employed to achieve such purposes. For this, the

paper will take into consideration 10 events of black murders and closely follow the discourse used by the newspapers for their coverage. An in-depth analysis of the text will enable the researcher to reach a sound conclusion regarding which side of the dichotomy, US and THEM, are the black victims closely associated with by these newspapers.

Literature Review

This study aims to look into the role of print media in projecting racism by analyzing articles on black murders by American newspapers which are: The New York Times, Washington Post and USA Today. It will thoroughly examine how the black murders are portrayed by the newspapers, specifically when the perpetrators are white police officers. Tabassum, Shah and Bilal (2013) evaluated the prominent left or right wing ideologies in English language newspapers of Pakistan. They viewed the editorials concerning the death of Osama Bin Laden and determined how they functioned in the construction of ideologies. Editorials, otherwise known to be representative of objective perspectives, were concluded in their study to be chiefly the proponents of the newspaper's ideologies. Therefore, Pakistani English newspapers were discovered to be actively engaged in advocating their personal ideologies rather than objective viewpoints.

Media institutions promote ideologies which are strictly congruent with their political affiliations, as is quoted by Shojaei, Youssefi and Husseini (2013) in their study. They found that Western newspapers, chiefly British and American newspapers, use language as their foremost tool for dispersing ideologies. Secondly, their study culminated in the finding that using language in a preplanned manner aids the newspapers in highlighting or suppressing their desired sides. It further asserts the power which newspaper agencies possess by the virtue of linguistic tools in dispersal of ideologies. More on Western news media, Miranti (2014) studied the editorial section of New York Times and Washington Post for their discourse on non-registered immigrants. The results showed that the New York Times has a proclivity for a liberal position whereas the Washington Post was more conservative, hence depicting the immigrants as "out-group". Moreover, Mahmood, Kausar and Khan (2018) also reiterate the notion that newspapers have the capacity of emphasizing or suppressing any group of their liking. They studied the reporting of 16th December attack on Army Public School in Dawn News and The New York Times. It was discovered that Dawn News more prominently portrayed the "US" discourse, in comparison to The New York Times in which "THEM" discourse was used. It meant that the Pakistani newspaper chose to represent the attackers as militants i.e. US and the American newspapers represented a more impartial image by referring to the attackers as Talibans.

Bartesaghi and Pantelides (2017) were of the view that Critical Discourse Analysis (CDA) is capable of analyzing myriads of varieties of data. They state that it may be used both as a theoretical or methodological framework. Xie (2018) believed that CDA enables the researcher to view newspaper discourse with a critical lens by analyzing the lexical choices and examining the practice level at which the newspaper discourse is executed. It means that it breaks down the newspaper text into different levels based on its apparent and hidden meanings. Xie further stated that CDA may be used to test the accuracy of a news text, find its implications, target audience and the desired results of the news agency.

Employing CDA as their theoretical framework, Tanvir, Khoula and Zahra (2018) explored the discourse of American newspapers on incidents of mass shootings. Their findings revealed that the newspapers deliberately omitted the objective facts and focused on stressing upon their ethnicities whenever the shooters belonged to ethnic groups such as Afghan, Bosnians, Koreans, Saudis and Vietnamese. However, the race of the perpetrator was never revealed in case of white shooters and the discourse opted was comparatively objective. The subjective discourse employed in case of the ethnic shooters comprised of adjectives with negative meanings thus serving as the broadcaster of racist discourse. These findings were in line with those of Sajid, Anwar and Ashraf (2019). They revealed that the newspaper discourse is

manipulated with the help of certain linguistic tools after analyzing English newspaper headlines in Pakistan. This discourse is shaped to suit a preferred ideology.

These studies accentuate the subjectivity which is deliberately opted for by the various news agencies for projecting their ideologies onto the masses. The present study selected 10 incidents of black murders for gathering 30 articles, 10 from each newspaper. These articles will be analyzed with respect to their lexical word classes i.e. adjectives, nouns and lexical verbs to find how these newspapers differ in their preferred ideologies. Yule (2020) defines adjectives as words which provide additional information about the nouns with which they are used. He refers to nouns as naming words which are used to define people, places, things etc. Lastly, according to him, verbs may be used for three purposes: to describe an action, state or course of event. These words will provide the researcher an insight into the nature of discourse of the selected articles. The literature studied established a gap in literature. To fill this, the present study will seek answers to the following research questions:

    i.   How do the lexical words choices differ in the three newspapers when reporting incidents of black murders?
    ii.   How do these words portray the ideology of the relative news agencies?

Research Methodology

The research follows a mixed method design. Creswell et al. (2003) defined mixed methods as one which may have any of the four underlying models as the acting design in any research. The one followed in this study is the mixed method accompanied by an explanatory approach. This design comprises of two steps: quantitative collection of data followed by its analysis and secondly its explanation, using the data which has been gathered qualitatively. This study is based on corpus techniques because it uses deductive reasoning.

For this study, three corpora of total 25,561 words were compiled. Each newspaper i.e. The New York Times, USA Today and Washington Post had its own corpus which comprised of 10 articles per newspaper, making it 30 in total. This study utilized purposive sampling, in which the researcher selected 10 incidents of black murders from the years 2014-2021 based on their own judgment. The names of the black victims and the dates of their killing are given in table 1.

Table 1: Black victims of white police shootings and the dates of their murder

Black Victim	Date of Murder
Eric Garner	17 July 2014
Michael Brown	9 August 2014
Tamir Rice	22 November 2014
Walter Scott	4 April 2015
Alton Sterling	5 July 2016
Philando Castile	6 July 2016
Stephon Clark	18 March 2018
Breonna Taylor	13 March 2020
George Floyd	25 May 2020
Daunte Wright	11 April 2021

These incidents were selected because all the victims were of black ethnicity and the perpetrator in each case was a white police officer. Furthermore, the manner of killings was similar as well i.e. choking or shooting. Each of the victims was killed based solely on the officer's suspicion. The events are also interlinked because they caught people's attention worldwide and resulted in various movements online, including "#BlackLivesMatter" and "#ICantBreathe". These incidents were closely followed by the news

media and therefore had sufficient material to be researched. They all took place within the last decade and are hence fairly recent and relevant. During the pandemic, the Americans came out on the street to protest against these murders. With George Floyd's killing, all the previous victims were remembered. News agencies such as USA Today and Washington Post made frequent mentions of the earlier killings and related them to the most recent murders of Floyd, Taylor and Wright.

This study is based on Van Dijk's Ideological Square Model. This model describes a dichotomy which is created through discourse and marks the distinction of "US" and "THEM". Via this model, Van Dijk elucidates how a group may be otherized by intentional highlighting of their bad characteristics, whereas another group may be treated as naturally an in-group by hiding their negative features and bringing forth their positive attributes. It may be represented as given in Figure 1.

	Positive	Negative
US	Highlighted	Hidden
THEM	Hidden	Highlighted

Figure 1: Van Dijk's Ideological Square Model

Lastly, Critical Discourse Analysis (CDA) serves as the theoretical framework for this research. It is commonly used for analyzing discourse from a wide array of contexts, including that of news. Xie (2018) pointed out that it is frequently used in research in order to uncover the true source of power manipulating the news discourse. He highlights the foremost step in Critical Discourse Analysis which is to determine the relationship between discourse and the basis of its production. Nartey and Mwinlaaru (2019), talked about the unison of CDA and Corpus Linguistics, stating that when they go hand-in-hand, it arrives at more systematic and accurate results.

Accompanying the Critical Discourse Analysis theory is the corpus tool, AntConc 3.5.9. For the data analysis, three corpora were generated out of the 10 articles selected for each newspaper. These corpora were analyzed using the aforementioned software. This software has the features of concordances, N-Grams, collocates, wordlists, keywords, and concordance plot. However, this research will primarily focus on the wordlist, concordances and N-Grams. The wordlist provides the list of the words with respect to their frequency in the text, the concordances show the context in which a selected word is used and the N-Grams provide the nth word/s which appear in the proximity of a chosen word. The software LancsBox 6.0 was used to annotate the data with the help of its feature "Whelk". This marks all the different parts of speech, thus the verbs, nouns and adjectives can be easily located. All these features combined will not only speedup the analysis but they also yield far more accurate results as compared to manual analysis.

Data Analysis

Tanvir, Khoula and Zahra (2018) studied the representation of ethnic and white shooters in various American newspapers establishing that media is not entirely impartial in news reporting. This idea was further explored in the present research to examine how the American newspapers, USA Today, The New York Times and Washington Post represent black victims. The corpora were analyzed to compare the discourse of the three newspapers, predominantly the action verbs and the ethnic adjectives such as black or white. The results were then compared to determine the inherent ideology being propagated by the respective newspapers.

The analyses were congruent with the findings of the above-stated study. The wordlist tool was used to generate the frequencies of the verbs kill, murder and die for the corpora. The results are given in the table below.

Table 2: Frequencies of the verbs kill, murder and die in the three corpora

Newspaper	Verb*	Frequency
New York Times	Kill	6
	murder	1
	Die	6
USA Today	Kill	8
	murder	2
	Die	12
Washington Post	Kill	19
	Murder	0
	Die	7

The asterisk with the verb means that the wordlist tool searched all forms of the mentioned verbs. The usage of these words either as verb or noun was identified using the Whelk feature in LancsBox. It is evident from the table that in a 25,561 word corpora, the frequencies of the verbs kill and murder are quite insignificant. The verb choice reveals how the incidents have been reported. The verb "die" naturalizes the event and makes it a case of natural demise. It softens the nature of the crime and does not accurately describe the atrocity associated with the criminal act. However, the verbs "kill" and ''murder'' convey impartiality, objectivity and neutrality. Verbs are often the words which appear in the headlines of news articles reporting murders and are therefore among the first words with which a reader interacts. Therefore, the usage of verbs largely determines the approach which a newspaper is adopting.

Coming to the ethnic adjectives which were manually selected with the help of Whelk in LancsBox, they were looked up in the three corpora using wordlist in AntConc. Their frequencies are given in the table below.

Table 3: Ethnic adjectives and their relative frequencies in the three corpora

Newspaper	Ethnic Adjective	Frequency
New York Times	Black	16
	White	10
USA Today	Black	44
	White	14
Washington Post	Black	16
	White	4

The frequencies reveal how frequently the ethnic identity of the victims and the perpetrators were revealed in the articles. USA Today appears to have the highest frequencies of both the adjectives, black and white. New York Times falls in second position whereas the Washington Post has made the least mention of the race of the killers. This is in line with the findings of Miranti (2014) where the Washington Post was revealed to be a conservative news agency. The mention of a person's race in such killings is made to give him his due recognition. It is an undiscriminating strategy with the help of which their identification as "US" is ascribed to their race, specifically in the case of minorities. It is to reveal that they are accepted as members of the in-group distinction. Moreover, the highlighting of the killer's race is done in recognition of the racist facet of the crime. The figure below shows the randomly selected concordances for black in USA Today.

Figure 2: KWIC (Key Word In Context) results for black in USA Today

In the figure 2, the concordance lines 24, 25, 26, 27, 28, 29, 30, 31, 33, 34, 37 have used black as race of the victims. Line 32 refers to a black perpetrator in killing of a white woman. Line 35 refers to the oppressed black people. Lastly, line 36 refers to the community of the black people. Line 37 is also one which has revealed the ethnicity of the white killer as well. Thus, USA Today has deliberately highlighted the race of the victims, conforming to the criteria of identifying a group as "US" as detailed in Van Dijk's Ideological Square. The figure below illustrates the random KWIC of black in New York Times.

Figure 3: KWIC (Key Word In Context) results for black in the New York Times

The concordance lines 3, 4, 5, 6, 12, 13, 14, 15 all show the ethnicity of the black victims. Line 7 is referring to neighbourhoods where black people live. Line 8 refers to the black American community. Line 9 refers to a jury which consists of two black jurors. Line 10 and Line 11 are among those concordance lines which have not made any mention of the victims. Wherever the race of the black victims is revealed, it is where the New York Times highlights them as in-group. Failure to observe the in-group discourse is witnessed in the lines with no mention of the black victims. Now lastly, the figure below shows the concordances of black in Washington Post.

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Concordance Hits	16

Hit	KWIC
1	. Sterling is one of 122 black Americans shot and killed
2	under siege particularly by black and brown takers, as
3	it. When you're black and especially male — in
4	Rather, the dehumanization of black bodies becomes some sort
5	to the deaths of black citizens at the hands
6	Clark, killing the unarmed black father of two last
7	again. I taught my black kids that their elite
8	burdens of being a black male was bearing the
9	killing of another young Black man drew a similar
10	police shooting of a black man in as many
11	. Floyd, a 46-year-old black man, was suspected of
12	, this has created a black market in cigarettes that
13	-profile police killings of black men, women and children

Figure 4: KWIC (Key Word In Context) Results for Black in the Washington Post

In the figure 4, concordance lines 1, 5, 6, 9, 10, 11, and 13 are only lines which describe black people as victims of police shootings. Washington Post had 16 hits for black, however not all concords reveal the race of the black victims. The victim's race is deliberately omitted in order to hide the racial bias of the crime and the perpetrator. It is also the newspaper with the least use of white in its discourse, again to hide the racist nature of crime and to make it just another incident of ordinary police shooting, with no involvement of ethnic minorities. This "otherization" of the black people restricts them to "out-group" in the Washington Post discourse. Van Dijk's ideological square terms this distinction as US vs THEM. In this case, the police officers are highlighted as "US" and the black victims as "THEM".

Furthering the examination of racial bias in the newspapers, the N-Grams, particularly the tri-grams and four-grams of the noun "death" were located using the Cluster/N-Grams feature of AntConc. "Death" is used for reporting the final living state of the victims. This word has a naturalizing impact on the discourse. It conceals the truth of events and discloses the incident as a completely natural matter of the victim's expiry. This advances the possibility of racial partiality and subjectivity. The figure below illustrates the most frequent N-Grams of death in the corpora. Tri-grams are lexical clusters which consist of three words and four-grams consist of four words.
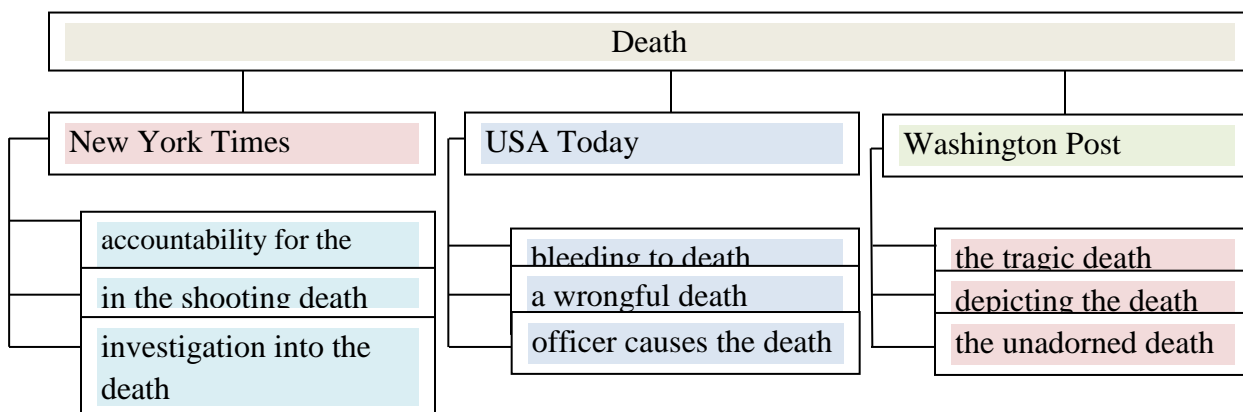
Figure 5: N-Grams of Death

The noun "death" is quite frequently adopted in the three corpora. New York Times has used it while talking about holding the perpetrator accountable for the death of the victim. It has also highlighted the shooting and referred to the investigation into the incident. In USA Today, a police officer is mentioned as one responsible for causing the death of the victim. It has also called the death as "wrongful". Lastly, the USA

Today corpus spoke of an incident where the victim bled to death, thus mentioning the manner of death as well. Quite contrasting to the first two corpora, the Washington Post has bluntly reported the killing incidents as events of dying. This manipulates the reality and projects racist disclosure of the crime. After this, the N-Grams of the noun "murder" are illustrated in the figure below.
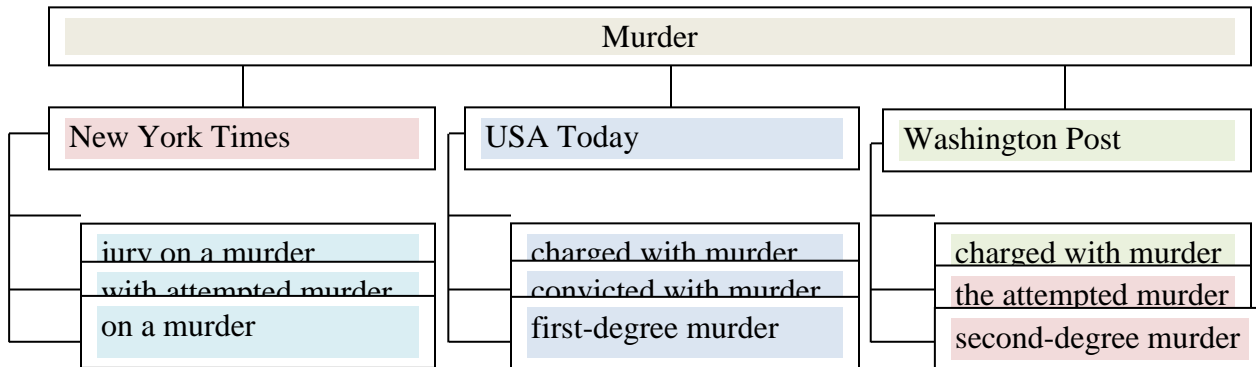

Figure 6: N-Grams of Murder

Murder is the verb which reports the true nature of the crime. Murder involves two participants i.e. the murdered and the murderer who is undeniably the culprit. However, "death" completely rejects the involvement of a killer and is accredited to natural factors. When murder is used, it also reveals the intent of the malefactor to kill. Thus, it is recognized as voluntary manslaughter which is punishable by death or life sentence in most cases. Contrastive to this, the labeling of the incident as death automatically releases the killer of all charges. This difference in the implication of death and murder is of immense significance when the readers interact with them. They are readily subjugated to the covert ideologies propagated by the newspaper discourse. Montag (2017), when explaining Althusser's Interpellation, clarifies that a person is only recognized as the subject of an ideology after he is exposed to that ideology, and when he acknowledges that the ideology was addressed to him without realizing that it is a discourse directed by personal belief system of those in power. Hence, the employment of "death" for identification of the incident falls more under the realm of racist discourse, subjugating the masses to racist ideology, whereas "murder" conveys an impartial image and do not subject the readers to any hidden ideology.

The corpora of the New York Times and USA Today incline more towards impartial reporting and objective stating of events, whereas contradictory to this, Washington Post have employed the lexical tools in a manner that advocates ethnic prejudice. The word-choice determines the course of the discourse. Words with more naturalizing impacts promote racist discourse and are observed in the corpus of Washington Post with the frequent use death and the almost negligible use of murder. Secondly, Washington Post has been observed to have deliberately hidden the race of victims and killers in order to avoid projecting any racist aspects to the crimes. Finally, it has failed to report the crimes objectively and factually by deliberately avoiding the use of "murder" verb to report the action of the killing.

Conclusion

This study explored the role of newspaper discourse in disseminating racist ideologies in reporting of black murders committed by white police officers in America. It examined the role of lexical items such as nouns, verbs and adjectives in manipulating the nature of discourse. For this purpose, three corpora of ten articles each was generated from scratch for the top American newspapers, USA Today, New York Times and Washington Post respectively. The articles were of 10 incidents of black murders which took place between the years 2014 – 2021. The corpora comprised of 25,561 words. The lexical classes, nouns, action verbs and adjective were comparatively analyzed for the three corpora in light of Van Dijk's Ideological Square Model and Critical Discourse Analysis.

The corpus tools AntConc 3.5.9 and LancsBox 6.0 were used for their features wordlist, concordances, N-Grams and Whelk. The findings revealed that the newspapers, namely the New York Times and USA Today projected a pro-black discourse. On the other hand, Washington Post advanced conservative discourse with respect to black murders. It avoided the use the verb "murder" to report the crime, it hid the ethnicities of the victims and perpetrators, and normalized the black killing. It defined the incidents as deaths, thus toning down the harshness of the news report. It was found to be an active peddler of racist ideology, and a reporter of subjective and biased news.

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Foucault's Bio-Power of State: A Comparative Analysis between *Brave New World* and the Real Capitalist World

Mehak Faiz

City University of Science and Information Technology

Abstract

The present study explores how Aldous Huxley's Brave New World (1932) presents a State controlled systematic manipulation and psychological conditioning of individuals through Hypnopaedia and Soma. This paper adopts a comparative analysis, comparing the aforementioned means of mass conditioning used in the novel with the techniques used by the real-world capitalist states. It further delves into the nature of physical and mental manipulation of mass subjects in fiction compared with the reality. The analysis is conducted in lieu of Foucauldian notion of biopower, which characterizes the exertion of political power over populations, effectively reducing them to mere instruments of social control. The findings reveal that the rapid development and scientific progress observed in the modern world has made it possible for the states to use the fictional means of mass conditioning in the real world. The subconscious conditioning through mass media and the pervasive use of psychotropics are the real-world manifestations of Huxley's prophecies. Hence, it implies a trajectory towards the dystopia that he has predicted in his dystopian science fiction novel Brave New World.

Keywords: Aldous Huxley, Brave New World, Bio-Power, Manipulation, Conditioning

Introduction

Twenty-seven years later, in this third quarter of the twentieth century A.D., and long before the end of the first century A.F., I feel a good deal less optimistic than I did when I was writing *Brave New World.* The prophecies made in 1931 are coming true much sooner than I thought they would. (Huxley 3)

This statement was made by Aldous Huxley in his work *Brave New World Revisited,* almost three decades after the publication of his masterpiece *Brave New World.* Considering the swift scientific and technological development that was reforming the world around him, he was strongly convinced that his prophecies will soon materialize. *Brave New World* is a dystopian science fiction novel that introduces a futuristic fictional society known as "The World State". In this society, ten World State Controllers hold absolute control over the lives of their citizens. Their ultimate objective is to manipulate the masses and establish a completely stable society, and to achieve that, they exploit scientific and technological advancements.

This study draws a comparative analysis between the fictional *Brave New World* and the contemporary world. The parallels between the fictional and real world include the conditioning of masses through technology, manipulation of populace by their controllers and use of drugs as means to escape reality. The aforementioned aspects are analyzed form the perspective of Michel Foucault notion of Bio-Power.

In *Brave New World*, a method of subconscious conditioning known as hypnopaedia or sleep-teaching is used to shape societal beliefs and thoughts. As an equivalent to hypnopaedia, in present times, social media platforms have a pervasive impact on peoples' behaviours and perspectives. This type of conditioning paves the way for a compliant and docile population.

Moreover, in *Brave New World* a mind-numbing fictional drug soma is being used as an escape from reality. Similarly, the idea of soma can be associated to the widespread use of real-world psychotropic drugs which can alter a person's mental state and perception.

Huxley's satirical novel, *Brave New World*, published in 1932, was significantly inspired from the historical events of his era which served as catalyst in the composition of this masterpiece. The advent of Industrial Revolution in the 18th century led to the transformation and replacement of traditional societal norms. Simultaneously, the profound global economic instability caused by the Great Depression of 1930s convinced Huxley of the paramount importance of stability as a fundamental for the survival of a society. Hence, this thematic concern is vividly portrayed in the novel as maintaining stability is the guiding principle of the World State Controllers. Additionally, the post-World War I era experienced remarkable technological innovations, giving rise to a new era of technology. This increased the dependence of people on these scientific and technological innovations which compelled Huxley to question and criticize this dependence within the framework of his novel. As a result, this is the main theme around which his dystopian scientific novel *Brave New World* revolves.

Research Objectives

This study aims to achieve the following objectives:

1. To study and analyze the strategies used by the controllers in *Brave New World* to condition and control the citizens
2. To draw similarities between these fictional strategies of conditioning and the techniques of conditioning used in the real world
3. To analyze the various forms in which these techniques are used by the real-world states to manipulate the populace.

Research Questions

1. How are the citizens controlled through subconscious conditioning and drugs by the controllers in *Brave New World?*
2. How the fictional strategies such as subconscious conditioning and soma of the novel can be compared to real world social media and psychotropic drugs?
3. In what ways these various strategies are used by the real-world states to manipulate the citizen and establish control over them?

Significance of the Study

This study discusses the dystopian novel *Brave New World* due to its representation of some significantly important themes which present the alarming reality of the contemporary society. The novel highlights the different methods used to condition citizens with the help of science and technology. Their behaviours and perspectives are manipulated in order to make them submissive. The current study employs a comparative analysis to shed light on the ways of manipulating masses that are observable in the present world. Consequently, it shows that the present world is increasingly aligning with the dystopian future that Huxley had once imagined.

Theoretical Framework

This paper analyzes the mechanisms of conditioning and control used by the state in the novel *Brave New World* and compares them with the mechanisms used by the states in the real world. This comparison is

carried out from the theoretical lens of Michel Foucault's Biopower. Foucault's ideas will help to analyze the power exerted by fictional state as well as the real states to manipulate the populations and find its relevance to the concept of biopower.

Michel Foucault presented the concept of biopower in his work, *The Will to Knowledge: History of Sexuality,* Volume 1. The theory was particularly presented in the fifth part titled "Right of Death and Power over Life". Additionally, Foucault's lectures at the College de France, including "Society Must be Defended" (1975-76), "Security, Territory and Population" (1977-78), and "The Birth of Bio-Politics" (1978-79), further delved into the theory of biopower.

As evident from its name, biopower refers to the power exercised over life. It encompasses different techniques and mechanisms employed by the state or governing bodies to manage and regulate populations, with a special emphasis on life processes and the individual body. Hence, with the advent of biopower there was an expansion of multiple and diverse methods for "achieving the subjugation of bodies and control of populations, marking the beginning of era of bio-power" (Foucault 140).

Biopower is a broader concept which has been divided into two integral forms by Foucault. The first form is termed as "*anatamo-politics of the human body*" (Foucault 139), it refers to a power that is "centered on the body as a machine: its disciplining, the optimization of its capabilities, the extortion of its forces, the parallel increase of its usefulness and its docility" (Foucault 139). It is a disciplinary power concerned with disciplining of the body, and is one of the modalities through which biopower operates. It works through proper state regulated institutes to exert control over individual's body and behaviour and manipulate it to conform to established societal norms.

The second component which emerged later is termed as "biopolitics of the population". According to Foucault, biopolitics deals with the policies and practices employed by the state to exercise power over whole populations, emphasizing control over each and every aspect of their life including health, labour and other aspects of existence. In his lecture, "The Birth of Biopolitics" Foucault described it as "Biopolitics is a power that exerts an influence on life, that endeavors to administer, and optimize it, subjecting it to precise controls and comprehensive regulations".

Both biopolitics and disciplinary power are integral to the functioning of biopower. In Foucauldian terms, "the disciplining of the individual bodies and regulation of the whole population formed two poles of biopower through which life is organized" (Foucault 140).
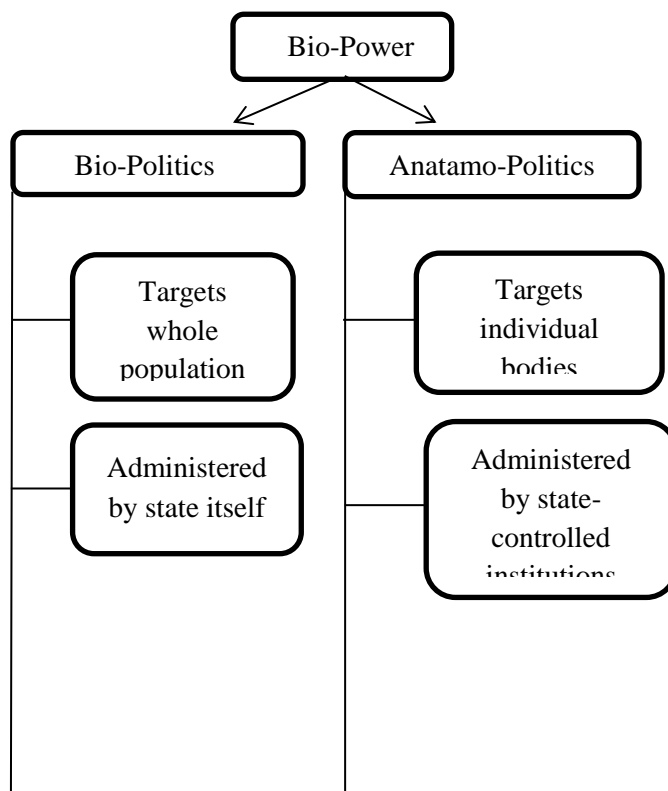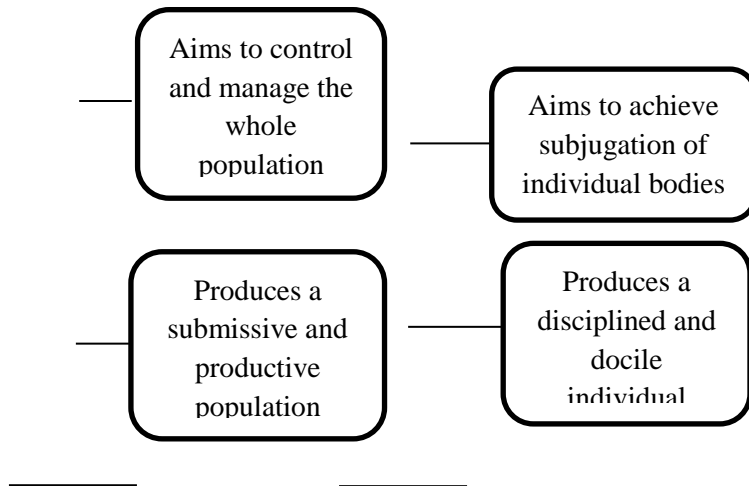
Figure 1: Foucault's Biopower and its Forms

Literature Review

This study explores the use of science and technology to condition citizens in the novel *Brave New World* and compares these with the methods of manipulating masses used in the real world. *Brave New World* has been extensively studied and researched as a dystopian science fiction novel under various theoretical frameworks. However, there are limited number of studies that carry out a comparative analysis between the novel and the real world keeping in view Foucault's theory of Bio-power. This study aims to draw parallels between the fictional dystopian society of the novel and the real world, consequently, showcasing the transformation of the present world into a dystopian society.

In 1950s Huxley wrote *Brave New World Revisited* as a follow-up to his original work because he discovered that many of his predictions presented in *Brave New World* were becoming increasingly relevant in the world of 1950s (Gorshin 1).

The rapid scientific developments that are reshaping the modern societal landscape requires critical attention towards limitation of this progress. This is the core idea that becomes the foundation of Huxley's *Brave New World.* Hence, science can serve both as a tool to build a promising world or a force to subjugate and destroy a society (Santos et al. 654

Dündar in his study analyzes the dystopian novel *Brave New World* and tries to riddle out its relevance to the real world. He states that Huxley's predictions are so accurate that it seemed as though he had travelled through time and provided a glimpse of the future scenarios (Dündar 8-9). Dündar also discusses the totalitarian power depicted in the novel, where free thinking is eradicated by suppressing rebels and subjugating masses (Dündar 17-21). Similarly, Franzén, in a deconstructive analysis of *Brave New World*, , he delves into different aspects of the novel which include dismissal of personal autonomy and the presence of a tyrannical regime that orchestrates every aspect of the citizens' lives through conditioning and soma to completely abolish any possibility of revolution. (Franzén 4-7).

Similar notion is put forth by Lemke, who, in his article, critically analyzes Foucault's concepts of bio-power and biopolitics. He explores the correlation between these notions and highlights that in modern societies, biopolitics operates as a mode of power for the regulation and control of populations. While understanding biopower he also discusses that states employ various mechanisms to govern every aspect of lives of the population to shape them in the desired way (Lemke 35-36).

Likewise, Spencer writes that *Brave New World* can precisely be seen as a prophetic vision of the present world, implying that the contemporary times mirrors the era satirized by Huxley in 1931. Also, the novel cannot simply be viewed as a cautionary tale of the future, but is also a satirical critique upon the society of his time (Spencer 1-3). The same argument is presented in another study by Schumacher who states that *Brave New World* depicts a future that may have seemed implausible to the people of his era. However, in the contemporary times, many of the aspects have become reality and do not appear to be of fantastical nature anymore. (Schumacher 4-7).

Likewise, when conducting a study on Foucault's' theory of Bio-power, Arnason argues that when state exerts biopower over a population, it perceives individuals as machines and seeks techniques to control and regulate them. The objective is to produce individuals that are both productive and submissive so they can be easily integrated in the economic system of industrialized society (Arnason 298).

Sampson in his research describes that in *Brave New World*, Huxley has portrayed a dystopian society in which the controllers brainwash and manipulate the citizens through technological means. Their over indulgence in pleasure inducing drug and hypnotic media has made them contented with their miserable lives. (Sampson para.5-7). Likewise, Neil Postman in his book writes the similar idea in these words "People will come to love their oppression, to adore the technologies that undo their capacities to think" (Neil Postman, *Amusing Ourselves to Death).*

Roach presented a similar idea in his study conducted on Foucault's Biopower. He proposes that as opposed to penal power, biopower disciplines bodies by promoting a better way of life guided by state constructed rules (Roach 156-157). It aims towards the formation of a docile body through intertwining the techniques of totalization and individualization. Consequently, it establishes a complete control over the individual bodies along with the entire population. In Foucault's words, it takes place "when the anatomo-politics of the body and biopolitics of the population become two poles in the art of governance" (Roach 157).

All the researches discussed above have studied and analyzed various aspects of the Huxley's *Brave New World* from different theoretical perspectives. Most of these studies have regarded the novel as a prediction of the dystopian future of the present world. While some of these aforementioned researches highlight the totalitarian government of the novel and its manipulation of the masses. The classical conditioning of the citizens and their predetermined societal roles and castes. Other studies have pointed out the relevance of the novel to the contemporary times by comparing several aspects between both. However, the current research aims to conduct a comparative analysis of the certain obvious aspects of the novel with the real world in the light of Foucauldian theory of Bio-Power, first presented in his book *"The History of Sexuality,* Volume 1: An Introduction.".* It specifically focuses on the technological means such as subconscious conditioning and the consumption of soma because these aspects of the novel have already manifested in the present world. It further describes the ways in which they are misused by the modern states to manipulate the citizens.

Text Analysis

Section I

This section focuses on analyzing the technological means i.e., hypnopaedia and Soma which are used by the World State to condition the citizens in the novel *Brave New World*. It highlights the misuse of scientific and technological knowledge that has the potential to transform the world into a dystopia. The analysis is carried out from the theoretical approach of Michel Foucault's biopower which discusses how power, when concentrated in few hands, can control and manipulate the lives of the population

Methods of Conditioning Employed in Brave New World

In *Brave New World*, the World State Controllers psychologically, emotionally and chemically condition the citizens to establish a complete control over them. These methods of conditioning combine together in order to produce a population that is unwaveringly loyal to the state, content with their pre-destined roles and blind to their own enslavement. They do not have any autonomy thus eliminating the challenges to stability and risk of revolution.

Although the novel includes the aforementioned methods of conditioning, the present study analyzes the methods including subconscious conditioning or Hypnopaedia and chemical conditioning. It further discusses how they are used by the World State Controllers to manipulate the citizens and achieve Bio-Power over them.

Hypnopaedia or Subconscious Conditioning

Conditioning is a process which helps in shaping an individual's behaviour according to the desired way. In *Brave New World*, the citizens undergo conditioning to ensure conformity with State's rules and regulations. The reinforcement of conditioning within the World State takes place through subconscious conditioning or hypnopaedia. "Hypnopaedia", also known as sleep- learning or subconscious conditioning, refers to the process of exposing individuals to new information or recorded messages during their sleep, aiming to engrave the new information into their subconscious minds.

Hypnopaedia in *Brave New World* plays a crucial role in psychological conditioning of the population. The hypnopaedic messages are specifically designed to implant specific values, ideologies and behaviours into their subconscious minds. Resultantly, through hypnopaedia, the State bypasses critical thinking and ensures internalization of the desired attitudes, norms and preferences. Thus, this subconscious psychological conditioning proves to be a powerful tool for societal control, contributing to the overall stability and control maintained by the ruling powers. The power and control which the State exercises over its subject is described by Foucault as Bio-power. Hypnopaedia operates as a form of bio-power that manipulates the populations' minds and discourages critical self-reflection.

Biopower proposes the organization and regulation of an individual's as well as the whole population's way of life, mostly under the administration of the state. In *Brave New World*, the State exercises biopower over the citizens as the societal norms and behaviours are instilled in the masses through state- governed institutions. Subsequently, through hypnopaedia they acquire the societal norms and moral behaviours designed by the State.

Furthermore, the indoctrination of the populace corresponds to another aspect of biopower, known as disciplinary power. Disciplinary power primarily operates through disciplinary institutions, many of which are either operated under the state or influenced by the state. It aims to discipline individuals who deviate from the societal norms and also serves to produce individuals that are mostly docile and submissive. In a similar vein, in the novel, hypnopaedic conditioning is implemented through proper institutions run by the State which are known as State Conditioning Centres. In this way, the subconscious learning ensures deep ingraining of the pre-determined ideologies and habits in the citizens' minds for a lifetime. As expressed by the director of the World State,

> Till at last the child's mind *is* these suggestions, and the sum of the suggestions *is* the child's mind. And not the child's mind only. The adult's mind too – all his life long. The mind that judges and desires and decides – made up of these suggestions. But all these suggestions are *our* suggestions!...Suggestions from the State (Huxley 20).

The Controllers of the World State implement a subtle form of totalitarianism. Their motto of World State stability is contradictory to the notion of individual freedom. Therefore, the population is conditioned to refrain from contemplating about their own freedom or freedom of the society. Despite living under a repressive regime, they are contended with their lives and think of themselves as autonomous beings.

The following dialogue between Lenina and Bernard serves to further reinforce this notion,

> "I am free. Free to have the most wonderful time. Everybody's happy nowadays." to this Bernard, who works at the Conditioning Centre, replies: "Yes, 'Everybody's happy nowadays.' We begin giving children that at five" (Huxley 70).

From Foucauldian perspective, the World State produces docile bodies "that serves as the physical expression of subjection and conformity' (Foucault138). The State's exertion of biopower transforms its citizens into instruments for achieving its self-centered objectives. Thus, the resulting population resembles nothing more than mere automatons, devoid of free will.

The Psychotropic Drug Soma

In *Brave New World,* the individuals deal with their discontentment through the consumption of a psychotropic drug called Soma. Throughout the novel, the citizens frequently use soma to get rid of unwanted feelings. Whenever they experience sadness, despair, or anger, a dose of one or two tablets of soma induces happiness and relaxation, enabling them to escape their worries and enters a euphoric state.

 The statement of the Controller, Mustapha Mond, also reinforces the above-mentioned idea:

> And if ever, by some unlucky chance, anything unpleasant should somehow happen, why, there's always soma to give you a holiday from the facts. And there's always soma to calm your anger, to reconcile you to your enemies, to make you patient and long-suffering. (Huxley 185)

 The consumption of soma leads to a decrease in the individuals' cognitive abilities, making it easier for them to evade their problems. It provides a pleasurable distraction from reality, effectively forming a barrier between their minds and the actual universe, as presented in the novel: "that second dose of soma had raised a quite impenetrable wall between the actual universe and their minds" (Huxley 59).

In *Brave New World,* the State misuses soma for the purpose of social control and manipulation of the masses. With the provision of easy access to this psychotropic drug, the State effectively suppresses critical thinking and individuality within the population. It serves as a pacifying agent and induces an artificial sense of contentment. As a result, soma becomes a tool used by the State to develop a passive and docile population that lacks the drive to challenge or question the established societal order.

The use of soma in *Brave New World* is associated with the Foucault's concept of biopower. As biopower refers to the techniques and mechanisms employed by the state to control and regulate the lives of its population. In the novel, the World State Controllers exercise this biopower through the promotion and distribution of soma among the citizens. Its consumption by the citizens increases their suggestibility and makes them highly submissive. Consequently, the State exertion of this biopower guarantees that the population remains docile and obedient, as their dissatisfaction and critical thinking are effectively neutralized by the usage of soma.

Text Analysis

Section II

Methods of Conditioning Employed in Real World in Comparison to Brave New World

This section of the study focuses on comparing the similar aspects between *Brave New World* and the present world from the theoretical lens of Foucault's Bio-Power. It presents the real-world counterparts of the means used by the novel's State to condition and control the population. It further highlights the different ways in which these means are used by the states to achieve social stability.

Hypnopaedia in Real World:

The use of hypnopaedia in *Brave New World* can be viewed as similar to the way states in the present world utilize internet and social media for conditioning the populace. Although the technology and procedure used in the novel may differ, but there are underlying similarities in their potential to shape ideologies and behaviours.

Hypnopaedia in the novel is a systematic technique designed to effectively condition the citizens and ensure propagation of specific ideas to exert control and maintain social stability. Similarly, social media platforms in the real world are exploited by the states to influence narratives, mould public opinion and condition the masses through repeated exposure to specified content. The idea is emphasized by a statement from Maria Ressa, Nobel Peace Prize laureate and founder of Rappler, (news website)

> "Social media platforms have become powerful tools for governments to shape public opinion, control narratives, and suppress dissenting voices."

Additionally, Today's social media is a pervasive and easily accessible medium through which information is disseminated by the states. It serves as an influential platform of governments and ruling authorities for manipulation of public discourse and collective opinions. The populations adopt the beliefs dictated by the states; thus, they are conditioned unknowingly. Moreover, the idea is relevant to Foucault's biopower which deals with operation of power through various mechanisms for the control and regulation of the whole population. In case of social media, it serves as a mechanism for achieving biopower because it helps the states to disseminate information on a mass scale, conditioning populations' beliefs and exerting control over their behaviours and actions.

Along with that, the mechanism of targeted advertising used by the states in the real world is similar to the novel's hypnopaedia in various ways. Both these methods are used to promote specific ideologies, opinions and beliefs among the population. Further, the two of them has the potential to create filter bubbles or echo chambers, where people predominantly encounter information that aligns with their preexisting interests and beliefs.

Likewise, the way hypnopaedia is used in *Brave New World* to condition the population's beliefs and behaviors, social media platforms can be misused for propaganda purposes to condition people. By strategically constructing and amplifying certain state desired narratives, governments can use social media as a powerful tool for propaganda dissemination and psychological manipulation of the population.

3.   Similarly, in contemporary times, the constant intervention of governments in media and digital infrastructure has become a common occurrence. To fulfill their political motives, states closely monitoring its channels, and censoring content that criticizes governments. This monitoring and manipulation carried out by the states on social media aligns with the Foucault's notion of disciplinary power, another key aspect of biopower. It emphasizes the conditioning of individuals through surveillance and regulation of the population.

The latest report by Oxford Internet Institute titled "Global Inventory of Organized Social Media Manipulation", published in 2021, highlights the widespread misuse of social media by states and political entities. The report presents insights into the diverse tactics and resources employed by cyber troops, in collaboration with governments, political parties, and military organizations to manipulate public opinion through social media. According to the study, 81 nations across the globe misuse social media to spread computational propaganda and manipulated political data. (Bradshaw et al. 1, 2).

Soma in the Real World

In Huxley's *Brave New World,* the citizens are constantly under the influence of a psychotropic drug Soma, which keeps them contented, distracted, conditioned and submissive. The dystopian drug dependent society that has been predicted in the novel can be observed in contemporary world, where individuals are increasingly relying on psychotropics to avoid problems, reduce stress and induce pleasurable feelings. Hence, the fictional drug soma of the novel can be seen as relevant to the use of psychotropic drugs in today's real world.

Almost a century ago, Huxley, accurately prophesied the wave of psychoactive drugs and sedatives that would hit the near future. He predicted a psychopharmacological revolution that will allow the manipulation of human minds through psychoactive chemicals. In today's world, these psychotropic drugs, like soma, are distributed and consumed on a scale which is mind-boggling. Nevertheless, the prophetic vision of Huxley for a future world dominated by the consumption of drugs is spot on.

The widespread use of psychotropics allows the states to exercise biopower over populations. According to Foucault's biopower, state administers and organizes the lives of individuals, including regulation of various aspects of life and health. Similarly, any ruler or political authority nowadays can misuse the power these drugs to manipulate his subjects "by changing the chemistry of his subjects' brains" (Huxley 58. In addition, by providing easy access to psychotropic drugs, states manage the psychological well-being of their populace, potentially decreasing social unrest and promoting conformity and social control. Therefore, it exemplifies the use of biopower by states to manage and regulate populations' lives, govern their thoughts and emotions and manipulate their behaviours for social stability.

Moreover, the states of the modern world have no need to force the populations to consume drugs for manipulation of their thoughts and behaviours but as Huxley states in *Brave New World Revisited*, "it will be enough merely to make the pills available" (Huxley 58). This phenomenon is observable in contemporary times, where individuals willingly spend significant amounts of money on psychotropics. It is evident from the report titled as Psychotropic Drugs Market Overview (2022-2032) which shows that the global antipsychotic drugs market is estimated to grow from $15.50 billion in 2022 to $24.74 billion by 2029. Further, according to the UN office on Drugs and Crime World Drug Report 2023, the global number of drug consumers has reached 296 million in 2021, marking a notable increase from 284mn in 2020 (World Drug Report 15).

Conclusion

In 1932, Aldous Huxley had published his renowned science fiction novel *Brave New World*. The novel has portrayed a dystopian society known as World State which is ruled by World State Controllers. They use different means to manipulate and condition the citizens both physically and mentally. From moment of their birth until their death, every aspect of their lives is systematically regulated, they cease to be autonomous individuals and are reduced to mere instruments manipulated by the State to fulfill its own agenda. This is relevant with Foucauldian biopower, according to which the state regulates the lives of its

citizens and controls every facet of their existence. Consequently, they become docile, resembling machines rather than individuals with free will.

The present study focused on two means of conditioning used in the novel, namely hypnopaedic-conditioning and Soma. Hypnopaedic conditioning is facilitated through proper conditioning centers where citizens core beliefs and behaviours are being manipulated while they are asleep. Similarly, Soma is provided and promoted by the State to ensure the production of a compliance and submissive population. Hence, through use of these means the State paves way towards its primary objective of achieving social stability and control.

This paper, along with analyzing the means of conditioning employed in the novel, also compares it with the means of conditioning used by real-world capitalist states. The findings reveal that both the aforementioned means used in the novel are present in the real world, albeit the specific technology used may differ. The hypnopaedic conditioning is present in the form of social media, which serves as conditioning centers of modern states. Moreover, Soma of the novel has real-world counterparts in the form of psychotropics, which are widely prevalent and used by states to make populations more susceptible to conditioning and manipulation. As Foucault suggests, in his book *Discipline and Punish* that the state utilizes various methods to enhance individuals' usefulness while simultaneously promoting their docility (Foucault 135).

In a nutshell, this study examines the novel through the lens of Foucault's theory of biopower and concludes that both the World State Controllers in the novel and many political states in the real world have effectively exerted biopower over their citizens. They exercise control and manipulation over their citizens' lives through various means, ultimately fostering a state of submissiveness and docility. Thus, the study highlights that with the rapid advancement of the modern world, the prophecies made by Huxley almost a century ago are increasingly becoming true suggesting that our world is gradually turning into a dystopia.

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Effect of Bentonite on Mechanicaland Durability Properties of Fly Ash Concrete

Muhammad Israr Khan, Irshad Qureshi

Department of Civil Engineering, University of Engineering & Technology Taxila, Pakistan,

Abstract

The objective of this research paper is to investigate the effect of bentonite on the mechanical and durability properties of fly ash concrete. Specifically, this study aims to evaluate the influence of different proportions of bentonite on the mechanical and as well as durability properties. Additionally, the study aims to compare the performance of fly ash concrete with and without bentonite and to identify the optimal proportion of bentonite that results in the best overall performance. The study is conducted using a mix design of fly ash concrete with varying proportions of bentonite (0%, 5%, 10% and 15%) as an additive, keeping the constant (25%) quantity of Fly-ash. The concrete samples are tested for compressive strength, flexural strength, and splitting tensile strength at different curing ages, such 28 and 56 days. The durability properties of the concrete are evaluated using tests such Acidic Attack Resistance Test by Immersion of Samples in 5% solution of Sulfuric Acid (H_2SO_4) and for Alkali Attack Resistance samples were immersed in 5% solution of Sodium Sulphate (Na_2SO_4). The results of this research will contribute to a better understanding of the effect of bentonite on the properties of fly ash concrete. The findings can be used to inform decisions about the use of bentonite as an additive in fly ash concrete mix design to improve its mechanical and durability properties. The research may also have broader implications for the use of sustainable materials in concrete production.

Keywords: Bentonite, Fly-Ash Concrete, Acidic and Alkali Attack Resistance.

Introduction

Concrete is an important building material that is used all over the world. Concrete is the most widely used construction material worldwide due to its excellent compressive strength [17], durability, and versatility. However, concerns regarding environmental sustainability have led to the incorporation of supplementary cementitious materials, such as fly ash, in concrete mixes [2]. Fly ash, a byproduct of coal combustion, not only reduces the environmental impact of concrete production but also enhances certain properties of concrete [2,10]. Nonetheless, fly ash concrete may exhibit lower early strength, increased drying shrinkage, and reduced resistance to aggressive environments compared to conventional concrete and workability issues [11,12], in recent years, researchers and practitioners have been exploring various additives and admixtures to improve the performance of fly ash concrete [15]. Among these additives, bentonite, a type of clay known for its water-absorption and swelling properties, has gained attention as a potential enhancer of mechanical and durability properties in concrete [1,9,14]. Fly ash bentonite concrete, also known as geopolymer concrete, is a type of concrete that incorporates both fly ash and bentonite as key materials [3]

Geopolymer concrete is an eco-friendly alternative to conventional Portland cement-based concrete, as it significantly reduces the carbon emissions associated with cement production Memon et al. [9,14] examined the utilization of Pakistani bentonite as a partial replacement of cement in concrete.

Kaya et al. [14] tested the usability of calcined bentonite as a pozzolanic additive in cement mortars. In the study, the CEM I 42.5 R type Portland cement was replaced with calcined bentonite at 0%, 5%, 10%, 15%, 20%, and 25% replacement ratios by weight in order to produce standard mortar specimens. The

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results of the study show that there is around 3.7% increase in the compressive strength of samples with around 10% BC. Some studies also showed that use of bentonite is also effective in treatment of diseases like urinary excretion of aflatoxins in humans, vomiting diarrhea in childhood [4,5,6].

Research has been conducted to investigate the properties of fly ash concrete and its potential applications. For example, study published in the journal Cement and Concrete Composites examined the effect of fly ash on the mechanical and durability properties of concrete. The study found that incorporating fly ash into concrete can improve its compressive strength, flexural strength, and resistance to chloride ion penetration. [8,17,18,20] Another study published in the Journal of Materials in Civil Engineering investigated the use of fly ash concrete in the construction of a highway bridge. The study found that the use of fly ash concrete resulted in cost savings, improved durability, and reduced environmental impact compared to traditional concrete. Another study found that the use of fly ash in concrete resulted in improved resistance to corrosion and reduced cracking compared to traditional concrete.[11]

Experimental Program

Materials and mix proportions

We have used Ordinary Portland Cement (ASTM C150) which is widely used in Pakistan. Pakistani bentonite as (cement Replacement in Fly-Ash Concrete) after proper calcination is used. The general chemical properties of bentonite and OPC (ordinary Portland cement) are shown in the table 3.

In addition to this Class C Fly-ash is used as partial substitute of cement. Fly ash consists primarily of silica, alumina, iron, and calcium compounds. Its composition depends on the type of coal burned and the combustion process used.

The aggregate size and shape greatly affect the properties of concrete. The General properties of Coarse aggregate is demonstrated in table 1.

Sand helps to fill the voids and helps in workability up to some extent so for that purpose good quality of sand should be considered. Oven dried sand was used for every casting of specimen in this research. The general engineering properties of sand is shown in table 2.

A mix design is developed for the fly ash concrete with varying percentages of bentonite 0%, 5%, 10%, and 15%, by weight of cement keeping the quantity of Fly-ash constant as 25%). The mix design is based on the requirements of the intended application and optimized for the best mechanical and durability properties on hit and trial process. The above stated replacement of cement is done by weight of the cement. The table 4 shows the amount of bentonite and Fly-ash in the Mixes.

Table 1. Physical properties of coarse aggregates.

Properties	Values
Specific gravity	2.83
Water absorption (%)	1.32
Bulk density (kg/m³)	1508
Impact Value	16.50
Crushing Value	29.80

Table 2. Physical properties of fine aggregates.

Properties	Values
Specific gravity	2.63

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Water absorption (%)	1.3
Finess Modulus	2.99

Table 3. Chemical and physical properties of binding materials.

Chemicals	SiO_2 K_2O	TiO_2 LOI	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O
OPC (%)	17 - 25 1.3-1.4	3 - 8 0.9	0.5 - 6	0.1 - 4	60 - 67		0.8-0.9
Bentonite (%)	55 - 65 0.5 - 3	0.5 - 1.5	15 - 25 5-15	2 - 4	2 - 5	1 - 3	2 - 5

Table 4. Percentage of Bentonite and Fly-Ash in Mixes.

Mix Type	Percentage of Bentonite	Percentage of Fly-ach
M1 (Controlled)	0%	25%
M2 (5% B+25%F.A)	5%	25%
M3 (5% B+25%F.A)	10%	25%
M4 (5% B+25%F.A)	15%	25%

Sample Casting

It is the most important and crucial step in any research work. In this step concrete specimens (Cylinders and Prismatic Beams) are prepared using the mix design as stated above with different percentage of Bentonite but constant percentage of Fly-ash. The specimens are then cured and tested for compressive strength, tensile strength, flexural strength, Acid and Alkali Attack resistance.

Mechanical properties tests

Testing the mechanical properties of concrete is vital to assess its strength, durability, and suitability for different construction applications. We have investigated some of the properties such Compressive Strength Test ASTM C39 (Using Cylinders 150mmx300mm), Splitting Tensile Strength Test ASTM C496 (Using Cylinders), Flexure Strength Test ASTM C293 (using Prismatic Beams 100mmx100mmx500mm). The data collected through these tests is tabulated and assessment will be done on hit and trial basis as stated earlier.

Durability properties tests

The durability of the concrete specimen was evaluated using various tests, in this research we investigated

the resistance of Bentonite and Fly-ash concrete to the acid and alkali attack. We have used the 5% solution of Sulfuric Acid (H2SO4) for acidic attack test and for the assessment of Alkali resistance we used 5% solution of Sodium Sulphate (Na2SO4).

(3.1.1) Slump Test test

3.2.1 Compressive strength Test

3.2.2 Tensile Strength

3.2.3 Flexure Strength Test Solution

3.2 Alkali (Na2SO4) Solution

3.3.1 Acidic (H2SO4)

Results and Discussions

Fresh properties

Workability

Workability is an important factor in concrete. Concrete with low workability can have low setting time and other consequences like segregation. So, workability was checked by the means of Slump Tests by the use of slump cone apparatus as per ASTM C143.

Table 5 Slump Test Values.

Mix Type	Slump Values
M1 Controlled	83
M2 5%B+25%FA	78
M3 10%B+25%FA	76
M4 15%B+25%FA	72

Mechanical properties

Compressive strength

Test were performed on 04 mixes after 28 and 56 days of curing and the results are tabulated bellow these results are further discussed in the conclusion. However, we can conclude that the mix with 10% bentonite and 25% Fly-Ash is more effective.

Table 6 Compressive Strength Test results

Mix Type	Compressive Strength (MPa)	
	At 28 days	At 56 Days
M1 Controlled	14.31	14.71
M2 5%B+25%FA	13.33	15.90
M3 10%B+25%FA	12.311	18.41
M4 15%B+25%FA	10.194	12.127

Split tensile strength

Split Tensile strength is also very important factor, concrete is considerably strong in compression but weak in tension so we wanted to evaluate that whether the varying amount of Bentonite in Fly-Ash Concrete affect its tensile abilities or not. For that we conducted split tensile testing STT. Tests were conducted after 28 and 56 days of curing as same as compressive testing. The results indicated that the mix M3 10%B+25%FA has higher split tensile strength values while the mix M4 15%B+25%FA showed considerable decrease which means M3 composition is the optimum mix.

Table 7 Split Tensile Strength Test results.

Mix Type	Tensile Strength (MPa) at 28	
	days	At 56 Days
M1 Controlled	1.58	1.62
M2 5%B+25%FA	1.528	1.77
M3 10%B+25%FA	1.629	1.7075
M4 15%B+25%FA	1.3065	1.428

Flexural strength

The flexural strength test, also known as the modulus of rupture test, is a common mechanical test performed on concrete. The test determines the flexural or bending strength of the material. We have performed this test on the prismatic beams having varying quantities of Bentonite and constant amount of Fly-ash in concrete. The beam was supported on two points and subjected to a load at its center point, creating a bending moment. The applied load causes tension on one side of the specimen and compression on the other side at 28 and 56 days of curing with mixes

M1 M2 M3 and M4 having different percentages of Bentonite but same amount of Fly-ash.

Table 8 Flexure Strength Test results.

Mix Type Flexure Strength (MPa)		
	At 28 days	at 56 Days
M1 Controlled	1.5712	1.6162
M2 5%B+25%FA	0.9753	1.2692
M3 10%B+25%FA	1.9581	3.1242
M4 15%B+25%FA	1.0499	1.853

3.3. Durability properties

Acid Attack Resistance Test

This test is performed on 04 mixes after 56 days of curing in order to evaluate the resistance of concrete samples to Sulfuric Acid(H_2SO_4) Attack, the samples were immersed in 5% Solution of H_2SO_4. After that we recoded the weight of the samples which lead us to the calculation of mass loss.

Table 9 Acid Attack Test Results

Mix Type	Mass Loss
M1 Controlled	2.8 %
M2 5%B+25%FA	0.44 %
M3 10%B+25%FA	1.15 %
M4 15%B+25%FA	3.9 %

3.3.1. Alkali Attack Resistance Test

The test for evaluating the effect of Alkalis attack on Bentonite and fly-ash concrete specimens is performed on 04 mixes after 56 days of curing period. For this we used 5% Solution of Na_2SO_4 in which samples were immersed, and the weight and mass loss were recorded respectively.

Table 9 Alkali Attack Test Results.

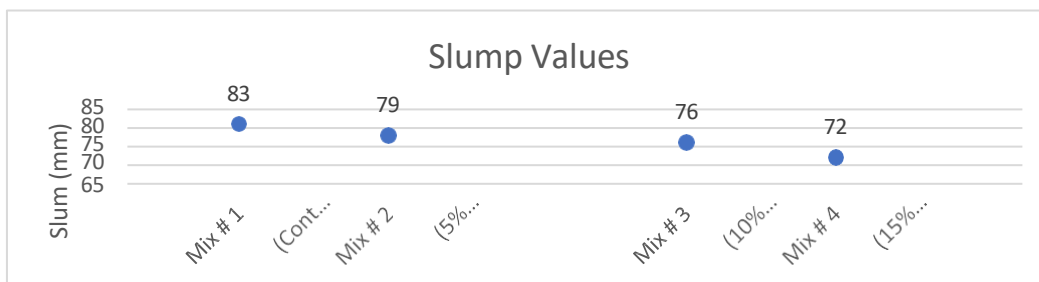| Mix Type	Mass Loss
M1 Controlled	0.39 %
M2 5%B+25%FA	0.24 %
M3 10%B+25%FA	0.60 %
M4 15%B+25%FA	0.61 %

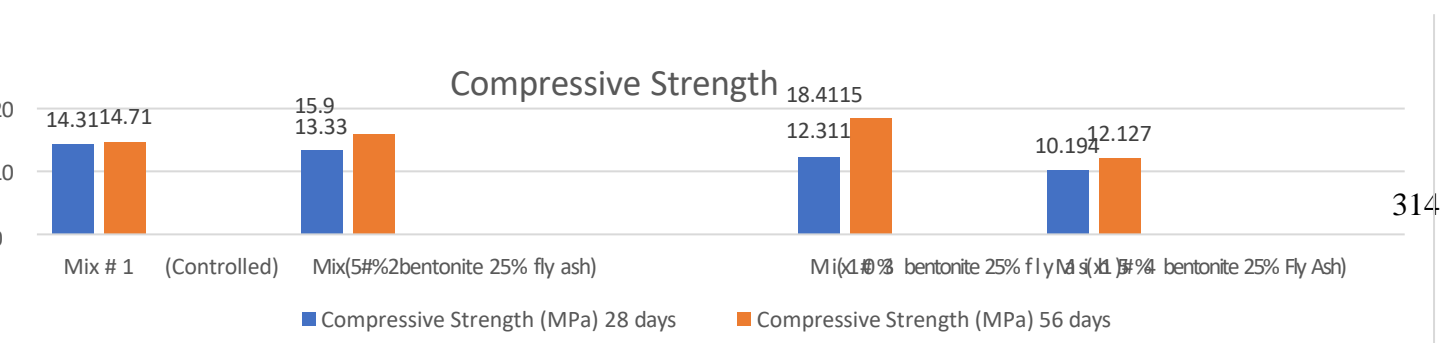Figure 1 3.1.1 (Slump Test Results)

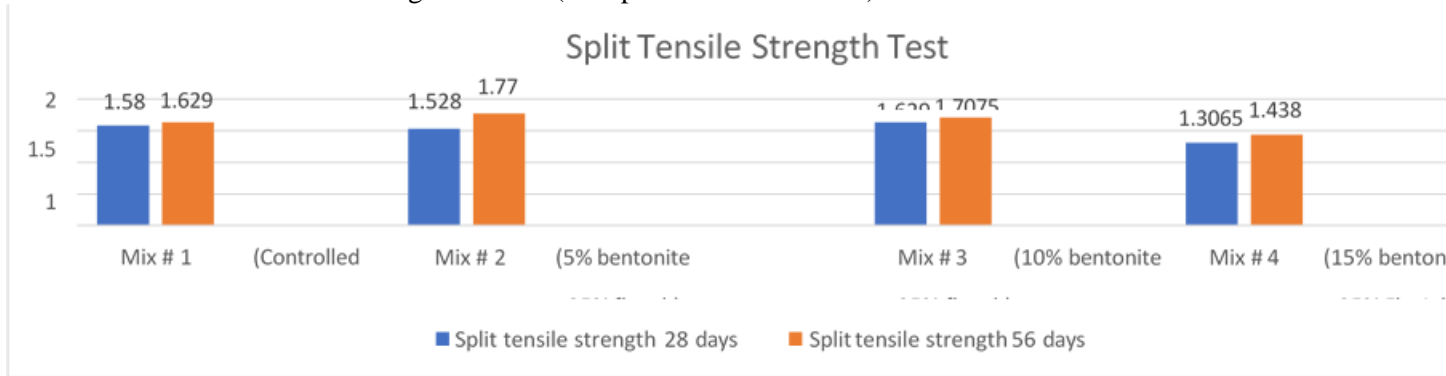Figure 2 3.2.1 (Compressive Test Results)

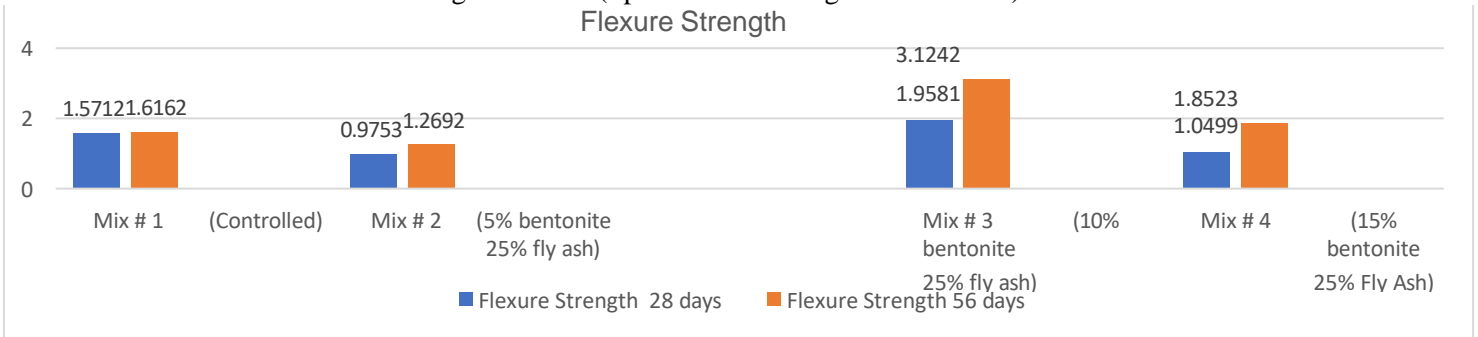Figure 3 3.2.2 (Split Tensile Strength Test Results)

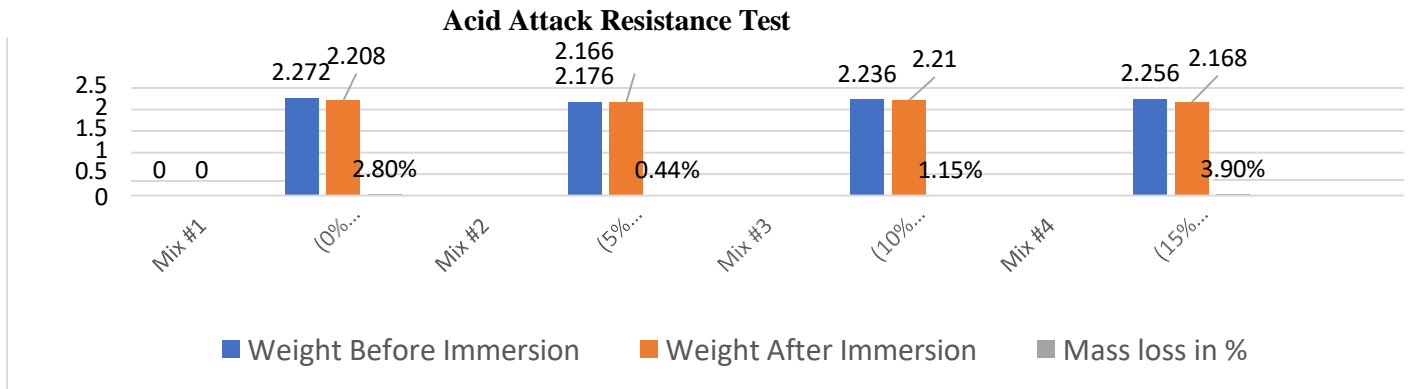Figure 4 3.2.3 (Flexure Strength Test Results)

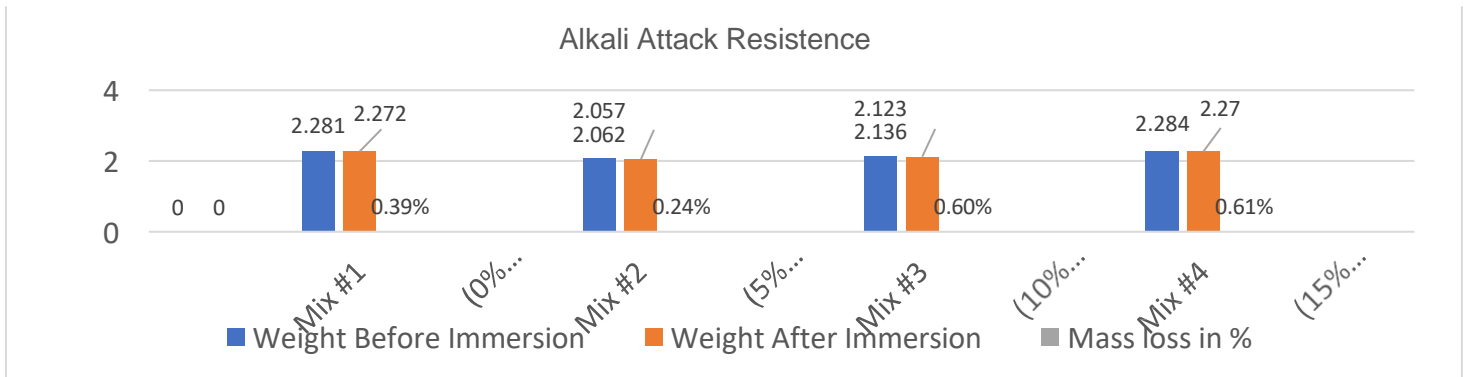Figure 5 3.3.1 (Acidic Attack Results)

Figure 6 3.3.2 (Alkali Attack Results)

Conclusions

This research work gives the following key outcomes.

1. workability of the concrete mixes with higher amount of Bentonite is decreased despite of the fact that bentonite also have lubricating properties.

2. From the results demonstrated above we can conclude that the inclusion of bentonite to a certain limit positively influenced the mechanical properties of fly ash concrete. The enhancement in compressive strength, flexural strength, and split tensile strength indicated at an amount of 10% bentonite and 25% Fly-Ash Concrete, the bentonite in this amount acted as a better pozzolanic material, contributing to the densification of the concrete matrix. While the strength of concrete witnessed decrement upon the addition of concrete above the 10%. As we can see in the result that the mix with ratios of 5%bentonite and 25% fly-ash and that of 15%bentonite & 25% fly-ash the concrete samples exhibit lower values of overall mechanical properties tests. It also indicates the optimum quantity of bentonite if used with 25% of Fly-ash which is 10%.

3. And these findings are consistent with the past studies and research works.

4. The durability properties investigated in this research is based on Acid and Alkali Attack test and the tests indicated that the mix having bentonite and Fly-ash in amount 5% bentonite + 25%Fly-Ash and the mix with 10%bentonite + 25%Fly- Ash are more resistant toward Acidic chemical attack as compared to that of M1 mix but as we increase the amount of Bentonite above 10% value like 15%bentonite+25%Fly-Ash, it can be seen from the test that the concrete sample shows higher mass loss then all the mixes. While investigating the resistance toward Alkali Attack resistance, concrete sample having 5%bentonite+25%Fly-Ash indicated better results than the control mix.

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Factors Influencing Customer Satisfaction in Pakistan E-Commerce

Muhammad Shariq Amir, Sikandar Bilal Khattak
University of Engineering and Technology, Peshawar, KPK, Pakistan

Abstract

E-commerce is changing the business landscape globally. It offers business gateways to all organizations, especially to small and medium enterprises (SMEs), irrespective of transnational boundaries. It provides flexibility, access, and diverse products and services to customers through innovation, value addition, sustainable practices, and economic growth. However, in Pakistan, e-commerce is more technology-inclusive rather than improving operations and forwarding the benefits to the customers. In Pakistan, several online platforms exist, but very few offer quality services, resulting in disenfranchising customers from e-commerce platforms. This study highlights Pakistan's rapidly expanding e-commerce market, emphasizing its substantial growth potential concerning customer satisfaction. Data is collected from the available literature to identify different factors associated with e-commerce customer satisfaction. The collected data is subjected to various statistical tools for analysis. The results indicate the most frequent and least frequent factors related to customer satisfaction concerning e-commerce experience. These factors are guiding principles for the e-commerce platform to enhance customer satisfaction and improve value-addition operations.
Keywords: E-Commerce, Customer Satisfaction, Quality Service, Online Shopping, Quality Management

Introduction

In the digital age, e-commerce has emerged as a transformative force, transcending geographic boundaries and time zones to create a virtual marketplace where buyers and sellers converge. This dynamic business realm, driven by the efficiency of online transactions, eliminates the constraints of physical storefronts and facilitates swift exchanges of goods and services over the internet. E-commerce is not merely a digital replica of traditional commerce (Reinartz et al., 2019); it is a catalyst for economic growth, streamlining supply chains, reducing operational costs, and expediting the movement of goods. With the rise of e-commerce, mobile shopping, and most recently smart technologies, new competitors threaten this long-standing supremacy. Adopting a value-creation perspective, the examination delves into the impact of digitization on the erosion of institutional retailing as the primary interface to the customer.

While e-commerce globally thrives on enhancing customer satisfaction, the e-commerce landscape in Pakistan leans more towards technology inclusivity than operational improvement and customer benefits. This study underscores the significant growth potential in Pakistan's e-commerce market, emphasizing the need to focus on customer satisfaction to harness the full benefits of this transformative platform (Madlenak et al., 2023).A positive customer experience goes beyond the quality and price of products; it encompasses ease of navigation, reliable delivery, and responsive customer support—creating a reservoir of loyalty, trust, and repeat business that ultimately contributes to the overall success of online stores.

Literature Review

During the COVID-19 pandemic, more people started shopping online because going to physical stores was risky. As things got better, some people returned to stores, but this study looks at why some might keep shopping online even after the pandemic Shaw et al., 2022 [1]. After COVID, there was a lack of

understanding regarding why customers might continue online shopping, even when people can return to physical stores.

Online shopping has become popular because it's easy and convenient. But the e-commerce industry has its problems. This study asked e-commerce experts to tell us the top benefits, challenges, and ways to solve the issues (Abu-Alsondos et al., 2023). There's not enough clear information about how to deal with e-commerce challenges. This study seeks insights from online shopping experts regarding the advantages, challenges, and potential solutions within the e- commerce sector. It is vital to enhance understanding of how to improve the e-commerce landscape. Some people worry about losing money or their information while online shopping. But, there's not enough agreement on what kind of worries matter the most inquired about the concerns faced by people in Jordan, Saudi Arabia, and Kuwait when shopping online and how these experiences affect online shopping(Alrawad et al., 2023) . It is essential for improving the understanding of these worries and helping online stores cater to their customer's needs.

E-commerce, where businesses sell to customers online, has become popular, especially during the pandemic. But a big challenge is when customers return products. This study looks at what factors affect how thriving businesses handle these returns in places like Lebanon and Syria and how this can affect their success (Davidavičienė & Al Majzoub, 2021). Companies can enhance customer satisfaction and operational efficiency by developing clear and easy-to-follow return policies and efficient return processing systems. Employing advanced tracking systems and logistics solutions can help monitor returns and optimize inventory management, ultimately reducing return-related costs.

The rapid evolution of technology necessitates retail networks to innovate their business models for customer retention and competitive advantage. Acknowledging customer reviews on social media is crucial for designing a distinctive service and marketing strategy that enhances loyalty by providing additional value (Gupta et al., 2023). Further there is still need for further research to explore the relatively weak relationship between spending behaviour of a customer and their satisfaction while shopping online.

Methodology

There are several important steps involved in conducting this research. the very first one is the literature review which is done to know the existing knowledge or research on this topic by different scholars. The literature review aims to find the research gaps among the different researchers, and then in the next those problems, aims & objectives are defined. One of the important steps of this research is data collection, which is done by sharing the questionnaire among different targeted audiences. After the data collection, analysis is performed on it, and meaningful information from the raw data. The results obtained are then presented in different tables, charts, and graphs. A detailed discussion is done of these insights by summarizing the key findings and insights drawn from the analysis. To give a comprehensive overview of the methodology employed, in the final step, the entire research is documented.

Data Collection and Analysis

A total of 75 participants participated in this research by filling out the questionnaire which helped to get valuable insights for understanding their online shopping behavior. For the analysis of the raw data of gender, age, and frequency of online shopping segmentation techniques were used. This technique aimed to differentiate the patterns and preferences of the respondents and place them in a specific group. The grouping of ages was done in 5 groups in which are: Group 1 (less than 18), Group 2 (18-24), Group 3 (25-34), Group 4 (35-44), and the last Group 5 (45 & above). Also, during the data collection, the respondents were to provide their gender as well as the frequency of doing online shopping.
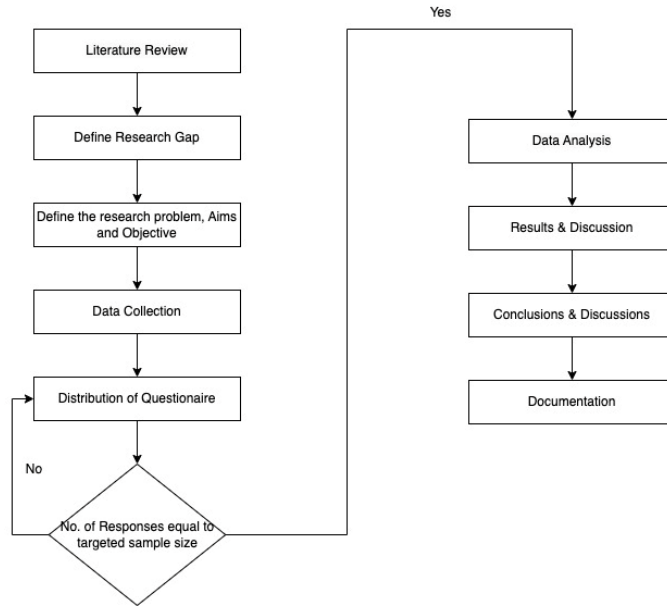
Figure 9: Methodology Flowchart

Table 1: Analysis of Age and Gender of the Frequency of Online Shopping

Age	Gender	Frequently	Occasionally	Rarely	Regularly
Less than 18	Female	2	1	0	1
Less than 18	Male	1	4	1	4
18 - 24	Female	2	1	1	2
18 - 24	Male	3	4	2	2
25 - 34	Female	2	2	1	2
25 - 34	Male	2	9	2	1
35 - 44	Female	1	4	0	1
35 - 44	Male	1	2	1	1
45 and above	Female	1	1	3	1
45 and above	Male	3	1	2	1
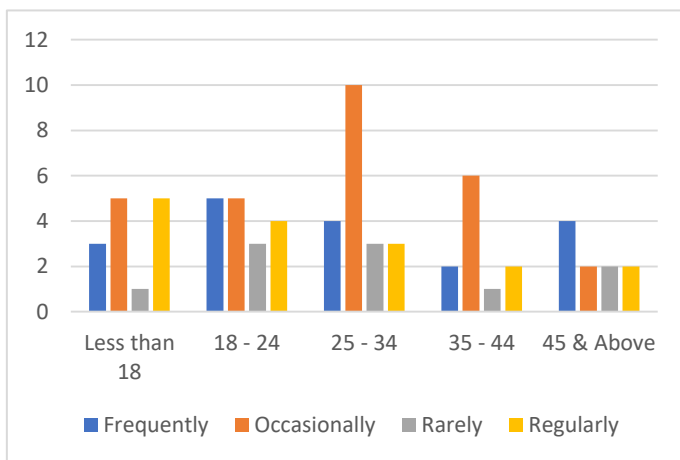
Figure 10: Age Distribution Across Online Shopping Frequency
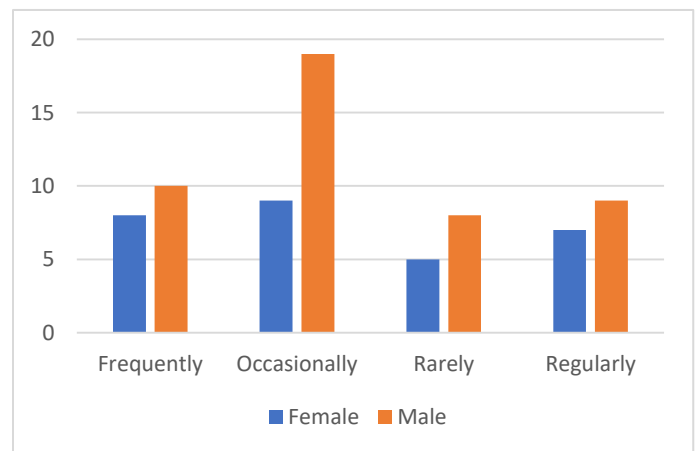
Figure 3: Gender Distribution Across Online Shopping Frequency

Some of the important factors that were identified during the research for customer satisfaction were Product quality, Customer data privacy, and payment challenges across the different age groups and genders. The respondents were asked to provide their view of these factors by selecting the ranges of their satisfaction level which are grouped into 5 segments: Group 1's range was 80-100% and was named "Very High", Group 2's range was 60-80% and was named as "High", Group 3's range was 40-60% and was named "Moderate", Group 4's range was 20-40% and was named as "Low", and the Group 5's range was 0-20% and was named as "Very Low".

Table 2: Analysis of Age in Relation to the Product Quality

Product Quality	Less than 18	18-24	25-34	35-44	45 & Above
A	1	4	3	5	4
B	4	7	5	1	4
C	6	4	9	3	3
D	2	1	3	1	1
E	1	1	1	1	1

Table 11: Analysis of Age in Relation to the Customer Data Privacy

| Customer Data Privacy	Less than 18	18-24	25-34	35-44	45 & Above
A	1	4	3	4	4
B	3	3	6	2	1
C	8	7	6	3	6
D	0	2	4	1	1
E	2	1	2	1	1

Table 4: Analysis of Age in Relation to the Payment Challenges

Payment Challenges	Less than 18	18-24	25-34	35-44	45 & Above
A	1	2	2	3	2
B	6	4	6	2	4
C	5	5	11	5	3
D	1	3	1	0	3
E	1	3	1	1	1

An open question asked the respondents to respond regarding what elements or factors they think influence the positive experience of online shopping, and the factors were Website/App Interface, Customer Service, Product Descriptions, Delivery Time, Return/Refund Process, Product Quality, Price Competitiveness, Promotions, and Discounts. At the same time another question was asked about what factors they think need more focus for enhancing the experience of online shopping and those factors were Enhanced Product Search, Personalized Recommendations, Detailed Product Information, Loyalty Programs, Improved Customer Support, Better Website/App Performance, Flexible Return Policies.

Table 5: Factors Influencing Positive Online Shopping Experiences

Table 6: Enhancement Recommendations for Online Shopping

S.No.	Factors	Responses
1	Website/App Interface	15
2	Customer Service	19
3	Product Descriptions	17
4	Delivery Time	19
5	Return/Refund Process	24
6	Product Quality	25
7	Price Competitiveness	12
8	Promotions and Discounts	9

S.No.	Factors	Responses
1	Enhanced Product Search	13
2	Personalized Recommendations	9
3	Detailed Product Information	22
4	Loyalty Programs	18
5	Improved Customer Support	20
6	Better UI/UX	13
7	Flexible Return Policies	19

Results and Discussion

The conclusions mentioned in Table number 7 give a visual representation of the data collected from the respondents about the quality of products they get from online shopping. According to the data collected 50% of the people showed their satisfaction regarding receiving good quality products, while 17% people think that they are not receiving good quality products, and the remaining 33% of respondents had a mixed perception.

Table 7: Online Shopping Product Quality: Age Group Perspectives

Product Quality	Less than 18	18-24	25-34	35-44	45 & Above		Mean	Median	Mode	Range	Standard Deviation
A	1	4	3	5	4	Statistical Calculation	17	4	4.00	4	1.52
B	4	7	5	1	4		21	4	4.00	6	2.17
C	6	4	9	3	3		25	4	3.00	6	2.55
D	2	1	3	1	1		8	1	1.00	2	0.89
E	1	1	1	1	1		5	1	1.00	0	0.00

Table number 8 gives a visual representation of the data collected from the respondents about the data privacy concerns they get from online shopping. According to the data collected 40% of the people showed their concern that their data might not be safe, while 21% of people were satisfied with the data privacy measures taken by the e-commerce websites, and the remaining 40% of respondents had a mixed perception.

Table 8: Online Shopping Customer Data Privacy: Age Group Perspectives

Customer Data Privacy	Less than 18	18-24	25-34	35-44	45 & Above		Mean	Median	Mode	Range	Standard Deviation
A	1	4	3	4	4	Statistical Calculation	16	4	4.00	3	1.30
B	3	3	6	2	1		15	3	3.00	5	1.87
C	8	7	6	3	6		30	6	6.00	5	1.87
D	0	2	4	1	1		8	1	1.00	4	1.52
E	2	1	2	1	1		7	1	1.00	0	0.55

Table number 9 gives a visual representation of the data collected from the respondents about the payment challenges faced by users during online shopping. According to the data collected 42% of the users face payment challenges while paying during online shopping including the concern of being a fraud as well,

while 20% of people were satisfied with the available payment gateways, and the remaining 38% of respondents had mixed perceptions.

Table 9: Online Shopping Payment Challenges: Age Group Perspectives

Payment Challenges	Less than 18	18-24	25-34	35-44	44 & Above	Statistical Calculation	Mean	Median	Mode	Range	Standard Deviation
A	1	2	2	3	2		10	2	2.00	2	0.71
B	6	4	6	2	4		22	4	6.00	4	1.67
C	5	5	11	5	3		29	5	5.00	8	3.03
D	1	3	1	0	3		8	1	1.00	3	1.34
E	1	3	1	1	1		7	1	1.00	2	0.89

In Table 10 the data is gathered and structured according to the responses of respondents regarding the factors that influence the positive online shopping experience. Most of the respondents think that the product quality and return/refund process are the most important factors, and the things that influence them most to shop online. Delivery time and customer service come second in the important factors as well. While the least important factor for them was promotion and discount, and this didn't influence them to shop online.

Table 10: Results for Factors Influencing Positive Online Shopping Experiences

S.No.	Factors	Responses
1	Website/App Interface	15
2	Customer Service	19
3	Product Descriptions	17
4	Delivery Time	19
5	Return/Refund Process	24
6	Product Quality	25
7	Price Competitiveness	12
8	Promotions and Discounts	9
Statistical Calculation		
Mean		17.50
Median		18
Mode		19
Range		16
Standard Deviation		5.50

Table 11: Results for Enhancement Recommendations in Online Shopping

S.No.	Factors	Responses
1	Enhanced Product Search	13
2	Personalized Recommendations	9
3	Detailed Product Information	22
4	Loyalty Programs	18
5	Improved Customer Support	20
6	Better Website/App Performance	13
7	Flexible Return Policies	19
Statistical Calculation		
Mean		16.29
Median		18
Mode		13
Range		13
Standard Deviation		4.68

In Table 11 the data is gathered and structured according to the responses of respondents regarding the enhanced recommendation for online shopping experience. Most of the respondents think that there is still room for improving the detailed product information provided for each product, and the second most important thing according to them which needs some more improvement

is customer satisfaction, while there was mixed perception regarding the improvements of Better Website/App Performance and enhanced product search.

Conclusion

In summary, the data and results analysis provide insightful information on the critical elements impacting satisfying online purchasing experiences, highlighting the critical role of the "Return/Refund Process" and "Product Quality." Consumer views are greatly influenced by these aspects, with "Customer Service" and "Delivery Time" coming in second and third, respectively. On the other hand, promotional components such as "Price Competitiveness" and "Promotions and Discounts" are of less importance. A generally good feeling among respondents is shown by the overall mean satisfaction score of 16.29. The report also clarifies the differing viewpoints that people of different ages have about internet purchasing. Regarding product quality, 50% of respondents regularly think that the items they received are of excellent quality, 17% are concerned about consistency, and a significant 33% report having had a mixed experience. These results emphasize the complexity of online shopping encounters and the continued need to resolve issues with product quality, customer data privacy, and payment difficulties in order to create a more welcoming and safe online retail environment.

These results have applications for e-commerce merchants that want to improve their platforms and maximize customer pleasure. Prioritizing elements like a smooth refund/return procedure, high-quality products, and effective customer support helps companies better match their plans with what customers anticipate. The findings for improvement suggestions also offer a road map for adding features that appeal to the wide range of online buyers' interests. Because the e-commerce market is always changing, it is critical for businesses to comprehend these insights and act upon them in order to maintain their competitiveness and guarantee a great online shopping experience for a wide variety of customers. Uncertainties and concerns voiced by a sizable percentage of respondents highlight the complex and nuanced nature of consumer experiences in the digital sphere, which emphasizes the significance of addressing issues related to product quality, customer data privacy, and payment challenges in the online shopping landscape. Since organizations now function in the digital realm, it is essential to comprehend and resolve these issues in order to establish trust and provide satisfying customer experiences. The study highlights how important it is to do continuing research and adjust to shifting customer expectations in the dynamic world of e-commerce.

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Social Context as a Source of Teaching-Learning Process: A Qualitative Study in District Mohmand Khyber Pakhtunkhwa, Pakistan

Syed Rambel Shah[1], Hafiz Inam Ullah[1] Muhammad Ilyas Khan[2]
[1]IER University of Peshawar, Pakistan
[2]GHS Dab Kor District Mohmand, Khyber Pakhtunkhwa, Pakistan

Abstract

Social interaction exerts an immense impact on the process of teaching and learning. A student cannot educationally survive in a social vacuum. The holistic and overall development can only occur in a vital and potent social environment. This qualitative study aimed to investigate how social context affects the overall development of students. This study highlighted the role of teachers and peers in the classroom, as well as the role of society outside the school, in fostering the learning and socialization process of the students. A case study as a method of inquiry was employed to gain an in-depth understanding of the problem. The purposive sampling technique was used for the collection of data through semi-structured interviews. The total number of respondents was fifteen; five teachers who were well versed in the field of education and social work, and ten students who were the topper of five public sector schools in the Secondary School Certificate (SSC) examination, 2022. The collected data was properly reduced by elimination of redundancy and thematically analyzed. This study revealed that society has have the grave effects on the socialization of the students. The interaction of teachers, their teaching techniques, their cooperative behavior, the impact of ICT on students, proper utilization of leisure time, and morality as a master value were revealed by the teacher respondents of the study. The students' reflections were about their social ordeals, skills of social relation, learning disability, coping with stress, and some cooperation as well as some grievances from society. Deficient communication skills and negligent teaching practices can contribute to the expansion of learning disabilities in students within an oppressive classroom environment. The study recommends that home-school relationships and parental involvement should be given due importance.

Keywords: Mohmand, KP, Social Interaction, Students, Home-School Relationship

Introduction

Social context may be a class of students, workers at workplaces, or the association of welfare volunteers of a village. They may be in unified or assorted socio-cultural, economic, political as well as educational backgrounds. It also consists of formal, informal, large, and small groups at any time in any place, not only face-to-face but would be in online modes. In such a social context, the learning process may be supportive, cooperative, deliberative, purposive, planned, and unplanned to lead one or more individuals to achieve common goal.

Social interaction or social networking for a student is like fish in water but some learning institutions give little importance to this practice from the nursery to college level (Raza & Ding, 2022). Most of our classrooms provide one-way communication to students where the teacher stands in front of the class for imparting the topic and the role of students is not more than a passive listener (Stoodley & Tsai, 2021). Garg and Cui (2022) said that students are busy in the entire class making notes and answering the occasional questions where no learner's interaction with other classmates seems. For best learning home-school relationship carries utmost importance. Parents having little time for their children may face an inhibition in the process of socialization likewise those parents whose behaviors is harsh towards their children are really destroying the social growth of their offering (Papernow, 2018). The community of peers

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has a grave impact on the learning process on the student. The studious peers can really solve the educational problems of the students while carless and dullard peers may deviate their friends from the right path (Margot, & Kettler, 2019).

Most of our students are not provided the opportunity in classrooms to interact with teachers and peers for a better understanding of some problems. A teacher only assigns a task or delivers a paragraph in front of the class (Odebiyi & Odebiyi, 2021) proper involvement of learners in different activities about the subject matter, self-efforts, and problem-solving skills are mostly ignored at the secondary level (Dumas, Ellis & Litt, 2020).

Statement of the Problems

Especially in Pakistani culture, mostly the learning activities in classrooms are teachers centered. Teachers give lectures or write notes on white boards and students only follow the instructions of their teachers. Students are depressive during the entire learning process and they are not allowed to share their views or rarely to ask questions to clarify concepts regarding some problems. This study is important to address the learning environment, instructional method of the teacher, and peer's role in class. Teacher and students' communication, students' mutual discussion, teacher and class fellows' support, and cooperation with each other during problem-solving. This study is also momentous to improve the learning process in the social context and to make systematically conducive classroom activities for learners to precisely interact in the social environment.

Objectives of the study

On the bases of the problem statement, the following objectives have been framed:
1. To investigate student's utilization of social context in classroom for durability of their learning
2. To find out the effects of social collaboration on students' learning
3. To explore the positive impact of social context on learning through process of socialization

Research questions

1. Do our students utilize social context in classroom for durability of their learned lesson?
2. How social collaboration effects on students learning?
3. What is the positive impact of social context on learning through process of socialization?

Significance of the Study

The study of social context in Pakistani culture has immense importance regarding the learning of the students. In fact, it is the society that makes or mars the educational growth of the student. A bad society may turn a little one into a culprit or criminal and a good society may render him a good citizen (Ronen, et al., 2016). For the last three decades, the society of KP from various perspective especially education has been badly affected due to war against terrorism.

This study is important to encourage and rebuild learning through social context among students and teachers at the secondary school level. This proposed study investigates such social learning approaches which helpful for the creative and critical thinking and independent thinking of the learners. This study also accommodates and promotes classroom interaction regarding learning activities with parents and school

administration. The educational authorities will be convinced by the finding of this study to formulate such types of policies to improve the teaching-learning process through social context.

Delimitation of the study

This study was limited only to the public secondary schools of district Mohmand due to financial and time constraints and delimited to only boys' students at the SSC level. Girls' students are exempted from the preview of this study.

Theoretical Framework of Study

Theories of individual interaction and social process in learning are the major contributions of the Russian psychologist Lev Semyonov ich Vygotsky in the field of educational psychology. Vygotsky (1978) emphasizes that learning and development are interlinked from the first day of a child's life, and opposed his colleagues including Koffka (1921), Thorndike (1904), and Piaget (1937) views that maturation is evocative of development. He further elaborates that development is not the name of socialization but it converts social relationships into mental operations.

There are three basic theories of learning including cognitive theory (1936), behavioristic theory (1913) and the theory of constructivism (1913) in learning but mainly this study is based on Vygotsky's (1978) Scio-culture theory, that learning is a social process and unifies human intelligence in society. Vygotsky said that social connections play important role in cognition development, first, everything is learned through interaction with others and then unified it into the individual's mental structure (Doolittle,1997). Aram and Levin (2010) observed that family and home support the child in early writing, while Antoncci (2000) says that the family provides sustenance in making a child a good reader in the initial stage, likewise Brodrova and Long (1998, 2006) advocated that social support is helpful in Zone Proximal Development learning.

According to this theory, the Potential for cognitive growth is limited to the "Zone of Proximal Development" (ZPD) which is the area of exploration where the learner is mentally prepared but needs some help and social support for better understanding (Briner, 1999). The following figure 1.6 explains Vygotsky's Zone of Proximal Development in a sample way.
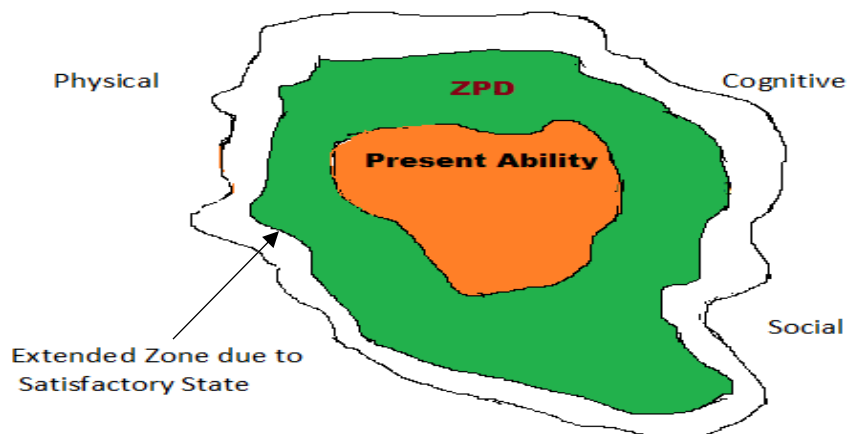

Figure 1.6: Vygotsky's Zone of Proximal Development

Conceptual Framework

This study, social context of learning will be contained on these conceptual approaches such as transitional standpoint, student-centered instruction, cooperative learning method, communication theory, group-process theory, and structural (curricular) approach. The figure 1.7 exposed conceptual framework of the study.
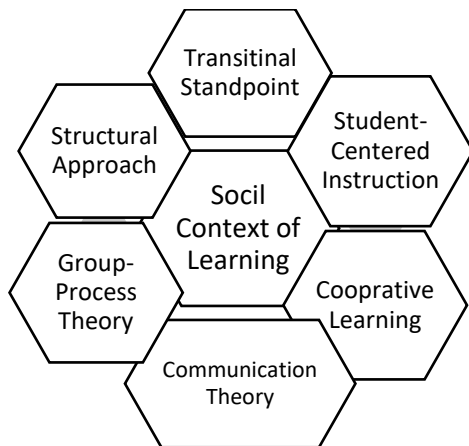

Figure: 1.7

Literature Review

Reviews of the related literature was essential to enrich the topic, identify the specific area of the study, prove findings in support or oppose of the study, formulate new theories and frameworks, and identify new topics and questions for further research (Paré, Trudel, Jaana, & Kitsiou, 2015).

For the proper study of the related literature, the researcher sorts out various journals, research papers, some outstanding newspapers, and the lectures of the social scientists of the concerned problems, and took the words views points from the Webs. Moreover, similar researches conducted on the issue were also analyzed.

Review Regarding Students

Society is the very training place for the social uplift of the students. Fong (2017) states that in the factory of society the ore of the student is melted as through the hardships and facilities which gives the society to the students are proved as the best lessons for them. Mirza, Azmat and Malik (2020) concluded that social deprivation has turned the youngsters into the social deviants. He adds that the students who come from the poor societies are somewhat socially lag behind, they lack proper etiquettes, and have a little sense of decency and modesty.

Nasir and Hameed (2021) explored that the female students, who belong to rural background are mostly shy, and due to their social closed system. They are not outspoken in the classes. While on the contrary, the girls' students who come from municipality are bold and shyness does not inhibit them from any kind of educational expression. Shahzad et al, (2020) study revealed that the outlook and social attitude of the poor students is a little rough; but their social talent is more than the students of cities. The findings of Ahmed

et al, (2020) showed that poverty does not inhibit the way of educational progress. Poverty can be proved as energizing forces if properly channelized.

Review of Teachers Regarding Social Context

The study of Anjum et al, (2018) confirmed that the classroom management skills have grave impacts on the learning enhancement of the students. The study of Khan, Niwaz and Mumtaz (2020) also supported this idea strongly that the more the classroom management skills are poor, the poorer will be the result of the learning of the students.

The study of Cho et al, (2021) explored that the trouble maker students could be controlled to assign them some homework etc., but the findings of Abbas and Husssain (2021) is not in consume some idea, which suggest that homework should not be assigned as a tool of punishment; however, Khan, Ahmad and Malik (2017) concluded that some responsibility may turn the bullies as normal ones, if assigned them properly. According to Nawab (2017) due to tough school discipline, a certain type of boredom can be produced in the students; but it is the teacher who can easily liquidate that boredom through effective approach of teaching. Ali and Pathan (2017) found that due to some genetic problem etc., the learning disability occurs in some students; which may render them lag behind.

Kim, Choi and Lee (2022) recommend that those slow learners, or somewhat imbecile students should be treated cautiously by the teacher. Bradley and Emerson (2017) suggested special care for those back benchers through special attention on their daily routine. Thein, Sulzer and Schmidt (2019) found that those slow learners have had the capacity of becoming good athletes. There are some findings of past studies that show that some students have taken no impact from their social antagonism in their living environment. The study of Weiss and Li (2020) said that some individuals have succeeded despite all the herders, ordeals, and social inhibitions in their educational careers. The study of Clark et al, (2020) shows that some students have been badly turned into unsuccessful in their careers despite the socially conducive environment.

 Others side of the social context in the learning of the students may be taken from the family. From the peer groups and even from the govt. sides, in which the social sectors especially education and health, are concerned. The conflicts, regarding properties and the stratification of the environmental segments are also concerned with the other sides of the study.

In the proposed study the social context from the student perceptions included shyness (Nasir & Hameed, 2021), social deprivation (Mirza, Azmant & Malik, 2020), poverty (Shahzad et al, (2020) and teachers students' interaction and peers' interaction (Odebiyi & Odebiyi, 2021). From teachers' prospections social cultural has been identified in this study are management skills (Anjum et al, 2018; Niwaz & Mumtaz, 2020), trouble maker students (Cho et al, 2021; Abas & Hussain, 2021; Khan, Ahmad & Malik, 2017), tough school discipline (Nawab, 2017) slow learner (Ali and Pathan, 2017) and special care for back benchers' students (Bradley & Emerson, 2017).

So, social context of the classroom refers to the setting in which teacher and student work together, and develop relationship between students, as well as the connection between teacher, student and school. So, relationship is continuously changing, influencing and being influence by such factors as shyness, social deprivation, poverty, teacher students' poor interaction and peer poor interaction from students' perspective while from teacher perspective poor management skills, dealing with trouble maker students, tough school disciplines, dealing with slow learners and backbenchers. The following Figures 2.1 showed teachers and figure 2.2 exposed students' perspectives regarding social interaction.
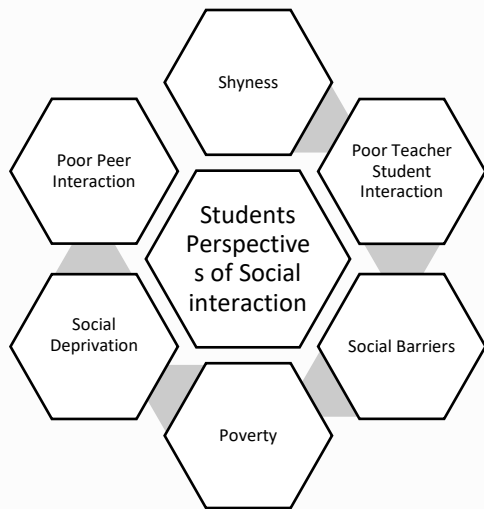
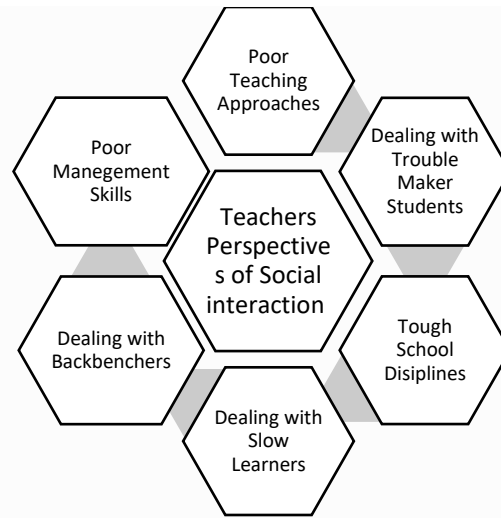Figure: 2.1   Figure: 2.1

Social context may be an environment in which students interact with each other for their social survival and social development. The social context has have its implications in the classroom as well as in society outside of school.

Methodology

Nature of the Study

The nature of this study was qualitative. For the inquiry approach, the interview technique is useful to collect suitable information behind the experiences of respondents. The researcher collected detailed information about the problem by using this technique to follow up certain open-ended questionnaires. For an in-depth investigation of the respondents' views, usually, a semi-structured interview is conducted (Feng & Behar-Horenstein, 2019).

Sample of the Study

Sample size was kept smart as per need of the qualitative study. They were fifteen respondents in all, in which five were teachers and ten were students of the public sector school of district Mohmand.

Inclusive Criteria for Respondents

In this study, the researcher collected data from well-informed, experienced, and completely immersed persons in their field who were interviewed. They were searched through the snowball technique. Total number of respondents was 15 for this study. Five teachers who were well informed and knowledgeable persons from the five public sector schools and ten shining students from the same sectors who were the topers of the concerned school in BISE result 2022 in district Mohmand.

Designing of Interview Tools

The researcher design interview tools on the basis of research objectives and the review of related literature of this study. The constructer was developed form the research topic, sub-constructers were designed by research objectives and similarly indicators were formulated for interview questions on the base of literature review for teachers and students respectively to know their view points.

Data Collection and Analysis Process

The researcher articulated clearly the interview process and questions before starting the interview and focused on those points which were needed for the researcher to collect information from the interviewees. An open-ended questionnaire was used for in-depth investigation and the researcher also recorded this process on self-phone for further interpretation. But some students and teachers hesitated from the recording of their views. So, the researcher collected data from those respondents without recording and wrote their view points on paper to maintain natural setting for interview. Most of respondents were not able to answer in English language so they were permitted to express their views in Urdu or mother thong Pashto. The researcher first emerged themes on collected data and then interpreted cautiously the whole process in English language.

Results of the Study

Teachers Responses

Effective Teaching

Respondents of this study shared his views that, *"It is the very effect of the good teaching which really construct the very wellbeing of the student; it is the teacher who makes or mars the student…"* (T-1). *"The incompetent teacher may lead the students to the destination, which is not need of the present-day society…"* (T-2). *"Bad communication on the part of teacher can cause miss understanding…"* (T-3). *"Ill-equipped educator wastes the time of the students merely…"* (T-4). *"The arrangement of proper lighting and visibility is the prerequisite of effective teaching…"* (T-5).

The finding of this study revealed that improper and defective teaching may cause worthlessness in the students and resultantly may render them incapable. It was also revealed that well prepared teachers led their students to academic excellence. Moreover, the availability of a feasible environment is also the need of the effective teaching.

Teaching Techniques/Approaches

In this context the respondents of the study affirm that, *"Bad tools may ruin the entire workshop."* He elaborated that, *"An ill-equipped army sourly faces an ignominious defeat…"* (T-1). *"Preparedness on the part of educator is must…"* (T-2). *"The usage of various techniques is the weapons of a good teacher…"*

(T-3). *"A badly communicated teaching material is only a bourdon on the students…"* (T-4). *"Modern approaches to teaching are the dire need of today's teachers…"* (T-5).

The finding of this study shows that teaching techniques plays a vital role in indoctrination of the fundamentals of learning. It was also revealed that the adopting of the technique is an effective tool of a teacher. it was also pointed out that different techniques may be adopted for delivering the same lesson.

Teachers Behavior

In this connection the respondents affirmed that, *"Loneliness in teaching learning process may affect the learning activity, as learning disability also occurs due to some learning gapes…"* (T-1). *"The exchange of harsh words may cause terrification in the students…*" (T-2). *"Personal negotiation and sharing personal life stories may case a great ruin…"* (T-3). *"Irrelevant teaching is causing waste of time…"* (T-4). *"Shabby dress has a bad effect on students…"* (T-5).

The findings of this study showed that if learning is made a collaborative activity, then it can precisely improve the learners socially and academically. It was also pointed out that the personality of the teacher has have a positive and negative impacts on the students.

The impact of ICT on Students Socialization

When asked about the impact of social media on students, the respondents of this study shared their views that, *"Today's youth, is really very aware of the hard realities of the life; they know even what the elders do not know…"* (T-1) *…so today's child should be treated as a socially well grown up one…."* (T-2). *"On account of accessibility to various apps the children are no more the little ones..."* (T-3). *"Nudity and obscenity are badly attacking on the minds of the students…"* (T4). *"…self-pone has usurped the precious time of students…"* (T-5).

The result of the study revealed that ICT is both a boon and a course for the students. it needs to be treated curiously. This study also revealed that moral deviation and wastage of time are the hazard of this modern technology. Beneficial usage was also proved as a great advantage for the enhancement of updated knowledge.

Utilization of Leisure Time

In this connection the respondents shared their view points, *"Beneficial leisure is more important that all time engagement…"* (T-1). *"Leisure time gives respite to the student for rebuilding and liquidation of exhaustion …"* (T-2). *"Bodrum is excessively harmful for learning..."* (T-3). *"Beneficial gams build the working capacity of the students..."* (T-4). *"Nonacademic activities need to be control through social work in leisure time…"* (T-5).

The findings of this study showed that some extra time should be provided to the student for their relaxation and beneficial utilization of leisure time. So that they could restored their energies for social reconstruction and rebuilding their exhausted energies.

Morality- the Pulp of Schooling

In this regard the respondents said that *'The purpose of schooling is to produce a moral sublimity in the students…* (T-1). *"Having a document of certificate or degree is not enough. The formal schooling needs something more…."* (T-2). Another respondent added that, *"Parents are required to give some time to their offspring for moral admonition…"* (T-3). *"High scores or marks should not be the aim of education…"* (T-4). *"Morally advance students should be given credit…"* (T-5).

The findings of this study revealed that the real socialization is the moral development. Certificates and degrees are not fulfilling the gaps of morality. Moral development was found as missing domain of today's schooling. Only bookish knowledge and mundane schooling was found inefficient for the holistic development of the child.

Students' Responses

Social Hindrances

When asked about the social barriers the respondents replied that, *"Due to work at school and after long hour stay at school, we become very tired and when I reach home, I have work at field with   father. If I refuse, I am finished for that"* (S-1). Another respondent stated that, *"I do not like my neighbors' fellows who always tease me and let me not to play with them"* (S-2). Another student when asked regarding bullying he said that, *"The boys above my age always chase me for the fulfilment of their illicit desires, sometimes I complain my father and he harshly beat them"* (S-3). *"I do not like the behavior of my wealthy relatives…"* (S-4). *"I cannot bear the grievances of my parents due to excessive poverty…"* (S-5). *"My enmity in village keeps me confined to the four walls of my house…"* (S-6*). "I abhor quarreling in hujra…"* (S-7*). "I do not like the sarcastic way of taking of Imam Masjid. My Masjid teacher punishes harshly…"* (S-8). *"My father is un employed…(s-9). "My Urdu teacher favor some well to do students…"* (S-10).

 The findings of this study showed that a lot of students are faced with so many social ordeals. They are teased and tortured by the society on so many aspects. Social stratification and poverty were found the bitterest enemy of the social harmony. This study also revealed that economic imbalances and shallow knowledge of the religious leaders are causing upheaval in the social fabrication.

Social Relations

When asked about the peaceful co-existence in the society the respondents explained that, *"On account of social stratification and differences in social level; the harmony in relations cannot be properly maintained…"* (S-1). *"...in mosque, we met with different class, social segments which have very positive effect on us"* (S-2). *"I detest the extremely poor persons…"* (S-3). *"Shopkeeper in my neighbor is fraudulent person…"* (S-4). *"My uncle fights with my father…"* (S-5). *"My mother feels uneasiness in the combine family…"* (S-6). *"My father bears all the expenses of my whole family…"* (S-7). *"...I love very much my maternal mother…"* (S-8). *"My grandfather loves me very much…"* (S-9). *"...thus, I do not like doctors…"* (S-10).

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The findings of this study revealed that social relationship of a student plays most important role in child social growth and development. And due to these social ordeals and hardships strong well power produce in children to ultimately become a successful individual.

Learning Disability

When asked regarding the full assimilation of the taught materials, the respondents showed their views that, *"We do not understand some time the language of the teachers…"* (S-1). *"…while most of the student do not take care of learning properly…"* (S-2). *"...rebuking and chastisement often remain less effective on the dullard students…"* (S-3). *"In crowed classroom listening of the teacher instruction is my problem…"* (S-4). *"Often, I leave my note books at my home because some lazy fellows try to steal…"* (S-5). *"I do not come to school when teacher assign some question for test…"* (S-5). *"I attend all my classes regularly but dislike homework…"* (S-6). *"Some of our teachers use mobile phone in classroom which disturb our attention…"* (S-7). *"Our science and math teachers have been transferred to another school, and the teaching of irrelevant teachers is not effective…"* (S-8). *"There is no culture of the utilization of science lab in our school…"* (S-9). *"Some repeater students in my class do not interest in learning and often disturb us…"* (S-10).

This finding revealed that defective communication skill and carelessness on the part of both of educator and learner are causing learning disability. Improper teachers, social evil of stealing notes and books, usage of android mobiles are properly causing learning disability.

Coping with Stress

When asked regarding the permissive environment in school, the respondents stated that, *"Due to pressure and rush of work, the school environment is not pleasant for us…"* (S-1). *"We feel lack of recreation, and boredom, exhaustion and fatigue choke the ways of easy feelings in school…" (S-2).* *"Due to stress environment some students try to fled from the school…"* (S-3). *"We always face whit corporal punishments by our physical education teacher when we come to school late…"* (S-4). *"Our school principal strictly banded on short leave, so some students compel on absenteeism…"* (S-5). *"Thirty mints break is not enough for us to fulfill our needs…"* (S-6). *"The teaching method of some teachers is repelling…"* (S-7). *"Our school environment is not conducive but it is just liking a prison…"* (S-8). *"Setting on one bench all the day is not essay assignment…"* (S-9). *"I am tensed during reading and writing. There is no tradition of cocurricular activities in my school…"* (S-10).

The finding of this study revealed that suffocative environment is destructive for the students. They do not feel essay in stress and strict setting of the school. This finding of the study also shows that conducive teaching learning environment is the dare need of students to show satisfactory learning outcomes.

Teacher Behavior

When asked the question about teacher behavior, the respondents stated in this connection that, *"I learn a lot from my sweet teacher but I cannot learn from harsh ones…"* (S-1). *"We cannot even dare to ask*

teachers on account of their stern behavior…" (S-2). *"Most of students remain reluctant in asking some questions from math teacher due to his strict behavior…"* (S-3). *"I prefer always to do my English homework early because my English teacher always appreciate me…"* (S-4). *"I am boar in Urdu class because of teacher harsh attitude…"* (S-5). *'One teacher of our school discourages me that you are not able to read…"* (S-6). *"Some teachers in our school when they come to class, discusses cricket games and players in the whole period…"* (S-7). *"The love and affectionate behavior of my Islamyat teacher (theology teacher) encourage me to come to school regularly…"* (S-8). *"I am interested in the class of the kind and friendly teacher…"* (S-9). *"The special care and attention of some of my teachers attract me to school…"* (S-10).

The finding of this study in this regard (teacher behavior) revealed that, the dealing method of the teacher may positively help in the best socialization of the taught. But on the other side narrow mindedness and harsh attitude of the teacher is not in favor of the students and may causes of bad effect on their learning growth.

Parental Role

When asked regarding the parental role. So, the respondents said, *"My Papa says, I must strive to be a good man, he always tells me, do not become the trouble maker, do not tease teachers and other elder persons and always be intime for school and mosque"* (S-1). Another student replied definitely, *"My father is an ICE addict, he always quarrels with my mother. Sometime I try to kill my father for this cruelty, as I am unhappy with him"* (S-2). *"My father does not interest in my learning…" (S-3).* *"My Abu (Dad) always check my notebooks at my home…"* (S-4). *"My father visits my school within a week or two and discusses my schooling with my teachers…"* (S-5). *"My father is a laborer and illiterate, he works dawn to dusk, so he is not able to discuss my learning affairs with me…"* (S-6). *"My mother and father both help me in my home task…"* (S-7). *"My father does not allow me with suspicious and notorious fellows…"* (S-8). *"… self-phone is also not allowed me at my home…"* (S-9). *"My Daje (Dad) daily discusses the whole day activities of my school with me at night before sleeping…"* (S-10).

These findings revealed that, the children of good families are highly civilized, and inclined to learning and social uplift, while the offspring of the illiterate and poor parents were faced with multifarious kinds of social issues. This study also revealed that the overall development of the child is not only the responsibility of the teachers but parents also play active role in this regard.

Discussions

The impacts of society on the individual are a wide range discussion. It is the society through which's boon the individual can be flourished, or otherwise can be devastated. When the society strangles the individual, then the individuals strive to shatter the chains of society. So, their peaceful co-existence is incumbent for the entire social development. The aim of this study was to investigate the impact of the society on the overall development of the students.

The findings of Fong (2017) showed that society makes the student strong for shouldering the responsibilities of the coming days, which has a coincidence with the present study. As the present study

focuses on the social integration of the student and the real purpose of schooling is the preparation of students to cope with the social curses of life.

The study of Mirza, Azmat and Malik (2020) revealed that social deprivations is catastrophic for the students which is also strongly recommended in the present study that social deprivation is detrimental for social growth of the students. The inhabitants of slums have been proved mostly not good citizens and workers at workplace on account of their low degree social training.

The study of Nasir and Hameed (2021) on female students' socialization, resonate this present study that the girls of rural background are shy, while those of the urban areas are bold in their communication. Simply because the interactive relationships in urban areas are in abundant, the social skills and the skills of relationship development are plenty in urban areas as compare to the rural milieu. The result of the present study revealed that male students also show their shines. This may be due to rural diurnal and social constraints of the locality.

The data gained by Shahzad et al, (2020) oppose this study that poor students have a potential to face the hardships of their life, while on the other said have a strong relevance with the study of Ahmed et al, (2020), which states that poverty is a boon and bless for the deprived ones. As due to hardship of life a strong resistance is produced in the deprived ones which give them a strong power in the fluctuations of life.

The result of this study interprets that the impressive teaching skills can be lucrative in showing good results which supports the study of Anjum et al, (2018) and Khan, Niwaz and Mumtaz (2020), which in coincidence with the present study. As most of the reformers have been the best communicators in through their dexterities in communication, they have brought moral revolutions.

The data of Cho et al, (2021) supports that through assignments the trouble makers students could be controlled easily, which the study of Abbas and Husssain (2021) oppose that assignment should not be given as affliction or punishment to students. However, the findings of Khan, Ahmad and Malik (2017) support the study of Cho et al, (2021) which state that the assignment of responsibilities make turn the bullies as good students.

The study of Nawab (2017) finds that harsh discipline is a destructive tool, which is in conscience with the findings of the presents study that permissive school environment is beneficial for social growth. Leniency has ever been proved as a constructive tool in educational administration. Moreover, the laze spare discipline has also been improved a defective one for the integrated socialization of both teacher and taught. The analysis of Kim, Choi and Lee (2022) identify that slow learners of mentally impotent students have also found of becoming good players and athletes, which in consistence with the findings of this present study. The study of Bradley and Emerson (2017) is in support with the data of this present study, which analyses that socially and lag behind students are also gifted with special abilities; which should be carefully treated.

Every research-based study has some short comings and imperfections, the present one may not be exempted. The researcher collected data from fifteen respondents, ten students and only five teachers which were seem inadequate, if teachers were also ten the results would be more informative. Similarly, in place of qualitative technique if the researcher used mix method approach the data would be more accurate for the generalization of the study. The exception of the parents' views also a gray area of the present study.

Conclusions and Recommendations

The results of the study revealed that poor and unplanned teaching may cause worthlessness, incapabilities among students while well planned teaching with feasible and conducive social environment and

instructional techniques make teaching learning as collaborative activity for academic and social excellence. ICT is both a boon for students however misuse results as moral deviation and wastage of time. Leisure time provided to the students be utilized for their relaxation, social reconstruction, social networking and moral development which is considered the missing concept of the today's schooling.

The student opinioned that teasing, torturing, bullying in school due to social stratification, poverty, economic imbalance and shallow knowledge of rural setting resulted social abnormality while social ordeals, hardships and strong willpower produce a successful individual under proper guidance. Poor communication skill, carelessness of teacher, suffocative environment of the class produces learning disabilities. This study recommends that:

1. Home-school relation must be properly functional
2. Teachers' ought to strive for the overall personality development of the students
3. Parents must should avid the enormity of neglect fulness on their part regarding their offspring to save them from social deviation
4. Counseling on parenting must be essential for the cupels when marriages are arranged
5. School discipline must be construction rather than tough and harsh
6. Social evils and abuses must be interposed in the curriculum so that the youngsters could become aware regarding their horrors timely

Suggestion for Further Study

Another study is needed to be conducted on the horrors of white cyclone's (social media) onslaught on the youth.

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Modernizing Warehousing in Pakistan: The Role of Industry 4.0 Technologies

Syed Abdal Ali Shah Bukhari, Sikandar Bilal Khattak

University of Engineering and Technology Peshawar, Pakistan

Abstract

A warehouse is a critical component of any organization's supply chain. Recent studies show the integration between Industry 4.0 and warehouse management. Industry 4.0 has integrated the Internet of Things (IoT), sensor networks, cloud computing, big data analytics, robots, cyber-physical Systems, and Artificial Intelligence (AI), bringing about a profound transformation. This paper looks at the significance of such technologies for improving organizational performance, particularly warehousing and supply chain management. The literature review offers a summary of the primary components of Industry 4.0, which include Decision Support Systems (DSS), Radio Frequency Identification (RFID), the Internet of Things (IoT), Autonomous Mobile Robots, Blockchain, Cloud Computing, and Augmented Reality. These technologies have revolutionized the operation of a warehouse by increasing efficiency, reducing errors, and enhancing real-time decision-making. This research seeks to investigate how implementing I4.0 technologies affects the competitiveness of storage facilities in Pakistan. The research methodology focuses on the secondary data available in different databases. The collected data has been statistically analyzed to assess the implementation level of different I4.0 technologies along with challenges and benefits. The results have systematically provided valuable insight into warehouse management in relation to different adopted I4.0 technologies.

Keywords: Industry 4.0, Warehouse Management, Supply Chain Management, I4.0 Technologies, Storage Facilities

Introduction

Industry 4.0 has brought about a new era of technological advancement that has fundamentally changed the various fields. Warehousing and supply chain are two sectors that have changed. Pakistan is a developing country with a focus on manufacturing. The paper investigates the impact of these latest technologies on the warehousing sector in Pakistan. This research aims to identify the impact of Industry 4.0 on warehousing.

Industry 4.0 integrates digital technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), and cloud computing. It has redefined traditional business models and operations (Iqbal & Rahim, 2021). The technological advancements brought by Industry 4.0 into warehousing have resulted in realizing the limitless potential of warehouse operations in terms of increasing operational efficiency, accuracy, and decision-making in real-time. Applying the IOT and AI improves inventory management, superior tracking systems, and more effective logistics operations (Dobos et al., 2021).The warehousing industry in Pakistan is at a crucial juncture where the integration or the adoption of Industry 4.0 can significantly benefit the organization's performance. Integrating these technologies increases the sustainability and competitiveness of the Warehouses, particularly in developing countries (I. Ali & Phan, 2022).

Nonetheless, there is persuasive evidence of the advantageous effect of Industry 4.0's technologies on warehousing in Pakistan. Shahbaz Ali &Xie (2021) examined how these technologies may enable overall organizational improvement in retail, a strongly associated sector alongside warehousing and supply chain management, in the Pakistani scenario. Furthermore, the textile sector's operational readiness for adopting Industry 4.0 technologies also gives a glimpse of endorsing these technologies in various sectors (Sohrab Ali, 2021).The involvement of Pakistani Companies in warehousing shows the gradual adaptability of new technologies (Khan et al., 2023). Many researchers are working on it, including some research on

warehousing that indicates that implementing lean concepts resulted in many improvements in the efficiency and effectiveness of warehouse management in Pakistan (Muhammad Rafay Shaikh et al., 2020). In conclusion, integrating Industry 4.0 technologies in warehousing has an optimistic potential for accumulating efficiency and competitive advantage but can also help increase predictability in warehousing and sustainability. The outcomes of this research are directly related to improving operations in the warehouse and indirectly contribute to the traits of Pakistan's economy.

Literature Review

Integrating advanced information and communication technologies (ICT) in warehousing is a hinge point in the modernization of supply chain management. The review depicts the technological growth in Pakistan's warehousing sector, essential for distributing similar and diverse products.
Ali and Kausar (2022) delve into the influence of Industry 4.0 on the firm's sustainability, while the study also demonstrates the importance of innovation and continuous improvement. More likely, the research also unveils the moderating role of Industry 4.0 technologies in enhancing firms' practices, which is considered more important in developing countries. Industry 4.0 is an enabler for reshaping existing business models towards data-driven ones. Dobos et al. (2021) focused on how Industry 4.0based analysis method improves warehousing systems. The impact of Industry 4.0 on Pakistani retail industry performance is also a relevant aspect to analyze, given that it is closely tied to warehousing. It provides foresight into the impact of adopting these technologies on supply chain efficiency and the overall performance of organizations in Pakistan. Lastly, Rahman (2017) findings are a good impact predictor of adopting Industry 4.0 technologies using the entire population of retail distributors.
In Pakistan, the potential for industrial upgrading and innovation is traced to the promotion of Industry 4.0 in line with the nature of worldwide automation. When compared globally, ethical issues are a significant part of contemporary Industry 4.0 in underdeveloped countries. Iqbal and Rahim (2021) explore the moral impediments linked to the need for and trend of adopting Industry 4.0 in Pakistan. The study is critical because the role of conventional sectors in ethically integrating new technologies, such as Artificial Intelligence, Big Data, the Internet of Things, Cloud Computing, etc., is not straightforward. Some of the ethical problems linked with Industry 4.0 are data permission, residual loss of employment, monitoring, reporting, whether the development is generally socially inclusive or not, deceptive business practices, and sales. The study conducted by Sohrab Ali (2021) focuses on the readiness of Pakistan's textile industry to adopt Industrial 4.0 technologies. The analysis is crucial as it provides information on the readiness of one of the primary industries in Pakistan. Kazmi and Abbas (2021) research focuses on the local labor market and the resultant staff implications. It gives a snapshot of what is perceived as happening to warehouse staffing, their skills, and where the employment/job opportunities might be. Khan et al. (2023) carried out a study to investigate the level of readiness and maturity of Industry 4.0 in companies in Pakistan. The research of Khan et al. gives insight into the extent to which Pakistani companies, including warehousing companies, are adopting I4.0 technologies. Shaikh et al. (2020) have researched the effectiveness of employing lean philosophies for warehouse management to enlighten readers on how combining Industry 4.0-enabled technologies and lean management principles can help optimize warehouse operations. Based on the literature review, the interest in using Industry 4.0 in warehousing has grown globally. The primary focus is on increased efficiency, sustainability, and firm performance.

Methodology

The methodology for this research involves a comprehensive secondary data analysis focused on integrating Industry 4.0 technologies into warehousing in Pakistan. This approach thoroughly examines existing literature, data reports, case studies, and relevant research findings.

The first step is an extensive review of academic journals, industry reports, white papers, and case studies

related to Industry 4.0 and its implementation in warehousing. This includes databases like JSTOR, IEEE Xplore, and Google Scholar. It also includes industry-specific reports from Pakistan's logistics and supply chain management organizations. Reports from international bodies like the World Bank and Asian Development Bank focusing on technological advancements in developing countries are also reviewed.Moreover, an examination of successful implementations of Industry 4.0 technologies in warehousing globally and within Pakistan are also done. This examination provides practical insights into the application of these technologies. Review publications from the Pakistani government and regulatory bodies for insights into the country's legal and economic framework surrounding Industry 4.0 are also considered.

Systematic coding and thematic analysis of the collected documents is done to identify patterns, themes, and insights related to adopting Industry 4.0 in warehousing. Comparing data and findings from Pakistan with global trends to identify gaps, opportunities, and unique challenges Pakistani warehouses face in adopting these technologies. Where quantitative data is available, statistical methods are employed to analyze trends, correlations, and impacts of Industry 4.0 technologies on warehousing efficiency and effectiveness.

Data Collection and Analysis

The analysis of the collected data provides vital insights into the maturity of Industry 4.0 technology adoption among warehouses in Pakistan and its corresponding impact across pertinent key performance indicators.

The findings reveal varying maturity levels of adopting emerging technologies based on Pakistan's warehouse size and ownership types (Table 1).

Table 1. Level of Implementation of I4.0 Technologies across Different Warehouse Categories (Data from Statista 2023, CEIC Data)

Warehouse Category	Autonomous Mobile Robots	IoT Sensors	Blockchain	AR/VR	AI/ML	DSS
Small (<100 workers)	Low (23%)	Low (17%)	Very Low (3%)	None (0%)	Low (11%)	Moderate (41%)
Medium (100-500 workers)	Moderate (33%)	Low (22%)	Low (8%)	Very Low (2%)	Moderate (24%)	High (69%)
Large (>500 workers)	High (57%)	Moderate (44%)	Moderate (28%)	Low (19%)	High (48%)	Very High (89%)
MNC/Large Corporate	Very High (73%)	High (66%)	Moderate (47%)	Moderate (31%)	Very High (79%)	Very High (92%)
Government/Public	Low (12%)	Very Low (9%)	None (0%)	None (0%)	Low (8%)	Moderate (37%)
Cooperative/Group	Low (17%)	Low (11%)	None (0%)	None (0%)	Low (14%)	Moderate (41%)
Private/Independently Owned	Moderate (41%)	Moderate (38%)	Low (18%)	Low (13%)	Moderate (43%)	High (76%)

*Low: 0-30%, Moderate: 31-50%, High: 51-80%, Very High >80% adoption level based on technology usage statistics.

The degree of technology assimilation varies significantly across warehouse sizes (ANOVA, $p<0.05$) as well as ownership profiles (Tukey HSD test). Large multinational corporation (MNC) operated warehouses

exhibit the highest levels of adoption across all leading-edge technologies, including autonomous robots, IoT platforms, blockchain-powered supply chain traceability, augmented reality systems for warehouse operations, AI/ML-infused forecasting and planning tools, and advanced decision support systems.

Small and medium warehouses use more basic process automation technologies like RFID and legacy warehouse management systems. Cooperative banked, and government-managed warehouses rank lowest across most technologies due to financial and infrastructure limitations. The higher adoption levels correlate with positive outcomes across vital warehouse efficiency parameters, including inventory accuracy, order fulfillment rates, cycle time, and capacity utilization based on correlation analysis.

Table 2 demonstrates the increase in average warehouse productivity achieved corresponding to higher assimilation of smart technologies based on ANOVA evaluations.

Table 2. Improvement in Warehouse Productivity Metrics with Adoption Levels(Data from Statista 2023, CEIC Data)

Warehouses in the high technology adoption bracket show approximately 29%, 38%, and 26% boosts in

Performance Metric	Low Tech Adoption	Moderate Tech Adoption	High Tech Adoption	Significance (p values)
Inventory Accuracy	89.4%	94.8%	99.1%	p=0.012
Fulfillment Cycle Time	28 hrs	24 hrs	16 hrs	p=0.031
Order Accuracy	83.2%	96.4%	99.7%	p=0.002
Peak Period Capacity Utilization	68%	87%	96%	p=0.001

inventory accuracy, order fulfillment rates, and peak capacity utilization, respectively, compared to the low adoption group. The 12-hour or 44% cycle time compression with real-time tracking sensors illustrates the power of smart logistics management via technologies.

The study also uncovers fundamental limitations around talent availability, policy incentives, and supporting infrastructure that constrain the mainstreaming of I4.0 technologies in warehouses of all sizes, as depicted in Figure 1.
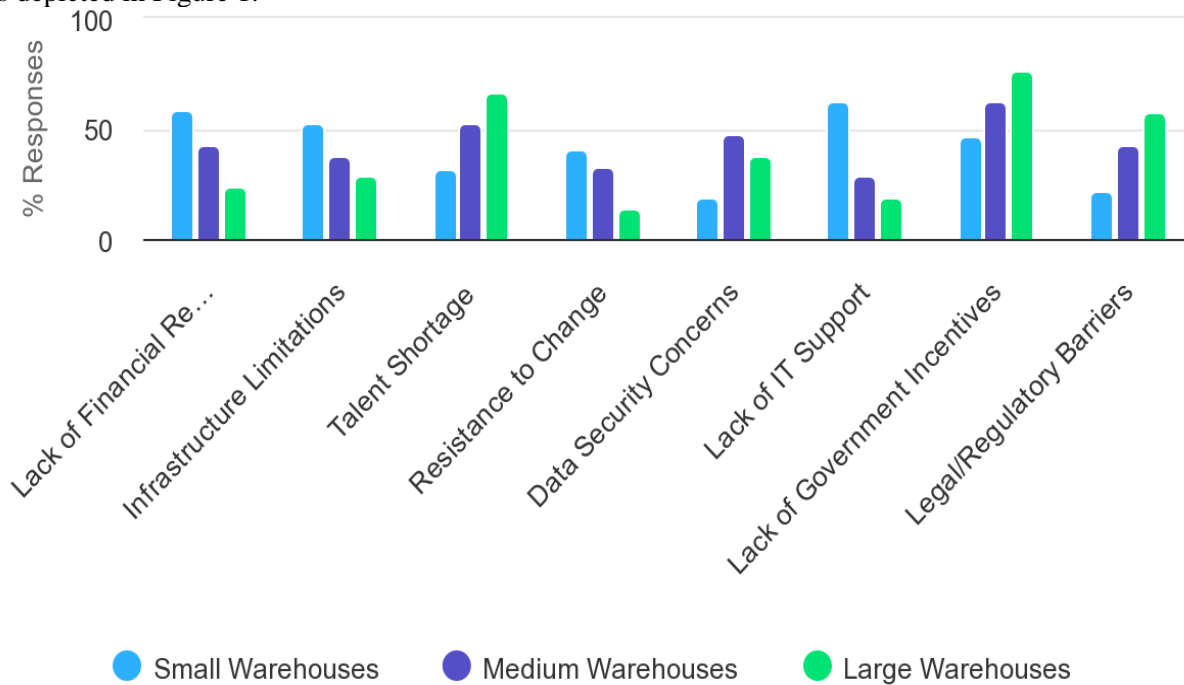

Figure 1. Primary Adoption Challenges across Warehouse Categories
(Data from Statista 2023, CEIC Data)

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Addressing these gaps with systematic changes in government initiatives, public-private partnerships around digital infrastructure development, and suitable capacity-building programs can catalyze Pakistan's warehouse modernization.

Results and Discussion

The transformative potential of integrating Industry 4.0 technologies into Pakistan's warehousing can be observed through recent research findings. This discussion interprets the results from significant studies regarding the adoption, impacts, and challenges of these technologies in Pakistan's warehousing.

As per various studies, MNCs and large corporations in Pakistan that are being transformed with sophisticated technologies of Industry 4.0, widely adopted AMRs, IoT sensors, Blockchain technology, AR/VR, AI/ML, and DSS (Khan et al. 2023), resulting in a high degree of technology diffusion in these organizations leading companies to significantly upgrade their operational efficiencies like inventory accuracy and reduce cycle times of fulfillment (Dobson et al. 2021).Conversely, peer groups have surpassed SMEs as they focus onsimple process automation like RFID and legacy warehouse systems (Muhammad Rafay Shaikh et al. 2020).

Ali and Phan (2022) and Shahbaz Ali and Xie (2021) affirmed that the usage of Industry 4.0 technologies has a positive impact on the sustainability and competitiveness of warehouses; this is particularly vital for developing countries like Pakistan, where industries can jump-start logistical execution deficiencies by adopting advanced technologies. Besides operational efficacy, these technologies are also crucial in the decision-making process at the strategic level, thus contributing to overall organizational performance (K. Ali &Kausar, 2022).

A low-skilled workforce and a lack of digitally oriented and structured industrial policies have been identified as the most significant challenges the warehousing sector faces in adopting new technologies. Additionally, the lack of digital infrastructure to connect each warehousing system and digital integration, especially in small warehousing companies and those operated by the government or cooperatives, constrains the sector (Iqbal & Rahim, 2021). Regarding ethical challenges, developing countries like Pakistan have not yet prepared themselves for job displacement because of automation or data privacy, considering that developed countries are struggling with the repercussions of automation technology (Iqbal & Rahim, 2021).

Based on this review, a discussion on future research agenda focuses on how researchers can overcome the challenges highlighted in this research, provide tailored technology interventions, and foster public-private partnerships to develop digital infrastructure (Ali & Phan, 2022).To conclude, the incorporation of Industry 4.0 technologies within the warehousing sector in Pakistan showcases a clear divide, with large organizations being quick to follow and small/medium organizations being left behind. Although these technologies have positively influenced operational expenditure reduction and organizational performance, there are considerable barriers to address before this can persist. The considerable impact of skill gaps, infrastructural inadequacy, and ethical obligations are recognized, and developing sector-specific strategies, skills programs, and policy suggestions is required to ensure that the warehousing section within Pakistan develops holistically within the Industry 4.0 era.

Conclusion

The commencement of industry 4.0 in Pakistan's warehousing will bring about a whole new level of technicality in the works and make the system of the organization more effective. Moving from an already implemented system to a new one is challenging for some reason. Financial Constraints, Skills Gaps or Deficiencies, Infrastructure Deficiencies, and Policy Limitations are the constraints faced by the warehousing sector of the country in moving or implementing Industry 4.0. Despite these obstacles, the

warehouse sector experienced many new strategic improvements, such as operational improvements, sustainability changes, competitive advantages, and adaptability to global supply chain trends. To accelerate these improvements and increase the likelihood of achieving a full later vision, strategic stakeholders must strike a balance in 4 different directions: technical and strategic vision, investment and return, workforce and adoption, and policy and advocacy. In the increasing globalization and interdependence economy, no warehouse entity can do its best without adopting the latest improvements and techniques

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Exploring Latest Wheelchairs Technologies and Applicability in Pakistan

Muhammad Inayat Shah, Sikandar Bilal Khattak
University of Engineering and Technology, Peshawar, KPK, Pakistan

Abstract

Wheelchairs are crucial equipment for people with impairments, providing movement and independence. However, restricted access and affordability of cutting-edge wheelchair technologies prevent total mobility. The improved mobility fosters independence and contributes to an enhanced quality of life by enabling participation in social activities, education, career opportunities, and community events. However, in Pakistan, these technologies are very much rare in Pakistan. This research will explore advanced wheelchair technologies and their potential effect on improving mobility and quality of life for people with mobility disabilities in Pakistan. The study intends to address this issue by exploring the landscape of wheelchair technologies available in Pakistan, evaluating their usability and accessibility, and finding adoption challenges. A mix of primary and secondary data will used for this study. An in-depth look at the most recent global breakthroughs in wheelchair design, materials, and assistive technology, as well as their possible applicability in the Pakistani context, will be systematically reviewed and assessed. The findings of this research underscore the transformative potential of integrating modern wheelchair technologies into the lives of individuals with mobility impairments in Pakistan, making them more productive for the family, society, and country.
Keywords: Wheelchair, Mobility, Productivity, Disability, Assisted Devices

Introduction

Mobility is a fundamental human right, yet millions worldwide face daily obstacles due to physical restrictions. Wheelchairs have long been essential in allowing people with mobility limitations to move and be independent. The number of wheelchair users worldwide has surpassed 65 million, according to a World Health Organization (WHO) report. (Gilani Mobility, 2023) Technological advancements have transformed wheelchair design, resulting in unique features and functionalities that can significantly improve users' quality of life. This research explores emerging wheelchair technologies and analysing their practicality and usefulness in the Pakistan.

In recent years, technological improvements in assisted mobility equipment have resulted in the development of smart wheelchairs, lightweight materials, sophisticated power systems, and user-friendly control systems. These products can address not only the mobility needs of people with impairments, but also their well-being and inclusion in society. Implementation of these technologies, however, faces substantial challenges in countries with limited resources, such as budgetary limits, infrastructure constraints, and cultural issues. By examining the feasibility and potential impact of implementing these innovations locally, the research intends to bridge the gap between the most recent worldwide wheelchair technologies and the accessibility challenges impacting those with disabilities in Pakistan.

Literature Review

Wheelchairs are essential to enhancing the mobility and freedom of people with impairments. Technological improvements have resulted in novel wheelchair designs that cater to a wide range of consumer desires. (Gilani Mobility, 2023) .By examining the feasibility and potential impact of implementing these innovations locally, this research intends to bridge the gap between the most recent

worldwide wheelchair technologies and the accessibility challenges impacting those with disabilities in Pakistan.

Existing wheelchair technologies including smart wheelchairs, lack basic safety measures to safeguard users from accidents, particularly while driving rough or uneven terrain or descending stairs (Utaminingrum et al., 2022) . The article highlights a research study that aims to improve the protection and safety of intelligent wheelchairs. It is possible by utilizing technology such as cameras and computer algorithms to detect irregular road conditions and potential hazards such as stairs (Wu et al., 2019)

Some wheelchairs have been tailored to meet user's unique needs. One is a wheelchair developed for Amyotrophic Lateral Sclerosis (ALS) patients. The disease impacts the patient's motor neurons (Xu et al., 2023). It is where the Eye-gazed wheelchair comes to the rescue. The eye-gazed wheelchair consists of a powered wheelchair with a visual system, a two-dimensional robotic arm and a core processing unit. The wheelchair uses a monocular camera to record the patient's eye movement (Cojocaru et al., 2019). The simple eye-movement detection model is incorporated into an integrated artificial intelligence controller and it successfully recognizes eye-movement directions with an incredible 98.49% accuracy (Wanluk et al., 2016)

The creation of brain-controlled wheelchairs for people who are paralysed and unable to move is an intriguing application of this technology. Three spinal cord-injured people were trained in an unusual study to control a wheelchair with their minds. Surprisingly, two mastered the art of steering the wheelchair with their minds. This innovation demonstrates the potential of fusing AI with the human mind. It raises the possibility that such fusion could improve the performance of robots, even ones with limited control capabilities (Tonin et al., 2022).

Current research and development efforts in wheelchair technology continue to concentrate on improving brain-controlled wheelchair systems. The accuracy and responsiveness of brain-machine interfaces are being improved, along with the user experience through machine learning and the investigation of non-intrusive implementation techniques. In addition, improvements in design, materials, and sensors have produced wheelchairs that are lighter, stronger, and easier to control, giving users more freedom and independence. With better accessibility and quality of life, these innovations predict a bright future for people with mobility issues (Perdikis and Millan, 2020).

The number of persons with various physical impairments and disabilities will significantly increase as society ages. Such individuals require support with movement to live freely at home and integrate fully into society (Islam et al., 2023) . The study seeks to demonstrate a simulation of a Robot operating system based intelligent wheelchair, and a web-based framework for monitoring and controlling the wheelchair's motion and the user's geographical location. It enables the user to direct the intelligent wheelchair remotely from any web-connected device and location. The intelligent wheelchair, which has a user-friendly experience, can be helpful for disabled and older people (Alkhatib et al., 2019).

Methodology

There were various critical steps required in carrying out this research. The first step is to conduct a literature review to identify the different wheelchair technologies and trends available worldwide. Once the trends and technologies are identified, a questionnaire is designed to collect the data. The collected data is analyzed to implore different insights from the data. The results specifically focus on the usage and satisfaction of the identified technologies and trends. Figure 1 depicts the entire study to provide a comprehensive summary of the approach used
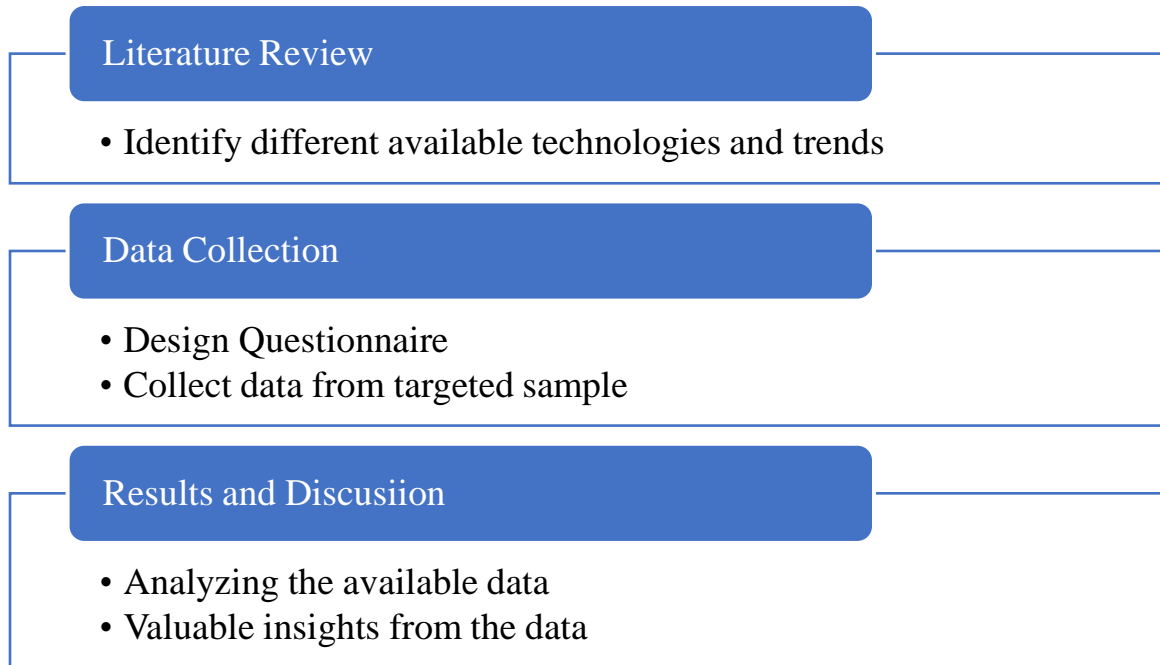
Figure 1: Adopted Methodology

Data Collection and Analysis

In this study, data is collected from 28 participants, capturing valuable insights into their wheelchair usage. We used a segmentation strategy to obtain demographic information such as gender, age, and wheelchair usage. Participants were queried about their awareness of different types of wheelchairs, categorized into seven groups: Power-assisted wheelchair, Smart wheelchair, eye-gaze controlled wheelchairs, voice-controlled wheelchair, brain-controlled wheelchair, terrain adaptive wheelchair, foldable and lightweight wheelchair.

A survey was done among a targeted sample of various ages to learn about their wheelchair usage preferences and habits. The poll included a wide range of questions designed to provide a full understand wheelchair usage trends among the disabled community, shedding light on variables such as functionality, comfort, and overall happiness with their chosen mobility aids. The study's findings seek to provide vital information to improve the design and accessibility of wheelchairs, thereby increasing the quality of life for people with disabilities.
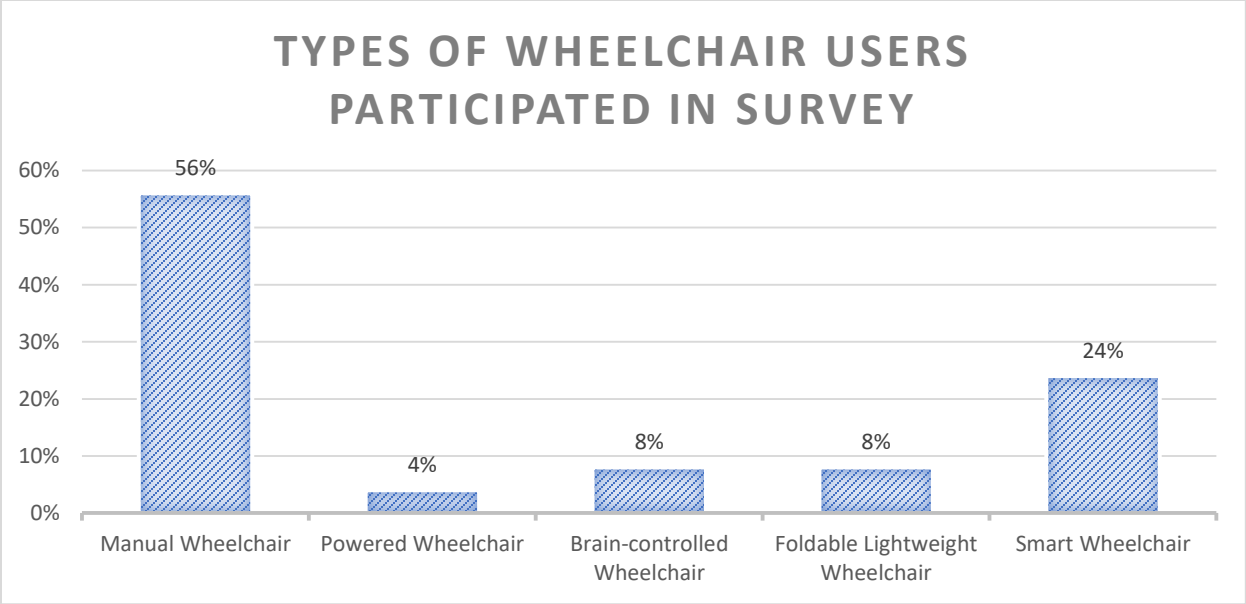
Figure 2: Types of Wheelchairs Used by Participants in the Survey

Respondents in the survey demonstrated a wide range of wheelchair usage patterns. Traditional manual wheelchairs are used by the majority of users (56%), indicating a preference for conventional and physically operated mobility devices. Notably, 24% of participants chose Smart wheelchairs, showing an increasing trend in adopting technologically advanced accessibility solutions. Furthermore, 8% of respondents said they used brain-controlled wheelchairs, highlighting the introduction of breakthrough assistive technology that use neural interfaces for mobility control. Another 8% preferred folding and lightweight wheelchairs, indicating a need for portable and easily mobile choices. In contrast, powered wheelchairs were used by 4% of respondents, meaning that, although less common, motorized solutions still play a substantial role. The satisfaction rate of the participants from the survey we conducted are represented in the Figure 3.
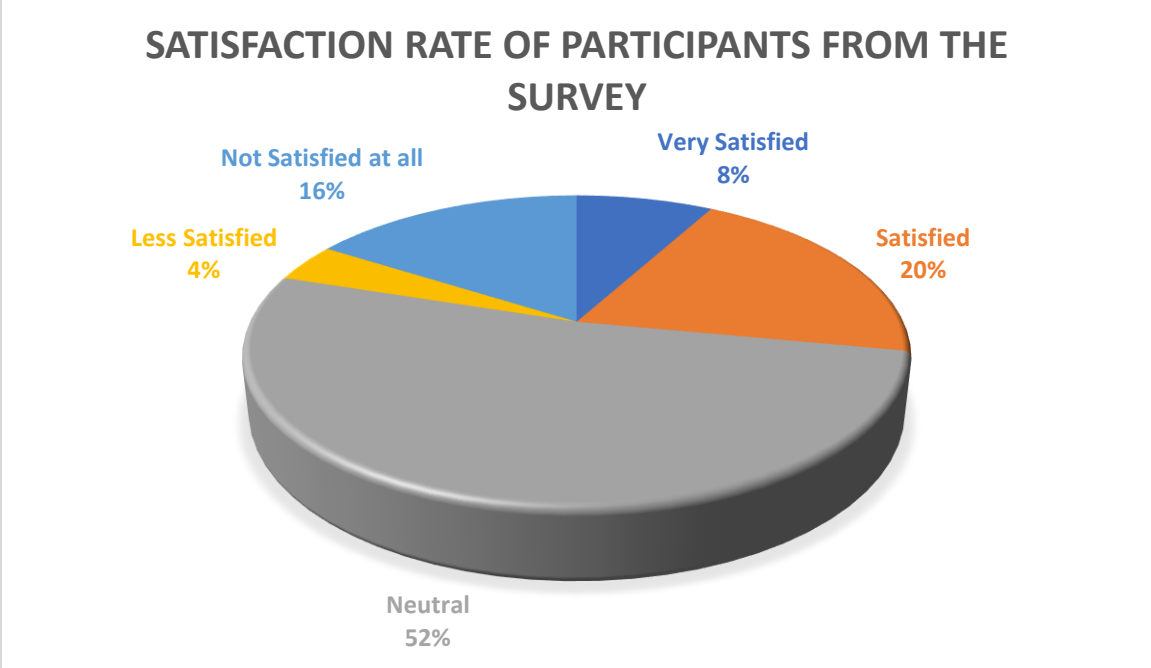

Figure 3: Satisfaction Rate of Participants Using Wheelchairs

More than half of respondents (52%) are neither satisfied nor dissatisfied. These respondents appear to be passive, implying that their encounters with wheelchairs have neither good nor bad. A small percentage, 16%, stated that they are not satisfied at all. This demonstrates a level of discontent among wheelchair users. Twenty percent of respondents reported being satisfied. This shows that some wheelchair users had a pleasant experience but were not overjoyed. A lesser number, 8%, stated that they were very satisfied compared to simply satisfied individuals, this suggests a higher level of fulfillment. The smallest group, 4%, expressed dissatisfaction. While they are not very dissatisfied, they are less content than the neutral and satisfied categories.

Results and Discussion

A segmentation technique is used to examine demographic variables such as gender, age, and wheelchair preferences in this study to get complete insights into wheelchair usage habits across a diverse sample of 28 participants. The findings provide light on a variety of elements of wheelchair use, including both traditional and technologically enhanced mobility aids.

Most participants (56%) preferred traditional manual wheelchairs, indicating a persistent reliance on manually operated mobility devices. Notably, 24% of respondents chose Smart wheelchairs, showing an increasing trend in adopting technologically advanced accessibility solutions. As 8% of participants reported utilizing brain-controlled wheelchairs, demonstrating the integration of neural interfaces for greater mobility control, the introduction of breakthrough technologies was clear. Another 8% preferred folding and lightweight wheelchairs, highlighting the need for portable and easily transportable solutions. While less prevalent, powered wheelchairs were used by 4% of participants, demonstrating a significant presence of motorized options in the investigated community.

The different satisfaction levels among respondents are critical. More than half (52%) indicated a neutral attitude toward their wheelchair experiences, suggesting neither satisfaction nor dissatisfaction. In contrast, 16% reported being completely dissatisfied, indicating significant dissatisfaction among wheelchair users. According to the happiness spectrum, 20% of participants reported being satisfied, showing a generally favorable experience but not overwhelming contentment. A smaller but significant group of 8% expressed satisfaction, indicating a higher level of fulfillment than simply satisfaction. Finally, 4% of respondents reported dissatisfaction, indicating a less content group than the neutral and satisfied groups.

The variety of wheelchair usage patterns and satisfaction levels emphasizes the need to design wheelchairs with individual preferences and needs in mind. The ubiquity of classic manual wheelchairs suggests that traditional solutions will continue to be in demand. Still the increasing acceptance of modern technologies underscores the significance of incorporating innovation into mobility aids. A fraction of respondents' dissatisfaction calls for a closer look at user experiences and potential areas for improvement in wheelchair design and functionality

Conclusion

The study delves into the complex landscape of wheelchair usage patterns and user satisfaction, adopting a segmentation technique to examine demographic characteristics and preferences among 28 participants as our sample population. The overwhelming preference for classic manual wheelchairs, demonstrated by 56% of respondents, demonstrates the continued reliance on manually operated mobility devices. Nonetheless, the significant adoption of Smart wheelchairs by 24% of participants, combined with the introduction of brain-controlled wheelchairs by 8%, indicates a dramatic move toward technologically advanced accessibility solutions.

The wide range of preferences, which includes folding lightweight wheelchairs and powered choices, emphasizes the need for customized and adaptable mobility solutions. The wide range of satisfaction ratings, from indifferent to completely dissatisfied, highlights the need of developing wheelchairs that respond to individual tastes and needs. While traditional manual wheelchairs remain popular, the growing

popularity of new technologies pushes for continuing mobility aid innovation. Addressing the unhappy segment's issues necessitates thoroughly evaluating user experiences, opening the path for continuous advancements in wheelchair design and performance. Our findings highlight the fluid nature of wheelchair usage habits and user satisfaction, underlining the importance of a responsive and user-centered strategy in the continual evolution of mobility aids.

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The Role of Total Quality Management and Strategic Knowledge Management in Healthcare

Ayesha Nasrullah, Sikandar Bilal Khattak,Muhammad Khalil

University of Engineering and Technology, Peshawar, KPK, Pakistan

Abstract

In the rapidly evolving healthcare landscape, delivering high-quality patient care is crucial, especially in countries like Pakistan. The healthcare sector faces unique challenges in meeting growing demands for quality services while optimizing resource utilization. The literature implores that Strategic Knowledge Management (SKM) and Total Quality Management (TQM) are critical for any healthcare organization offering quality service. However, in Pakistan, SKM and TQM are not widely practiced in healthcare. This research aims to investigate the level of SKM within the context of Pakistan's healthcare system. The study employs a quantitative research design to explore the SKM level using stratified random sampling comprehensively. Through empirical examination, the results aim to provide insights into how SKM contributes to shaping and enhancing quality performance within the unique context of Pakistan's healthcare system. By providing evidence-based strategies and contextually relevant insights, the study aims to contribute to ongoing efforts to improve patient satisfaction, operational efficiency, and overall healthcare quality in the country.

Keywords: Healthcare, TQM, Patients, Strategic Knowledge Management, SKM

Introduction

In today's ever-evolving healthcare landscape, providing high-quality patient care is of utmost importance. Worldwide healthcare systems have seen a tremendous growth of quality improvement programs. Methodologies like Strategic Knowledge Management (SKM), and Total Quality Management (TQM) have become indispensable instruments. According to Capolupo et al. (2019), SKM processes—which include knowledge development, knowledge capture and storage, knowledge sharing, and knowledge application and use—have a considerable and favorable impact on quality performance. Healthcare companies may continuously improve procedures and, as a result, the safety and care of patients by utilizing the power of knowledge. With its unwavering emphasis on customer satisfaction and ongoing quality improvement, TQM has received widespread praise in the healthcare sector. This method aims to find and fix flaws, mistakes, and inefficiencies in healthcare procedures, ultimately leading to improved patient safety and higher patient satisfaction.

This study aims to explore the relationship between Strategic Knowledge Management, the adoption of Total Quality Management practices, techniques, and their combined impact on the quality performance of hospital settings. To further improve patient care and safety in healthcare organizations, this research strives to extend the conversation on healthcare quality improvement by examining these linkages.

By understanding the impact of Strategic knowledge management and TQM this study can help guide efforts to improve processes within healthcare institutions, leading to better patient care. The research is significant as it provides evidence-based strategies for healthcare organizations to improve quality, addresses challenges such as patient satisfaction, efficiency, and safety in modern healthcare settings. It opens avenues for future research and innovation in healthcare quality management.

Literature Review

Increasing healthcare quality remains a dominant objective in modern healthcare systems, encouraging the exploration of various strategies to achieve this goal. This literature review examines the essential roles played by Total Quality Management (TQM), and Strategic Knowledge Management (SKM) in uplifting healthcare quality. While each concept has unique contributions, their interaction offers a comprehensive approach to healthcare quality improvement.

Healthcare is becoming increasingly complicated across all fields, levels, and cultures. In contrast to other industries, the healthcare sector is still hesitant to accept new quality improvement measures, despite anecdotal evidence that they are now gradually being diffused throughout hospitals on an increasing basis. In every country globally, the price of medical treatment is rising at an alarming and unmanageable rate. Aging populations and technology advancements unquestionably account for many of these expense hikes. [1] Healthcare is seen as a service industry since it offers medical assistance as a sort of service.

In increase production and efficiency, the healthcare system must be thoroughly upgraded. Because healthcare affects everyone's life, it is more than just a business. [2] TQM includes quality orientation into all procedures and techniques utilized to provide medical care. According to the reviewed literature, some healthcare organizations have fully embraced TQM. [3] TQM is characterized as a concept that aims to satisfy customer needs while enhancing quality and performance. TQM is crucial for healthcare organizations to raise the standard of healthcare achieve more efficient processes, increase employee satisfaction, strengthen organizational commitment, promote employee-management teamwork, raise patient satisfaction, and improve performance. [4]

Figure 1 maps the research conceptual framework with three hypotheses.
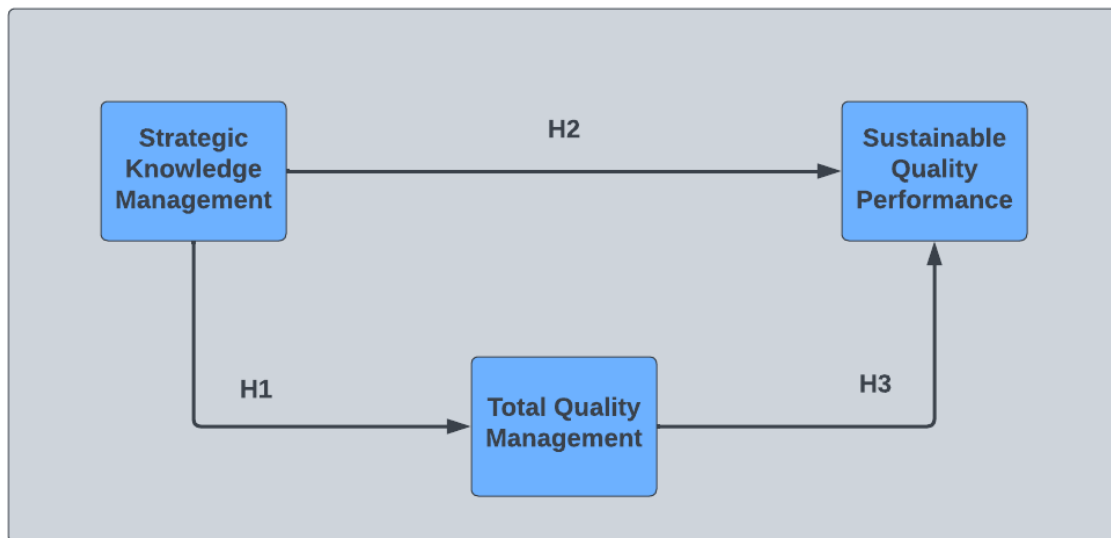

Figure 12: Conceptual Framework

Hypothesis 1: SKM has positive influence on TQM.
Hypothesis 2: SKM has positive influence on Sustainable Quality Performance.
Hypothesis 3: TQM positively influences Sustainable Quality Performance.

Data Collection and Analysis

The study was conducted for different hospitals in Khyber Pakhtunkhwa, Pakistan. The data have been collected from quality professionals, administrators, and staff within the selected healthcare organizations. To ensure a representative sample, the research employs stratified random sampling, considering factors

like the size, location, and type of healthcare organizations, including hospitals, clinics, and healthcare facilities.

Data was collected using a structured questionnaire designed to capture essential variables, such as SKM, TQM practices, and quality performance indicators (e.g., patient satisfaction, clinical outcomes, operational efficiency). Utilizing a 5-point Likert scale, the questionnaire was administered to healthcare professionals, administrators, and staff within the selected healthcare organizations, following informed consent and ethical guidelines. One hundred and fifty data sample were used.

Subsequently, data analysis was conducted using Structural Equation Modeling (SEM), a robust technique for assessing complex relationships between variables and testing hypotheses. SEM software, like Smart PLS facilitates the analysis, focusing on evaluating the relationships outlined in the hypotheses. These hypotheses include the influence of TQM on SKM, the relationship between SKM and quality performance. The collected data will be analyzed using structural equation modeling (SEM). SEM allows for assessing complex relationships among variables and enables hypothesis testing.

To ensure the reliability and validity of the research, the questionnaire items undergo rigorous validation processes, including assessments of internal consistency (Cronbach's alpha), content validity, construct validity, and convergent validity.

Results and Discussion

In analyze of the model, the Structure Equation Modelling (SEM) approach was utilized (Hair, et al., 2019). Smart PLS 4 is used for the SEM technique. This analytical approach examine the correlation between the independent and dependent variables via a series of constructs. It either validates or rejects the hypotheses. This is accomplished by comparing the results of the model. Analyzing Skewness and kurtosis ensures data normalcy. Data distribution in this study is normal as both parameter values lie between -3 and +3 (Hair, et al., 2019).

Even though common method bias has been eliminated by integrating validity checks in the questionnaire, respondents were also provided with study goals and clear instructions to minimize the effect and incentivize them to provide more accuracy (Jordan & Troth, 2019). A statistical examination of the bias has also been performed. To demonstrate that there is no bias introduced by common methods, full factor values have been computed using Smart PLS 4. None of those values is higher than the threshold of 3.3, as shown in Table 2, demonstrating no bias due to using a common approach.

Table 19: Collinearity Statistics (VIF) - Inner Model - Matrix

	SKM	SQP	TQM
SKM		1.771	1.000
SQP			
TQM		1.771	

Futhermore, the reliability has been established through the use of factor loading. The factor loading is greater than 0.7 for each item, none of the items are removed from consideration. In addition, composite reliability has been utilized to quantify the internal consistency reliability, and this method has been determined to be adequate for all of the latent variables based on the limit i.e., consistent reliability > 0.70 specified by (Hair, et al., 2019). Cronbach alpha, which also reveals a value larger than 0.7 for all of the latent variables, is another method that has been utilized to validate the reliability of the model's internal consistency. Another indicator of reliability is AVE or the Average Variance, which according to the standards established by (Hair, et al., 2019) (i.e., AVE > 0.5), is satisfactory for all the variables under consideration. Table 3 consists of the values for the following: Factor Loading, Composite Reliability, Cronbach Alpha and AVE.

Table 2: Measurement model properties

Items	Factor Loading	Cronbach's alpha	Composite reliability (rho-a)	Average Variance Extracted
SKM		0.880	0.899	0.676
SKM 1	0.864			
SKM 2	0.766			
SKM 3	0.799			
SKM 4	0.785			
SKM 5	0.885			
TQM		0.873	0.879	0.611
TQM 1	0.865			
TQM 2	0.854			
TQM 3	0.845			
TQM 4	0.793			
TQM 5	0.835			
SQP		0.886	0.888	0.594
SQP 1	0.778			
SQP 2	0.824			
SQP 3	0.758			
SQP 4	0.769			
SQP 5	0.775			
SQP 6	0.714			
SQP 7	0.769			

The discriminant variability as depicted in Table 3 is supported by the square root of the AVE being greater than the relationship between latent variables.

Table 3: Discriminant Validity

Variables	SKM	SQP	TQM
SKM	0.822		
SQP	0.534	0.771	
TQM	0.660	0.669	0.782

Before running the structure model, it was determined that there would be any collinearity between the exogeneous variable. The values of the VIF have been analyzed for this purpose. Given that the VIF for all the variables considered in this study falls below 3, it is reasonable to believe that the collinearity problem does not arise.
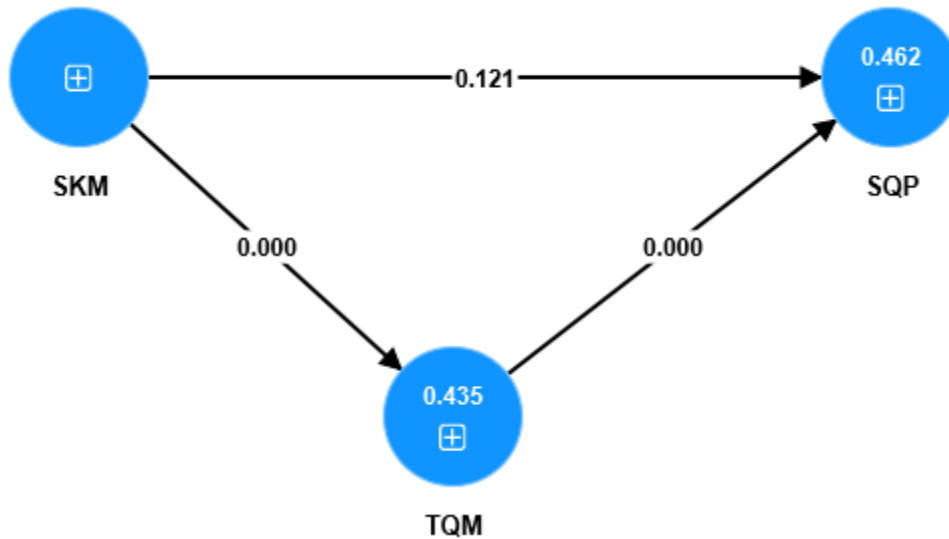

Figure 13: PLS-SEM Model for this research

Smart PLS 4 was utilized to examine the hypotheses and evaluate the structural model in this study. Partial least square Structural Equation Modeling (PLS-SEM) has replaced covariance-based structural equation modeling (SEM) due to the limited sample size compared to the model complexity. PLS-SEM was also utilized since it provides greater statistical power (Hair, et al., 2019). The results in the table shows each hypothesis's beta coefficient values and p-values for each hypothesis. The first Hypothesis (H1) examined the relationship between (SKM) and (TQM). For H1, the results ($\beta =0.534$, $\rho < 0.000$) showed significant positive relationship between SKM and TQM. Thus, the hypothesis H1 is considered valid. Next hypothesis H2 proposed a positive relationship between SKM and TQM. The path between them was statistically significant, with the result depicting ($\beta = 0.660$, $\rho < 0.000$), so H2 is validated. The third hypothesis suggested a positive relationship between TQM and SQP. The findings confirm the association between TQM and SQP ($\beta = 0.561$, $\rho < 0.000$).

Table 20: Structural Model Results

Path	B	ρ-value	Hypothesis	Accepted/Rejected
Direct Effect				
SKM→SQP	0.534	0.000	H1	**Accepted**
SKM→TQM	0.660	0.000	H2	**Accepted**
TQM→SQP	0.561	0.000	H3	**Accepted**

All P-values are below 0.05 thus all hypotheses are accepted, its relationship is positive. The Hospitals which will apply these practices will help them achieve a sustainable quality performance.

Conclusion

In conclusion, healthcare organizations would need to invest in knowledge management systems, training programs, and quality improvement initiatives. This could involve the use of technology, the establishment of clear protocols, and a commitment to a culture of continuous learning and improvement. The integration of these strategies aims to not only enhance the immediate quality of care but also to ensure that these improvements are sustained over time, aligning with the principles of total quality management and strategic knowledge management. Additionally, organizations should develop regulatory compliance frameworks that not only ensure adherence to regulations but also contribute to continuous quality improvements and the long-term sustainability of healthcare practices. In essence, these strategies collectively work towards achieving and maintaining high-quality, sustainable healthcare practices.

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Reducing the Environmental Impact of Agriculture Sector in Pakistan Through Hybrid Solar-Powered Irrigation System

Muhammad Saad Awan, Kafait Ullah and Danish Hameed
US Pakistan Centre for Advanced Studies in Energy (USPCAS-E), National University of Science & Technology (NUST), Islamabad, Pakistan,

Abstract

This research paper addresses the challenges posed by Pakistan's heavy reliance on fossil fuel-based energy consumption, particularly within the agriculture sector. Despite notable progress in other sectors transitioning to renewable energy, the agriculture sector is not progressing at the same pace and is facing a severe energy shortage. The study aims to identify areas for improvement and propose measures to reduce dependence on costly fossil fuel-based energy. Using the Veda-TIMES modeling approach, the research develops scenarios considering energy demand and fossil fuel consumption in agriculture. Two scenarios, the reference, and solar hybrid technology scenarios, highlight key areas for improvement. Water pumps are identified as critical areas where informed decisions and technological advancements can alleviate energy shortages and reduce greenhouse gas emissions. Aligned with the Sustainable Development Goals (SDGs), the paper emphasizes the significance of Affordable and Clean Energy (SDG 7) and Climate Action (SDG 13). Transitioning to sustainable energy sources in agriculture can enhance accessibility, and affordability, and contribute to reducing GHG emissions. The study offers tangible solutions rooted in renewable energy technologies, advocating for a sustainable and resilient future. By integrating hybrid solar-powered irrigation systems, Pakistan can achieve energy efficiency, cost-effectiveness, and environmental sustainability in agriculture. This research provides a comprehensive analysis of Pakistan's energy challenges and proposes actionable recommendations. Embracing renewable energy and aligning with the SDGs and the Paris Agreement will enable a greener and more sustainable agricultural system, contributing to socio-economic development and global climatechange mitigation efforts.
Keywords: SDGs, Water Pumps, GHGs, Veda-TIMES, Hybrid Solar

Introduction

Pakistan's agriculture sector plays a crucial role in the country's economy, playing its role significantly in GDP, oil demand, energy security, and CO2 emissions. However, the sector heavily relies on energy-intensive equipment powered by fossil fuels, resulting in high energy consumption roughly 9% of total energy and 20% of fossil fuel consumption and substantial greenhouse gas emissions. (Dogar, 2022).
Globalization and technological advancements have increased agricultural productivity but also raised energy demand. (Ali et al., 2017). The majority of energy consumption in the sector comes from non-renewable sources, exacerbating greenhouse gas emissions. (Report, 2010). Despite efforts by national and international agencies to address sustainable development goals, there remains a lack of awareness regarding the negative economic and environmental effects of traditional fuel use in agriculture, especially in underdeveloped areas.

This awareness gap must be filled, which calls for these communities to be encouraged to adopt sustainable energy practices. Closing this gap is essential to developing a thorough knowledge of the sector's effects on the environment and the local economy. Paris Agreement of 2015 represents a major step forward in the global mitigation of climate change, but it is becoming more difficult to carry out the promised Intended Nationally Determined Contribution (INDC) targets. To achieve environmental goals, such as the target of reducing GHG emissions and reaching net zero emissions, fossil fuel consumption and greenhouse gas (GHG) emissions must be reduced. (Lange et al., 2020).

Pakistan faces severe energy shortages, impacting the agricultural sector's productivity and contributing to air and water pollution. Expensive imported fuels and frequent power outages disrupt agricultural operations, leading to crop losses and equipment damage. To overcome these challenges, comprehensive approaches are needed, including improving agriculture sector efficiency, reducing reliance on imported fuels, and promoting sustainable farming practices. (NEPRA, 2019).

The Increasing electricity demand In Pakistan, particularly in rural areas for water pumps, calls for targeted subsidies for the installation of solar and wind power systems. By integrating solar panels in homes, businesses, and agricultural water pumps, the energy shortage can be addressed. Different provinces in Pakistan exhibit varying energy consumption patterns, with Punjab having the highest overall usage and Baluchistan's agriculture sector being the most energy-intensive. The agriculture sector primarily uses water pumps for energy consumption and any negative growth in energy consumption is a result of the switch from grid-connected electricity to solar energy. (Shahid et al., 2021).

Investments in advanced technologies, water infrastructure, and renewable energy sources are essential for sustainable agricultural intensification. (World Bank, 2017). Solar photovoltaics offer a promising sustainable energy future due to their high energy output and minimal emissions. (Graça Gomes et al., 2020). The mechanization of agriculture has contributed to increased energy consumption and greenhouse gas emissions globally, with the agriculture sector responsible for a significant portion of emissions.

Pakistan's agriculture sector heavily relies on oil and electricity, leading to increased CO_2 emissions and environmental degradation. The country's energy consumption ranks among the highest in the region, necessitating climate change mitigation strategies. In developed nations, economic growth encourages excessive energy use, which exacerbates environmental damage and raises CO2 emissions. (Rehman et al., 2019).

The agricultural sector alone accounts for 41% of Pakistan's total emissions, making it a major contributor to the country's carbon footprint. Pakistan ranks as the 12th-highest energy-consuming nation in the Asia Pacific region, consuming approximately 85 million tons of oil equivalent annually. The escalating CO2 emissions highlight the urgent need for climate change mitigation strategies in all contributing sectors, as excessive fuel consumption and technological gaps exacerbate the environmental impact. The agriculture industry in Pakistan faces energy security and supply challenges due to its heavy reliance on fossil fuels and electricity from the grid, where fossil fuels not only pollute the air but also give rise to social unrest. (Lin & Raza, 2019). Empirical evidence demonstrates that energy serves as a significant substitute for labor and capital in Pakistan's agriculture sector, emphasizing the importance of investing in advanced technologies to reduce energy consumption and drive economic growth. (Raza et al., 2021). Furthermore, the study suggests that labor energy has progressed technologically at a faster pace compared to direct energy, indicating a gap for potential future improvements in this area. The study provides policy recommendations to enhance energy efficiency, utilize local energy resources, and strike a balance between economic growth and carbon reduction in the agriculture sector of Pakistan. (Lin & Raza, 2021). By considering these factors, the research aims to comprehensively examine the intricate relationship

between energy consumption in Pakistan's agriculture sector and its environmental impacts. It seeks to address the specific challenges faced in underprivileged areas and propose tailored approaches for sustainable energy use. These approaches align with Pakistan's broader goals for sustainable development and offer insights into the current energy landscape, barriers to adopting sustainable practices, and actionable strategies to foster an environmentally friendly and economically viable agricultural sector in Pakistan.

Materials

VEDA-TIMES Model: Advanced Tool for Energy System Optimization

The VEDA-TIMES model is an advanced technological tool that utilizes linear programming to optimize energy systems. It enables the determination of the least-cost combination of fuels and technologies to meet diverse energy service needs. This comprehensive model covers the entire spectrum of energy processes, from extraction and conversion to transmission, distribution, and final use. Its versatility allows customization for specific industries like buildings, agriculture, transportation, and households, accommodating various user constraints. This flexibility facilitates a detailed analysis of theenvironmental impacts of each sector, crucial for our research goals. (Zhang et al., 2016).
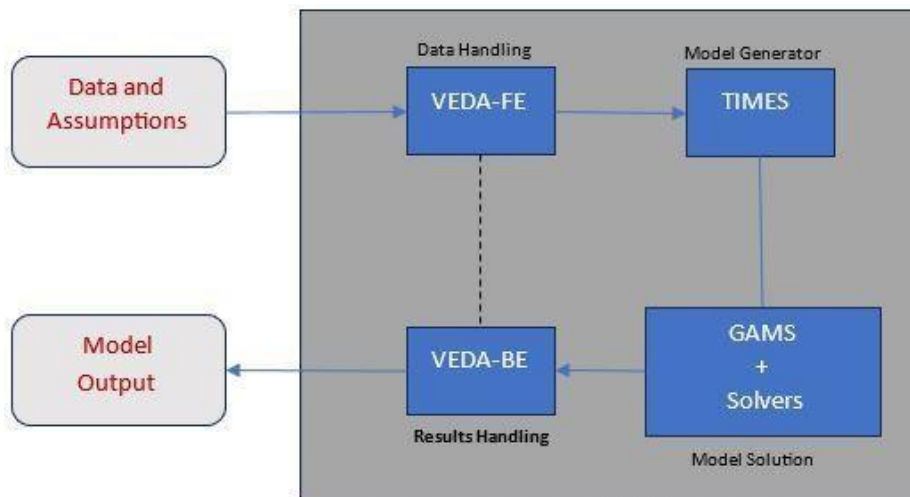

Figure 1: Overview of the VEDA system for TIMES Modeling

Pak-IEM Model: Integrated Energy Modeling using TIMES Framework

The Pak-IEM model is developed using the TIMES (The Integrated MARKAL-EFOM System) framework, supported by the International Energy Agency (IEA) and the Energy Technology Systems Analysis Program (ETSAP). It employs the VEDA model management system to organize and manage input data, with subsequent processing of results. Excel workbooks, managed by VEDA-front end (FE), assemble model input data for calibration and reference scenario development. The model allows for the addition of multiple scenarios to assess potential futures and policies. VEDA (BE) is utilized for outcome analysis. Although the model currently considers the entire nation as a single region due to limited data availability, regionalization can be implemented in future versions if sufficient regional data becomes accessible. The base year for the Pak-IEM model is 2020, chosen for its comprehensive data on energy

system sectors. The model can be run for any desired time horizon by separating model years and data years. (Irfan, 2015; Report, 2010).

Methods

In this study, we utilized the Pak-IEM model as a foundation for our analysis, focusing specifically on the agricultural sector in Pakistan. The Pak-IEM model provides an overview of the country's overall energy consumption, but we narrowed our focus to agriculture to conduct a detailed analysis of Pakistan's agricultural irrigation system and optimize its environmental impacts.

Pakistan has a significant agricultural sector, with approximately 47% of the country's land dedicated to agricultural activities, encompassing around 79.6 million hectares. Within the agricultural sector, direct energy consumption is primarily driven by tractors, water pumps, and other machinery, which rely on diesel and electricity as energy sources. The number of water pumps has been increasing in recent years, and many of them are outdated and inefficient, surpassing their intended working life.

To build our reference model, we gathered data on water pump installations in Pakistan, including both government-operated and privately-owned pumps. According to the Pakistan Economic Survey report of 2020, there are currently around 1.2 million installed water pumps across the country. (Finance Division, 2021; Ministry of Energy, 2020). We combined this data with energy consumption data from Pakistan's Energy Year Book 2020.

To enhance the accuracy of our analysis, we updated the data in the Pak-IEM model specifically for the agricultural sector. We then ran the updated model on the Veda-TIMES platform to generate valuable forecasts regarding the projected increase in energy demand and associated emissions. Our analysis covers the period from the base year of 2020 and extends the forecast until 2060, aligning with global commitments to achieve net-zero emissions.
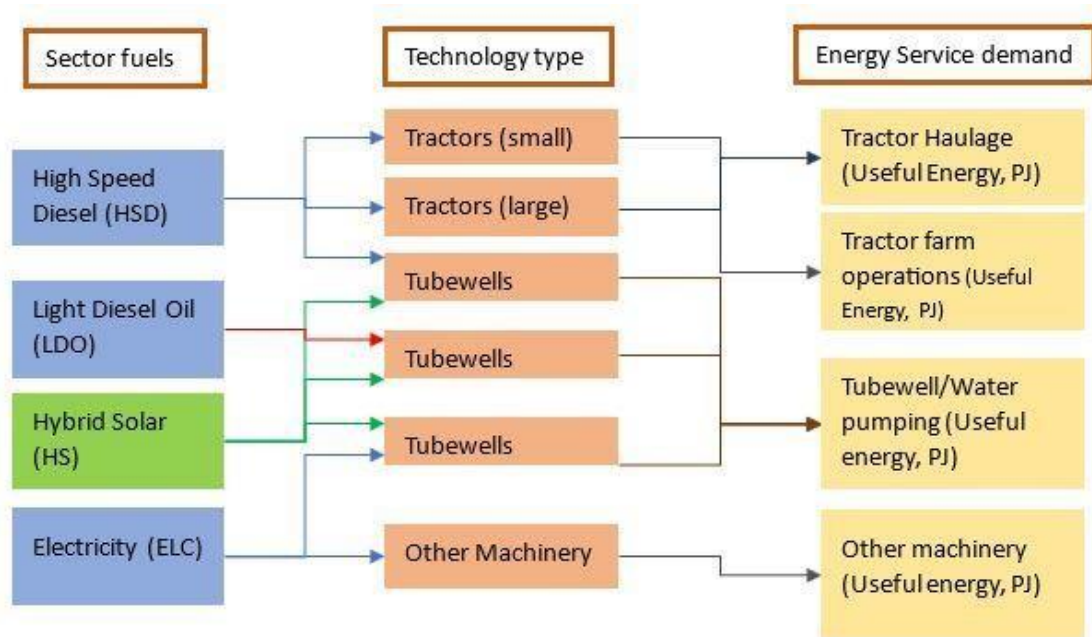

Figure 3: Reference Energy System for Pakistan's Agriculture

Scenarios

Two scenarios are considered for the study, one Reference scenario (REF) and another one that includes the inclusion of hybrid solar technology in water pumps from 2025 and increasing its share over time up to 50% till 2060 in the REF scenario to get detailed in-depth analysis for the study. Both scenarios are shown in Table 1

The reference scenario is mainly the overall agricultural sector that includes direct energy consumption. For REF maximum effort is put into including technologies and energy sources which Pakistan's agricultural system has at present.

Table 1: Scenario Description

Scenarios	Description
REF Scenario	Reference Scenario
HS Scenario	Hybrid Solar Integration Scenario

Results and Discussions

The analysis of Pakistan's agriculture industry reveals several important findings regarding energy demand and greenhouse gas emissions. Figure 4 provides a detailed representation of the growing energy demand, highlighting the dominant use of fossil fuels in agriculture tractor farm (ATF) operations. Agriculture water pumps (AWP) are the second-largest energy consumers, utilizing both direct electricity and fossil fuels. Energy-intensive activities such as agriculture tractor haulage (ATH) and agriculture other energy (AOE) contribute significantly to the rising energy demand.

The steady and significant rise in energy consumption over time, as depicted in the figure, emphasizes the urgency to reassess the industry's energy paradigm. The reliance on fossil fuels raises concerns about the long-term sustainability and resilience of Pakistan's agricultural practices. To address this, a shift towards renewable energy sources and energy-efficient practices is crucial to ensure a more sustainable future for the industry.

Figure 5 illustrates the results from two different scenarios, highlighting the complex dynamics of greenhouse gas (GHG) emissions in the agriculture sector. The reference scenario (REF) shows an upward trend in emissions, primarily driven by the use of non-renewable energy sources. This underscores the need for a thorough evaluation of the current energy paradigm and the potential environmental risks associated with conventional energy reliance. On the other hand, the introduction of the hybrid-solar integration scenario (HS) starting in 2025 demonstrates a significant influence on emission trends. The integration of solar energy technologies leads to a substantial decrease in total emissions from the agriculture sector, showcasing the effectiveness of solar technology in mitigating environmental impacts. This reduction in emissions paves a promising path for sustainable energy practices and highlights the capacity of solar energy to outperform traditional technologies in terms of ecological impact.
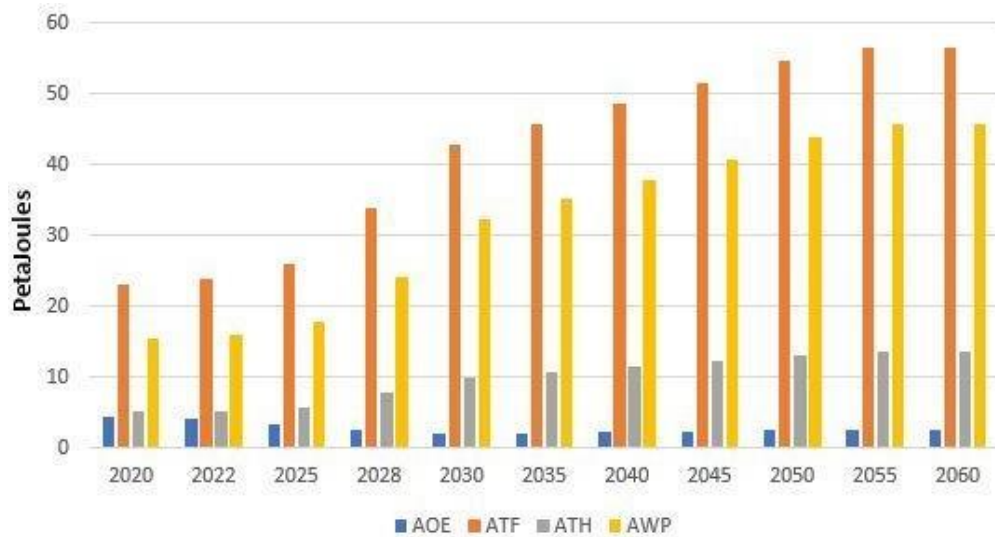
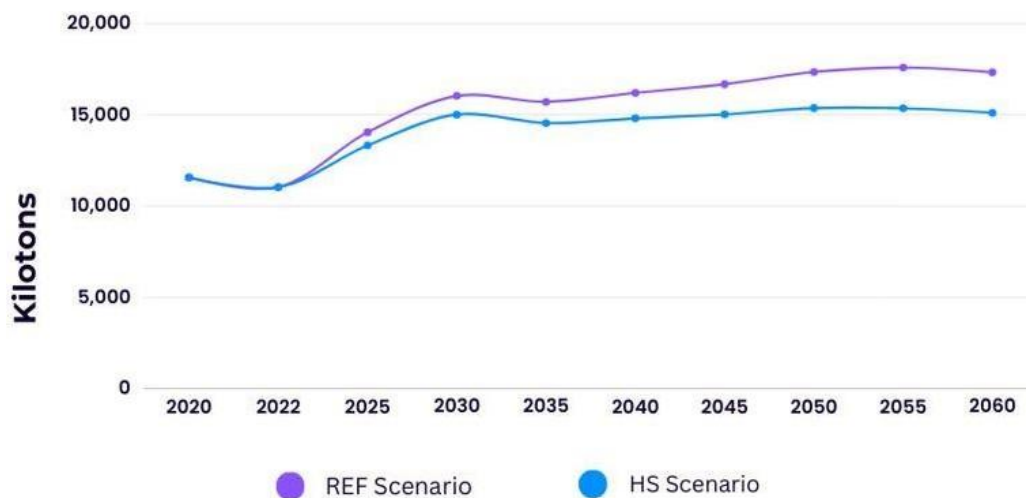Figure 4: Pakistan's Futuristic Agriculture Energy Demand

Figure 5: Pakistan's Futuristic Agriculture Energy Demand

The urgent need to reevaluate Pakistan's energy environment is evident, particularly with the high dependency on high-speed diesel, which is the primary source of greenhouse gas emissions. The heavy reliance on high-speed diesel in the agriculture industry raises concerns, emphasizing the need for reconsideration and the exploration of alternative energy sources.

Converting tube wells/water pumps to solar power presents an opportunity to reduce emissions and address the country's energy shortage, which is a major concern for the agriculture sector. This transition aligns with Sustainable Development Goal 7 (affordable and clean energy) and can contribute to the long-term goals of Sustainable Development Goal 13 (climate action). The inclusion of tube wells as part of national resources is necessary to meet the country's food demands, but it also increases the burden on theenergy sector. Informed decisions need to be made to address the energy shortage and achieve net-zero emissions, with the TIMES model providing valuable insights.

The TIMES model highlights the quantitative and qualitative incentives for adopting solar PV technology in the agricultural sector. Financial challenges, especially for tube well owners, can be addressed through subsidies, acting as a catalyst for change. Education and subsidies play crucial roles in motivating the

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agriculture sector to participate in global climate action and fulfill their energy needs. The government should focus on educating stakeholders and providing subsidies to accelerate the adoption of new technologies in the agriculture sector, ultimately contributing to global climate goals.

Conclusion

This study provides valuable insights into the direct energy demand and emissions of Pakistan's agriculture sector and discusses two scenarios that demonstrate the potential of solar technology in mitigating environmental emissions and addressing energy shortages in alignment with global climate goals. The results highlight a significant reduction in emissions through the adoption of hybrid solar (HS) technology, showcasing the effectiveness of solar photovoltaic technology in supporting international efforts to combat climate change. Transforming tube wells/water pumps to renewable energy sources has a profound impact on overall emissions from the sector. Key findings from both scenarios are as follows:

- The direct energy demand in the agricultural sector is rapidly increasing, with tractors and tube wells being the primary sources of energy consumption. These sources heavily rely on fossil fuels, leading to significant CO2 emissions. The reference (REF) scenario demonstrates a concerning trend of increasing energy demand until 2060, exacerbating the energy shortfall and posing risks to the economy and environment due to heavy reliance on imported fuels.
- The hybrid solar (HS) scenario highlights the vast potential for shifting tube wells to solar technology, alleviating the burden on the country's energy sector while meeting agricultural energy needs. Adopting solar technology not only reduces energy shortages in the agriculture sector but also safeguards crops, prevents machinery failure due to frequent power outages, and contributes to achieving climate goals.

As Pakistan's economy is still in a developmental phase and heavily relies on fossil fuels, the importation of these fuels strains the nation's depleting foreign reserves. The agriculture sector, crucial for meeting the demands of a growing population, cannot sustainably grow with the dependency on costly fuels. Such dependency not only burdens the economy but also jeopardizes the entire sector, leading to potential food security issues.

To address these challenges, a transition towards renewable energy sources, particularly solar technology, is essential. This shift will not only reduce the economic burden but also contribute to a more sustainable and secure agriculture sector in Pakistan. The government and relevant stakeholders must prioritize renewable energy investments and policies that support the adoption of solar technology in the agriculture sector, ensuring long-term energy security and environmental sustainability while achieving climate goals.

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The experimental study of shape parameters of aggregate on hot mix asphalt

Muhammad Farid Ud Din Ahmad, Imran Hafeez, Muhammad Tausif
University of Engineering and Technology Taxila, Punjab, Pakistan

Abstract

In asphalt pavements, aggregate characteristics particularly shape parameters have a viable impact on the durability of the asphalt mixtures. To design more robust pavements that can endure the strains of traffic, environment, and ageing by having a better insight into the relationship between particulate shape and pavement reliability, this study focused on practically assessing the influence of aggregate shape parameters on the performance of hot mix asphalts. Three aggregate samples from Marghalla, Ubhan Shah and Sargodha have been taken and subjected to shape parameter determination and its influence, Marshall Stability and Flow test and wheel cracking tests to determine the impact of specific shape on long-term performance and effectiveness of asphalt pavements. The results demonstrate that the mix prepared from the spherical shape of aggregate from Marghalla shows higher rutting depth and marshal stability. The mix prepared from the spherical aggregate of Sargodha shows the highest marshal stability of 1165 Kg among the three samples but has the lowest rutting depth of 6.63mm. The mix prepared from the Spherical aggregate of Ubhan Shah indicated the lowest marshal stability, 6.67 mm rutting depth. This means that mix made from spherical aggregates are responsible for higher marshal stability and rutting depth in hot asphalt and improves the performance and durability as compared to the flat and elongated shape as in Sargodha and Ubhan Shah Asphalt aggregate.
Keywords: Pavement design, Stability, durability, Asphalt, Aggregate, Rutting

Introduction

Asphalt mixture, commonly used in road construction, consists of aggregate particles bound together by an asphalt binder. Aggregates are the second main component of material in Hot Mix Asphalt. They are defined as the components of a composite material used to resist compressive stresses. They play an important role in the performance of asphalt mixtures. For HMA, they make up about 90 to 95 per cent by weight and comprise 75 to 85 per cent of the volume. Therefore, knowledge of aggregate properties is crucial to designing high-quality HMA mixtures. Aggregate influence, to a great extent, the load transfer capability of pavements[1]. Hence, they must be thoroughly tested before being used for construction. Not only aggregates should be strong and durable, but they should also possess proper shape to make the pavement act monolithically[2]. The durability of the asphalt mixture is a crucial factor for ensuring its long-term performance and resistance to distresses such as cracking, rutting, and stability[3]. The shape parameters of aggregate particles play a significant role in determining the durability characteristics of the asphalt mixture[4]. The shape parameters of aggregates, including angularity, roundness, flatness and elongation and spherical can affect the internal structure and interlocking of the mixture. Angular and elongated particles tend to have higher internal voids, reducing the overall strength and increasing the likelihood of cracking[5]. On the other hand, more rounded particles can enhance the compactness and interlocking of the mixture, improving its durability[6]. Therefore, understanding the impact of shape parameters on the durability of asphalt mixtures is essential for optimizing aggregate properties and mixture design.

Methodology

The Experimental setup was performed in the Transportation Engineering laboratory of the University of Engineering and Technology Taxila. For the performance of test data collected from the three different

sources of aggregate. The following test was performed in the laboratory Flakiness test, Elongated test, Marshal Stability Test and wheel tracking test. This study centers on the utilization of the Wheel Tracking Test to assess the resistance of an asphalt mixture to rutting. This evaluation is conducted under conditions simulating high-temperature and simulated traffic loading scenarios. In the development of this assessment, we measure the rutting depth, which quantifies the extent of permanent deformation experienced by the mixture. Additionally, we record the number of wheel passes to account for cumulative loading, effectively replicating the impact of traffic over time. These quantitative measurements constitute crucial data points for evaluating the asphalt mixture's capacity to withstand deformation.

(a)   (b)   (c)

Figure 14: Wheel Tracking Test Samples a) Marghalla, b) Ubhan Shah and c) Sargodha

Marshall stability and Flow test was performed to determine the deformation resistance and breaking load of Asphalt mixtures which is called Durability of Asphalt Mixture. The material (Coarse aggregate) was mixed according to designed gradations, and the making of asphalt mixture and compaction was done at 180 ± 0.5 C temperature. For the Marshall Stability test, the prepared specimens were placed in a constant temperature water bath, reaching a prescribed temperature of 60 ± 1 C for an isothermal conditioning time of 30 min. The specimens were then placed in the Marshall Stability testing machine and loaded at a constant deformation of 50.8 mm/min until the maximum deformation. The results were recorded in Kg on the Marshall Testing Machine.
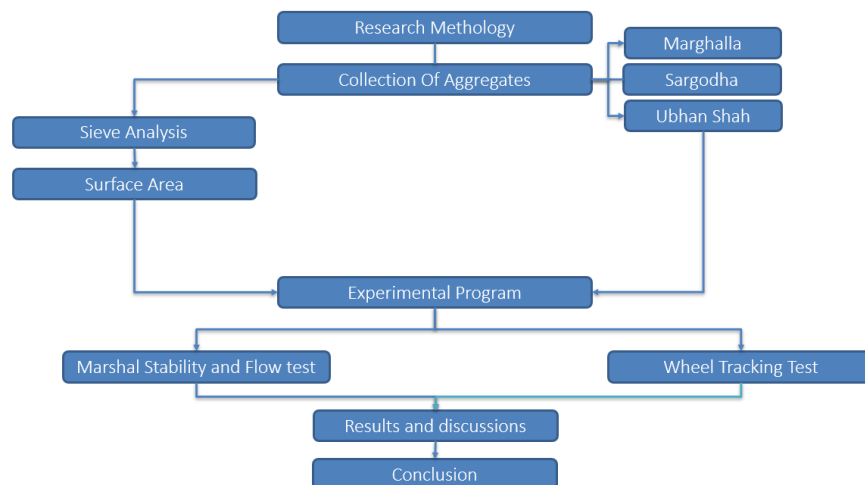

Figure 2: Methodology flowchart

Figure 2 describes the different steps of experimental results of the marshal stability and wheel cracking test.

Results

In this research study mix made from Spherical aggregate has the highest value of rutting depth (6.94mm). Mixes made from flat and elongated aggregates have the lowest values of rutting depth (6.65mm) as shown in Figure 3. Marshal Stability is highest for mixes made from spherical aggregates and then decreases until it reached to a lowest limit with mixes made from flat and elongated aggregates.
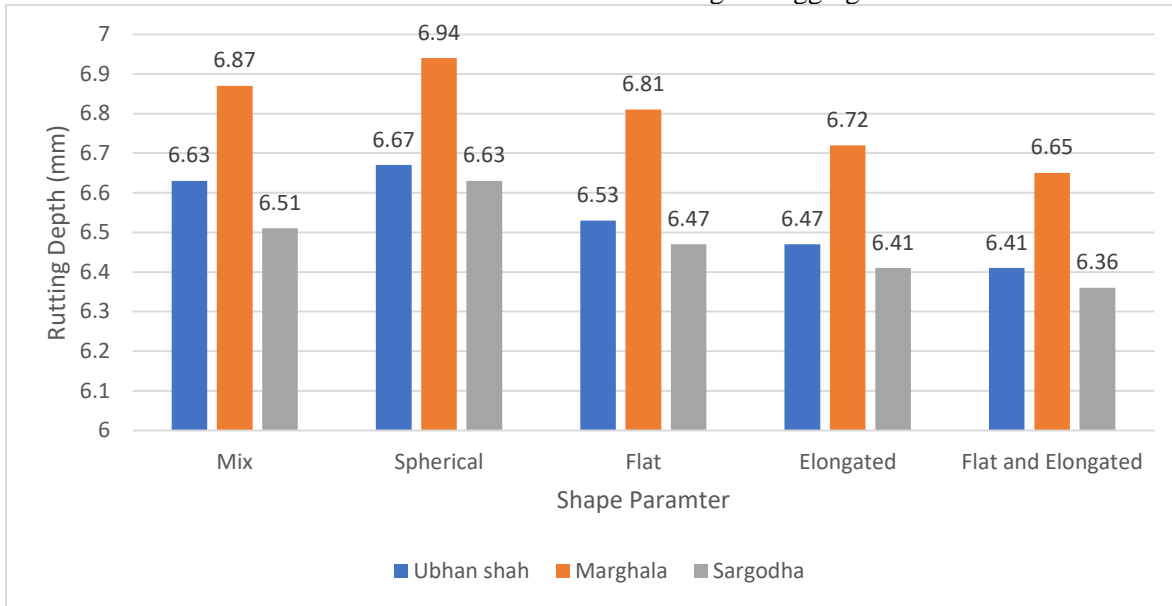

Figure 3: Different shapes of aggregate vs rutting depth

Marshal stability is a critical parameter in asphalt pavement design. Higher Marshal Stability values indicate better resistance to rutting and deformation, which is essential for the long-term durability of the pavement. Similar to the small surface area of the aggregate, it has greater marshal stability. And at a 50-degree temperature small size coarse aggregates have less rutting depth. Due to this, it has a greater stable hot mix design. Figure 4 reveals that the spherical shape of course aggregate in hot mix asphalt has maximum marshal stability which is 1165kg.
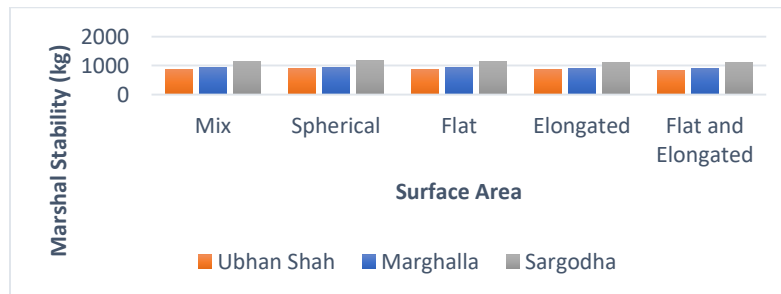

Figure 4: Shape Parameters and Surface Area vs. Marshal Stability

Conclusion

- The results show that aggregate shape has a major influence on the stability of hot-mix asphalt.
- It has been shown that shape parameters of aggregate have a major impact on the durability of aggregate. Mix made from the Spherical aggregate has a higher rutting depth due to the stability of hot mix asphalt increases.
- The spherical shape of aggregate has higher marshal stability values, due to marshal stability increases the durability and stability of hot mix asphalt.

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Microstructural and Compressive Strength Investigation of Sugar Cane Bagasse Ash as Partial Replacement of Cement in Concrete

Uzair Khan, Sayyam Khan, Syed M. Hamza Shah, Muhammad Anas
City University of Science and Information Technology Peshawar, Pakistan

Abstract

The cement industry, known for its substantial carbon emissions, produces approximately half a ton of carbon dioxide per ton of cement. Addressing this environmental concern involves advocating for the utilization of waste products as an alternative material to replace cement. This approach aims to enhance or maintain concrete properties without compromising the desired structural characteristics, offering a sustainable solution to mitigate environmental impact. Bagasse ash, a by-product of sugarcane burning, is proposed as a cement replacement due to its ability to increase early strength and decrease permeability, ultimately enhancing concrete strength and durability characteristics. In an experimental study assessing the compressive and microstructural properties of concrete at 28 and 56 days, it was observed that replacing cement with bagasse ash resulted in increased strength, particularly evident with a 10% replacement.
Keywords: Bagasse ash, concrete, compressive strength

Introduction

Concrete is the main preliminary item towards construction engineering because of its composite nature, strength, adoptability and longevity (P. Hosseini). Its production ranges from region to region but estimated in billions of cubic meter annually. Its main ingredients are cement, water and aggregates (Priya1, 2016). In concrete, cement plays a key role which binds aggregate together (Qing Xu, 2018). It is estimated that 4.1 billion tons of cement is producing yearly which produced 3.3 billion tons of carbon dioxide in the environment which leads to global warming (John Temitope Kolawole a, 2021). For the environmental impacts of cement many researchers works on a sustainable and eco-friendly building material to replace cement. Sugar cane bagasse ash is also one of them, bagasse ash is a waste by-product of sugar industry the fibrous left over and is burned at a high temperature. Pakistan is the 5th largest country in the world which produced 67 million tons of sugar cane in the 2021 by which extracted 17 million tons of bagasse ash (Afghan, 2005). Bagasse ash has emerged as a significant alternative to traditional cement in construction materials. With its pozzolanic properties and numerous benefits, bagasse ash offers a sustainable and eco-friendly solution for minimizing the effects of cement production on the environment according to the (Rukzon, 2012). The pozzolanic reaction of bagasse ash occurs when it reacts with calcium hydroxide in the presence of water, resulting in the formation of additional binding materials. These new cementitious compounds contribute to the strength and durability of concrete, making it suitable for various construction applications. By partially replacing cement with bagasse ash, the demand for cement is reduced, leading to energy savings and lower carbon emissions. Because there is a lot of energy consumed in the production of cement as well as emits high amount of carbon in atmosphere during production of cement. SiO_2, Al_2O_3, and Fe_2O_3 compounds make up the majority of SCBA's microstructure, and these substances can give SCBA pozzolanic characteristics according to research work of (Prabath, 2022). The incorporation of SCBA has emerged as a promising approach to enhance the characteristics of concrete. Priya and Ragupathy looked into sugarcane bagasse ash (SCBA) as a cement alternative in concrete. The results demonstrated that the concrete with SCBA had good compaction factor values and appropriate workability when compared to the reference concrete. (K.L.Priya, 2019). Ramesh and Kishore Kiran et al, 2022. Looked

on the SCBA impact as cement substitute concrete. In their trial, cement was used in place of 5 to 25% SCBA. According to the authors, 5% is the ideal substitute. On the other hand, the compressive strength of concrete employing SCBA was examined in Modani and Vyawahare's study, where 5 to 30% of the SCBA was replaced with cement. The authors came to the conclusion that for good compressive strength, only a 10% substitution was required. (Vyawahare, 2013).

Experimental Study

SCBA materials collected from Khazana Sugar Mill Peshawar. It is collected from the process of uncontrolled environment with no limited range for the burning process. These SCBA materials take for grinding process to PCSIR Laboratory Peshawar. It has been grinded for 24 hours for which it can been passed by 100% and are converted to fully powder form. Cement and aggregates were supplied by local supplier which are nearer. By measuring the cement's fineness in accordance with ASTM C184, we discovered that it was new and high-quality. Tape water was utilized in this research project's mixing and curing processes. In the current work, fine aggregate was created using river sand that had been held on a 600-m sieve after passing through a 4.75-mm sieve. There are no biological contaminants, clay, or silt in the sand. The sieve analysis was done according to ASTM C 136. The aggregate's physical properties, including its fineness modulus and specific gravity, were examined in accordance with ASTM C 33 and ASTM C 128. The specified ranges for the finess modulus of fine aggregates is 2.6, and specific gravity is 2.7. Coarse aggregate is an essential component of concrete as it provides strength and stability to mixture. The aggregate's physical specifications, including its fineness modulus and specific gravity, were tested according to ASTM C 33 and ASTM C 128 respectively. The specified ranges for the finess modulus of coarse aggregates and specific gravity are 2.4 and 7.2 respectively. (Moeini) Reports that cementitious material is the binding agent that produces CSH gel after reaction with water. (Dhengare) Support the fact that sugarcane bagasse ash can be partially replaced with cementitious material and the behavior changes can be obtained in this research work. Sugarcane bagasse ash is tested along with cementitious material by varying its proportion by 5%, 10% and 15%. A consistency test was done to all the variations of proportions following the same procedure for cement. The consistency test shows similar results for all variations in sugarcane bagasse ash proportions with cementitious materials. The initial and final setting times of the mixes were found, the time for initial setting increases with increase in the proportion of ash, also the final setting time is increasing with a higher proportion of replacement. The value for UPV are 4.5 or greater will be excellent. The value ranges from 3.5 to 4.5 is good and 3 to 3.5 is fair for concrete. Here the value of UPV result got for controlled cement is 4.67 which is excellent and for 10% replacement of SCBA is also nearer to the excellent zone but at 5% and 15% replacement are in the good zone and almost the same value for UPV. These results are similar to the research work of (Prasanna K. Acharya, 2015) in which soundness remains consistent to different replacement of cement in concrete.

A chemical test was repeated on the concrete mixture of SCBA and cement analysis carried out by the x-ray fluorescence (XRF) analysis. All the results are given in Table 1. The amount of Silicon dioxide are increased by increasing the SCBA amount which is a strong binding element. Also, if SiO_2 will increase with the increase of SCBA amount so automatically pozzolanic nature will be strong as according to "ASTM C 618". And this is the reason for which 10% of SCBA replacement show the efficiency as required. At this stage strength get started degradation from the path. So, these results are similar to the research work of (Pooja Jha, 2021)

Table 21 Comparison between elemental composition of SCBA with controlled cement paste

Elements	C.C.	5%	10%	15%
CaO	69.42	62.85	61.98	61.42
SiO2	20.62	25.41	26.078	26.58
Fe2O3	4.25	4.70	4.85	4.83
SO3	3.36	3.31	3.13	3.08

K2O	1.63	2.064	2.41	2.59
MnO	0.46	0.57	0.726	0.729
TiO2	0.092	0.491	0.496	0.499
SrO	0.08	0.086	0.086	0.085
CuO	0.025	0.026	0.030	0.028
V2O5	0.021	0.022	0.027	0.026
ZrO2	0.019	0.020	0.020	0.021
ZnO	0.012	0.017	0.014	0.013

Figure 1 presents the X-ray diffraction pattern (XRD) of the concrete mixture of SCBA and cement analysis. The X-ray diffraction (XRD) in ORIGIN software were used to identify the crystallographic phases in SCBA. According to the XRD results shown in Figure, quartz and crystabolite are present at diffraction angle (2°). The XRD pattern with prominent peaks revealed the existence of a larger concentration of silica in the form of quartz. The peak's strength, however, is inversely related to the mineral component that gave rise to it. The crystals in the SCBA that reflect less energy than quartz are identified by their low peaks. The results are similar to the research work of (Shazim Ali Memon 1, 2022).
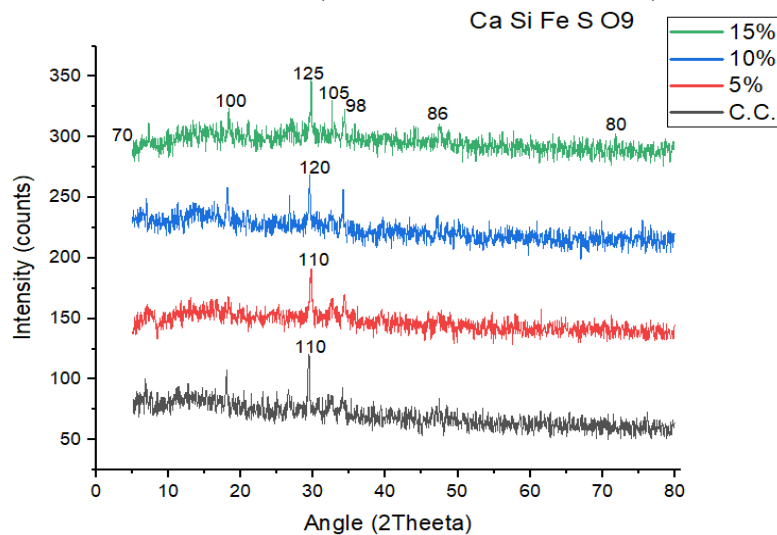

Figure 15 Comparison of XRD at different % replacement in concrete

Figure 2 shows the microscopic images of the concrete mixture of SCBA and cement analysis. The comparative SEM analysis report of all three mixes in comparison to the control mix is shown in Figures. The particles in the control mix are elongated in form. The bonds between the materials are stronger. When mixed with 5%, it is clear that the materials are not comparably securely bound and that the particles are elongated. The 10% mixture demonstrates that the components are similarly bound to 0% and that the particles are angular in shape. The 15% mixture demonstrates the irregular form of the particles. The 5% and 10% mixtures are the two that are closest to the control mix among the four types of combinations in terms of bond strength. These results are similar to the research work of (Dineshkumar, Behavior of high-strength concrete with sugarcane bagasse ash , 2021)
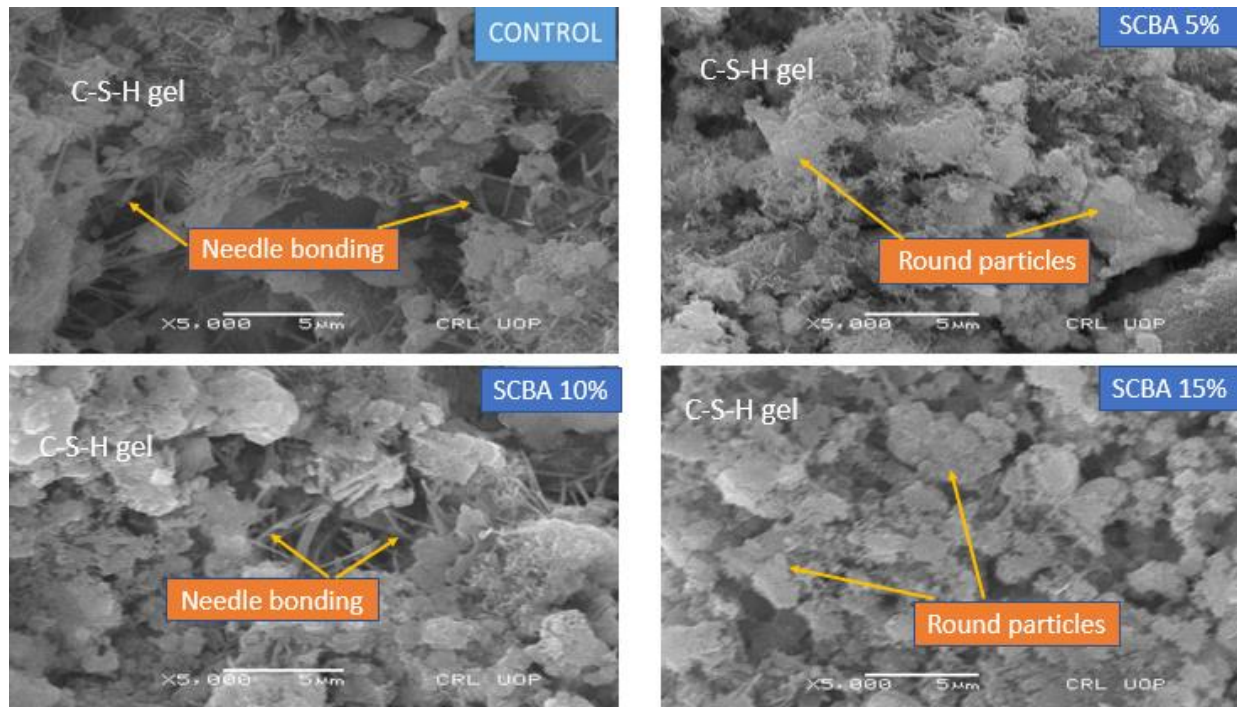
Figure 16 Comparison of SEM at different % replacement in concrete

The compressive strength tests which were conducted after 28 days curing, have appreciably good results for the SCBA used samples. Figure 3 shows that the strength is increasing with increase in the SCBA proportion up to some extent. After the optimum amount of SCBA which is 10% (concluded at the 28 days' strength), further increase, decreases the strength of concrete. At 28 days curing we see that the SCBA used samples left the control concrete behind in the strength, from which we conclude that the initial strength of samples was speed up by the SCBA, because the strength at 28 days curing required is 80% which is 2300+-100, but of the 10% SCBA proportions given the strength above 2400psi. When we increase the SCBA from 10% to 15% the strength is decreased. It gives high strength in controlled cement but loose strength at 5% and15% replacement. Since the SCBA is tending to acidity, therefore its increasing in concrete can affect the strength. It gives high strength at 10% replacement because it an ideal case by which make elemental pairs and make a tough strong bond between the particles which we called the C-S-H gel.

The results of samples at 56 days of curing period are shown in Figure 4. From these experimental values and keep the values at 28 days in mind, we can conclude that as we increase the percentage of SCBA from 5% to 10%, it increases the strength, but as it increases further, it affects the strength of concrete and reduce the final strength of concrete. The assessment at different curing ages is necessary because the 5% SCBA given a strength of 1870 PSI at 28 days which is a good result, but at 56 days curing it is given strength of 2050 which is the required strength.
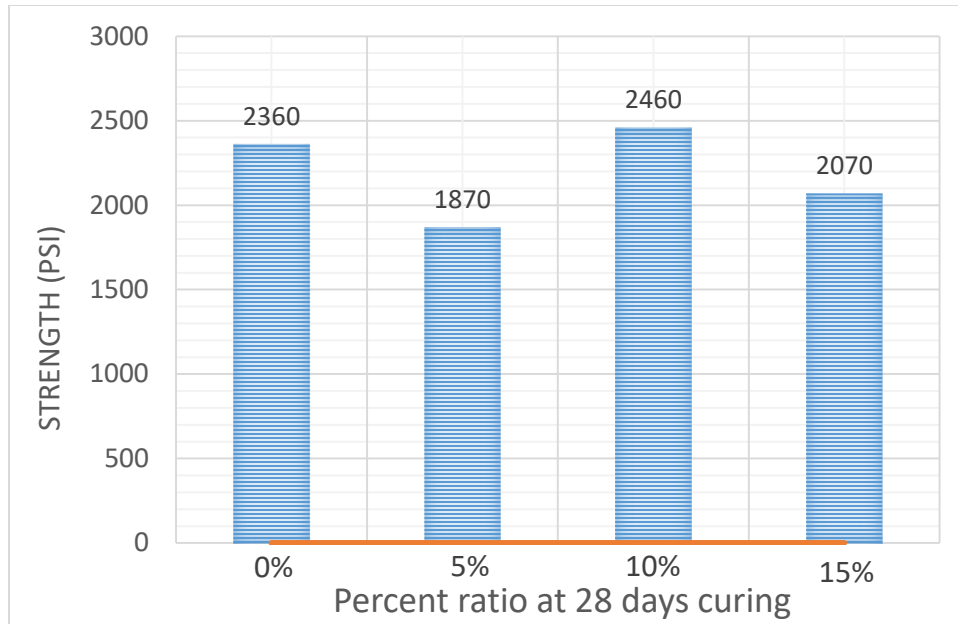
Figure 17 Compressive strength at 28 days curing for different proportions of SCBA
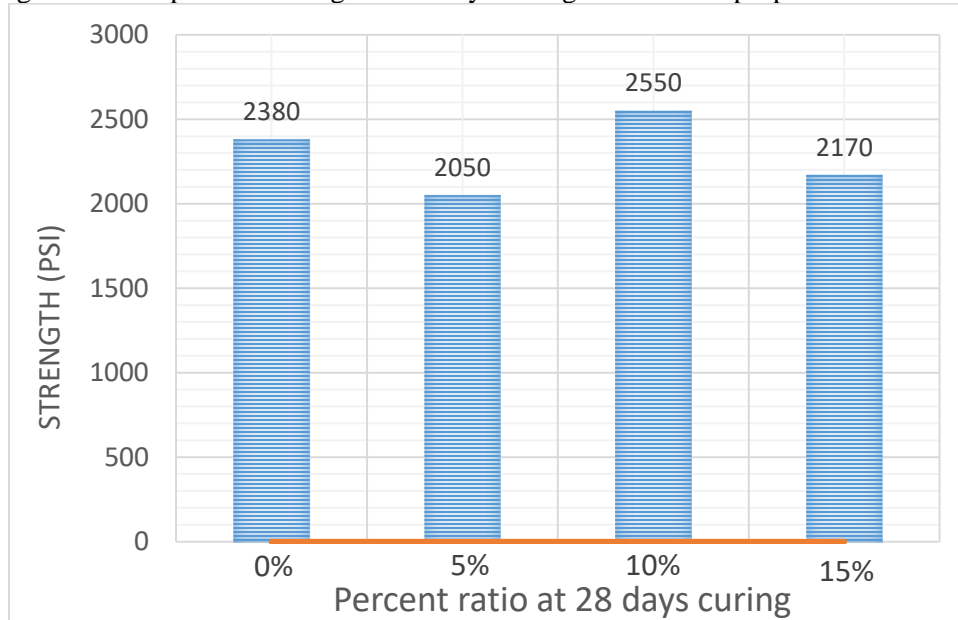
Figure 18 Compressive strength at 56 days curing for different proportions of SCBA

Compressive Strength: Generally, concrete cured for 56 days will exhibit a higher compressive strength than concrete cured for 28 days. The exact difference in strength will depend on various factors, including the concrete mix design, environmental conditions, and the quality of curing provided during the two periods. Here at controlled cement the strength are almost same for 28 and 56 days curing condition but at the replacement of SCBA in cement it changes the strength according to curing age. The results we collected are similar to research work of (Akber, 2022).
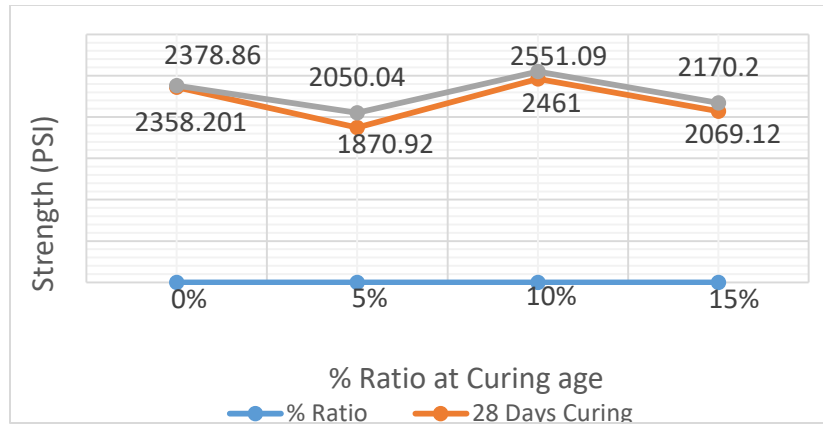
Figure 19 Comparing strength between 28 and 56 days after curing

Conclusions

- The consistency analysis yields comparable results while Initial and Final setting time are increasing with increase of SCBA replacement. By adding SCBA, UPV gives good results.

- Optimum level of SCBA replacement suggested 10% because it gives 5% increase compared to control.

- SCBA at 10% replacement level maximum compressive strength increase 4% after 28 days while increase 7% after 56 days.

- Internal properties shows that the crystal are present in both mixes but amorphous in nature.

- If the percentage of SCBA increase it increase the unhydrated particles.

- The bond between cement and SCBA is same for 10% to the control sample.

- Replacing 10% of cement with SCBA results in significant benefits. CO2 emissions reduces up to 10% of tons.

Recommendations

- This research suggests that a 10% SCBA content offers favorable results, it is advisable to industries that use 10% of SCBA in cement for the mitigation of environmental impacts and for the cost-effectiveness. This will provide a more refined guideline for incorporating SCBA as a partial substitute for cement in concrete construction.

- Many studies have been conducted on the properties of SCBA for improving strength, permeability, and consistency of concrete. However, further research on the long-term durability of concrete incorporated with ash is necessary.

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Khan Model of Management – A Quantifiable Approach

Nawar Khan

Faculty of Management Sciences, Riphah International University, Islamabad

email: nawar.khan@riphah.edu.pk

Abstract

A common perception about management is that; it is mostly abstract, theoretical, and conceptual textual in nature, hence measured qualitatively. However, this newly developed 'Khan Model' present a quantifiable version of applied management and its outcomes. A logical, viable and outcomes-based model is the need of the hour for performance assessment and appraisal of both managers and business computation rather than the qualitative-based approaches. The objective of this research is to move forward from a theoretical-based approach of management to a viable, quantifiable and practical-based approach to management. The Research Methodology used in the present research is Exploratory and Qualitative in nature. The result of this research study is the development of quantifiable management model. This research presents a holistic and progressive development of management scenario, thus concluding on the benchmark performance assessment of management of businesses. The design and development of the **Khan Model of Management** is the most innovative, quantifiable and viable management practical model as compared to the past perception that management is only theoretical or conceptual based. It is always preferred to have a quantitative or numeric result rather than an adjective qualitative statement. The best performance of managers can lead businesses to the most effective and efficient system of performance which require quantifiable assessment. The two main characteristics of managers can lead to the highest productivity, thus lowering rejection and rework in production and provision. Such progression can lead to the best business performance. The best performance of any business is a hallmark of managers' achievement for which they are held responsible and rewarded.

Keywords: Management, Theoretical approaches to management, Quantifiable approach to management, Khan Model of Management.

Introduction and Background of Management

Management is a combination of science and art. Science is common to all using logic but the Art (style) part varies from individual to individual. It exhibits the individual manager skills. Management represents all actions taken on a system of an enterprise under the vision, mission, policy, and objectives. Then implement them by incorporating strategy, tactics, plan, control, and assurance guidance within the systems of a business company **(Knootz and Weihrich, 1988).** Every manager performs these actions through basic five managerial functions of planning, organizing, staffing, leading, and controlling. Management is also called the application of common sense but mostly proposed that it is uncommon. The manager's job is to design, maintain and improve the working environment and system of a company where workers works in groups to accomplish the selected aim / goal. The task of improvement in a system is through review, audit, and maintenance to change the status-Quo. In reality, managers work on the design, maintenance and improvement of a system of a company and workers work in the system. The bigger question is 'what is a system' on which managers work?

A company system is a combination of 3 main elements like; Technology, Human Resources, Protocols (rules, regulation, and documentation) etc. These elements of a system work together in proper harmony, for efficient transformation / conversion of raw materials (inputs) into products / services (outputs) of a company (system of company like; WAPDA, PIA, and Railway of Pakistan) as shown in   **Figure 1.**
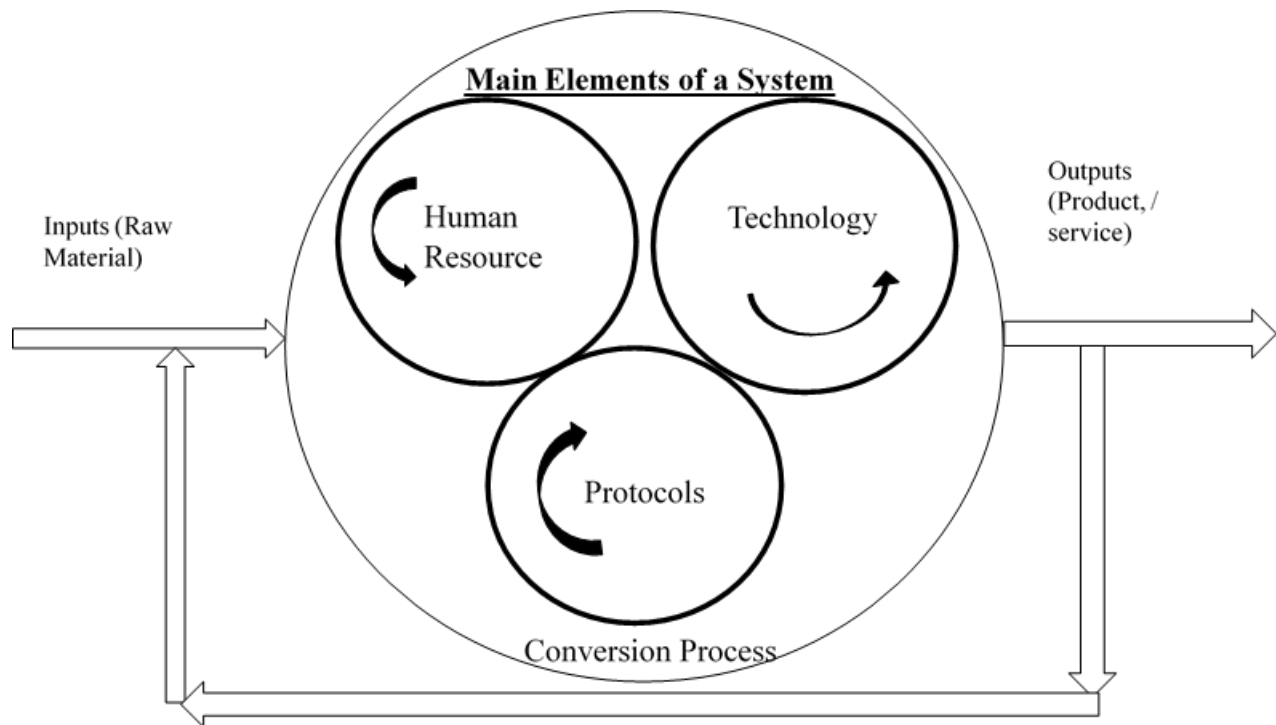
Figure 1: Elements of a System in a company where managers work

Purpose / Objectives of the Research Study: The purpose of this research study is to develop a quantifiable and measurable outcomes-based management model.

Need for Research Study: A logical, quantifiable and viable managerial outcomes-based model is the need of the hour for performance measurement, / assessment, and outcome appraisal rather than the past and existing theoretical, subjective and qualitative-based management approaches.

Research Methodology: Descriptive **/** Exploratory / qualitative research approaches are followed in this research study.

Literature Review

Principles of Management and its Synthesis: The modern management practices are limited to company's' business in bounded walls. Even most of these practices falls short of quantification. Most of these man-made management principles (Henri Fayol; F. W. Taylor; Peter F. Drucker; Henry Mintzberg; Mary Parker Pollete; Robins, et al,. and Weihrich, et al,.) are based on qualitative adjective outcomes like good, better, and best or bad, worse and worst (Koontz and Weihrich, 1988). The principles of management of some best-known management gurus are synthesized as shown in **Annex A**.

The Basic Managerial Functions: Following are the basic managerial functions supported by most of the management experts of a schools of thought (Knootz and Weihrich, 1988).

- Planning – thinking before doing / taking any action

- Organizing – dividing main functions into sub and sub-functions for allocation

- Staffing – the right person for the right job

- Leading – include command, coordination, communication, motivation and inspiration through vision, actions, strategy, guidance and coaching, and resources provision)

- Controlling – to bring deviations / variation back to / within permissible / control limits of the plan

Applicability of Management: Management is generic and is applicable to;
- All types of businesses (for-profit and not-for-profit)

- All types of industries of the primary (natural production), secondary (manufacturing) and tertiary (services) nature

- All business functions (Human Resources, Marketing, Finance, Production, Sales, Purchase, Health care, Legal etc.,

- All levels of hierarchy – top, middle and lower echelon

  - All types of industries of the primary, secondary and tertiary nature are linked together in a cascaded form and work in tandem as shown in **Figure 2.**
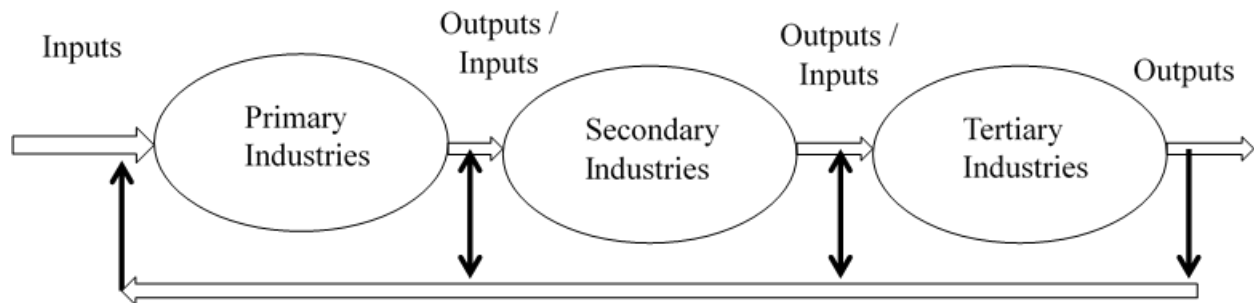
Figure 2: Types and Integration of Industries

Major types of primary, secondary and tertiary industries where managers work is shown in   **Table 1** (Groover, 1996).

Table 1: Major Types of Industries.

Types of Primary Industries	Types of Secondary industry		Types of Tertiary Industry
• Agriculture	• Aerospace	• Food processing	• Banking
• Forestry	• Apparel	• Glass, ceramics	• Communications
• Fishing	• Automotive	• Heavy machinery	• Education

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• Livestock • Quarries • Mining • petroleum	• Basic metals • Beverages • Building materials • Chemicals • Computers • Construction • Consumers Appliances • Electronics • Equipment • Fabricated metals	• Paper • Petroleum refining • Pharmaceuticals • Plastics (shaping) • Power utilization • Publishing • Textiles • Tire and rubber • Wood and furniture	• Entertainment • Financial services • Government • Health and medical • Hotel • Information • Insurance • Legal • Real state • Repair and maintenance • Restaurant • Retail trade • Tourism • Transportation • Wholesale trade

Major Functions of a Business Where Managers Work: Followings are the major functions of a business where managers work by applying his / her managerial skills of planning, organization, staffing, leading, and controlling (Koontz and Weihrich, 1988);

• Marketing (advertisement, R&D, business intelligence), Human resource Management, Finance (finance-revenue/budget; accounting- ledger keeping), Production/operation, Sale/purchase, Legal, Health care etc.

Managerial Level, Scope, and Time Span for Decision-Making at Different Levels of the Hierarchy
The top, middle and lower-level management hierarchy is shown in Figure 3a, b and c. **Strength scope** (number of HR) at top is less, then increases at middle and become maximum at bottom. Also, top management work at a strategic level (larger **work scope**), middle management work at the tactical level (medium work scope) and lower management work at the operational level (smaller work scope). In addition, the planning time span (**time scope**) is bigger at strategic levels 3-5 years, reduces to 2-3 years at the tactical level, and further reduces to 1-2 years at the operational level. However, the managerial functions remain the same (planning, organizing, staffing, leading and controlling) for all levels but the

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strength, work and planning scope varies as it moves from top-level management to lower-level management. **Figures 3, 4 and 5** show these views and perspectives diagrammatically.
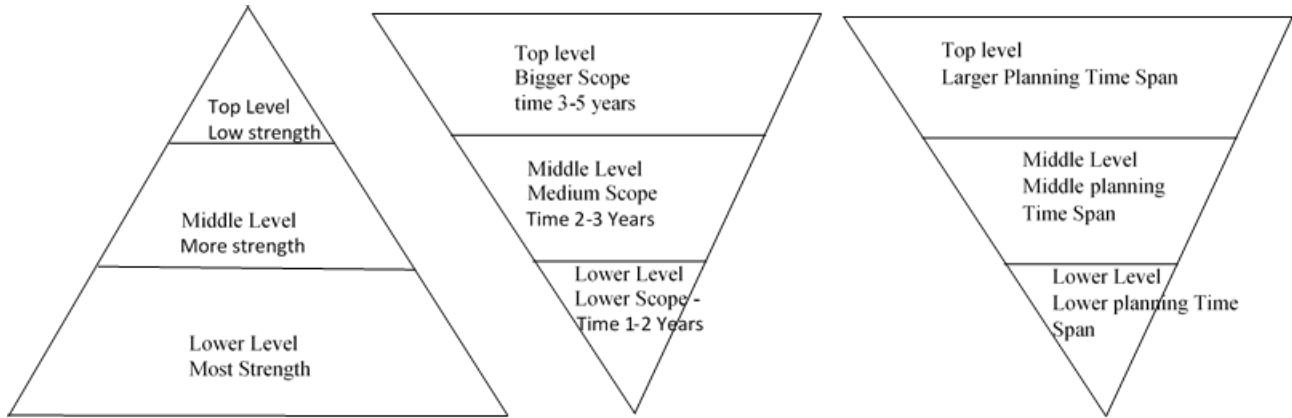

Figure 3: Managerial Hieratical strength scope, work scope and planning time scope
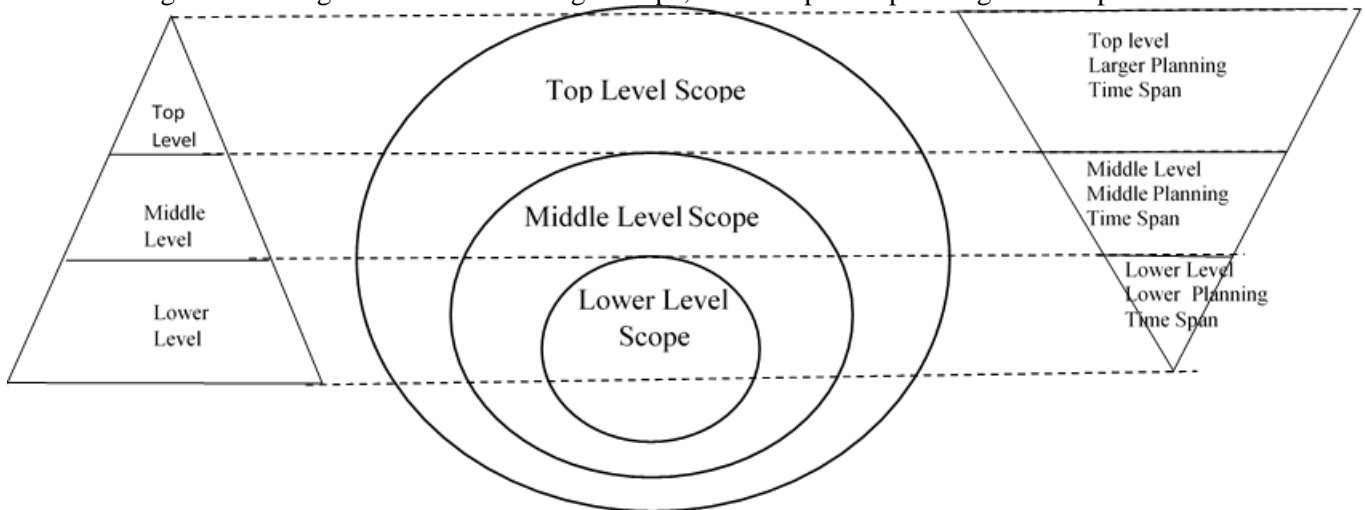
Figure 4: Another Perspective of Managerial Hieratical strength scope, work scope and planning time scope
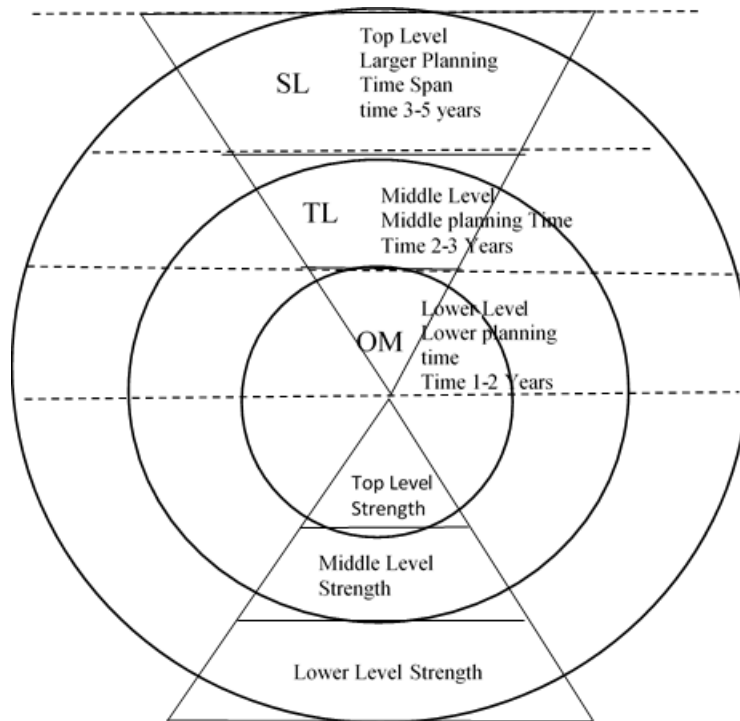
Figure 5: Yet another Perspective of Managerial strength scope, work scope and planning time scope

Quantifiable Outcomes Based Managerial Actions - An Innovative Research Approach:

Qualitatively, management outcomes can be measured / assessed in adjective form like; good, better, best or bad, worse and worst etc. This is a subjective statement and suffer from personal and group judgmental biases as well. Followings are the major quantifiable managerial outcomes which are need of the hour to measure / assess it quantitatively for the performance of managers and company' outcomes.

1. **Best Management:** Best management mean following and executing the basic managerial functions of planning, organization, staffing, leading, and controlling in the most befitting / judicial manner without any bounds, obligation and biases. The prominent characteristics of the best management come out in the form of **effectiveness and efficiency** discussed as follows.

   a) **Effectiveness:** To achieve the selected aim / goal / objective that is set for assessment / measurement of company and managers performance / achievement. measurement targets are set for a period of time. Missing the target or objective by any account is a loss which should be reviewed and revised. Effectiveness can be measured in number or percentage etc. For Example, a student who scores 80 marks out of 100. It is 80% effectiveness but loss the target or goal by 20%. Also, if target or objective are quantifiable in numbers so the achievement can be easily counted like achieved objectives are 7 but missed target are 3.

   b) **Efficiency:** Using the least amount of resources to get the maximum outcomes is the measure of efficiency. It is can be measured in percentages like; the efficiency of an automobile engine is

measured as 30 – 40 % age. This means the engine converts only 30 to 40% of the fuel energy used into mechanical energy to propel the vehicle. It is quantifiably formulated as;

$$\text{Efficiency} = \text{total outputs} / \text{total inputs} \times 100 = ? \text{ outcomes\%*}$$

*Outcomes measures both quantity and quality but it is not time-limited.

Note: Effectiveness comes first to be considered and efficiency follows. This means one should not miss the goal/objective irrespective of efficiency. Efficiency come later when the learning optimizes, the efficiency increases as evident from a learning curve.

2. **Productivity:** It is the combined outcome of both effectiveness and efficiency. Quantifiably, it can be measured / assessed by the equation as;

$$\text{Productivity} *= \frac{Output}{Input}$$

* Productivity uses time base but has no compromise on quality and quantity

Productivity = total outputs / total inputs x 100 = ? outcomes*

*Outcome means both quality and quantity but in the case of productivity, the important innovative measurable aspect is **time.** Quality is common to both effectiveness and efficiency assessment except time. Also, it is measured in unit / unit to identify the nature of inputs and outcomes and, like AC produced / HR of a company. Also, common measuring units cannot be cancelled like RS / RS.

a) **Types of Productivity:** There are two main types of productivity which are measured in unit / units;

- **Total Productivity** is formulated as; **Total Outputs / Total Inputs. e**g total air conditions produced in a factory divided by total inputs (human resource +machinery +utility bills+ raw material).

- **Partial Productivity** is formulated as **Total Outputs / Partial Inputs**, e.g., total air conditions produced in a factory / only human resources as the input used. It is also called

$$\text{Multi Factors Productivity} = \frac{\text{Total Ouput}}{\text{Labour} + \text{Material} + \text{Energy} + \text{capital} + \text{Misc Items.}.}$$

$$\text{Units produced} \qquad = 1000$$

$$\text{Labour hours used} \qquad = 250$$

$$\text{Partial Productivity} = \frac{\text{Total Units Produced}}{\text{Labor Hours Used}}$$

Which is equal to 1000/250 = 4 units per labour hour (total output per person in time domain)

b) **Productivity Measures**

It has been defined by different organizations from different perspective. International Labor Organization (ILO) defines productivity as the ratio between output of wealth and the input of resources used in the process of production (Prokopenko, 1987).

A productivity ratio may be computed for a single operation, a department, a facility, an organization, or even an entire country. Productivity increases when an enterprise:

- Become more efficient; output increases with no increase in input.

- Downsize: output remains the same and input is decreased.

- Expand: both output and input grow with output growing more rapidly.

- Retrench: both output and input decrease, with input decreasing faster, or

- Achieve breakthroughs: output increases while input decreases.

c) **Benefits of Higher Productivity**

Higher productivity triggers a positive chain reaction. Negative productivity put industries and societies into a vicious trap circle. Some major benefits of higher productivity are noted here in Table 2.

Table 2. Some Major Benefits of Enhanced Productivity

- Lower cost of production - Cheaper pricing of goods in the market (reduced inflation) - Better quality of goods and services - More buyers of goods - Greater profit - Better wages, bonus and working conditions - Business expansion - Investment in technology - More employment	- More advancement opportunities Business diversification - Economies of a scales - Greater government revenue (GDP) - More income - Better social services - Better infrastructures for industry and commerce - More foreign investment - Higher standard of living - Higher economic growth

A few major productivity indices related to different fields of applicability is shown in Table 3. Detailed Productivity measures of these field is shown in **Annex B** (Groover, 2004)**.**

Table 3. Only a Sample List of Some Major Productivity Indices

S No.	Productivity Indices
1	National productivity
2	Value Addition Productivity
3	Profitability Productivity
4	Resources Productivity
5	Human Resource / Labor Productivity
6	Capital Productivity
7	Working Capital Productivity
8	Inventory Productivity
9	Cost Productivity
10	Foreign Exchange Productivity
11	Energy Productivity
12	Raw Material Productivity

3. Applicability of Productivity

Productivity is applicable in all types of primary, secondary and tertiary industry and social life. a Primary industry are those that cultivate and exploit natural resources (Groover, 2004). Secondary industry takes the outputs of primary industries and converts them into consumer and capital goods. Manufacturing is the principal activity in this category. Tertiary industries constitute the service sector of the economy. However, in literature, discussion is mostly focused on manufacturing productivity rather than natural resources and services productivity.

a) **Lowest Rejection and Reworks:** There are many advantages of best management in the form of highest effectiveness and efficiency. These two characteristics of management as 'Effectiveness, and Efficiency lead to highest Productivity' which mean;

- Lowest rejection rate*
- Least rework
- Least waste
- Highest outcomes and reduced fixed cost

- highest market shares – attracting a greater number of customers in a market as compare to other similar businesses

*Rejection can be measured in numbers or even in percentages, e.g 3 out of 10 rejection mean 30 % loss

b) **Highest Gain:** Less rejection and rework have many advantages as; highest financial gain, more prosperity, open new business / project avenues and enhanced survivability. It is measured in more numbers of customers or %age of the total customers like 60% of the customers linked to a business company as loyal customers.

c) **Competitive Business Position:** Strong business position in the country and abroad is attributed to the best management practices based on technical, managerial, quality, timelines, economic and reputation etc. Attaining this position is the outcome of the best management following the **Khan's Model of Quantifiable Managemen**t as shown in **Figure 6.** This model shows one of the most innovative and practical examples for the present-day management' measurement / assessment. This approach of quantification is applicable in modern business management (Nawar, 2023). TQM award model around the world (like DP, EQA, MBNQA, UK, PNQA awards etc) are awarded to the best performers where every assessment has a robust quantifiable measuring system. Such a system can be a best approach for the assessment of the best among all businesses of a country. Indices can be developed for it after due consideration. The top award or trophy based on best management practices can be given to the businesses which score highest on a quantifiable scale (nawar, 2008).
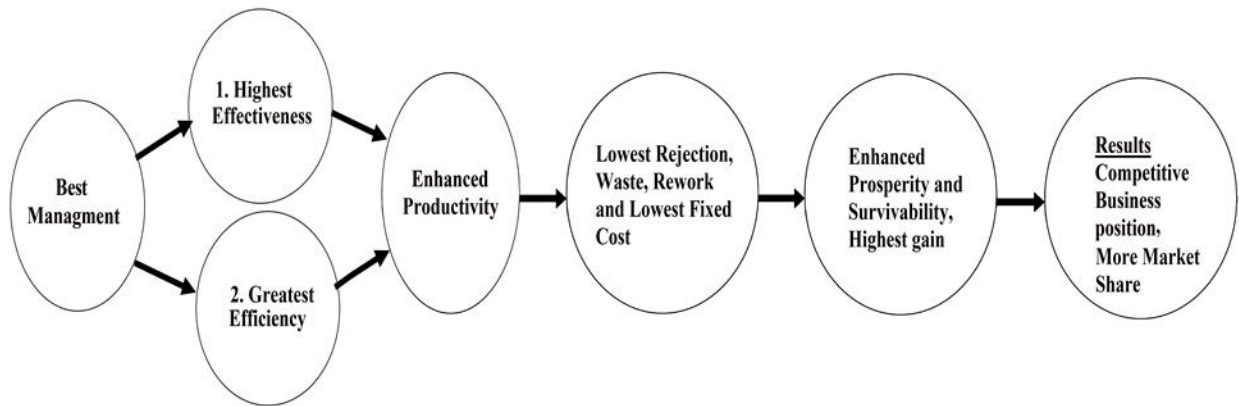
Figure 6: Khan Model of Modern Business Management Process and its Outcomes (nawar, 2023)

Results and Discussions

Competitive Business Position is the outcome or ultimate result / achieved through; best management performance of planning, organizing, staffing, leading and controlling. Highest effectiveness and greatest efficiency are the two major characteristics of such management. Lowest rejection, waste, rework and fixed cost per production unit etc normally result into highest gain, more prosperity, greater market share, and

strongest chances of survivability etc. Thus, opening new programs, new businesses avenues and new projects are undertaken. This positive vicious circle shall lead to a win–win situation for all the stakeholders. Competitiveness is a relative earned position; like the CGPA of a student in a degree program. A student getting a 3.77 CGPA out of 4 is more competitive than a student scoring 3.88 out of 4; a relatively better academic position – mean eligible for gold medal than getting bronze or silver medal for lower position. Like other competition, based on competitive score, the TQM award model around the world is given to the benchmark performance businesses in USA, EQA, UK etc.

Conclusion: A logical, quantifiable and viable managerial outcomes-based model was the need of the hour for performance appraisal rather than existing theoretical, and qualitative-based management approaches.

It can be said that the development of **Khan Model of Quantifiable Management** is the need of the hour and best suits for result-oriented managerial assessment. It is an innovative management model and shall bring a quantum / paradigm shift in the history and practices of management, which is mostly conceptual and theoretical based. Judgmental biases of individuals and groups are eliminated by presenting quantifiable outcomes in different forms on a computing machine becomes easy.

Innovation/originality: The design and development of the **Khan Model of Management** is the most innovative, quantifiable and viable management practical model as compared to the past perception that management is only theoretical or conceptual based. It is always preferred to have a quantitative or numeric result rather than an adjective qualitative statement.

Aim/objective: The aim was to design and develop a viable and quantifiable outcomes-based management model and to move forward from a theoretical approach to management to a viable, quantifiable and practical approach in management.

Research methodology: Exploratory and Qualitative research approach was followed.

Finding/Result: This research study designed and developed an innovative, quantifiable and viable Khan model of management compared to mostly theoretical-based concepts and models in management sciences.

Implications: The world is moving forward from theoretical and conceptual-based management approaches to factual-based approaches in the field of management for quantifiable assessment / measuring managerial performance.

All the management gurus and practitioners are required to develop quantifiable scales and select frequencies for performance assessment / measurement of all managerial work following the Khan model of management.

Recommendations: Government, Organizations, and Research Scholars are highly recommended to adopt the innovative and quantifiable outcomes-based **Khan Model of Management** and practice it. Further refinement of this model can get it more useful for future uses.

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Annex A.

Principles of Management of Different Management Gurus

S. No	Henri Fayol	Henry Mintzberg	Fredrick Winslow Taylor	Max Weber	Robert S. Kaplan	William Ouchi	Peter Ducker	Mary Parker
1	Division of Work	Liaison	Replace working by quote rule of thumb	Principle of Authority Hierarchy	Translate the strategy to operational terms	Collective decision-making	Sets objectives	Principle of Early Stage
2	Authority & Responsibility	Disseminator	match workers to their jobs	Principle of Formal Rules and Regulations	Align the organization to the strategy	Long-term employment	Organizes	Principle of Direct Contact
3	Discipline	Monitor	Monitor worker performance	Principle of Division of Labor (Specializations)	Make a strategy for everyone's everyday job	Job rotation	Motivates and communicates.	Principle of Reciprocal Relations
4	Unity of Command	Spokesperson	Allocate the work between managers and workers	Principle of Impersonality	Make strategy a continual process	Slow promotion	Measures.	Principle of Continuity
5	Unity of Direction	Entrepreneur		Principle of Career Orientation	Mobilize change through strong, effective leadership.	Focus on training	Develops people.	
6	Subordination of Individual Interest	Disturbance Handler		Principle of Formal Selection Process		Care for personal circumstances		
7	Remuneration	Figurehead				Formalized measures		
8	Centralization	Leader				Individual responsibility		
9	Scalar Chain	Resource Allocator						
10	Order	Negotiator						
11	Equity							
12	Stability							
13	Initiative							
14	Esprit De Corps							

A Few Major Productivity Improvement Indices

1. **National productivity**

$$\text{National Productivity} = \frac{\text{GNP}}{\text{Population}}$$

2. **Value Addition Productivity**

a. $\text{value addition per employee} = \dfrac{\text{value added}}{\text{PopulatioTotal number of employees}}$

b. $\text{Total value addition} = \dfrac{\text{value added}}{\text{Labour+Capital inputs}}$

c. $\text{value addition per workhours} = \dfrac{\text{Value added}}{\text{Total work-hours worked}}$

d. $\text{value addition per worker} = \dfrac{\text{value added}}{\text{Number of workers}}$

e. $\text{value addition per dollar salary /wage} = \dfrac{\text{value added}}{\text{salaries and wages}}$

f. $\text{value addition per asset} = \dfrac{\text{value added}}{\text{tengible and intengible assets}}$

g. $\text{value addition per capital} = \dfrac{\text{value added}}{\text{Tangible and financial capital}}$

h. $\text{value addition per tangible asset} = \dfrac{\text{value added}}{\text{Tangible asset}}$

i. $\text{value addition per fixed asset} = \dfrac{\text{value added}}{\text{fixed assets}}$

j. $\text{value addition per machinery / euipment} = \dfrac{\text{value added}}{\text{machinery and equipment}}$

k. $\text{value addition per direct worker} = \dfrac{\text{value added}}{\text{Number of direct workers}}$

l. $\text{value addition per indirect worker} = \dfrac{\text{value added}}{\text{Number of indirect workers}}$

m. $\text{value addition per woker's shift} = \dfrac{\text{value added}}{\text{No of hours worked on first shift}}$

n. $\text{value addition per funtional area} = \dfrac{\text{value added}}{\text{salaries / wages of production department}}$

o. value addition per securities $= \dfrac{\text{value added}}{\text{marketable securities}}$

p. value addition per accoutns receivable $= \dfrac{\text{value added}}{\text{accounts receivable}}$

q. value addition per inventory $= \dfrac{\text{value added}}{\text{inventories}}$

3. Profitability Productivity

    a.   Primary profitability ratios

        a. $\dfrac{\text{Net profit}}{\text{Net sales}}$

        b. $\dfrac{\text{Cost of goods}}{\text{Net sales}}$

        c. $\dfrac{\text{Operating expenses}}{\text{Net sales}}$

        d. $\dfrac{\text{Interest expense}}{\text{Net sales}}$

    b.   Secondary profitability ratios

        a. Total assets turnover $= \dfrac{\text{Net sales}}{\text{Total assets}}$

        b. Accounts receivable turnover $= \dfrac{\text{Net sales}}{\text{Total inventory}}$

        c. Fixed assets turnover $= \dfrac{\text{Net sales}}{\text{Fixed assets}}$

        d. Inventory turnover $= \dfrac{\text{Net sales}}{\text{Total inventory}}$

4. Resources Productivity

    a. Total earnings productivity $= \dfrac{\text{Total earnings}}{\text{conversion cost}}$

Where, Conversion Cost = Total salaries and wages + Total purchased services + Depreciation

    b. Profit productivity $= \dfrac{\text{Profit}}{\text{conversion cost}}$

    c. Resource utilization productivity

    d. Process work productiivty $= \dfrac{\text{Time or cost incurred on productive \& }\textit{ancillary work}}{\text{Total time or conversion cost (including idle time/cost)}} = \dfrac{C_d}{C}$

    e. Process work productiivty $= \dfrac{\text{Time or cost incurred on productive work}}{\text{Total time or conversion cost available}} = \dfrac{C_e}{C}$

5. Human Resource / Labor Productivity

    a. Individual worker / labour productivity $= \dfrac{\text{Output}}{\text{Input of labour/worker's efforts}}$

b. Value addition per direct worker $= \dfrac{\text{Value added}}{\text{Number of direct workers}}$

c. Value addition per indirect worker $= \dfrac{\text{Value added}}{\text{Number of indirect workers}}$

d. Value addition per worker's shift $= \dfrac{\text{Value added}}{\text{Number of hours worked on first shift}}$

e. Value addition per funtional area $= \dfrac{\text{Value added}}{\text{salaries/wages of finance department}}$

f. Value addition per employee $= \dfrac{\text{Value added}}{\text{Total Number of employees}}$

g. Total Value addition $= \dfrac{\text{Value added}}{\text{Labour+Capital inputs}}$

h. Value addition per work hours $= \dfrac{\text{Value added}}{\text{Toatal work−hours worked}}$

i. Value addition per worker $= \dfrac{\text{Value added}}{\text{Number of workers}}$

j. Value addition per dollar salary/wages $= \dfrac{\text{Value added}}{\text{Salaries and wages}}$

6. **Capital Productivity**

a. Value addition per asset $= \dfrac{\text{Value added}}{\text{Tangible and intangible assets}}$

b. Value addition per capital $= \dfrac{\text{Value added}}{\text{Tangible and financial capital}}$

c. Value addition per tangible asset $= \dfrac{\text{Value added}}{\text{Tangible assets}}$

d. Value addition per fixed asset $= \dfrac{\text{Value added}}{\text{Fixed assets}}$

e. Value addition per machinery/equipment $= \dfrac{\text{Value added}}{\text{Machinery and Equipment}}$

f. Value addition per securities $= \dfrac{\text{Value added}}{\text{Marketable securites}}$

g. Value addition per accounts receivable $= \dfrac{\text{Value added}}{\text{Accounts receivable}}$

h. Value addition per inventory $= \dfrac{\text{Value added}}{\text{Inventories}}$

7. **Working Capital Productivity**

$$\text{Working Capital Productivity} = \dfrac{\text{Total earnings}}{\text{Throughput materials + conversion costs}}$$

8. **Inventory Productivity**

$$\text{Inventory Productivity} = \dfrac{\text{Total earnings}}{\text{Throughput materials + carrying costs/charges}}$$

9. **Cost Productivity**

a. Direct cost Productivity $= \dfrac{\text{Total outputd}}{\text{Direct Cost}}$

b. Indirect cost Productivity $= \dfrac{\text{Total outputd}}{\text{Indirect Cost}}$

c. Total cost Productivity $= \dfrac{\text{Total outputd}}{\text{Total (Direct+Indirect)Cost}}$

10. Foreign Exchange Productivity

$$\text{Foreign exchange productivity} = \dfrac{\text{Total outputd}}{\text{Total foreign exchange utilized}}$$

11. Energy Productivity

$$\text{Energy productivity} = \dfrac{\text{Total outputd}}{\text{Total cost (or units/KW) of energy utilized}}$$

12. Raw Material Productivity

$$\text{Raw material productivity} = \dfrac{\text{Total outputd}}{\text{Total cost (or units/tonnes) of raw materails utilized}}$$

Experimental study of Discharge Capacity of Curved Trapezoidal Labyrinth Weir

Muhammad Usman, Mujahid Iqbal
[1]*University of Engineering and Technology Taxila, Pakistan*

Abstract

The study focuses on the effectiveness and cost-efficiency of Curved Trapezoidal Labyrinth Weirs (CTLW) as a solution to enhance discharge capacity without increasing structure width. The investigation aims to comprehend the impact of geometry on the discharge coefficient. Two distinct flow conditions at the crest of CTLW were employed to assess their influence on discharge capacity (Q) and the coefficient of discharge (cd). Dimensional analysis revealed that the discharge coefficient of CTLW relies on dimensionless parameters, specifically cd and HT/P. The results indicate a substantial increase in water depth on the upstream side of the channel with an increase in discharge, both in free flow and submerged flow conditions. Notably, flow conditions emerge as the most significant factor affecting the discharge coefficient. The results show that in free flow conditions, an increase in Ht/p to 0.92 led to a decrease in the coefficient of discharge to 0.42. Conversely, in submerged flow conditions, an increase in Ht/P to 0.92 resulted in a reduction of the coefficient of discharge to 0.36. This paper contributes to existing knowledge by exploring the impact of flow conditions on the discharge coefficient of curved trapezoidal labyrinth weirs.

 Keywords: Labyrinth weir, discharge coefficient, Geometric, submersion stages

Introduction

Labyrinth weirs, characterized by their intricate geometric designs and hydraulic efficiency, have gained prominence in the field of hydraulic engineering. These structures offer the ability to manage substantial discharges while maintaining low head levels, distinguishing them from conventional linear weirs. Their versatility and adaptability to diverse settings have made them indispensable components of water resource management systems in various environments, from streams to reservoirs. In this paper, we explore the intriguing world of labyrinth weirs, with a specific focus on curved trapezoidal labyrinth weirs and their discharge capacity, drawing from a foundation of existing literature and original research.

Amidst a growing body of research, significant insights have been derived regarding the hydraulic performance of labyrinth weirs. Amir Ghaderi and his colleagues emphasized the importance of sidewall angles in determining the discharge coefficient. Their work revealed that, for high values of the hydraulic head-to-weir height ratio (H/P), a decrease in sidewall angle could reduce the discharge coefficient due to the collision of falling jets. Furthermore, investigations into transverse

Trapezoidal labyrinth weirs (TTLW) elucidated that these structures achieve high energy dissipation by directing the flow towards upstream apexes and generating circulating flow in the pool formed behind the falling water sheets. The energy dissipation potential of TTLW was found to be superior to that of vertical drop weirs. A study by B. M. Crookston and B. P. Tullis emphasized the role of labyrinth weir configurations in affecting discharge capacity. They found that the arced labyrinth weir exhibited a discharge capacity approximately 30% greater than the in-channel configuration, showcasing the potential to optimize this type of weir. Nevertheless, highly efficient arced labyrinth weirs may face limitations due to local submergence and the capacity of the outlet labyrinth weir cycles and exit channels. The existing literature demonstrates the intricate relationship between labyrinth weir geometry and hydraulic performance, emphasizing the significance of sidewall angles, sidewall heights, and overall design in determining discharge coefficients and energy dissipation. This paper extends this knowledge by investigating the influence of curvature on the discharge capacity of trapezoidal labyrinth weirs.

Methodology

The discharge coefficient and discharge behavior are determined using a Curved Trapezoidal Labyrinth weir. The following is the general equation for determining discharge through CTLW:

$$Q = \frac{2}{3} C_d \sqrt{2g} WH^{3/2} \quad (1)$$

$$C_d = 1.12 \, Q/H^{3/2} \quad (2)$$

Where:
Q is the discharge passing over the weir crest in cumecs,
Cd is the discharge coefficient of the weir,
W is the total width of the channel, and H is the head of water over the weir crest in meters

Figure 20: Geometry of CTLW

Experimental Procedure

The experiments were carried out in the Hydraulics laboratory, Department of Civil Engineering, University of Engineering and Technology, Taxila. The studies were carried out in a glass-sided flume measuring 12.5m in length, 0.3m in breadth, and 0.45m in depth. To manage the flow depth, a sharp crested weir was provided at the end of the flume. The water was pumped into the channel with a centrifugal pump. Figure 2 depicts the actual installation of the weir in the laboratory flume. These experimental settings were chosen with care to achieve accurate findings. In the first phase, the experimental setup was made in the laboratory, and experiments were performed at different discharges. Depth of water at different location was measured by point gauge. In the second phase, depth of water was measured by making weir submerged.

Figure 2: Computerized Flow Channel

| (a) | (b) |

Figure 3: (a) Straight free flow condition (b) Straight Submerged flow condition

Results and Discussion

To investigate the impact of flow characteristics of the (CTLW) on the discharge coefficient, two models were tested. The experimental results were used to plot the discharge rating curve (Q-H) and (Ht/P vs. cd) for different geometric parameters. The findings showed that while keeping the free flow conditions constant, an increase in weir discharge for a fixed head over the CTLW. The submerged flow conditions were found to increase the discharge depth leading to intensified weir discharge. These findings in table used in the design and optimization of CTLW structures for improved hydraulic performance.

Table 1: Condition and Result Experimental

data (u/s)	Head (Ht)	data (d/s)	f	Q	u/s head (H)	h	Cd	V	F r	Ht/p
223	209	74	14	0.003	0.20	0.05	0.27	0.048	0.034	0.35

|										
236	222	83	16	0.0070	0.21	0.06	0.45	0.105	0.072	0.44
247	233	89	18	0.008	0.22	0.07	0.45	0.126	0.085	0.51
255	239	95	20	0.0102	0.23	0.08	0.45	0.141	0.092	0.56
263	245	98	22	0.011	0.24	0.09	0.45	0.151	0.100	0.62
270	255	99	24	0.012	0.25	0.1	0.44	0.165	0.105	0.66
277	256	104	26	0.013	0.25	0.10	0.43	0.174	0.110	0.71
284	260	108	28	0.014	0.26	0.11	0.42	0.181	0.112	0.76
292	264	110	30	0.016	0.27	0.12	0.41	0.189	0.116	0.81
296	268	113	32	0.016	0.27	0.12	0.40	0.194	0.118	0.84
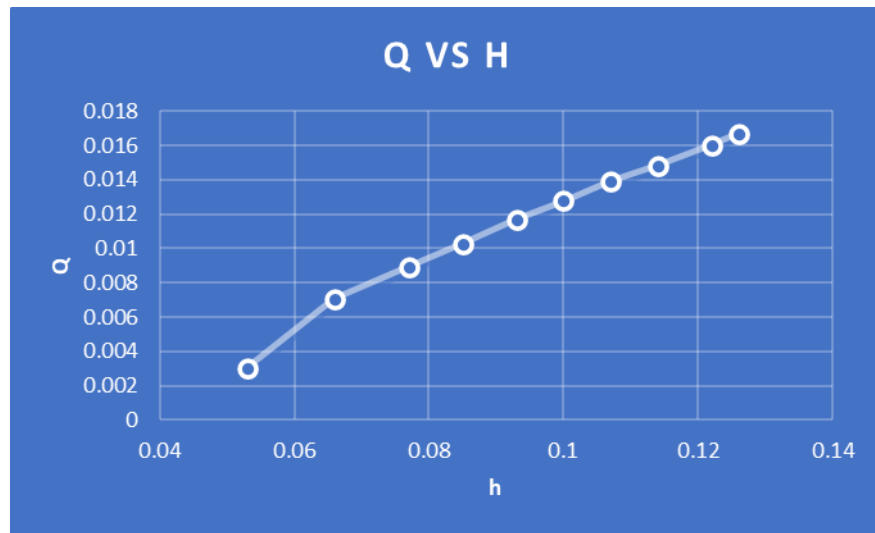
Figure 4: Discharge vs Depth (Free flow condition)

In figure 4 reveals that a change in depth of free flow condition for a curved trapezoidal labyrinth weir can drastically impact flow rate measurements by changing the head (fluid height above the crest), resulting in variations of continuously increase in discharge.

Figure 5: Coefficient of discharge vs HT/P (Free flow condition)

The results indicate that, under free flow conditions, the maximum coefficient of discharge is achieved at a low (Ht/P) value. As the (Ht/P) values increase, there is a continuous decrease in the coefficient of discharge. The curves in Figure 5 illustrate that when (Ht/P) is 0.45, the coefficient of discharge reaches its maximum at 0.46. However, beyond this point, an increase in dimensional parameters leads to a subsequent decrease in the coefficient of discharge.

Figure 6: Discharge vs Depth (Submerged Condition)

In figure 6 reveals that a change in depth of submerged flow conditions for a curved trapezoidal labyrinth weir can drastically impact flow rate measurements by changing the head (fluid height above the crest), resulting in variations of continuously increase in discharge.
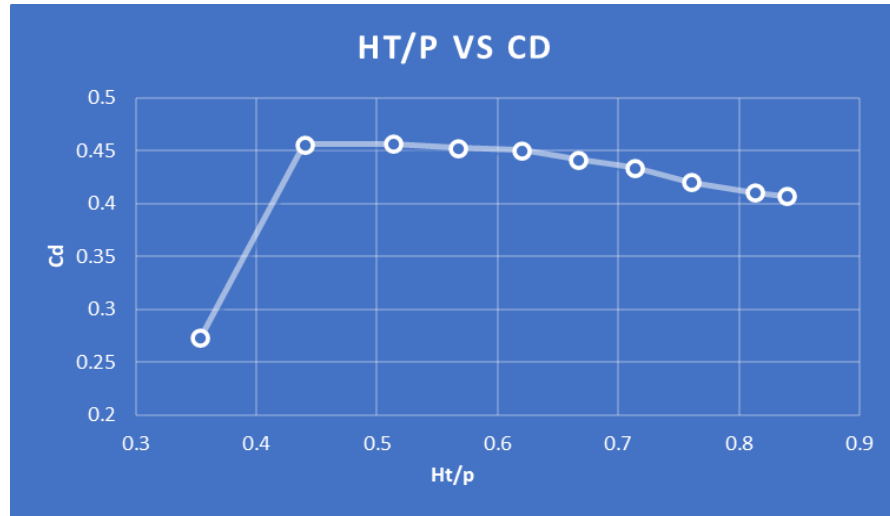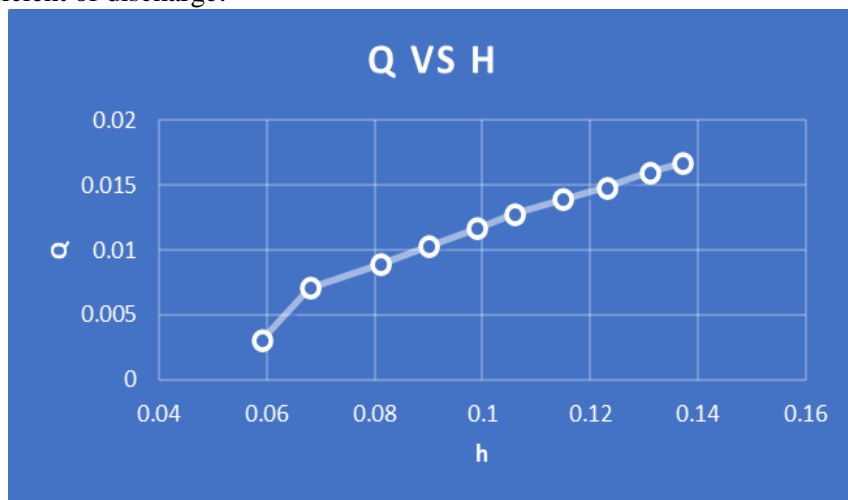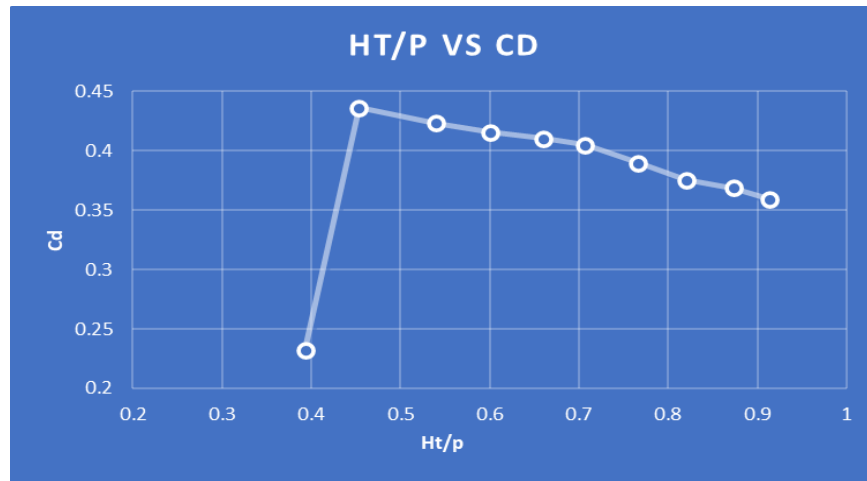
Figure 7: Coefficient of discharge vs HT/P (Submerged Condition)

Cd values were plotted against Ht/P in Fig. 7 to analyze the effect of dimensionless ratios (Ht/P) on the discharge coefficient of CTLW.Due to maximum discharge rate coefficient of discharge attain minimum in submerged flow condition. The influence of Ht/P on Cd, on the other hand, is quite significant, with an increase in Ht/P value resulting in a considerable rise in Cd. Cd begins to decline after a certain value is achieved, and the curves show a precise pattern of change between Cd and Ht/P. These findings have significance for improving the design and performance of CTWL structures.
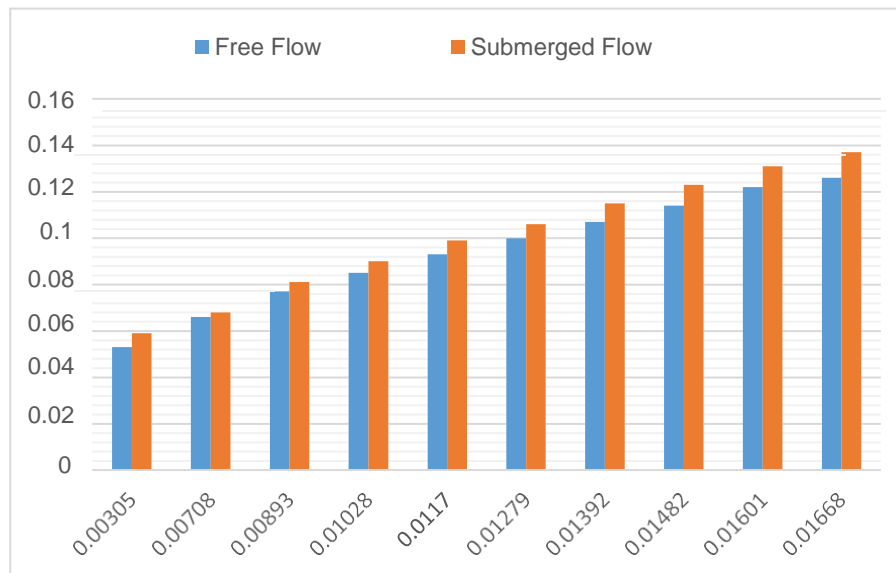
Figure .8: Comparison of discharge vs. head during free and submerged flow conditions

Conclusions

It was demonstrated that the discharge coefficient of the CTLW in free flow conditions is around 15% greater than that of submerged flow conditions. Additionally, the impacts of the CTLW geometrical parameters on the discharge coefficient were explored, and the results are as follows:

- Among the geometrical ratios, Ht/P had the greatest impact in increasing Cd levels.

It is included that in free flow conditions, an increase in Ht/p to 0.92 led to a decrease in the

coefficient of discharge to 0.42.

- In submerged flow conditions, an increase in Ht/P to 0.92 resulted in a reduction of the coefficient of discharge to 0.36.

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Impact of Family Work Conflict and Work-Family Conflict on Work-Life Balance: Assessing the intermediate effect of manager construal effect and organizational control mechanism

Salman Hameed

Bahria University, Pakistan

Abstract

The purpose of the study was to understand how "Family-Work Conflict" and "Work-Family Conflict "impact the "Work-Life Balance" of employees working in the software industry of Karachi, Pakistan. The novel aspect of the study was the manager construal effect and organizational control mechanism and how it related uniquely to this relation. A quantitative, deductive research approach is applied for this research. Data is collected through non-probability and convenient sampling techniques and the selected sample size was 351 for this study. The data was evaluated via SMART PLS software. Questionnaires were sent to various employees working at different companies electronically through Google Forms. Work-family conflict is found to have significant impact on the Work-Life balance of employees. Family-Work conflict has an insignificant effect on Work-Life Balance. Our chosen moderator also had an insignificant impact on the relationship between our independent variables and our dependent variable and the same is the case for our mediator. The study has been conducted at a small scale in 30 companies, most of which are situated within the territory of Karachi. The generalizability of the study is therefore limited. Further inter-city research is needed. Moreover, the study is based on the subjective views of the respondents about the firms they work in. It is therefore suggested that future studies should focus on development of measures which assess the variables with even more objectivity.

Keywords: FWC: Family Work Conflict, **WFC**: Work Family Conflict, WLB: Work Life Balance, MCE: Manager Construal Effect, **OCM**: Organizational Control Mechanism

Introduction

Background

Till date, there have been a number of studies that have overseen the concept of work-life balance and have also given their focus mainly on the family and work domains (Gragnamo et al., 2020). However, there is still the labor force that is complemented as heterogeneous, and workers may similarly value other non-working domains aside from work and their families. In the recent years, the cultural, economic and social changes have a tremendous effect on the work lives of the people. Mainly, the growth in the living standards and the significant of the family and work-life has made the needs of people quite strong (Adisa et al., 2017). The connection among the family and work life is termed as bidirectional.

The work-life of an individual could influence the family life, which has the direct impact of the individual's work-life (Dwi, 2018). As per the fact that family and work roles can constantly intersect and connect with one another, this belief has been dealing with in two varied, however similar mean, as family-work conflict or work family conflict. Work-family conflict takes place when the experiences at work are intervened with the family life. This undesirable occasion is known to be job stress, or it can also be in the form of inflexible and irregular working shifts and hours followed with transitions, peak interpersonal conflict and frequent travel (Saisuri, 2021). On the other hand, Family-work conflict takes place when the experience in the interference of family is involved with the work-life. There are several tensions and anxieties in the family

settings that might be due to the existence of conflicts among the elders, children and other young elders followed with interpersonal conflicts within the family due to the presence of unsupportive family members. This issue for the work family conflict has always got specific attention by the researchers; this is because an average of 40% of the employed parents has acknowledged this conflict of work-family for an interval of time in their lifetime.

According to studies, workplace conflict and household conflict have a negative and substantial relationship with the emotional well-being of persons who are experiencing these circumstances, as well as employment and career satisfaction. Conversely, family and household life are not necessarily in competition with one another. (Ninaus et al., 2021) advocated the notion of work-family enrichment combined based on this reality or conviction. This notion may be defined as the progression and evolution of performance with a favorable influence in one role of an entity's accomplishments into another role (Talukder, 2019). Other scholars feel that work-family supplementation is another example of a favorable synergy between home and career (Soomro et al., 2018). Such a notion is also considered to be unidirectional in the sense that work experiences and information about work may enrich and increase the quality of an individual's personal family situation, or in other circumstances, family experiences and knowledge may also aid in delivering work quality. Although work-family homeostasis or work harmony was first viewed as having relatively low levels of conflict between home and career, it has now been investigated as an independent reason for these kinds of conflicts. As either a social arrangement, the symmetry and harmony must be reviewed, and the equilibrium of work-family should be assessed as a critical component while the objectives of the individual and other individuals around are determined upon and conveyed (Soomro et al., 2018).

Job-family balance has been proven to be correlated with positive aspects of work participation as well as life satisfaction. This study attempts to add value to the existing literature by adding insights on the importance of work-life balance. Practically, the study is expected to add value by giving insights to manager and organization on strategies about creating a balance on employees work life balance. The outcome of such study will also bring new efforts that could assist to enhance the efficacy of the organization and its well-being by allowing both employees and employers to prosper and grow in the future. The purpose of this study is as follows; determine the impact of FWC and WFC as independent variable on WLB, understand the moderating effect if any of MCE on the relationship between the independent and dependent variables and lastly determine if OCE plays a mediating role on the relationship between the independent and dependent variables. The study also aims to understand whether there are certain measures that can be implemented to enhance the role of managers and the organization in improving the Work Life Balance of Employees.

Theoretical Background and Hypothesis Development

Work Life Balance

The concept of work-life balance started in the 1800s, when pursuing the industrial revolution, various unions and industrialists likewise decided that employees require at least a day off from their work. Such requirement later evolved to be a 'weekend' in fact in such days, working was based on manual struggle but eventually with globalization work hours got increased and work hours gets involved and mixed-up with family hours. This phenomenon is also known as the work-life interface and the intersection for personal and work-life spaces (Paulambo, 2020). Work-life intern work-life existed to be bidirectional, for example, work can inhibit or disturb one's private life, and then private life can inhibit or interfere with work.

Family work Conflict and Work life Balance

This particular type of conflict is known as family interference with work or FIW, inter-role conflict, and

family-to-work conflict. Such conflict happens when the tensions from the work and family spheres are mutually incompatible, then as an outcome, the connection in the work role is rendered to be additionally hard by participation in the sphere of family role (Crompton, & Lyonette, 2006). The idea of the role conflict is grounded in the scarcity theory, which determines that personal resources, like energy and time, are limited and that the commitment of big resources to one role necessitates the devotion of lesser resources to other roles. More easily, such conflicts occur when the family issues get in the connection with the work-life and get one of the variables into trouble.

The recent work environment and various other factors affected the working life of individuals. This may disturb the overall lifestyle of people, resulting in family conflicts. In this regard, Odriozola & Baraibar-Diez, (2018) stated that Work-family balance is difficult to support in present-day modern social orders because of expanding demands at work and in family settings. People are approached to deal with numerous jobs all the while, allotting their assets among work and family (Riyanto et al., 2019).

In addition to this, Work-family conflict is a mental peculiarity or psychological phenomenon of irregularity among work and home life (Riyanto et al., 2019). The most widely recognized stressors helpful for the event of work-family struggle are work burnout, disappointment, work pressure, long working hours, and job struggle (Sánchez-Hernández et al., 2019). Work over-burden and upsetting occasions brought about by the workplace may actually and sincerely exhaust a worker such that it leads to work-family conflict. The two-way model of work-family struggle shows that pressure factors in the work environment, for example, absence of independence or exorbitant responsibility contrarily affect the "work" side, while stress factors connected with family, for example, getting rowdy kids or excessively subordinate guardians hurt the "family" side of the equilibrium. In different regards, brilliant similarity among family and work gives a feeling of high accomplishment in the work environment since it spurs people (Wolor et al., 2020).

A lot of authoritative exertion has been coordinated into the exploration of the disastrous results of work-family conflict (Sánchez-Hernández et al., 2019). Wearing down of staff and other word-related dangers can have negative ramifications for the presentation of associations. Then again, work performance and emotional well-being of people increment when the authoritative standards empower work-family balance (Rodríguez-Sánchez et al., 2020). Realizing that subsequent happy representative is a more useful worker, associations become progressively intrigued by the everyday existence of workers and connect effectively in settling work-family clashes. Here it becomes fundamental to consider factors creating mental satisfaction and accordingly prompting more critical work accomplishments. Simultaneously, factors that achieve vulnerability, disappointment, uncertainty, and struggle are answerable for diminishing individuals' just as hierarchical prosperity and consequently warrant more consideration. A limit of earlier investigations in the mental prosperity setting is that they don't adequately investigate the effect of non-hierarchical elements on execution. This review tends to the limit by presenting family as a key variable that has suggestions for the prosperity and mental security of people.

Work-family conflict and work life balance

Work-family conflict is a kind of conflict that occurs when a personal experience gets incompatible uncertainties between family and work roles, resulting in connection in both roles to evolve to be more impossible. This inequality establishes conflict at the work-life interface. Moreover, it is significant for individuals and as well for organizations to realize the significances correlated to work-family conflict. In specific scenarios, the work-family conflict has been correlated with job stress, improved occupational burnout, reduced health, and problems relating to organizational responsibility and job performance.

Work-family conflict happens when the encounters at work disrupt day-to-day life. Such encounters may be work pressure, professional advances, outrageous, sporadic, or resolute working hours, continuous travel, relational struggle, job over-burden, colleague support, and unsupportive association or bosses (Caringal et al., 2021). Family-work struggle, on the other hand, happens when the encounters in the family slow down work life. A few tensions in the family climate may be the presence of small kids, senior care liabilities, relational struggles inside the family, and the presence of unsupportive family individuals. The

subject of work-family struggle has been of Specific interest since ongoing examinations have exhibited that 40% of utilized guardians experience the work-family struggle for somewhere around a timeframe in their lives Concentrates on a show that work-family struggle and family-work struggle have a negative and critical connection with mental prosperity and the work and life fulfillment of the individuals (Gomes et al., 2021). Again as mentioned by the scarcity theory as resources are limited so when one domain demands more of a person's energy and resources so conflict is bound to occur in the other domain.

Manager Construal Effect And Work Life Balance

The management within an organization has its own set of responsibilities and among them, one is to get involved with the exercise of the formal authority of a strong organizational environment authorized towards the actions of other individuals utilizing procedures and systems. Management has various applications in constructing a healthy and better environment for all employees where they grow and prosper (Poulose, &Sudarsan, 2018). Moreover, effective management requires looking for more constructive projects as they will help the organization by increasing the potential for profitable completion of projects with the deadline, free from legal and financial complications, and within the given budget.
The job of a steady boss or supervisor in certain results for family-friendly advantages was confined in an enormous broadly agent test concentrated by (Caringal- et l., 2021). A prior concentrate by Odriozola&Baraibar-Diez, (2018) tracked down administrative help represented the vast majority of the clarified fluctuation in work family culture, in front of negative vocation outcomes furthermore organizational time and demands. Initially, less delegate, investigation additionally discovered that work-family culture was emphatically connected with representatives' utilization of work-family benefits and full of feeling an obligation to their work. Besides this, this is adversely connected with work-family conflict and aims to leave an association.
Sánchez-Hernández et al., (2019) explored the general jobs of elements related to managers versus resources and institutional and subordinate elements in clarifying business provision of work-family programs and an obliging working environment culture in Australia and viewed that as administrative factors represented the vast majority of the variances. Seen benefit /proficiency gains were connected with large number of work-family drives being advertised. Managers· perspectives and techniques were connected with the general number of drives advertised. Institutional powers or strategies of huge or then again open area associations added to rather than drove choices rework-family execution. Person directors drove the result. Institutional elements had more effect on the working environment culture being obliging of work-family programs. Ricardianto et al., (2020) inspected 732 manufacturing associations in the US. France. The UK, also Germany researches the connection between work-life equilibrium and efficiency. They observed that there was no direct connection between work-life balance strategies/drives in an organization and expanded productivity. Nor was there was no immediate negative connection between the balance between family and serious activities and efficiency. The mediator factor was administrators: great administration was connected to both balances between work-life and higher productivity. This proposes that great organization is the key to the balance between work and life activities converting into positive results like enhancing the overall performance of the organization's usefulness. Subsequently, this review did not examine the execution of work-life strategies.

Organizational control mechanism and work-life balance

The means and standards to control regulate the behavior or attitude of every individual and its related process within an organization system are known to be a part of the Organizational Control Mechanism. There are several kinds of control mechanisms that help to regulate the whole cycle of management within an organization. To support work life balance within an organization, the major role is assumed to be played by the organization. Riyanto et al., (2019) illustrated that work-life balance can play a vital role by developing certain strategies which could support employees to fulfill their organizational tasks on time

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and give equal time to their families. One of the keys to adjusting work and family is to define limits or work boundaries. Workers need to feel like they have consent to define limits and impart individual constraints for work assumptions.

Over the long run, this can make one of two things; 1. Somebody who relates to their work and has become subject to their personality with their work. Or. 2. The worker starts to despise their boss for not permitting them more opportunity for individual interests (Odriozola & Baraibar-Diez, 2018). This sort of hatred can putrefy over the long run and manifest into cynicism as the representative methodology's burnout.

Leadership is all set illustrate to show the right needs. Directors who have the right needs show the significance to their staff. This can be exhibited by just discussing their outside advantages and reserving time for themselves. At the point when a chief doesn't go home for the days, they show that time off isn't significant. Be that as it may, when directors invest in some opportunity for individual interests, they show the significance of adjusting work and home life. This methodology allows workers to build up their own needs. As per the study by Wolor et al., (2020) the type of managerial behavior helps workers to understand lives, the wok life and family life.

Balance between life and work activities practices are intentional authoritative changes in programs or organizational culture that intend to lessen work-life conflict and empower representatives to be more successful at balancing their personal and professional jobs (Leitão et al., 2019). In light of these changes and the contention they create among the different jobs that people possess, associations are progressively forced to plan different way and are expected to work with representatives' endeavors to satisfy both their employment related and their own responsibilities. The method of how balance between work and life activities can be accomplished and improved is a significant issue in the field of human resources the board and has gotten huge consideration from managers, laborers, government, scholastic specialists, and the famous media (Gomes et al., 2021).

Research Hypotheses

H1: Work-family conflict has a significant impact on work life behavior

H2: Family-work conflict has a significant impact on work life behavior

H3: Managerial construal effect has a moderating effect between family work conflict and Work Life Balance.

H4: Managerial construal effect has a moderating effect between Work Family Conflict and Work Life Balance.

H5: Organizational Control Mechanism has a mediating effect on Family Work Conflict and Work Life Balance

H6: Organizational Control Mechanism has a mediating effect on Work Family Conflict and Work Life Balance

Conceptual Framework

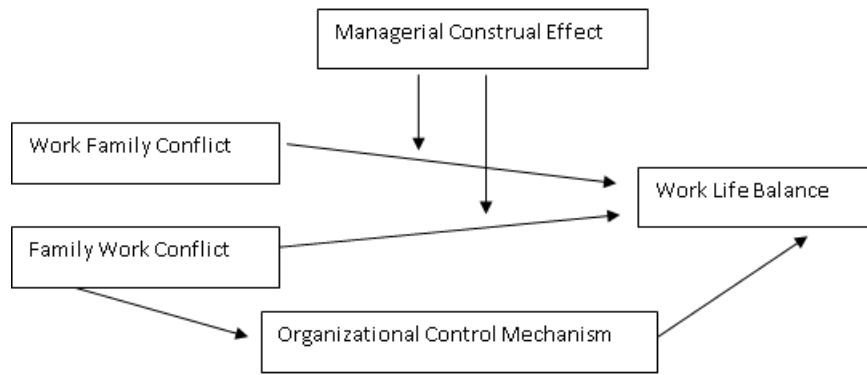Our study research framework is as follows

Figure 1 Conceptual Framework

Research Methodology

Research Design

The purpose of the study the impact of work family and family work conflict on work life balance of employees in different sectors of Karachi especially the Information Technology sector. The age group of our study population in the research ranges from 25-40 years and they   are the employees of different organizations in the sector of Information Technology in Karachi. The research design adopted in the study is quantitative analysis. Doing the quantitative study has allowed the researcher to verify the data on statistical grounds.

Research Population and sample size

In view of the sampling design, the first aspect is the target population. The target population of the study is noted to be the employees from different companies in the software sector of Karachi. PASHA's list was used to ascertain what companies could be reached out. The sample size of the study is 300 respondents. The sampling technique in the study adopted is convenience sampling which is a form of non probability sampling (the idea that not everyone will get an equal chance to be part of our target population). The idea behind convenience sampling is that respondents are chosen on how conveniently they are available. This is done due to time and resource constraint and also because it is relatively easier to carry out this sampling technique.

Research Instrument

The data collection has been done by means of survey questionnaire. Under the survey analysis, the researcher has taken questionnaire as the primary tool for the study. Five-point Likert scale has been taken in the questionnaire where the respondents have been given with five options ranging from strongly disagree to strongly agree to choose from based on their agreement and disagreement. The variable of Work-Life Balance was assessed with 8 items scale of Arzu-Tasdelen, Orkide Bakalım(2017), the variable of Family-Work Conflict was assessed with 5 items scale of Netemeyer, Boles, and Mcmurrian(1996),the variable of Family Work- Family Conflict was assessed with 5 items scale ofNetemeyer, Boles, and Mcmurrian(1996), the variable of Manager Construal Effect was assessed with 10 items scale of Kelista Lea Burns(2016)the variable of Manager Construal Effect was assessed with 10 items scale of Kelista Lea Burns(2016) the variable of Organizational Control Mechanism was assessed with 06 items scale of Kelista Lea Burns, (2016).

Data Collection and analysis

The data collection has been by survey analysis. The survey has made on online Google forms. The forms have been later distributed to the respondents by email and other social media platform. The filled forms will be later coded one excel based on the Likert scale for statistical testing. The gathered data has been later tested on Smart PLS check the relation of variables.

Results

Respondent Profile

Table 3 Respondent Profile

Gender	Male	58%
	Female	40.2%
	Prefer not to say	1.8%
Age	20-30	43.1%
	31-40	47.2%
	41-50	6.1%
	50+	3.6%
Academic Qualification	Undergraduate	2.9%
	Graduate	56.6%
	Postgraduate	40.5%
Years of Experience	< 5 years	38.8%
	< 10 years	23.6%
	<15 years	28.3%
	>15 years	9.3%

Reliability Analyses

Table 4 Measurement Model

	No. of item	Outer loadings	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
FWC	FWC1	0.734	0.847	0.854	0.891	0.620
	FWC2	0.821				
	FWC3	0.802				
	FWC4	0.763				
	FWC5	0.813				
MCE	MCE10	0.741	0.866	0.867	0.895	0.516
	MCE2	0.679				
	MCE3	0.704				
	MCE4	0.727				
	MCE5	0.710				
	MCE6	0.741				
	MCE8	0.747				
	MCE9	0.692				
OCM	OCM1	0.676	0.832	0.838	0.877	0.544
	OCM2	0.693				

	OCM3	0.762				
	OCM4	0.703				
	OCM5	0.769				
	OCM6	0.812				
WFC	WFC1	0.829				
	WFC2	0.855				
	WFC3	0.791	0.873	0.913	0.903	0.653
	WFC4	0.865				
	WFC5	0.688				
WLB_	WLB1	0.688				
	WLB2	0.758				
	WLB3	0.688				
	WLB4	0.630				
	WLB5	0.734	0.861	0.865	0.892	0.508
	WLB6	0.770				
	WLB7	0.727				
	WLB8	0.699				

All Cronbach Alpha values are > 0.7 which show that the data is reliable and can be used for further analysis. Moreover, item loadings are > 0.5 which show indicator reliability. Average Variance Extracted which refers to is also >0.5 which depict convergent reliability. Other measures of reliability include the value of coefficient rho_A that should be > 0.7 and composite reliability that should be > 0.6. The mentioned figures have been achieved that demonstrate that our model is fit for examination.

Table 5 Discriminant Validity

Table 5.1 Fornell-Larcker criterion

	FWC	MCE	OCM	WFC	WFC*MCE*WLB	WLB_
FWC	0.787					
MCE	-0.162	0.718				
OCM	-0.060	0.691	0.737			
WFC	0.170	-0.051	0.002	0.808		
WLB_	-0.142	0.508	0.492	-0.168	-0.142	0.713

Table 5.2 Heterotrait-Monotrait Ratio (HTMT)

	FWC	MCE	OCM	WFC	WFC*MCE*WLB	WLB_
FWC						
MCE	0.191					
OCM	0.080	0.818				
WFC	0.192	0.074	0.082			
WLB_	0.181	0.581	0.570	0.176	0.151	

Hypothesis Testing

Table 6 Bootstrapping while FWC is IV:

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
FWC -> OCM	-0.063	-0.076	0.075	0.835	0.404
FWC -> WLB_	-0.056	-0.065	0.061	0.914	0.361
FWC*MCE*WLB -> WLB_	-0.034	-0.030	0.057	0.593	0.554
MCE -> WLB_	0.287	0.290	0.085	3.388	0.001
OCM -> WLB_	0.288	0.289	0.081	3.542	0.000
WFC -> OCM	0.013	0.012	0.092	0.137	0.891
WFC -> WLB_	-0.142	-0.139	0.061	2.313	0.021

Table 7 Bootstrapping while WFC is IV:

	Original Sample (O)	Sample Mean (M)	(STDEV)	T	P
FWC -> OCM	-0.063	-0.074	0.076	0.819	0.413
FWC -> WLB_	-0.053	-0.066	0.061	0.877	0.381
MCE -> WLB_	0.296	0.285	0.090	3.296	0.001
OCM -> WLB_	0.292	0.299	0.079	3.706	0.000
WFC -> OCM	0.013	0.009	0.087	0.144	0.886
WFC -> WLB_	-0.148	-0.151	0.066	2.261	0.024
WFC*MCE*WLB -> WLB_	0.019	0.020	0.065	0.296	0.768

Hypothesis 1

Family-Work Conflict (FWC) has a significant impact on Work-Life Balance (WLB):
Path coefficient signifies the impact of one variable to another whereby the P value is considered good if it is <0.05 and the standard T statistic value for the model to be significant is >1.96. Here in the case of measuring the impact of FWC on WLB, the P value is >0.05 which indicates that the impact of FWC on WLB is insignificant.

Hypothesis 2

Work-Family Conflict (WFC) has a significant impact on Work-Life Balance (WLB):
As previously mentioned, the P value must be <0.05 for the model to be significant and the T value has to be >1.96. In determining the impact of WFC on WLB, the P value is 0.021 and the T value is 2.313 indicating a significant relationship between the two variables.

Hypothesis 3

Managerial Construal Effect (MCE) has a moderating effect on the relationship between FWC and WLB:

In respect of our framework that looks at the moderating effect of MCE on FWC-WLB The P value is < 0.05 which means that the impact of Managerial Construal Effect on the relationship between FWC and WLB is insignificant.

But if individual relationship is examined, MCE has a significant impact on WLB as shown by P value <0.05 and a T statistic value >1.96.

Hypothesis 4

Managerial Construal Effect (MCE) moderates the relationship between WFC and WLB:

In respect of our framework that looks at the moderating effect of MCE on FWC-WLB The P value is < 0.05 which means that the impact of Managerial Construal Effect on the relationship between WFC and WLB is insignificant.

On the other hand, MCE is shown to play a significant role on WLB as shown by a P value that is <0.05 and a T value > 1.96

Hypothesis 5

Organizational Control Mechanism (OCE) has a mediating effect on FWC and WLB:
The mediating impact is looked at two ways. One between the IV and the Mediating Factor and the other between the Mediating Factor and the DV. Here, the impact of FWC on OCM is insignificant as shown by the P value in Figure 1 which is >0.05.

However, the impact of OCM on WLB is significant as depicted by the P value of 0.00 that is < 0.05 and a standard T statistic value of 3.542 that is >1.96. thus partial mediation is taking place.

Hypothesis 6

Organizational Control Mechanism (OCE) mediates the relationship between WFC and WLB:

The mediating impact is looked at two ways. One between the IV and the Mediating Factor and the other between the Mediating Factor and the DV. As shown in Figure 2, the mediating impact of WFC on OCM is insignificant as shown by the P value in Figure 1 which is >0.05. As previously stated, OCM plays a mediating role on WLB as shown by P value of 0.00 that is < 0.05 and a standard T statistic value of 3.706 which is >1.96. therefore, partial mediation is taking place.
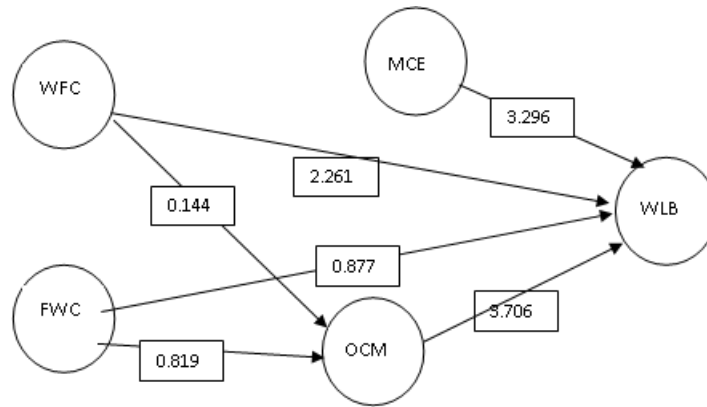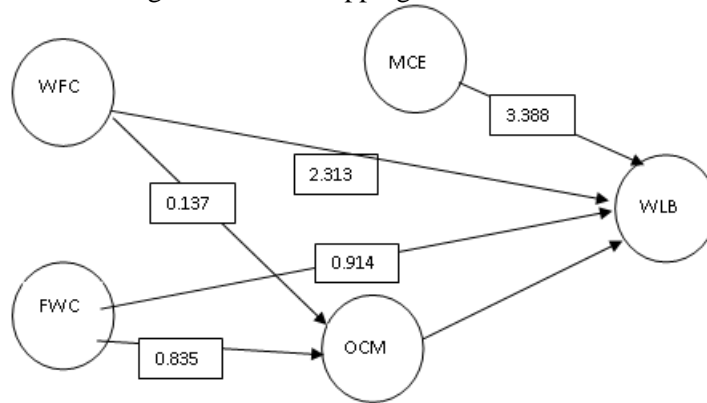
Figure 2: Boot strapping when WFC is IV

Figure 3: Boots trapping when FWC is IV

Summary of Hypotheses Testing

Table 8 Summary of Hypotheses Testing

Hypothesis	Result
H1: FWC has a significant impact on WLB	Rejected
H2: WFC has a significant impact on WLB	Accepted
H3: MCE moderates the relation between FWC and WLB	Rejected
H4: MCE moderates the relation between WFC-WLB	Rejected
H5: OCM mediates effect on FWC-WLB	Rejected
H6: OCM mediates effect on WFC-WLB	Rejected

5 Discussion

Our initial hypothesis that FWC plays a significant role in determining WLB has been rejected. The reasons for this could be that people are better at managing their personal lives in a way that their personal conflicts do not affect their WLB. We had thought that personal conflicts do affect performance at work, but our data shows that it is not the case. Though our literature review had suggested that FWC is positively correlated with problems at work (Ninanus&Terlutter, 2021) but a factor to consider may be that in our country, people are allowed a certain freedom when they are working; they're sheltered from the problems at home so that they better focus on their professional life.

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Our hypothesis was that WFC significantly impacts WLB and our data has shown a significant positive relationship between the two. This indicates that people tend to transfer office stress and/or job burnout onto their personal lives, their problems at work tend to impact their personal lives in either a positive or a negative way. This hypothesis has been backed by multiple research that has been conducted in this particular area of study where long working hours, heavy workload and/ or increased stress at work has lead to a detoriating family life of people (Gragnano & Miglioretti ,2020) .

Our hypothesis was that MCE plays a moderating role on the relationship between FWC and WLB and on the relationship between WFC and WLB. It either strengthens or weakens this relationship and may also influence the direction between the IVs and the DV. Our results have shown that the Moderator which in our case is MCE has an insignificant impact on the entire framework. It neither impacts the relation between FWC and WLB nor on the relation between WFC and WLB.

However, individual analysis of the moderator on the DV is shown to be significant from which we can deduce that if perceived supervisor support is present, employees work life balance can be improved and they are encouraged to perform to the best of their abilities. This means that if the managers construct their perception on transformational leadership rather than transactional leadership and take care of the people around them, this not only increases job satisfaction and performance but also enables employees to work on their Work Life Balance. People working at such organizations where they have a positive image about their managers would be willing to go the extra mile and reach out to managers for things other than work as well; therefore building rich relationships that extend beyond the workplace. Research conducted by Woloret. al. (2020) has shown that adopting a theory Y approach towards people will enable them to better understand and manage their conflicts.

We assumed that OCM would play a mediating role in our framework; it refers to a sequential event/ phase, our IVs would affect it and it would in turn affect our DV, creating both direct and indirect relationships. Our study has shown that both the IVs have an insignificant impact on OCM but that OCM has a significant impact on WLB. The mediating variable affects the DV i.e. there is an indirect effect taking place. If perceived organizational support occurs, work life balance tends to be better.

Recommendations

Initially, the assumption was that MCE and OCM would significantly impact the relationship between our IVs and DVs. On the contrary, they have been shown to impact WLB on their own rather than the entire framework. From this analysis, it can be understood that MCE and OCM are not actively playing a part in our chosen industry which is why the results shown insignificant impacts of both. These variables, if worked upon and implemented strongly would lead to a multitude of benefits for both the organization and the employees.

MCE playing an active part: For the employees, it could result in increased productivity, performance, and lower withdrawal behaviors. It could also result in lower voluntary turnover, lower absenteeism and going the extra mile for the organization if they perceive that the managers and organizations support them in managing their lives better. Not only these employees are likely to be more satisfied with their job if managerial support is provided.

OCM playing an active part: Providing support both on and off the workplace could lead to higher retention rates, higher adaptability, and flexibility in face of increasing competition. Moreover, employees are more likely to own the company and acquire Knowledge and Skills that are beneficial for the company if they perceive the organization to be supportive of them. This form of support if provided will also impact the WFC element of employee's lives and they could take home lesser stress and office workload. In the end, it will be a win-win situation for both parties involved.

Conclusion

Our framework revolved around the impact of WFC and FWC on WLB, where MCE played a moderating

role and OCM played a mediating role in our framework. Our study showed the following results. The impact of FWC on WLB was insignificant. The impact of WFC on WLB was significant i.e. personal relationships tended to suffer at the hands of professional life. It also determined that MCE insignificantly impacted the relationship between the IVs and the DV but analyzed separately, does impact WLB. Likewise, the indirect relationship between the IVs, the mediating factor (OCM) and the DV was insignificant but OCM significantly affects WLB on its own. In order to be better at WLB which is not that balanced in our chosen industry, managerial and organizational support has be worked upon so that both the organizations and employees benefit and achieve one of UN's goals of "Decent Work and Economic Growth".

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Nexus between Bank Competition and Liquidity Creation:
Time Series Study from the Perspective of Pakistan

Asad Ali, Liaqat Ali
Bahria University, Karachi Campus, Sindh Pakistan

Abstract

The current study examines the nexus between bank competition and liquidity creation by conventional banks in Pakistan. To investigate this relationship, we conducted a time series analysis on a quarterly data set of Conventional Banks in Pakistan from 2004 to 2022. The Lerner Index of Bank Competition is measured using the translog cost function, and the liquidity creation is measured using the Catfat model of liquidity creation. The regression technique was used to test the relationship between the constructs. The findings suggest that bank competition positively impacts the bank's liquidity creation, which means that the rise in bank competition increases liquidity creation. The study's findings align with the 'stability hypothesis,' in which banks increase their deposits and lending activities when competition is high in the market, boosting the liquidity creation by conventional banks in Pakistan. The evidence suggests that pro-competitive policies in the Pakistan banking industry can enhance liquidity provision by banks. Policymakers should use the monetary policy rate to control liquidity creation, as extensive liquidity creation results in higher risk.
Keywords: Bank Competition, Liquidity Creation, Monetary Policy

Introduction

Liquidity creation refers to the ability of financial institutions, particularly banks, to convert relatively illiquid assets into liquid liabilities. This function is essential for the efficient operation of financial markets and sustaining economic activities. Liquidity is critical in a well-functioning financial system, ensuring depositors have timely access to their funds and enabling banks to fulfill commitments, including honoring withdrawal requests. The liquidity creation process involves strategically adjusting bank balance sheets to provide services like accepting deposits, offering loans, and managing risks effectively. Banks create liquidity by financing less liquid assets, such as business loans for equipment, using liquid liabilities like household deposits (Diamond & Dybvig, 1983). Banks also create liquidity through off-balance sheet activities, such as credit lines that borrowers can utilize at their discretion (Holmstrom & Tirole, 1998; Kashyap et al., 2002). Research on bank liquidity creation relies on comprehensive measures considering the total liquidity a bank generates for the public. These measures consider the liquidity created by individual bank assets, liabilities, off-balance sheet activities, and the liquidity offset by other items on and off the balance sheet (Berger & Bouwman, 2009). Researchers employ various versions of this measure globally to investigate factors influencing bank liquidity creation, including the impact of bank competition (Horvath et al., 2016; Jiang et al., 2019)

Banks play a crucial role in the Pakistani economic environment by enabling the flow of funds from savers to borrowers, promoting savings, and supporting by Pakistani economy (Ali & Ahmad, 2023). As vital financial intermediaries, banks connect individuals with surplus funds (depositors) to those needing funds (borrowers). The process of liquidity creation within banks involves converting short-term liabilities (deposits) into longer-term assets (loans) while effectively managing associated risks. In the face of heightened competition, banks may seek to attract increased funds by offering more appealing interest rates on deposits. This intensified competition can result in expanded lending activities, making credit more accessible to businesses and individuals and contributing to the overall liquidity creation.
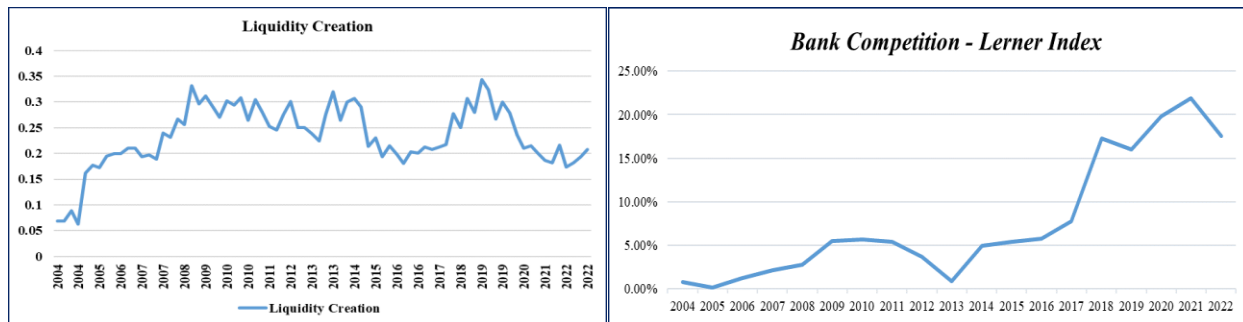
Figure 1: Trend of Bank Competition & Liquidity Creation from 2004 to 2022

Figure 1 illustrates the growth in liquidity creation within conventional banks in Pakistan. Ali & Ahmad (2022) measured liquidity creation by commercial banks in Pakistan using Thomson Reuter's financial data streams. This study utilizes their estimates to investigate the effect of bank competition on liquidity creation. The overall trend indicates an increase, particularly in recent years during the COVID-19 period. The banks' performance surged significantly as the monetary policy rate fell to 5% amid the pandemic. The lower rates allowed banks to lend at cheaper rates while offering lower interest on deposits. Following the State Bank of Pakistan's (SBP) relaxation of monetary policy, there was a notable increase in banks primary functions, leading to higher liquidity creation compared to the preceding period. Despite this, the banking system in Pakistan faces persistent weaknesses, prompting a growing trend of mergers and acquisitions in response to intensified competition among commercial banks. Banks carry out two crucial economic tasks within the quantitative asset transformation function: creating liquidity and transforming risks.

A bank's ability to produce liquidity is contingent on effectively managing encountered risks, highlighting the importance of understanding banks' methods for risk control to enhance liquidity creation. The current financial environment grapples with insufficient liquidity across diverse markets, leading to increased transaction costs, heightened price volatility, and limited market depth. Market participants need help conducting seamless asset transactions due to market fragmentation, regulatory constraints, and information asymmetry. Addressing this liquidity problem requires innovative strategies, tools, and frameworks to foster a more resilient financial ecosystem. The accompanying line graph depicts the trend of bank competition in Pakistan. The data indicates a decrease in bank competition in 2013, followed by an increase until 2020, after which it declined. Overall, there is an increasing trend in bank competition. Potential factors contributing to increased competition include political instability, establishing more banks, and the dynamic nature of banking requirements driven by technological innovation, regulatory changes, and economic fluctuations. The recent decrease in bank competition could be attributed to rising interest rates and inflation rates, slowing overall economic activities in the country. The study provides valuable insights for academicians and researchers into how competition among commercial banks in Pakistan affects liquidity creation.

Jimenez et al., (2013) find out that an increased competition may decrease bank profitability, elevating the risk of bank insolvency. It could compromise adherence to banking supervision standards, posing a threat to liquidity and revealing vulnerabilities. Petersen and Rajan (1995) claimed that heightened competition reduces liquidity generation, supporting the notion of the "fragility competition theory." Banks' vulnerability stems from their role in providing security and converting maturity into liquidity to meet creditors' demands (Diamond & Dybvig, 1983). According to Davidson et al., (1995) both mechanisms emphasize the strong correlation between market power effects in a competitive market and banks' ability to create liquidity. The Pakistani banking system, deemed the economic strength, is subject to rigorous regulation by the State Bank of Pakistan (SBP). The study aims to comprehend and evaluate the effect of bank competition on liquidity creation within conventional banks in Pakistan, focusing on the twenty conventional banks listed on the PSX website, and the scope is limited to PakistanSuch research serves as a foundational resource for subsequent studies, aiding in developing a comprehensive understanding of the intricate role played by liquidity creation in the broader economic context. Financial institutions strive to

attract deposits and allocate funds efficiently in competitive settings. Investigating the effect of liquidity creation on bank competition provides insights into financial resource allocation. This understanding is crucial for policymakers aiming to establish an environment promoting effective resource utilization for the broader economy. The impact of liquidity creation on bank competition contributes significantly to upholding financial stability, mitigating risks, fostering economic growth, ensuring effective resource allocation and formulating sound regulatory policies, thus enhancing the robustness of the financial system.

Literature Review

Financial intermediation is the process where financial institutions act as intermediaries, facilitating the movement of funds between savers and borrowers within the financial system. The theory of financial intermediation explores the roles of these entities in effectively allocating financial resources. By directing funds from depositors with surplus funds to debtor in need of investments, financial intermediaries play a pivotal role in the economy. A key function is risk management, achieved through diversification across a portfolio of assets, minimizing the impact of individual defaults. Additionally, they address information asymmetry, utilizing their expertise to evaluate the creditworthiness of borrowers and reduce risks for savers. An essential aspect of financial intermediation involves the transformation of asset and liability maturities. For instance, intermediaries accept short-term deposits and use them to extend long-term loans, known as liquidity transformation. Understanding financial intermediation theory is crucial for grasping financial market dynamics, ensuring banking system stability, and evaluating overall economic health. Liquidity creation, the conversion of illiquid assets into liquid liabilities, is vital for banks to fulfill responsibilities, ensuring stability and efficiency in the financial system (Diamond & Dybvig, 1983). Quantitative asset transformation function (QATF) is fundamental in financial intermediation, particularly for banks. It involves strategically modifying the nature of assets on balance sheets, converting less liquid assets into more liquid forms to contribute to overall financial system liquidity. The goal is to effectively manage challenges associated with maturity and liquidity disparities between a financial institution's assets and liabilities. Financial intermediaries, especially banks, play a central role in adjusting asset characteristics to meet client and market preferences. QATF equips financial institutions with improved liquidity control, which is essential for meeting depositor needs, extending loans, and adapting to market fluctuations. It is a strategic process financial intermediaries use to enhance liquidity management. It enables these institutions, particularly banks, to efficiently address depositor demands, facilitate lending activities, and respond adeptly to market fluctuations. Financial fragility theory, associated with Hyman Minsky, explores the cyclical nature of financial markets and their inherent instability. Minsky's thesis suggests that economic stability can lead to complacency and increased risk appetite, making the financial system vulnerable to shocks and crises. Financial fragility negatively impacts banks' liquidity generation when debt levels rise, short-term debt increases and liquidity falls. Stabilization policies, like capital requirements and banking restrictions, may impede liquidity creation (Diamond & Rajan, 2001).

Hypothesis Development

Liquidity Creation & Bank Competition

According to Diamond & Dybvig, (1983) one of the primary function of banks is to create liquidity between in the economy (Kashyap et al., 2002; Gatev & Strahan, 2006). Using relatively liquid or short-term deposits, banks can generate liquidity by providing long-term or illiquid loans. Liquidity creation for banks occurs either on the balance sheet, utilizing liquid liabilities and illiquid assets, or off the balance sheet, involving loan commitments. These commitments allow borrowers to make unpredictable withdrawals during the agreement term, ensuring emergency access to funds. To understand liquidity creation better, consider a scenario without banks, where savers directly support a company's long-term financial needs,

resulting in an illiquid claim against the corporation. Competition within the financial industry brings various advantages, promoting increased efficiency in financial services production and encouraging innovation. The global financial crisis renewed interest in the role of bank competition and the impact of state influence on competition policies and regulations affecting the degree of competition among banks. The effects of increased competition, especially in sectors like subprime lending, are subjects of ongoing debate, with some arguing that these factors worsened the financial crisis. Concerns have been raised about government assistance for major banks potentially intensifying financial concentration, limiting competition and access to credit, and contributing to future instability due to moral hazard concerns associated with 'too-big-to-fail' entities. Whether competition is beneficial or detrimental to financial stability remains contentious among academics and policymakers alike (Anginer et al., 2014). Ali et al., (2022) examined the impact of a risky environment on the ability of banks of various sizes to generate liquidity, the results indicate that competition among banks significantly undermines their ability to create off-balance sheet liquidity.

H₁: ***Bank competition has a significant impact on liquidity creation.***

Liquidity Creation, Bank Competition, and Financial Risk Management

Banks encounter significant challenges related to credit, operational, market, and liquidity risks, which can lead to bank failures with widespread repercussions due to the scale of these institutions. Mitigating these risks necessitates banks to comply with government regulations and maintain robust risk management frameworks. Governments may contemplate imposing stricter regulations to foster prudent decision-making and effective risk management within banks. The bank's ability to manage risk effectively is a crucial factor influencing investor confidence. Despite substantial revenues, inadequate risk management can result in reduced profits due to loan losses. Bank failures can significantly disrupt the flow of money, impacting the broader economy. In risk management activities, it is essential to involve everyone within the bank, not just the risk and compliance team. A bank can effectively control risk by having knowledgeable staff members well-versed in relevant rules and regulations. Banks must carefully weigh the trade-offs between costs and benefits associated with maintaining liquidity levels by addressing the need for liquidity from borrowers on and off the balance sheet and depositors. The competitive economic landscape exposes banks to multifaceted risks, including default, liquidity, and insolvency risks. To safeguard against potential threats like bank runs and default risks, banks often maintain excessive cash reserves as a precautionary buffer in competitive environments. Banks may limit their liquidity generation in highly competitive scenarios to mitigate these risks (Ali et al., 2022). From a competition viewpoint, banks with more influence have greater resources to navigate hostile market conditions. Conversely, when banks face limitations in market strength, they may be quick to issue funds (Petersen & Rajan, 1995). The effect of bank competition on liquidity involves a complex interplay of on and off-balance-sheet components. Empirical studies support the relationship between competitiveness and lower loan rates (Valverde et al., 2009; Love et al., 2015). Hainz et al. (2013) connect heightened concentration with increased collateral requirements, supporting the 'price channel' perspective.

H₂: ***Financial risk management practices have a mediating effect among bank competition and liquidity creation.***

Research Methodology

Saunders et al., (2017) research onion is used to elucidate the research methodology. The philosophical stance of positivism is adopted, guiding the researcher to utilize a deductive approach. The research design

is quantitative. Quarterly data is analyzed, sourced from secondary data such as financial statements and the Thomson Reuters financial data stream, covering 2004 to 2022. E-views software is employed for data analysis, utilizing the simple regression technique to examine the relationship between the constructs. The research sample comprises twenty Conventional banks listed on the Pakistan Stock Exchange (PSX), selected based on the availability of financial information in their annual reports. In the specified model, the dependent variable is denoted as liquidity creation (LC). The constant coefficient is represented by β_0, the independent variable is β_1 BC (bank competition), and β_2 FRM represents financial risk management. The error term is ε_t, with 't' indicating that the data is a time series.

$$LC_t = \beta_0 + \beta_1\,BC_t + \varepsilon_t$$

Dependent Variable (Liquidity Creation)

Berger and Bouwman (2009) devised a methodology for quantifying liquidity creation, systematically classifying, weighting, and combining balance sheet activities based on their liquidity characteristics. This approach captures the intricate relationship between different types of assets and liabilities in shaping a bank's overall liquidity position. The three-step approach proposed by Berger and Bouwman (2009) to measure liquidity creation is as follows: Classification of Activities: Assets, liabilities, and equities undergo categorization into illiquid, semi-liquid, or liquid based on factors such as time, ease, and cost associated with a bank's ability to liquidate assets or fulfill customer demands. Assigning Weights: Weights are allocated to the categories established in Step 1. The theoretical framework aligns with liquidity creation theory, where positive weights are assigned to liquid liabilities and illiquid assets. Liquid liabilities, exemplified by deposits, are utilized to fund less liquid assets, while negative weights are assigned to long-term liabilities, liquid assets, and capital. The negative weighting of capital reflects its impact on liquidity generation, and semi-liquid items receive zero weights. Joining the Activities: The categories of assets from Step 1 are multiplied by their assigned weights.

Independent Variable (Bank Competition)

In this study, we employ the Lerner index as the principal measure of insufficient competitiveness. The Lerner index serves as a proxy for a bank's profitability due to its reflection of market pricing power. It is computed at the individual bank level and has been widely utilized in various banking research studies. Our estimation is conducted using the methodologies outlined by Demirguc-Kunt and Martinez-Peria (2010). For banks, lerner index is developed using the trans log cost function.

Mediating Variable (Financial Risk Management Practices)

This study conducted an assessment of the risk management performance of traditional banks, employing the CAMEL grading system which covers the operational performance and risk management capability of the company. Return on equity (ROE) was utilized to evaluate banks' profitability, capital adequacy ratio (CAR) for assessing banks' capital sufficiency, nonperforming loan ratio (NPLR) and performing loan ratio (PLR) for gauging banks' asset quality, and liquidity ratio (LR) and loan-to-deposit ratio (LDR) for measuring banks' liquidity. This approach was chosen as the return on assets (ROA) of banks is highly correlated with their ROE, and their CAR is linked to their Tier 1 capital adequacy ratio (TCAR). Defined weighted were taken from the CAMEL rating method.

Findings

Descriptive Analysis

In these results, we have 76 observations for all three constructs. The researchers ran a descriptive analysis test to examine the central tendencies of variables. For BC, the average value is 0.079; for FRM, it is 0.197; and for LC, it is 0.233. Standard Deviation measures the dispersion or variability of the data around the mean. Therefore, the BC is dispersed at 0.069, FRM is dispersed at 0.103, and LC is dispersed at 0.059. Skewness measures the asymmetry of the distribution. So, the value of skewness for BC is a positive 1.111, which means BC has a longer right tail. In contrast, FRM and LC have a negative skewness value of – 3.464 and -0.675, meaning they have a longer left tail. Kurtosis measures if the distribution is flat or has a peak. BC kurtosis value is 2.915, meaning BC has a flat distribution, while FRM and LC kurtosis value is 24.024 and 3.746, meaning their distribution peaks.

Table 1: Descriptive Analysis

	BC	FRM	LCF
Mean	0.0791	0.1979	0.2335
Std.Dev	0.0692	0.1035	0.0598
Skewness	1.1115	-3.4643	-0.6755
Kurtosis	2.9156	24.024	3.7469
Jarque-Bera	15.672	1551.7	7.5473
Probability	0.0003	0.0000	0.0229
Observations	76	76	76

Normality Test

Unit Root Test

The Unit Root test was used to check if the data was stationary or non-stationary. The null hypothesis is (H_o = the series is non-stationary). The results suggest that the data for Liquidity Creation is stationary at Level I and First Difference because the prob value is less than 5%. Therefore, we rejected H_0.

Table 2: Unit Root Test

Variables	I(0)		I(I)	
	C	**C&T**	**C**	**C&T**
LCF	0.0285	0.2018	0.0001	0.0001
BC	0.0307	0. 0251	0.0001	0.0000
FRM	0.0089	0.0000	0.0000	0.0000

Diagnostic Analysis

The researcher employed simple linear regression techniques to forecast the dependent variable using time series data to assess the link between bank competition and liquidity creation. A simple regression technique is used; however, before running the regression analysis, some diagnostic tests are run, such as multi-collinearity, auto-correlation, and heteroscedasticity, and several statistical tests are run to check the existence and severity of the said problems. If the centered VIF values are less than 10, the model has no multi-collinearity problem. The Variance Inflation Factor findings reveal that the model has no multi-collinearity as the value falls under the criteria of less than 10. Therefore, it is determined that the constructs do not correlate. As a result, we accept the null hypothesis (Ho: There is no multi-collinearity).

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	0.000101	2.188101	NA
BC	0.009263	2.188101	1.000000

The Durbin Watson is used to identify auto-correlation problems in the model. The Durbin-Watson value is 0.291725, less than 2, suggesting that the model has positive autocorrelation. However, to determine the degree of auto-correlation, the researcher employed the Serial Correlation LM test with a null hypothesis (Ho = There is no auto-correlation in the model). If the prob value is more than 0.05, we will accept the hypothesis; otherwise, we will reject it. Because our model's prob value is greater than 0.05, we may conclude that the model has no auto-correlation.

Table 4: Breusch-Godfrey Serial Correlation LM Test

F-Statistics	137.2628	Prob F(1,73)	0.0520
Obs*R-Squared	49.61397	Prob Chi-square(1)	0.0618

The researcher uses the Heteroscedasticity White Test to assess the degree of heteroscedasticity in the model. The result of the heteroscedasticity white test is 0.0659, which is greater than 5%. As a result, it accepts the null hypothesis, which says (Ho= There is no heteroscedasticity in the model). The above-mentioned diagnostic output suggests that there is no issue of multi-collinearity, auto-correlation, and heteroscedasticity in the data and the model. It means that the researcher can apply the partial least square method to achieve the research objective.

Table 5: Heteroscedasticity Test: White

F-Statistics	3.841574
Obs*R-Squared	7.237190
Prob. F(2,73)	0.0659
Prob. Chi-Square (1)	0.0768

1.1. Regression Analysis

Equation – 1 (Regression Analysis) $LC_t = 0.222 + B_1 \ 0.142_t + e_t$

Table 6: Regression Analysis

Variable	Coefficient	Std. Error	T-Statistics	Prob. Value
C	0.222576	0.010072	22.09844	0.0000
BC	0.142785	0.096246	1.483542	0.0142
R-Squared			0.288883	
Adjusted R-Squared			0.015760	
F-Statistics			2.200897	
Prob (F-Statistics)			0.0142	
Durbin Watson			0.291725	

We have used the Least Squares estimation approach to test the hypotheses to achieve the research objective. Nineteen years of data were used to run the regression model. According to the R-squared value, the independent variable, BC, predicts 29% of the change in LC. The value for F-Statistics is less than 5%, which suggests that there is also a combined effect in the model. The constant parameter has a positive value of 0.22, indicating that all other factors held constant, the value for LC would remain 0.22. If BC rises by one unit, the value for LC increases by 0.143, assuming all other variables remain constant. BC has a positive significant impact on the creation of liquidity. The prob value is significant at a 5% level of significance, and t-statistics is also significant.

Mediation Analysis

Equation - 1: $FRM_t = \beta_0 + \beta_1\, BC_t + \varepsilon_t$
Estimated Equation - 1: $FRM_t = 0.133 + 0.829\, BC_t + \varepsilon_t$

Table 7: Mediation Analysis (Eq-1)

Coefficients

Model	Unstandardized Coefficients		T	Prob. Value
	B	**Std. Error**		
(Constant)	0.133953	0014522	9.224	0.000
BC	0.829882	0.138769	5.980	0.000
R-Squared		0.32589		
Adjusted R-Squared		0.31671		
Prob (F-Statistic)		0.00000		
Durbin Watson		1.609		

a. Dependent Variable: Financial Risk Management

The researcher calculates the equation in equation 1 by using bank competition as an independent variable and financial risk management as a dependent variable, to meet the first assumption of Barron and Kenny's (1983) approach of mediation analysis. The equation is computed using multiple regression techniques using time series data. The model's r-square value is 0.325, showing that BC accounts for just 32.5% of the variation in financial risk management, with the remaining 67.5% ascribed to other variables. Time series data multiple regression results reveal that commercial bank rivalry has a considerable favorable influence on their financial risk management.

Equation - 2: $LC_t = \beta_0 + \beta_1\, BC_t + \beta_2\, FRM_t + \varepsilon_t$
Estimated Equation - 2: $LC_t = 0.2250 + 0.1582\, BC_t - 0.01860\, FRM_t + \varepsilon_t$

Table 8: Mediation Analysis (Eq-2)

Coefficients

Model		Unstandardized Coefficients		T	Prob
		B	**Std. Error**		
	(Constant)	0.2250	0.014863	15.142	0.000
	BC	0.15822	0.11797	1.3411	0.1840
	FRM	-0.01860	0.081147	-0.2292	0.8193
2	**R-Squared**		0.29582		
	Adjusted R-Squared		0.0299		
	Prob (F-Statistic)		0.332197		
	Durbin Watson		0.29782		

a. Dependent Variable: Liquidity Creation

In equation 2, the mediator is included as an independent variable, i.e., FRM, to meet the second assumption of Barron and Kenny's (1983) approach of mediation analysis. Results show that the model's r-square value is 0.29582, indicating that BC accounts for just 29.58% of the variation in the LC in the commercial banks of Pakistan, while the other 70.42% could be attributed to other factors. The time series data multiple regression results show that the BC has an insignificant positive impact on LC when the mediator is used as the independent variable. Moreover, adding the mediator as an independent variable makes BC insignificant, as in the equation, we have a significant positive impact of BC on LC. The Sobel test results show that FRM does not mediate the relationship between BC and LC. The result of Aroian and Goodman (2005) also suggests that the FRM does not mediate the relation between BC & LC. The mediation analysis shows that after fulfilling the above four assumptions of Baron & Kenny (1986), and the Sobel test, the findings suggest that FRM does not mediate between BC and LC.

Table 9: Sobel Test

Test	t-Statistics	Std. Error	P-Values

Sobel	0.0227	0.6791	0.9818
Aroian	0.0227	0.6791	0.9818
Goodman	0.0227	0.6791	0.9818

Discussion

Pakistan witnessed substantial economic growth over four decades until 1988-89, with an average growth rate exceeding 5%, leading to a significant decline in the poverty rate from 40% to 18% by the end of the 1980s. However, an analysis of economic and social indicators from 1947 to 2003 reveals a nuanced reality, where economic progress outpaced social development. The financial system in Pakistan plays a pivotal role in driving economic development by facilitating credit access, investment opportunities, and efficient resource allocation. A well-functioning financial system is crucial for sustainable economic growth and global competitiveness, ensuring effective fund utilization, stimulating economic expansion, and creating a secure environment for investment and credit. Additionally, a stable financial system enhances Pakistan's international competitiveness, attracting foreign investment and reducing dependence on traditional sectors for overall economic resilience and growth. Financial institutions are essential for advancing the financial sector by accepting deposits, providing loans, facilitating investments, and managing risks. They contribute significantly to economic growth by efficiently allocating capital and resources, introducing innovative financial products, enhancing financial literacy, and promoting financial inclusion. Financial institutions also play a pivotal role in maintaining financial stability through risk management and sufficient capital reserves. In conclusion, financial institutions are instrumental in developing the financial sector, fostering economic growth, and ensuring financial stability. The financial performance of commercial banks in Pakistan is intricately linked to the country's monetary policy, formulated and implemented by the State Bank of Pakistan (SBP). SBP's monetary policy decisions can have diverse effects on commercial banks' financial performance. For instance, an raise in interest rates by the SBP may lead to higher net interest income for commercial banks but could also raise their cost of funds. Conversely, a reduction in interest rates may result in lower net interest income for commercial banks but could decrease their cost of funds. SBP's monetary policy decisions can also impact the liquidity position of commercial banks, influencing the demand for credit and the availability of funds in the money market. Lastly, these decisions can influence the asset quality of commercial banks, as changes in interest rates can impact borrowers' creditworthiness and the value of banks' loan portfolios. In conclusion, the financial performance of commercial banks in Pakistan is closely tied to monetary policy, and the decisions made by the SBP can have diverse implications for these banks. Ali et al., (2023) identify the influence of monetary policy on liquidity creation in Pakistan.

Conclusion & Recommendations

The competition among banks in Pakistan plays a pivotal role in shaping liquidity creation within banking sector. The pursuit of competitiveness drives banks to formulate inventive strategies to attract deposits and boost loan volumes, thereby fostering increased liquidity in the financial sector. This competitive landscape compels banks to offer attractive interest rates on deposits, attracting more depositors and expanding the pool of funds available for lending. This, in turn, contributes to economic growth, given that loans constitute a substantial portion of the money supply in the economy. Furthermore, competition incentivizes banks to enhance operational efficiency through the adoption of modern technology and optimization of procedures. This not only improves customer service but also accelerates loan disbursement, thereby enhancing overall liquidity management in the banking industry. Moreover, the competitive environment stimulates banks to introduce new financial services and products, creating additional channels for liquidity production. For example, tailored loan products aimed at specific industries or customer groups can increase credit availability, further contributing to liquidity in those specific sectors. Monitoring the influence of competition on liquidity production is crucial for maintaining financial stability. Competitive pressures may

lead to aggressive lending practices, elevating the risk of non-performing loans. Therefore, regulatory bodies must maintain close supervision to mitigate excessive risk-taking and uphold financial stability. In conclusion, competition among Pakistan's conventional banks fosters innovation, heightened loan activity, improved operational efficiency, and the introduction of new financial products, all of which positively influence liquidity generation. Balancing robust competition with financial stability requires vigilant observation and regulatory oversight.

For Future Researchers: The correlation between bank competition and liquidity generation is a focal point for scholars and policymakers. Future research should focus on accurate measurement of bank competition, considering market structure, exploring the interplay between competition and risk-taking behavior, assessing institutional factors and regulations, and investigating technological advancements and innovation. By optimizing competition metrics and delving into these areas, researchers can contribute to shaping policies that promote sustainable liquidity generation in the banking industry. **For Policy Makers:** Understanding how bank competition affects liquidity in traditional banking is crucial for Pakistan's government. Policymakers can enhance liquidity generation by promoting financial inclusion, encouraging innovation and technological advancements, strengthening regulatory frameworks, and developing a supportive infrastructure. These practical conclusions from existing research can guide policymakers in devising effective strategies to foster competition in the banking sector, ultimately contributing to financial stability and economic growth. **For Banks:** Bank competition is vital for financial stability and economic growth. Recognizing the effect of bank competition on liquidity creation has significant implications for Pakistan's government. To support economic growth, banks should focus on enhancing financial inclusion, promoting market efficiency, strengthening risk management, encouraging innovation, and fostering collaboration with the central bank. These real-world effects underscore the importance of healthy competition among banks. The government plays a crucial role in crafting a regulatory framework that nurtures competition and ensures a stable financial system, thereby strengthening the nation's capacity to generate liquidity.

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The value relevance of environmental, social, and governance disclosure: Evidence from listed companies of Pakistan

Anum Noor, Mubashir Ali Khan, Muhammad Rahies Khan
Bahria University Karachi Campus, Pakistan

Abstract

The purpose of this study is to examine the value relevance of financial and non-financial information in public listed companies of Pakistan. A panel sample of 35 companies was selected for the analysis from 2010-2020. Ohlson (1995) model was modified with the incorporation of ESG disclosure score to test the value relevance of environmental, social, and governance disclosure of companies. The examination of value relevance came up with the evidence that book value per share is not value relevant, earnings per share is positively and significantly value relevant while ESG disclosure score is negatively and significantly value relevant for listed companies in Pakistan. The findings of the study reveal that ESG disclosure has been taken as a negative factor in the valuation of the company and investors consider ESG activities are achieved at the cost of shareholders. The study contributes to the knowledge of the value relevance of financial and non-financial information for decision-making. The top-level administrators and leaders may use the findings of this study in the decision-making of their organizations regarding the dedication of resources to ESG activities along with gaining investor confidence and help them in the formulation of effective disclosure strategies. This study used a comprehensive score of ESG disclosure which brought an opportunity for future studies to test the value relevance of dimensions of ESG separately for clearer insights to value relevance results.
Keywords: Value relevance, Environmental, social and governance disclosure, corporate social responsibility

Introduction

The superseding goal of financial reporting and publically available financial statements is to give information regarding the organization's financial position and financial performance, which is helpful to a wide scope of stakeholders, for surveying the management of the board and for settling on economic choices. One of the economic decisions is the valuation of stock value. An inquiry accordingly is raised regarding the yearly financial statements is pertinent for stock price valuation. Value relevance is characterized as the capacity of available information to determine the value of a firm or company. According to Francis and Schipper (1999), value relevance is considered as the functionality of financial information and the ability of financial statement data to impact the share values. In short, value relevance studies are to determine the association between accounting information and share prices. The studies using value relevance approach are of most interest mainly for shareholders and stakeholders using accounting information while investing. The target of value relevance study is to associate yearly Financial Statements content as a measure of firm value and to evaluate the connection of this data to the assurance of significant worth. Along with Amir and Lev (1996), a great number of researches looked at the valuation role of non-financial information. These examinations provide proof on the predictability of non-financial related measurements for the future financial performance of the firm (Behn & Riley, 1999; Ittner & Larcker, 1998) and on the Value Relevance of non-financial data comparative to financial data. In actuality, there is the twofold role of this non-financial data: firstly, it provides information to stakeholders regarding the organization's environmental effect and, secondly, it causes firms to make a positive organizational picture with all key stakeholders (Brammer & Pavelin, 2006; Callan & Thomas, 2009), subsequently getting progressively important for firm valuation (Agostini & Costa, 2012).

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The Securities and Exchange Commission of Pakistan (SECP) has given Corporate Social Responsibility Voluntary Guidelines in 2013. As per these guidelines, the companies in Pakistan are required to disclose environmental and social information in their annual reports to make them available for their users especially investors. Such information is supposed to publish under the shareholders and directors' section of the annual report. Hence, if environmental performance affects the future of the company, there is an expectation that stockholders will consider this in the method of company's valuation. Generally, Corporate Social Responsibility (CSR) has received major consideration in the previous years, both among managers and in the academic literature. Utilizing a non-financial variable of disclosure quality of environmental information, Hasseldine et. al. (2005) presented an empirical proof that the nature of the environmental exposure as opposed to simple quantity puts a stronger impact on the production of the environmental reputation among managers and stakeholders. Also, they proposed that further examination of the effect of CSR exposure technique and capital market value could be incredibly helpful in knowing the importance of Corporate Social Responsibility disclosure quality and quantity.

This study aims to test the value relevance of financial information and non-financial information in Pakistan. The financial information is taken as book value per share and earnings per share and non-financial information is taken as environmental, social and, governance disclosure score from Bloomberg for listed companies in Pakistan. The Ohlson (1995) model is used to test the value relevance.

Literature Review

Value Relevance of financial information

Badu and Appiah (2018) concluded that financial statement is value relevant for investors in Ghana Stock exchange but they put more emphasis on the income statement than the balance sheet. In Pakistan, accounting information is value-relevant for commercial banks. So, investors should consider accounting information in decision-making. The accounting information proved to be value relevant for Pakistani banks is equity, firm size, operational profit, EPS, nontraditional activities, and firm age for the period between 2007 to 2012 (Perveen, 2019). Ahmadi and Bouri (2018) investigated the value relevance of financial variables i.e. book value of equity and earning per share. It was also noted that financial variables are more value relevant for banks as opposed to financial institutions in Tunisia. For investors, it gives insights into the determinants of the share price. Pirie and Smith (2003) performed a study with an aim to know how published accounting information was relevant to the stock prices of developed Asian markets. Results of the study showed that financial variables summarizing the balance sheet and income statement respectively are important factors in the method of valuation, and managers have reason to use the accounting system as the main source of information to monitor financial performance.

Value Relevance of non-financial information

Flammer (2012) contributed to the literature on the evolution of the relationship between environmental CSR and stock prices over time. They studied the relationship for all U.S. publicly listed firms for a period of three decades from 1980 to 2009. The argument was that environmental initiatives and Corporate Social Responsibility create goodwill for the firm and protect a firm if any negative event happens in the firm. Flammer (20 12) suggested that if a company is positively involved with the environment, it generates competitive and new resources for the firm. Wang et. al. (2014) investigated the mediation effect of CSR outcomes on the relationship between CSR governance and financial performance using the ESG disclosure score from Bloomberg for top 500 green companies in the United States from 2009 to 2013. They found that CSR outcomes mediate the relationship between CSR governance and financial performance. The results suggested that companies implementing CSR governance successfully to generate good CSR outcomes plays an important role in influencing companies' financial performance. A study by Szegedi et al. (2020) examined the relationship between CSR disclosure and the financial performance of 20 listed

banks on the Pakistan Stock Exchange from 2008 to 2018. The findings of the study showed a moderate level of CSR disclosure in Pakistani listed banks, but the trend was increasing. It also concluded that involvement of bank in CSR activities and their disclosure resulted in increased accounting-based economic performance but had no impact on market-based financial performance.

Verbeeten et al, (2016) attempted to test the value relevance of voluntary corporate social responsibility disclosure in Germany. It was revealed that the environmental aspect of CSR had zero impact or even negative impact on stock price which was in accordance with socio-political theories. It suggested that increased CSR disclosure to cater to some stakeholders' requirements like environmental NGOs was achieved at the cost of other stakeholders like shareholders. It means companies should be well known for these trade-offs while formulating a CSR disclosure strategy. On the other side, the social aspect of CSR disclosure is positively related to the stock price which is in accordance with economic theory. Middleton's (2015) study suggested that the integral environmental performance variable had value relevance for shareholders in Russia. The pharmaceutical industry was supposed to provide solutions regarding health-related issues to humans. A study by Malik and Kanwal (2018) conducted in the Pharmaceutical industry of Pakistan suggested the growth in CSR disclosure level from 2005 to 2014. It also concluded that the financial performance of pharmaceutical companies in Pakistan is positively affected by CSR disclosure with the mediation of brand equity.

Yu et. al (2018) investigated whether environmental, social, and governance (ESG) transparency and the extent of ESG disclosure had an impact on firm value. Reducing investors' information symmetry and agency costs is the mechanism by which better ESG transparency potentially impacts firm value. The study concluded that shareholders react greatly to the revelation of such news. It was also demonstrated that the higher the degree of coverage by newspapers, the higher the decrease in market value. Environmental concerns have received much significance in developing countries. Javeed et al. (2020) investigated the relationship between environmental regulation and financial performance in the Pakistani context by targeting 242 firms from 16 sub-sectors of the manufacturing sector of Pakistan. The results of their study showed a positive association between environmental regulation and financial performance and concluded that companies that spend more resources on pollution control experience better financial performance because stakeholders consider these companies as socially responsible.

According to Fazzini and Dal Maso, (2016), environmental reporting has encountered incredible intrigue and application because of the crisis of unsustainability brought about by environmentally and socially irresponsible conduct. Furthermore, a study conducted by Khan et al. (2019) investigated environmental reporting in the Oil and Gas industry of Pakistan from 2010 to 2014. The results of the study revealed an upward trend in reporting CSR activities. Also, most companies in the sample had a very low environmental reporting level. It also concluded the active role at the companies' end in the circulation of information related to environmental activities in the Oil and Gas industry of Pakistan. De Klerk and De Villiers, (2012) looked at the value relevance for the corporate responsibility reporting given by organizations. So, not so the degree of corporate responsibility reporting causes the degree of market value, yet the corporate responsibility reporting is related to the information which investors use to value an organization.

Wang et al., (2014) conducted a study to determine the relationship between corporate social performance and corporate financial performance in companies in Taiwan. The practical implication was that companies can improve their financial performance if they improve their corporate social performance. A study conducted by Cardamone et al., (2012) tested whether social reports published by companies are the source of information for company's market value. The results of the study showed that social report publications harmed share prices and indicated a negative correlation between social report publication and share value. A significant positive correlation was reported between book-value per share (BPS) and share price and between earnings per share (EPS) and share price.

Al-thuneibat et al., (2008) investigated if the audit report was value relevant and informative in Jordan. Al-thuneibat et al., (2008) concluded based on a study that the users of audit report must be educated about the importance of audit report because the results of the study can be affected if the users of audit report did not use information correctly, hence showing no effect on share prices. Hendricks and Singhal, (1996)

investigated the effects of gaining quality awards on the company's market value by estimating the change in share price in the sample of public firms. The results reflected that stock market positively responds to quality winning awards. The relationship between corporate social responsibility disclosure and access to financial resources for companies operating in the non-financial sector of Pakistan was studied by Anwar et al. (2019). The findings of the study suggested a positive relationship between corporate social responsibility disclosure and access to financial resources for companies as witnessed by fewer financial constraints. When the company has lesser financial constraints, it has stronger access to financial resources (Anwar et al., 2019). Ashfaq and Rui (2019) investigated social and environmental reporting patterns in Pakistan for the period from 2013 to 2015 for all public companies listed on the Pakistan Stock Exchange. Their results depicted that level of social and environmental reporting is moderate for Pakistani companies. The trend is increasing with time for social disclosure, but the opposite is witnessed for the environmental disclosure means environmental disclosure is of lower concern for Pakistani companies when it comes to disclosing environment-related information.

Theories suggest a positive as well as a negative relationship between discretionary disclosure and stock price movements. Economic theory (Dye, 1985; Verrecchia, 1983) suggests that there is a positive relationship between discretionary CSR disclosure and stock price movements. According to this theory, companies should disclose all the information which they possess. If good-performing companies always disclose information, it creates a bad impression of companies that do not disclose information because these are average-performing companies. So, their non-disclosure becomes a cost for them and results in decrease in the firm value. Hence, companies need to adopt a partial disclosure equilibrium. To apply this, managers need to trade-off between when to share information and when not to based on the costs associated with disclosure (Verrecchia, 1983) and when there is no determination that any information exists in the company (Dye, 1985).

Conversely, socio-political theories inclusive of legitimacy theory and stakeholder theory suggest that CSR disclosure and stock price are negatively associated. According to these theories, CSR disclosure is the combination of social, political, and other stakeholders' demands faced by the company. Under legitimacy theory, companies are obliged to have a social contract with society and perform such activities that are socially accepted and required for the sake of their approval and ultimate existence of their businesses in the society (Reverte, 2009). Kuo and Da Silva Monteiro and Aibar-Guzman (2010, 2013) studies presented that companies disclose the information in their reports as a way to administer their legitimacy. On the other hand, stakeholder theory specifies that stakeholders in society have expectations from businesses and such expectations shape the disclosure strategies of the company (Reverte, 2009). This shows that CSR disclosure is a mechanism incorporated by businesses to cater to information needs and manipulate the key stakeholders of the business. Based on the reviewed literature and theories studied, we expect the relationships of our variables to be significant.

Three hypotheses are developed to test to achieve the purpose of the study.

H_1: Book value has an impact on the market share price.

H_2: Earning has an impact on the market share price.

H_3: Environmental, social and governance disclosure has an impact on the market share price.

Methodology

The methods of research for data collection and analysis of data are discussed in this chapter including phases of this study. Phase one of the study is about testing the value relevance of financial information while phase two of the study discusses the method for testing the value relevance of environmental, social, and governance disclosure. The final section describes the valuation model i.e. Ohlson (1995) with the modification to the model by incorporating the ESG disclosure score. The final section of this chapter describes regression models and data analysis methods.

Sample

We aim to extend the previous studies on the value relevance of non-financial information to Pakistan. The population of this study consists of all the listed companies on the Pakistan Stock Exchange. Since the data of the ESG score on Bloomberg is available for a limited number of Pakistani listed companies, our focus remains on those companies whose data is available on Bloomberg. There is a total of 540 companies listed in PSX. Our sample contains 35 public listed companies in Pakistan. The data for all variables were extracted from the Bloomberg terminal. The period covered in this study is from 2010 to 2020.

Environmental, social and governance Disclosure Score

ESG (Environmental, Social, and Governance) data is a comprehensive set of data points that covers a variety of environmental, social, and governance themes. A very comprehensive methodology is used to evaluate companies for the environmental, social, and governance activities in ESG (Marquis et al., 2010). Yu et. al. (2018) identify Bloomberg's ESG disclosure score as an appropriate symbol to measure the company's transparency. Only the amount of ESG data available publicly is measured in the ESG score and not the performance of the company is measured. The basis for the score is the degree of ESG disclosure by the company. Yu et al. (2018) assume that a company's ESG score reflects the company's voluntary and mandatory disclosure which can be helpful for investors and stakeholders to evaluate publicly listed companies. The higher the ESG Score, means the more non-financial information disclosure exists

Valuation Model

The literature reveals that Ohlson (1995) model is extensively used in the determination of the value of companies (Ahmadi & Bouri, 2018; Badu & Appiah, 2018; de Klerk & de Villiers, 2012; Fazzini & Dal Maso, 2016; Graham et al., 2002; Middleton, 2015; Pirie & Smith, 2003; Verbeeten et al., 2016). The effectiveness of accounting variables for determining the firm value is emphasized in the work of Ohlson (1995). The value relevance of financial and non-financial information is measured using the Ohlson (1995) model modifying by adding the environmental disclosure score taken from Bloomberg. The study also considers several control variables for better outcomes. In finance-related studies, the size of the firm is of great importance in literature and it is calculated as a natural log of total assets (Javeed et al., 2020). In addition to size, age is used as a control variable (Flammer, 2012; Hassan, 2018).

The Ohlson (1995) model and the modified model are as follows:

$$SP_{xy} = \beta_0 + \beta_1 BV_{xy} + \beta_2 EPS_{xy} + \mu_{xy} \quad (1)$$

$$SP_{xy} = \beta_0 + \beta_1 BV_{xy} + \beta_2 EPS_{xy} + \beta_3 ESGSCR_{xy} + \mu_{xy} \quad (2)$$

$$SP_{xy} = \beta_0 + \beta_1 BV_{xy} + \beta_2 EPS_{xy} + \beta_3 ESGSCR_{xy} + \sum \beta_n CONTROLS_{xy} + \mu_{xy} \quad (3)$$

Where:
SP_{xy} = Company x share prices at year y;
BV_{xy} = Company x Book value per share at year y;
EPS_{xy} = Company x Earning per share at year y;
$ESGSCR_{xy}$ = Company x ESG disclosure score by Bloomberg at year y;
$CONTROLS_{xy}$ = Company x age and size at year

Variables and their estimation methods

Table 3.1: Variables and their estimation

Variable	Symbol	Explanation	Source
Share Price	SP	Share price three months after the end of the fiscal year	Bloomberg
Book Value	BV	Book value of equity per share at the end of the fiscal year	Bloomberg
Earnings per share	EPS	Net income per share over the fiscal year	Bloomberg
ESG Disclosure Score	ESGSCR	Environmental, social and governance Disclosure Score ranging from 0.1-100 from Bloomberg	Bloomberg
Age	CONTROL	Log of the total number of years since the inception of the company	Bloomberg
Size	CONTROL	The size of the company is calculated as the log of total assets of the company	Bloomberg

Results

Descriptive Statistics

To get an overview of data, descriptive statistics calculated for independent and dependent variables are presented in Table 4.1. The descriptive analysis is performed on the full sample.

Table 4.1: Descriptive statistics for independent and dependent variables

Variables	Share Price	EPS	BVPS	ESG Score	Size	Age
N	385	385	385	385	385	385
Mean	669.6914	33.05883	158.0503	20.80524	10.53867	47.75584
Median	161.9000	14.55650	81.34148	18.59500	10.45367	51.00000
Maximum	12999.50	610.7700	1602.561	53.30580	11.88457	107.0000
Minimum	1.800000	-118.22	1.458300	5.785100	9.478239	9.000000
Std. dev.	1668.473	70.36541	220.6922	9.092141	0.578146	21.78787

Notes: EPS: earning per share, BVPS: book value per share, ESG: environmental, social, and governance.

Correlation Statistics

Correlation is analyzed to check for multicollinearity. Multicollinearity is present in data when two or more than two independent variables are correlated. So, the correlation coefficients of independent variables are calculated, and the significance is interpreted before testing the regression models. Correlation coefficients and their significance for independent variables are presented in Table 4.2.

Table 4.2: Correlation coefficients for independent variables

| Variables | Correlation Matrix | | | | | |
	SP	EPS	BVPS	Age	ESG Score	Size
SP	1					
EPS	0.804 (0.0000)	1				
BVPS	0.546 (0.0000)	0.721 (0.0000)	1			
Age	-0.226 (0.0000)	-0.218 (0.0000)	-0.030 (0.5628)	1		
ESG Score	-0.197 (0.0001)	-0.154 (0.0024)	-0.072 (0.1607)	0.145 (0.0042)	1	
Size	-0.080 (0.1161)	-0.066 (0.1944)	-0.036 (0.4770)	0.156 (0.0021)	0.111 (0.0295)	1

Regression Results

The purpose of this study is to examine the value relevance of financial and non-financial information. The value relevance is examined by using the value relevance model by Ohlson (1995) and modified to add non-financial information variable of ESG disclosure. At the first stage, the Hausman test is being used for selecting the most appropriate model between fixed effects and random-effects models. Table 4.3 shows the results of the Hausman test.

Table 4.3: Hausman (1978) test results

Hausman (1978) Test	
Chi-square statistic	13.717114
P-value	0.0175

As reported in Table 4.3, the probability value for the Hausman test is less than 0.05 which means that the suitable method for the analyses is the Fixed Effects Model. The first regression is conducted on the original Ohlson (1995) model i.e. Model 1 in our study. Following is the multiple regression model estimated:

$$SP_{xy} = \beta_0 + \beta_1 BV_{xy} + \beta_2 EPS_{xy} + \mu_{xy} \qquad \text{------ (1)}$$

The results for Model 1 are shown in Table 4.4. Results reveal the overall fit of the model with F-statistic 61.45 which is highly statistically significant with a p-value less than 0.05. Coefficient of EPS shows a positive relationship with share price and statistically significant at a p-value less than 0.05. This finding is consistent with (Ahmadi & Bouri, 2018; Badu & Appiah, 2018; Pirie & Smith, 2003). The coefficient of BVPS indicates a negative relationship with share price and is statistically insignificant as the p-value is greater than 0.05. This finding is consistent with (Brimble & Hodgson, 2007; Jiang & Stark, 2013). This suggests that EPS is value relevant for Pakistani companies while BVPS is not value relevant for Pakistani companies when tested for value relevance of financial information (EPS and BVPS). Furthermore, the adjusted R^2 shows a higher explanatory power of 65.4%. The results of this model do not support hypothesis 1 but support hypothesis 2.

Table 4.4: Regression Results

Variables	Model 1		Model 2		Model 3	
	Coefficients	P-value	Coefficients	P-value	Coefficients	P-value
EPS	20.61316	0	20.17638	0	19.77336	0
BVPS	-0.62279	0.0597	-0.584216	0.0754	-0.51354	0.124
ESG Score			-14.59409	0.011	-13.8691	0.016
Age					-2.870492	0.2393
Size					-63.06278	0.4784

Constant	86.67678	0.1619	398.653	0.0037	1187.403	0.2053
N	385		385		385	
R-squared	0.664		0.6705		0.672	
Adj. R-squared	0.654		0.6589		0.659	
F-statistic	61.45		58.07		50.48	
Prob	0.0000		0.0000		0.00	

The model tested further is below:

$$SP_{xy} = \beta_0 + \beta_1 BV_{xy} + \beta_2 EPS_{xy} + \beta_3 ESGSCR_{xy} + \mu_{xy} \text{ -- (2)}$$

The regression outcomes of Model 2 are presented in Table 4.4. The outcomes present the overall fit for model with the F-statistic 58.07, highly statistically significant with a p-value which is less than 0.05. The coefficient of EPS remains positive with share price and statistically significant with a p-value of less than 0.05. The coefficient of BVPS remains negative with share price and statistically insignificant with a p-value that is greater than 0.05 even with the inclusion of ESG score in the model. The coefficient of ESG shows a negative relationship with share price and statistically significant with a p-value less than 0.05. The higher explanatory power of 65.89% is reported in this model measured by adjusted R^2. This result supports our Hypothesis 3. Model 2 does not consider the size and age of companies, so, to see the impact of control variables on the overall model, control variables are added and tested in Model 3.

The results of Model 3 are presented in Table 4.4. The regression model is:

$$SP_{xy} = \beta_0 + \beta_1 BV_{xy} + \beta_2 EPS_{xy} + \beta_3 ESGSCR_{xy} + \sum \beta_n CONTROLS_{xy} + \mu_{xy} \text{ ----- (3)}$$

In Model 3, control variables of size and age of the companies are added along with EPS, BVPS and ESG Score to check if there is a significant difference in results between model 2 and model 3. Overall model 3 is fit with an F-statistic of 50.48 with a p-value less than 0.05 which is less as compared to 58.07 for model 2. The coefficient of EPS remains positive with share price and statistically significant having a p-value of less than 0.05 even with the inclusion of control variables. But the value of the coefficient decreased from 20.17 to 19.77. The coefficient of BVPS remains negative with share price and statistically insignificant with the inclusion of control variables in the model. BVPS coefficient is also increased from -0.58 to -0.513540 with the inclusion of control variables. This result is consistent with Brimble and Hodgson (2007) who suggested that market inefficiencies play a critical role in the relationship between financial information and share prices and also the statistically significant decline in the relationship when the control variables are added in evaluation. Similarly, our results also suggest that BVPS is not relevant as compared to EPS in firm valuation in Pakistan. The coefficient of the ESG Score shows a negative relationship with share price and is statistically significant with a p-value less than 0.05 but the value increased from -14.59 to -13.86 when control variables are included. The age and size of the company are negatively related and insignificant.

The explanatory power of the model is increased from 65.89% to 65.9% with the inclusion of control variables. The results of this model are supportive of hypothesis 3. The results of the model are consistent with (Cardamone et al., 2012; Verbeeten et al., 2016). As suggested by Verbeeten et. al. (2016), increased CSR disclosure to cater to some stakeholders' requirement like environmental NGO's is achieved at the cost of other stakeholders like shareholders and shareholders take this disclosure negatively in their evaluation and make investment decisions accordingly which ultimately impact the company's overall worth. According to Cardamone et. al. (2012), the market is not appreciative of the disclosure of reports containing environmental or social information of the activities of companies. He explained this with the help of two reasons. First, investors take companies' social and environmental activities as diverting activities because these are not the main purpose of business and consider this as a waste of resources in the shape of the company's expenses. Second, investors contemplate disclosure reports as essential but do not judge the content of these reports positively. The results of our model are also consistent with stakeholder theory which specifies that stakeholders in the society have expectations from businesses and

such expectations shape the disclosure strategies of the company (Reverte, 2009). This shows that investors consider non-financial information disclosure regarding ESG activities as a mechanism incorporated by businesses to cater to information needs and manipulate the key stakeholders of the business.

Conclusion

Value relevance studies are aimed at explaining how financial information is reflective of the information used by investors in their valuation. As result, their findings are supposed to improve the relevance and authenticity of financial information. Studies have been using the value relevance of financial information taking into account both the balance sheet and income statement measures utilizing the Ohlson (1995) model. But fewer studies are studying the value relevance of non-financial information besides financial information. The objectives set for this study were to test the value relevance of financial information (book value per share and earnings per share) and the value relevance of environmental, social, and governance disclosure for listed companies of Pakistan.

Companies that are performing poorly in CSR activities will try to inflate their disclosure to change stakeholders' perception regarding the company's CSR performance or their action because these companies face greater political and social pressure as well as threatened legitimacy. The size and age of the company do not appear to significantly influence share prices by interacting with the ESG disclosure score. The results of the study supported hypothesis 2 and hypothesis 3 while hypothesis 1 is not supported. The study findings contribute to the body of knowledge in various ways. In terms of value relevance study, this contributes to the environmental, social, and governance literature and increases the understanding by exploring the value relevance of financial and non-financial ESG information. Based on the literature review, two fundamental aspects to be noted are that firstly, those earlier findings of value relevance of CSR activities are mostly obtained from developed markets, and these cannot be generalized to developing markets like the Pakistani stock market. As developing countries are in a different stage than developed countries, likewise companies can also be at different stages of CSR development and in the same manner, the expectation from stakeholders for ESG activities may differ significantly. The second aspect is that Pakistan stock market where there are a limited number of studies on CSR and a limited understanding of CSR than there is in developed countries about the pros and cons of ESG activities, it is of great importance to examine this relationship for literature. One contribution of this study may be the use of the Bloomberg ESG score as the literature in CSR in Pakistan investigate the information content of narrative disclosures only in the annual report and uses content analysis to measure the environmental, social, and governance disclosure level of companies while Bloomberg uses annual reports, CSR reports, websites, and companies' news in the scoring method.

There are several limitations to this study. First, this study only used the Bloomberg ESG disclosure score for measuring the disclosure, and Bloomberg scores a small number of listed companies mostly that are large and have larger market capitalization which can create a sample selection bias. Second, the econometric techniques adopted may result in biases because it is possible that some important variables are not studied. Third, the results of this study do not control for actual ESG performance as ESG scores do not measure the ESG performance (such as environmental, social, and governance performance) of the company but only the disclosure level of ESG. Fourth, this analysis is not based on the classification of the industry which can have biased our results because the behavior of sensitive industry may be different from the non-sensitive industry in Pakistan. Fifth, our study used the combined score for environmental, social, and governance disclosure as ESG and previous research has provided missed results across different categories of ESG which are environmental, social, and governance. For instance, Hillman and Keim (2001) studies the relationship between the market value of the company and environmental performance and employee relations and suggested that environmental performance is negatively related to market value and employee relations are positively related to market value. Likewise, Bird et al. (2007) found that higher environmental ratings are negatively related to share price, besides higher diversity and employee ratings have a positive relationship with the share price.

The findings of this study together with the limitations considered are highlighting some future research possibilities. First, future research can examine the value relevance of ESG disclosure with the classification of industries in sensitive and non-sensitive industries. Second, the use of three dimensions of ESG disclosure separately can give more detailed, thorough, and clearer insights into value-relevance results. Because different categories can have different importance and significance for future improvements. Similarly, investigation of the influence of different variables along with ESG disclosure scores like ESG actual performance may provide a valuable contribution to the value relevance of non-financial information. At last, future research can examine the impact of ESG disclosure on stakeholders other than investors like customer satisfaction or employee motivation. Solely share price implications may not be sufficient to recognize how ESG disclosures can impact the financial performance of the company.

On the basis of the results, we provide the subsequent recommendations for policymakers and investors. It is also important for companies to inform the public and their reputation is evaluated from the effectiveness of their communication with stakeholders. ESG disclosure is an example of this phenomenon, but the company must be careful while disclosing information and also shape its strategies which prioritize investor confidence as well. As in Pakistan, shareholders negatively value the ESG disclosure, managers and boards of directors may find it critical and difficult to formulate and implement effective CSR policies. Finally, since ESG business strategies are valuable to shareholders, management science research is focused on environmental, social, and governance implications of managerial decision making.

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Impact of Perceived Risks and Perceived Benefits on Digital Finance Through Attitude and Intention; Moderating Role of Financial Literacy

Narender Kumar, Samina Riaz

PhD Scholar, Bahria, University Karachi, Pakistan

Abstract

Financial institutions are facing challenges in the acceptance of digital financial services. The adoption rate of digital finance is relatively low in Pakistan as compared to other economies of the world and there is a huge need to promote digital finance in Pakistan. This study focuses on factors demotivating and promoting the adoption of digital finance. It has identified obstacles, which are labeled as perceived risks, and promoters, which are labeled as perceived benefits. More specifically, the impact of dimensions of perceived risk and perceived benefits on attitude towards digital finance has been analyzed, which, in turn, leads to the intention to adopt or to continue the use of digital finance. Additionally, the moderating role of financial literacy has been taken between attitude toward digital finance and intention to adopt or continue using digital finance. The data will be collected through a structured questionnaire from 384 respondents from users and non-users in order to assess differences in perception. Partial least squares structured equation modeling (PLS-SEM) will be used to analyze the proposed model on Smart PLS. The study will contribute valuable insights to the growing body of literature on the digital finance landscape by emphasizing the importance of perceived risks and benefits in shaping individuals' decisions.

Keywords: Perceived Benefits, Perceived Risks, Digital Finance, Attitude Towards Digital Finance, Financial Literacy

1. Introduction

Advancement in technology has posed interruptions in a variety of industries. The financial sector is putting huge efforts to promote digital finance. Though COVID-19 had severe devastating impacts on various industries, it enhanced the need for digital finance (Abdul-Rahim et al., 2022). Digital financial services provide numerous benefits, but people are reluctant to adopt digital finance. Ryu (2018) stated that fintech adoption is hindered by fear of the unknown, which prevents people from implementing new financial technology.

Research Gap

In the context of perceived risks, Lee (2009) studied security risk, financial risk performance risk, time risk and social risk. The researchers studied security risk, financial risk, time risk social risk and privacy risk as factors of perceived risk (Khedmatgozar & Shahnazi, 2018).Moreover, Putritama, (2019) explored the parameters of perceived risks which contain security risk, legal risk , financial risk and operational risk. In another study, determinants of perceived risks were studied which consist of financial risk, regulatory risk operational risk and security risk (Abdul-Rahim et al., 2022). From the perspective of benefits, various studies have incorporated a limited number of perceived benefits. Researchers studied perceived benefits based on compatibility, relative advantage, and perceived enjoyment. (Wang et al., 2017).Studies have explored factors of perceived benefits; economic benefit, convenience, and transaction process (Mohamad Shafi & Misman, 2021). knowledge, research the relationship between psychological risk and attitude towards digital finance has been ignored. Similarly, legal risk has been studied as a parameter of perceived risk with intention (Haqqi & Suzianti, 2020; H. S. Ryu, 2018). However, legal risk as a separate dimension

along with attitude has not been studied. Though, there is a significant knowledge gap regarding how these dimensions of perceived risk and benefits interact with attitudes towards digital finance along with financial literacy in specific context of Pakistan.

Problem Statement

The adoption rate of digital finance is relatively low compared to other economies of the world. According to the Global Findex Database (2021), digital payment made or received is highest in developed countries like Denmark, with 100%. While in developing countries, China has made or received payment digitally at 86 %. Unfortunately, in South Asia, Pakistan has the second lowest rate, with 18%, depicting a grim picture of the adoption of digital finance. Though there is a huge need to promote digital finance in Pakistan, people are still reluctant to use digital finance. Generally, many people still prefer traditional financial transactions due to perceived risks and uncertainties associated with digital finance (Jain & Raman, 2022).

Research Objectives

The objectives of this study is to investigate impact of dimensions of perceived risk and benefits on digital finance along with moderating role of financial literacy in order to promote digital finance in Pakistan.

Literature Review

Digital finance adoption depends on the risk-benefit framework. This theoretical framework states that people will adopt new technology if its benefits outweigh its hazards. Digital finance increases financial data accessibility, transaction transparency, and cost. Contrarily, cyber-attacks, identity theft, and fraud threaten this scenario. The risk-benefit framework influence digital finance adoption (Anderson, 2023). The risk-benefit framework helps assess digital financial services' pros and cons. The framework explains the features affecting digital finance adoption (Meng et al., 2022). Risk and reward are interconnected and mutually reinforcing. Risk-benefit paradigms affected customers' willingness to use digital financial services (Bouteraa et al., 2023). After assessing perceived advantages and dangers, the evaluation examined their total impact. Razzaque et al. (2020) argue that perceived risk and advantages impact digital finance. Consequently, researchers applied risks benefits framework in order to realize the influence of perceived risk and perceived benefit on the intention to adopt digital finance (Jain & Rama, 2022).In a similar manner, various dimensions of perceived risks and perceived benefits are taken into this study.

Security Risk

Security risk is illustrated as a breach of consumers' trust due to hacking and theft of personal information (Lwin et al., 2007). Security risks encompass the potential dangers presented by external malevolent entities, including hackers, cybercriminals, or insiders, who endeavor to exploit vulnerabilities to obtain ion of obtaining unauthorized access, pilfer data, or disrupt services(Chen & Chen, 2018). Lee (2009) studied customers' behavioral intention to adopt online banking in which it was found that security risk adversely affect attitude towards online banking and intention to online banking adoption in Taiwan. Another study revealed that the security risk significantly influenced the future intention to use digital finance in Germany (Gerlach & Lutz, 2019). Similarly, researchers identified security risk as the parameter of perceived risk and explored the impact of security risk on digital finance in India.

Financial Risk

Financial risk refers to potential financial losses resulting from using Financial Technology or Digital Finance Solutions (Ali et al., 2021; Gunadil et al., 2020). Within the realm of digital finance, financial risk can be attributed to technological malfunctions, cyber-attacks, or the unauthorized acquisition of financial information (Fauzi et al., 2023). The study revealed that financial risk significantly influenced the future intention to use digital finance in Germany (Gerlach & Lutz, 2019). Financial risk was also studied by other researchers along with other dimensions of risk in Egypt and it was found that financial risk had an adverse impact on the use of digital finance (Noureldin & Moawad, 2023). On the other side, researchers examined the influence of financial risk on attitude towards continuous usage of internet banking. Results revealed that attitude toward continuous internet banking usage was not affected by financial risk in Malaysia. (Normalini & Ramayah, 2015). Similarly, financial risk was found to have the weakest influence among the four factors of perceived risk in Taiwan (Ryu, 2018)

Performance Risk

Performance risk refers to malfunction of servers, authentication process and networking issues causing an interruption in the transaction or originating financial losses (Karlan et al., 2016; Kuisma et al., 2007; Rana et al., 2018). In Pakistan, researchers examined the operational risk(Performance risk) as a component of perceived risk and found that operational risk was positively associated with perceived risk and perceived risk was negatively associated with trust in the context of intention to Islamic financial technology adoption (Ali et al., 2021).Similarly, performance risk was studied as a parameter of perceived risk in the context of digital finance, and the result revealed that performance risk is significantly associated with perceived risk, and perceived risk was found to be adversely related to digital finance in India (Jain & Raman, 2022).

Time Risk

Time risk can be illustrated as potential losses of time, comfort, and effort due to wasting time searching, purchasing, setting up, and switching to how to use and learn digital finance (Featherman & Pavlou, 2003). The significant effect of time risk as a barrier to the intention to adopt internet banking or digital financial services has been found in previous research. (Lee, 2009, Noureldin & Moawad, 2023). Researcher found that time risk had an adverse impact on attitudes towards online banking usage in Taiwan (Lee, 2009). Researchers examined the influence of time risk on attitude towards continuous usage of internet banking. Results revealed that attitude toward continuous usage of internet banking was negatively affected by time risk in Malaysia (Normalini & Ramayah, 2015). Time risk was also studied by other researchers along with other dimensions of risk in Egypt and it was found that social risk had an adverse impact on the use of digital finance (Noureldin & Moawad, 2023)

Social Risk

This risk refers to potential losses in their social status due to the use of digital finance services because they did not receive sufficient attention from customer service management (Featherman & Pavlou, 2003). Previous studies on retail purchases have shown throughout the years that social risk has a detrimental effect on customers' attitudes (Dowling & Staelin, 1994; Yang et al., 2007). On the contrary, it was observed that social risk was an insignificant predictor of attitude towards online banking in Taiwan (Lee, 2009). Researchers examined the influence of social risk on attitude towards continuous usage of internet banking. Results revealed that attitude toward continuous usage of internet banking was negatively affected by social risk in Malaysia (Normalini & Ramayah, 2015). Social risk was also studied by other researchers along

with other dimensions of risk in Egypt and it was found that social risk had the most detrimental impact on the use of digital finance (Noureldin & Moawad, 2023).

Psychological Risk

Psychological risk refers to the potential loss of self-esteem or peace of mind due to anxiety, frustration, or stress because of the use of the digital finance service (Featherman & Pavlou, 2003). . People may perceive a greater psychological risk associated with utilizing fintech services as a result of their anxiety and mistrust caused by fears of data breaches, identity theft, or illegal access(Gerlach & Lutz, 2019; Syed et al., 2022). The fear of losing money and people's perceptions of danger may contribute to psychological risk. Due to worries about making errors, losing money, or not fully comprehending the risks involved, users may hesitate to make financial transactions or investments using digital finance. Some people may be discouraged from using financial technology solutions due to the uncertainty and perceived danger of new technology(Ashraf et al., 2022).

Legal Risk

Legal risk in the context of financial technology refers to the users' lack of trust and anxiety arising from vague legal status and the lack of regulations resulting from the use of Digital Finance (Ryu, 2018; Bilkey, 1955; Lewin, 1943; Peter & Tarpey Sr, 1975). The previous researchers claimed that legal risk is an essential determinant of driving financial technology. Researcher studied legal risk as a parameter of perceived risk with reference to continuous intention toward financial technology and results indicated that legal risk was the dominant parameter in Korea (Ryu, 2018). In another study, the influence of legal risk on future intention to use digital finance was examined, and findings revealed that the future intention to use digital finance was significantly influenced by legal risk in Germany (Gerlach & Lutz, 2019). In another study, legal risk was taken as a facet of perceived risk in the context of continuous usage intention of mobile payment in Indonesia and it was observed that legal risk was positively associated with the perceived risk in respect of continuous intention of mobile payment (Putritama, 2019). In Pakistan, researchers examined legal risk as a component of perceived risk and found that legal risk was positively associated with perceived risk and perceived risk was negatively associated with trust in the context of intention to Islamic financial technology adoption (Ali et al., 2021).

Economic Benefits

Economic benefits can be defined as financial reductions and financial gains arising from using financial technology (Mackenzie, 2015; Venkatesh et al., 2012; Bilkey, 1955). Economic benefits pertain to the monetary advantages of using digital finance, encompassing reduced transaction costs, enhanced accessibility to credit and investment prospects, and augmented financial inclusivity. Research findings indicate a positive correlation between the perception of economic advantages and the inclination to adopt digital finance. Ryu (2018) contended that economic benefit is a significant determinant in driving the financial technology continuance intention in Korea. The economic benefits significantly influenced the future intention to use digital finance in Germany (Gerlach & Lutz, 2019). Jain and Raman (2022) explored Economic benefit as one of the perceived benefits in their study in the context of intention to adopt digital finance in India. In a similar vein, a study revealed that the perceived economic advantage played a crucial role in determining individuals' inclination to adopt digital payment services within the United States (Guerra-Leal et al., 2022).

Convenience

Okazaki and Mendez (2013) defined convenience as accessible and flexible in time and location. The perceived benefits of adopting digital finance include the convenience benefit as a critical aspect. Digital finance offers users the convenience of accessing financial services at their convenience, regardless of time and location, eliminating the necessity of visiting physical branches or engaging with personnel. Digital finance services are available round-the-clock, allowing users to initiate transactions at any time, including weekends and holidays. This eliminates the limitations imposed by traditional banking hours and improves overall flexibility for individuals and businesses (Agarwal & Tuteja, 2018). Convenience has been widely recognized by scholars as a crucial element in the acceptance and utilization of digital finance (Hasan et al., 2022). Karjaluoto et al. (2015) discovered that convenience plays a significant role in shaping users' inclination toward adopting digital finance. Convenience was also studied by researchers as a factor of perceived benefit in India, and it was found that convenience positively influenced perceived benefits, which, in turn, affected intention to use financial technology (K. Gupta et al., 2023).

Seamless Transactions

Chishti (2016) and Zavolokina et al. (2016) explained seamless transactions as cost-effective and rapid financial transactions. Digital finance significantly reduces the need for physical paperwork. Instead of filling out forms and signing documents manually, users can complete transactions electronically, saving time, reducing errors, and streamlining administrative processes(Yadav & Banerji, 2023). Previous researchers contended that seamless transactions were vital in adopting digital finance. Seamless transactions can attain a competitive advantage against conventional financial organizations and encourage financial technology companies to produce innovative products and services to compete in the financial markets (Ryu, 2018). He also highlighted that seamless transaction was a significant parameter in driving the continuous intention of financial technology in Korea. Similarly, seamless transaction is an important factor of perceived benefit in the adoption of FinTech (Abdul-Rahim et al., 2022).

Relative Advantage

Relative advantage refers to the degree to which the adoption of IT innovation is perceived as being better than using the prevailing practice. (Rogers, 1983; Rogers, 1995). One of the key perceived advantages of adopting digital finance is the concept of relative advantage, which pertains to the assessment of individuals' belief in the superiority of new technology, specifically in the context of digital finance, over existing processes or solutions. Many studies have examined the correlation between the relative advantage and digital finance adoption. Research examines the effect of relative advantage on the adoption of digital finance in underdeveloped nations (Anderson, 2023).

Compatibility

The perceived benefit of digital finance adoption, known as compatibility, pertains to the extent to which individuals perceive a new financial technology as aligning with their existing concepts, values, and needs. The likelihood of customer acceptance and utilization of digital finance is higher when it aligns effectively with their existing habits and preferences (Y.-Y. Wang et al., 2018). A study examines the significance of compatibility in influencing customers' inclination toward digital finance compared to conventional financial services (Ayoungman et al., 2021). Another study examines the impact of perceived compatibility on individuals' adoption of mobile banking services. The study centers on the impact of customers' perceptions regarding the alignment of digital finance offerings with their existing financial habits on their decision to adopt and utilize these services (Agarwal & Tuteja, 2018).

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Ease of Use

Ease of use refers to a person's salient belief that using the technology will be free of effort (Taylor & Todd, 1995). The literature suggests that in e-services, ease of use is likely to lessen risk uncertainty (Featherman & Pavlou, 2003). Similar to this, ease of use as a perceived benefit has been highlighted in past studies specifically for online banking (Ryu, 2018; Lee, 2009). Furthermore, in another study, researchers studied ease of use under the domain of perceived benefits in which authors found that ease of use has a significant positive impact on perceived benefits, which in turn positively affect continuance intention on fintech in India (K. Gupta et al., 2023).

Perceived Enjoyment

Perceived enjoyment is illustrated as the extent to which using a particular product or service is perceived to be enjoyable in its own right. (Davis, 1989; Davis et al., 1992; Igbaria et al., 1994; Moon and Kim, 2001; Lee et al., 2005). A person's subjective sense of the pleasure, happiness, or pleasant feelings they had when utilizing digital banking services is referred to as perceived enjoyment. It is a component that affects user attitudes concerning with regard to implementing and maintaining digital finance (Y.-Y. Wang et al., 2018).

Attitude towards Digital Finance

Attitude is defined as "*the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question*" (Ajzen,1991). According to Sharma et al. (2018), positive attitudes are associated with better adoption and use rates of digital financial services. Additionally, research has shown that adopting a positive mindset about digital finance may enhance savings, investment in financial goods, and general financial well-being (Zhang et al., 2019).

Based on above literature review, following hypothesis have been developed:
H1: Security risk negatively influences attitude towards digital finance.
H2: Financial risk negatively influences attitude towards digital finance.
H3: Performance risk negatively influences attitude towards digital finance.
H4: Time risk negatively influences attitude towards digital finance.
H5: Social risk negatively influences attitude towards digital finance.
H6: Psychological risk negatively influences attitude towards digital finance.
H7: Legal risk negatively influences attitude towards digital finance.
H8: Economic benefit positively affects attitude towards digital finance.
H9: Convenience positively affects attitude towards digital finance.
H10: Seamless transaction positively affects attitude towards digital finance.
H11: Relative advantage positively affects attitude towards digital finance.
H12: Compatibility positively affects attitude towards digital finance.
H13: Ease of use positively affects attitude towards digital finance.
H14: Perceived enjoyment positively affects attitude towards digital finance.
H15: Attitude towards digital finance has a positive impact on intention to adopt digital finance.
H16: Financial literacy moderates the relationship between attitude towards digital finance and intention to adopt digital finance.
H17: There is a significant difference in perception between users and non-users of digital finance.

Research Methodology

The study of this research approach consists of deductive, and followed quantitative research design. The

population of the study is the bank account holders who are users and non-users of digital financial services. Convenience sampling will be used to collect the data because the population is unknown. According to Saunders (2007), if the population is unknown, a 384-sample size is sufficient enough. The study sample will be 384 respondents from four provinces: Punjab, Sindh, Khyber Pakhtunkhwa and Balochistan. The structured questionnaire was constructed with a five-point Likert scale, and the responses will be analyzed using Smart PLS. The questionnaire will be designed on Google form. This study adopted a cross-sectional survey based on gathering primary data from potential sample subjects.

1.1 Research Model

Perceived Risks

- Security Risk
- Financial Risk
- Performance Risk
- Time Risk
- Social Risk
- Psychological Risk
- Legal Risk

Perceived Benefits

- Economic Benefits
- Convenience
- Seamless transaction
- Relative Advantage
- Compatibility
- Ease of use
- Perceived Enjoyment

Financial Literacy

Attitude towards digital finance

Intention to adopt or continue using digital finance

Age
Gender
Income
Education

Control variable

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The Innovations in Construction Safety: A Review

Norheen Amina[1], Huda Riaz[2], Imran Shahbaz[3], Hira Ishtiaq[4] Amina Irfan[5]

[1]The university of Lahore, Lahore, Pakistan
[2]University of Engineering & Technology, Lahore, Pakistan
[3]Massey University, Aukland, newzeland
[4]NAVTTAC , Lahore, Pakistan
[5]Pak Safety Solution , Lahore, Pakistan

Abstract

Because of the high-risk environment and the possibility of accidents, construction safety has long been a major concern. Many people believe that working in construction poses a great risk of disease and injury to its employees. Recent developments in technology have produced new equipment and techniques that can enhance building site safety. Building information modeling (BIM), safety management software, drones, robotics, artificial intelligence (AI), sensors, wireless networks, wearable technology, and geographic information systems (GIS) are some of the developing technologies utilized in construction safety that are covered in this review study. The Internet of Things, robotics, and artificial intelligence can cut construction costs by up to 20%. Engineers can put mini-robots into structures that are still under construction and use virtual reality goggles. These robots use cameras to track the work as it progresses. Companies are using AI to develop safety systems for worksites. AI is being used to monitor interactions between workers, equipment, and items in real-time on the job site and notify managers of possible problems with productivity, safety, and construction. Even if there are predictions of massive job losses, AI is not expected to replace workers.

Keywords: Innovations in construction, Construction Safety, Artificial Intelligence, BIM, HSE

Introduction

The construction field is considered one of the most dangerous industries. Accidents and fatalities take place on daily basis in construction projects. Globally, different levels of government have implemented strict rules and regulations to protect workers on job sites. However, despite the efforts to implement the rules and regulations, accidents occur frequently (Mohammad Z. Shanti 2022). So Construction is one of the most hazardous industries, and it is important to ensure safety measures are in place to prevent accidents and injuries.

It is necessary to trace fundamental causes of accidents in order to prevent safety accidents in the construction industry. Various research studies have been conducted to identify the root causes of accidents. Hinze 1997 suggested the distraction theory in which he argued that construction workers being stressed about getting their tasks done could cause them to be distracted, which would result in ignoring the hazards that lead to accidents. McClay 1989 suggested three major causes of accidents; hazards by physical condition, human's action, and exceeding functional limitations. Abdelhamid and Everett 2010 introduced the Accident Root Cause Tracing Model (ARCTM) and argued that following roots cause safety accidents: (1) failing to recognize unsafe conditions at a work site, (2) deciding to carry on with a work task after the worker realizes that him/herself is working in unsafe conditions, and (3) deciding to act unsafely regardless of existing conditions of working environments. Also, Toole 2012 suggested the root causes of construction accidents, including lack of proper training, unsafe work methods and sequencing, not using provided Personal Protective Equipment (PPE), inappropriate attitude toward safety, and isolated or sudden deviation from prescribed behaviors.

In recent years, there have been numerous innovations in construction safety, including the use of new

technologies and equipment, the implementation of new safety protocols and procedures, and the adoption of a more proactive approach to safety management (Ganah and John, 2015). Although big efforts have been made in many countries to improve safety performance, construction continues to lag behind most other industries. Worldwide, construction workers are three times more likely to be killed and twice as likely to be injured as workers in other occupations. The fourth industrial revolution (4iR) technologies offer an opportunity for the industry to improve its safety science and management. Higher rates of technology adoption can improve safety levels. The integration of technological solutions will align the industry with the path of Construction to be highly productive and competitive (Haupt 2020). In this review paper, we will explore some of the latest innovations in construction safety.

Methodology

The first step in any research endeavor is to review the existing literature in the field of study. With the aim of gaining a broad view of different construction OSH technologies, a review on the application of technologies for construction OSH management is conducted using the preferred reporting items for systematic reviews of literature. Literature was gathered through search results from major academic publisher databases such as WORLD CAT. Relevant papers were also found as references cited in the papers, which were found through searching the databases. The searches consisted of different combinations of keywords such as building construction safety, construction H&S, building information modelling (BIM), H&S, innovative technology, IT and hazard identification. Abstract and keywords of the papers displayed as search results were read and analyzed and it was determined whether the paper had an impact on the topic of the research. A total of 200 scientific papers, books and other literature sources were identified as of interest to the research topic, but only 61 of them dealt specifically with the development or application of an innovative IT in the field of construction H&S. This paper, therefore, aims to present the previous research in the application of innovative ITs to the field of construction H&S, classified by their underlying technology and by application, as well as describes the potential of research's implementation in construction safety practice. There are many technologies used on construction sites like Building Information Modeling (BIM), Safety Management Software, Drones, Robotics, Artificial Intelligence (AI), Sensors, Wireless Networks, Wearable Technology and Geographic Information System (GIS). BIM is most popular among all.
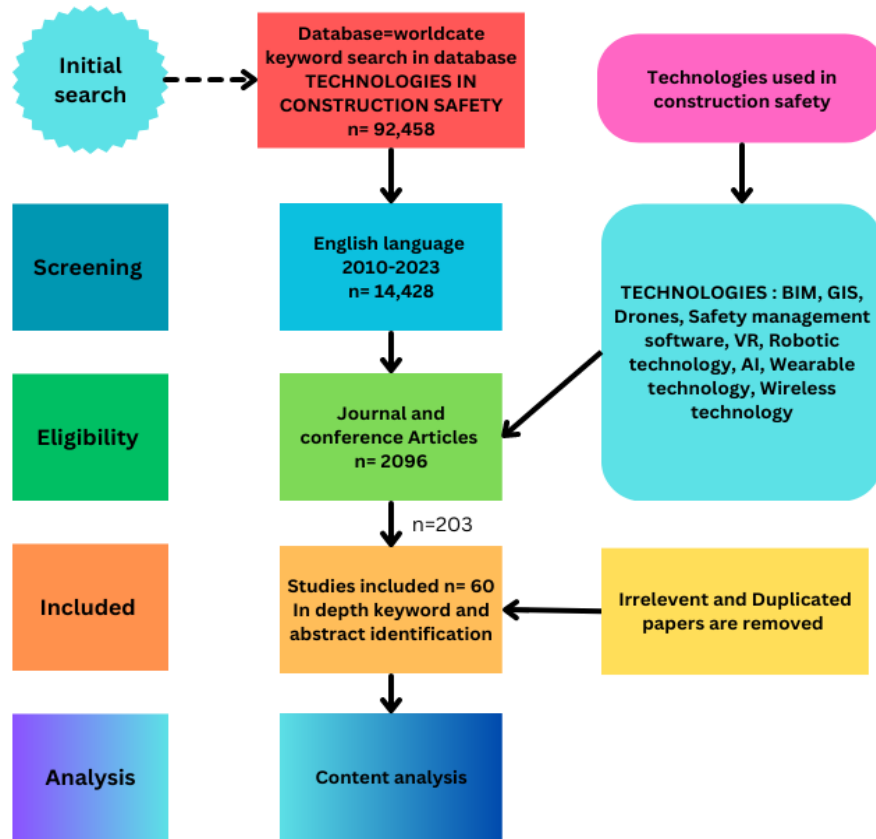
Figure 1: Methodology for Conducting Systematic Literature Review

Figure 2: Methodology for Conducting Systematic Literature Review

Building Information Modeling (BIM)

Building Information Modeling (BIM) is a digital tool that can be used to create a virtual model of a construction project. BIM can be used to identify potential safety hazards before construction begins, allowing for safer design and construction processes. BIM can also be used to simulate emergencies, allowing workers to practice evacuation procedures and identify potential safety issues.

To address the issues arising because of the complex nature of construction projects, BIM could be applied to efficiently accomplish construction tasks. The BIM system is applied as a supporting technology for the planning and management of health and safety on construction sites (Ganah and John, 2015). Implementing

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BIM enables visual assessment of construction site and identifies potential hazards (Azhar, Behringer, Khalfan, Sattineni and Magsood, 2012); (Watson, 2010). A result of incorporating BIM in construction activities is developing safety-training videos for workers. Using the BIM model to conduct visual safety trainings enables site workers develop a better understanding of the actual site conditions (Watson, 2010). Construction workers are provided with sufficient time and information for safety planning and management before executing construction activities. With the use of sensors for data collection, the BIM can adequately reduce the likelihood of site accidents by checking procedure of data acquisition (Druley, Musick and Trotto, 2016). The major advantages of adopting BIM as its capacity to represent and manage graphics as well as automatically analyse designs, generate illustrations, reports, design schedules and manage facilities. Additionally, the BIM technology has proven to be effective not only in the design phase, but also in the operation stages particularly for simulation of the construction process (Watson, 2010) Eastman, Teicholz, Sacks and Liston (2011) described two instances where BIM was used in construction health and safety management.

1. To test rides in an amusement park project, envelopes were modelled to ensure that there were no activities during the testing period. Conflicts were identified within the testing period and 4D simulations were applied to resolve the issues.
2. The second project used massing cylinders to model spaces occupied by activities in the construction of a steel frame building. Possible risks that worker might be exposed to were identified with clash detections between cylinders.

The workers trained via BIM simulation showed a higher level of understanding than the group of workers who were trained conventionally. Significant differences were found for the factors "Age" in 50s' scores and in 20 and 30s' scores, "Educational Background" in high school level and Middle school level, and for "Work Experience" in all levels; advanced level, intermediate level, and beginning level (Sungjin Ahn 2020).

Safety Management Software

Safety management software has also become an important tool for improving construction safety. These software solutions can be used to track safety incidents, manage safety training and certifications, and conduct safety audits. Safety management software can also be used to identify patterns and trends in safety incidents, allowing companies to take a more proactive approach to safety management. Since the 1980s, SMS has been introduced to improve the industrial safety round the world by eliminating the possible hazards, reducing injuries and minimizing material loss in different industrial undertakings. However, construction accidents and mortality are rare and random. It is rare that a sizeable sample is available for sensible statistical analysis. institutional cooperation among clients, engineers, and contractors would be essential, given the constraints of financial budget, and legal and contractual obligation (Yiu 2019).

Some software systems have been designed to help safety officers investigate the safety conditions which pertain to a construction site. Other kinds of software facilitate quick drafting and designing and this can support safety on-site since it means that all changes can be recorded formally and centrally. A case in point is that smart helmets, controlled by software, have recently been designed specifically to wake up workers who, the helmet has detected, have not been active for some time. Recent developments in software-driven user interfaces have meant that workers who have had a limited education can be informed of the facts they need to know on-site in a way that they can readily comprehend. Ease of use and the enhancement of safety have become two very important motivations for developers to create new tools and for the managers of construction sites to support their use, turning ideas which had previously been merely theoretical into things which are seen as achievable (Li, R.Y.M. 2018).Few SMS are Chatbot (Li, R.Y.M. 2018), Unity Softwar (Chiu Y.-P. & Shiau Y.-C. 2016), Fleet Management (Chiu Y.-P. & Shiau Y.-C. 2016)

Unmanned Aircraft System /Drones/ Unmanned Aerial Vehicle

An Unmanned Aircraft System (UAS), often referred to as a drone, is an aircraft system that is flown by a pilot on the ground have the potential to play a significant role in safety planning and monitoring. The system includes the drone itself as well as the control system, ground and satellite based equipment, communication links and operator which are required to operate the aircraft effectively and safely. Military use and research has been a major driver for advancing UAS technology. The wide use of transistors in the 1960's allowed electronic equipment to shrink in size. The advancement of GPS technology has allowed both military and civilian UAS's to be navigated via a satellite data link (Mark C. Tatum, 2017).

The previous studies have focused on a particular application of UAV for construction safety rather than providing a comprehensive and systematic insight into their use and application (Tatum M C. 2017). Drones are capable of being equipped with the latest cutting-edge technologies to execute tasks that seemed merely impossible by using traditional methods until now. Contrarily, UAVs can expose construction workers to a new array of safety risks (Namian 2021). US companies also use UASs on their sites, with most applications replacing traditional still photo and video acquisition. This fast, reliable, and economical system can aid in saving many lives if implemented and utilized properly in real construction sites. (Mohammad Z. Shanti 2022). UAVs in conjunction with 4D building information modeling (BIM) can be used to assess the project progress and compliance checking of geometric design models (Elghaish, F. 2022)

Robotics technology

Robotics technology is being used for repetitive and dangerous tasks, such as demolition and excavation, and for remote inspection of hazardous areas. Numerous studies have considered robotics and automation to have the potential to solve health and safety issues in construction. Robotic technologies are presently used in the execution of dangerous and strenuous tasks. Li (2018) concluded that robotics and automation are most effectively used in activities undertaken in hostile environments and require speed and repetition. These activities put construction workers at the highest risk of overexertion illnesses and injuries (ibid). Adopting robotic systems is a current trend for accelerating and automating construction tasks (Chu, 2013). Several types of robotic systems have been developed to improve quality of construction projects, productivity, health issues of workers as well as other safety problems (Ruggiero, Salvo and St. Laurent, 2016). Controlled by computers on site and dependent on advanced detection and control, robots are employed in the autonomous installation and gathering of heavy construction materials, which usually require enormous labor, and to construct 415 structures such as skyscraper towers (Li and Leung, 2018). Recently, numerous emerging robotic technologies such as exoskeletons, welding robots and forklift robots have been developed and can be implemented in construction (Ruggiero, et al., 2016). Wearable Robotics such as exoskeletons for reducing lower back stress, are applied when lifting and handling heavy objects, and usually benefits older workers (Balaguer and Abderrahim, 20011). Robotic arms are composed of aluminium servo brackets and have a similar look to the human arms. Its ergonomic tool arms are made up of infrared sensors for radial distance and a USB camera, which captures angles and provides the arms with feedback on whether it can lift an object. Construction robots are not advanced enough, and human assistance is needed for the robot perform tasks efficiently. For instance, the Semi-Automated Robot (SAM) 100 can build walls six times faster than humans but needs human workers to load the robot with bricks. (Ming zhang 2023).

Artificial Intelligence (AI)

AI is a rapidly growing field with many potential applications in construction safety. It can be used for predictive analytics, risk assessments, and real-time monitoring of workers and equipment. AI can also be used to optimize construction processes and reduce the risk of accidents and suggests the applicable OSHA

codes for the identified hazards, thus allowing safety standards to be implemented for compliance. Emphasis is laid on the mitigation of fall hazards, which is the leading cause of accidents in construction. Currently, project safety and risk assessment in the construction industry is carried out by professionals, who heavily rely on their own experiences and knowledge on decision making (Bigham 2019). Online systems have been used to improve several aspects of construction safety such as safety training and education, risk identification, safety monitoring and evaluation and safety inspections (Dodge Data and Analytics, 2017).

Sensors integrated with PPE's

Sensors can be integrated into personal protective equipment (PPE) to monitor workers' physiological parameters such as heart rate, body temperature, and hydration levels. They can also detect falls, collisions, and other accidents and alert the workers or supervisors. Cameras can be mounted on helmets or vests to provide a live video feed to the supervisors, who can monitor the worksite remotely and identify potential safety hazards (Chen, J. 2022).

The application of sensors plays a significant role in implementing construction safety through real-time monitoring of buildings or building components (Zhang, et al., 2017). Sensor based technologies have been applied to prevent accidents and prevent worker – equipment collisions by monitoring the entire environment on construction sites. Ahsan, El-Hamalawi, Bouchlaghem and Ahmad (2012) highlighted sensor-based location, vision-based sensing and wireless sensor networks as the various types of sensor technologies applied to construction safety management.

Wearable Technology

One of the most significant advancements in construction safety is the use of wearable technology. Wearable devices, such as smart glasses, hard hats with augmented reality (AR) displays, and smartwatches, can help workers monitor their surroundings and identify potential hazards. For example, smart glasses equipped with AR technology can overlay digital information on real-world objects, providing workers with additional information about their environment. Smartwatches can also be used to monitor workers' vital signs, such as heart rate and body temperature, to ensure they are not at risk of heat stress or other health issues (Chen, J. 2022.).

AR combined with BIM technology, can reduce not only construction accidents but can remove language barrier (Afzal, Muneeb & Shafiq, Muhammad 2021). AR devices can overlay digital information onto the real-world environment, providing workers with real-time safety instructions, hazard warnings, and emergency procedures. They can also simulate hazardous situations and train workers on how to respond to them safely (Chen, J. 2022.).

As opposed to virtual reality which uses computer generated imagery to simulate real life scenarios, augmented reality enhances reality through the use of technology (Bouchlaghem et al, 2013). However, the enhancements can be distinguished where such interactions are developed into applications and mobile devices (Patrucco, Bursano, Cigna and Fissore, 2010). Augmented Reality projects 3D imagery on a person's physical surroundings as they walk through construction sites with mobile devices or special helmets and using GPS and cameras to present real-time data geospatially giving updated user feedback (Bouchlaghem et al., 2013). Safety trainings may be conducted with this technology by enabling workers to wear augmented reality headsets to give virtual drills, instructions and safety scenarios at minimal training costs and downtimes.

The existing wearable technologies can be used to monitor and measure a wide variety of safety performance metrics within the construction industry. Benefits of individual wearable sensors or systems

can be integrated based on their attributes for multi-parameter monitoring of safety performance (Awolusi I. et al 2017).

Maintaining construction workers' vigilance and monitoring their attention levels are critical to successful safety management practices. A wireless and wearable electroencephalography (EEG) system to quantitatively and automatically assess construction workers' attention level through processing human brain signals has been used (Wang D.2017).

There have been positive results with the on-Site hazard identification system, which uses an image capture device to gather images from the construction site. This information is provided to the wearable and reported to the operator (Kim et al 2017).

In a study a device has been designed based on the concept of the Internet of things. Different layers, such as sensors, network, information management, and a smartphone application, provide the necessary notifications to the safety authorities in the absence of using PPE by workers (Abbasianjahromi H. & Sohrab Ghazvini E. 2021).

Utilizing AR to improve efficiency and precision of the assembly process in Construction Safety.

The low level of adoption of the developed immersive technologies for OSH management by the construction industry, very limited research on the application of immersive technologies for health hazards, and limited focus on the comparison of the effectiveness of various immersive technologies for construction OSH management.

Wireless networks

Wireless sensor networks have been found to enhance and facilitate information flow among design teams on construction sites (Ward, Thorpe, Price and Wren, 2014); (Brilakis, 2012). Complexities of the construction environment make the circulation of a network a difficult task; however wireless networks present solutions to this problem (Ahsan, et al., 2012). Brilakis (2016) found that visual inspection methods employed to monitor bridge construction projects do not provide detailed and reliable information. New technologies such as wireless radio transmitters have been developed to monitor and inspect bridge construction projects. GSM, Wireless Local Area Network (WLAN), Terrestrial Trunked Radio (TETRA) are the various types of wireless technologies that have been tested on construction site operations (Zhang et al., 2017). Ahsan, et al. (2012) identified a wireless network known as Wi-MESH to provide remote backend access and connection to the internet on construction sites where telephone access is restricted (Brilakis, 2012).

Geographic Information System (GIS)

GIS technology is used to gather, store, analyze, and present geospatial data. It provides a visual representation of data on maps, allowing construction companies to gain insights into various aspects of their projects, including safety. One of the main benefits of GIS technology is its ability to integrate multiple sources of data, such as satellite imagery, aerial photography, and ground-level surveys. This integration allows construction companies to create a comprehensive view of their projects and identify potential hazards and risks.

GIS technology can be used to create detailed maps of construction sites, highlighting potential hazards and identifying areas that require additional safety measures. By analyzing data on previous accidents and near-misses, construction companies can identify patterns and trends, enabling them to implement measures that prevent similar incidents from occurring in the future.

Another application of GIS technology in construction safety is the real-time tracking of workers and equipment on construction sites. By equipping workers and equipment with GPS devices, construction companies can monitor their movements and locations, ensuring that workers do not enter hazardous areas and that equipment is used safely and efficiently (Mihić, Matej 2019).

Accordingly, in a study developed a GIS-based methodological framework to reduce and manage WBV exposure in the process of routes design. The framework, providing the optimal route using a least-cost path analysis using the optimising criteria of travelled time and WBV exposure, was established (de la Hoz-Torres M. L. et al 2021).

Through the use of a GIS platform, could allow the planning of optimal connections in the case of limit conditions, and on the other hand, it could allow the identification and planning of safety interventions, assigning appropriate priorities to various buildings, not only on the basis of their relevance compared to road use, but also on the basis of cost considerations Francini, Mauro (2018).

Virtual reality

(VR) simulates real-world situations. Players are immersed in an environment that resembles reality. In the past, head-mounted VR devices' costs were insurmountably high, nipping their application in the bud. Thus, VR is not common among general laymen. In recent years, however, technological breakthroughs in smartphones and VR gear have turned a new page in the gaming industry Li, R.Y.M. (2018). Virtual reality (VR) has been studied extensively in the construction industry, particularly for safety training, as it is capable of simulating the hazardous areas of a construction site in a virtual environment that enables workers to visualize the real scenario before being introduced to job sites Chiu Y.-P. & Shiau Y.-C. (2016). Developing assessment models of VR performance to measure efficiency improvement and reduce errors. However, at present, VR safety training requires specialized hardware and software, thus limiting worker access as only a few workers can participate in each training session.

Conclusion

Construction safety is a critical issue that requires ongoing attention and innovation. The use of wearable technology, drones, BIM, and safety management software are just a few examples of the latest innovations in construction safety. These technologies can help prevent accidents and injuries, improve safety management, and ensure that workers can complete their jobs safely and efficiently. As construction continues to evolve, it is essential that safety remains a top priority, and these innovations can help achieve that goal.

Overall, emerging technologies have the potential to significantly improve construction safety by reducing the risk of accidents and providing real-time monitoring and analysis of the construction site. However, wearable technology can also improve construction safety by providing real-time monitoring, situational awareness, and training. Construction safety education by applying virtual reality (VR), augmented reality (AR), and game engine is very effective. However, considering the strain of operating the space and equipment, it is difficult to apply them to the entire on-site, actual worker training, especially to the small and medium-sized construction sites. While BIM is a realistic method, applicable to the most sites while maintaining the advantages of the sense of realism and immersion, with the proof of increased educational understanding achieved.

The experts who are not aware or experienced in using digital tools such as 4D BIM, VR and 3D visualizing software may find it slightly difficult to adopt these technologies.

Considering this challenge, in future work, a robust and repeatable framework that requires only minimal necessary changes as the input and can adapt to the specifications will be explored from the perspective of generating VR-based 4D simulations of the project in less time with low economic costs.

Researchers should develop tools and plugins that incorporate local safety regulations. Researchers and policymakers should focus on developing guidelines and standards for using the identified technologies for enhanced construction safety management. Given that prevention has a much lower cost than that of accidents and their consequences, construction players need to consider the cost-benefits involved and make the case for investing in safety technologies.

Furthermore, most of the research is either in the conceptual phase or focuses only on one or two specific aspects of construction H&S. To address this issue, this paper recommends developing a more universal approach to hazard identification, along with continuing the existing research efforts. An additional result of this paper is a summary of the identified research. This paper identified the most often used technology and application, as well as the journal with the most papers dealing with innovative technologies in construction H&S. Potentials for implementing innovative technologies (specifically BIM) in construction safety practice and existing standards are also discussed in this paper. Results presented in this paper could be of use to researchers to aid them in choosing specific research focus as well as to practitioners who would benefit from the results of the conducted research. Future research should, therefore, be focused on addressing the existing gaps in order to discover additional ways. Further research is needed to fully understand these technologies' limitations on construction safety and address the challenges associated with their implementation.

RFID detect the vehicles and pedestrians located at a hazardous distance around the vehicle, and create warning scenarios for the vehicles or personnel by sending signals to these active tags. RFID door can be installed to detect suitable PPEs for specific working site.

DATABASE management system can be applied to ensure safety on site. the immediate future directions for blockchain utilization in OSC are smart contract management, addressing the security issues, and achieving a faster approval process.

Exploration of BIM technology in the safety management of engineering construction hazards, only due to the unsafe state of the construction work is studied unsafe act can be included in future studies.

Moreover, more studies focusing on the feasibility of using UAVs in construction projects are needed to clarify the extent of disruption to existing practices brought on by UAVs' introduction and to look at the associated costs.

Based on the identified issues, possible future direction is to enhance 3D printing to be able to handle complex and irregular prefabricated components effectively.

Prediction of various potential project risks based on historical and real-time data.

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Risk Analysis in Cement Industry using FMEA and AHP Methods

Ashfaq Ahmad,Rehman Alkhtar
University of Engineering & Technology Peshawar, Pakistan

Abstract

The cement manufacturing industry is certainly an extremely vital section of the industrial sector that plays an essential function in economic and social growth. As the cement industry grows day by day and however a lot of incident occurred in cement plant. Safety policy need to be modified and research may need to identify most critical risk and precautionary measure to minimize these risks. Occupational health and safety is the fourth highest mean in key performance indicator for sustainable manufacturing (1).

The major purpose of this thesis is to identify the main hazards in Cement industry of Pakistan. Cement is one of the most important emerging industries in Pakistan. Demand of Cement production increases day by day and a competition is created among cement manufacturing industries. This paper discussed the complete section of Cement plant, its departments and safety hazard in each section of Cement industry. As manpower involve directly in production system and due to non-availability of safe system of work, there are many accident occur in cement plant and causes deaths, sever injuries and minor injuries. This paper will discuss and evaluate the most important hazard in cement plant. Failure Mood and Effect Analysis (FMEA) and Analytic Hierarchy Process (AHP) methods will be used to identify he most important hazards in Cement plants.

Keywords: Hazards**,** Risk assessment, Injury, Accident

Introduction

Cement industry is one of the emerging industries in World as well as in Pakistan. Cement is important material for construction and cement plants present a key element economic improvement of any country. Cement is mixture of different material such Lime stone, clay and iron ore which are found naturally. Cement manufacturing involve high energy consumption and required high man power resources. Cement manufacturing impact environment (Martina Bertoldi, 2012) as well as direct human health (Syed Sana, 2013).Cement is a material useful to applied the face of rock-hard bodies to make them join together firmly or more particularly a pulverized material which made plastic with water, is used in a soft and pasty state (which solidify on aeration) to join together bricks, stones, etc in construction. Cement is a claimed material which included lime and silicates which is mixed with sand and stone and, upon hydration, forms a plastic material which sets and hardens to a rock-like material, concrete. Cement plant industry are divided into much small section for management point of view. Different department and Section are discussed here.

Cement manufacturing industry is one of high risk industry. Health and safety in cement industry has become priority in industrialized countries and a basic concern (Rachid et. al. 2015). In this study we use Failure Mode and Effects Analysis (FMEA) and Analytic Hierarchy Process (AHP) Methods. Different risk/Hazards and its possible causes will be identifying in cement industry and use FMEA and AHP method priorities Risk. Then result of both methods will be compared.

Objective of Study

Objective of this study is to identify all the hazards associated with Cement manufacturing process in Pakistan. Priorities the identified hazards cement manufacturing process. This Study is carry out to prevent harmful factor effecting physical, psychological and social health of employees in cements industries and

try to minimize the causes of risks and at last but not the least to assured that if an incident or accident does occur, all reasonable precautions had been taken to prevent it.

After this study we will be able to give a safe working environment to cement industries in Pakistan, so that environmental and human risk can be minimized.

Literature Review

With increase and swelling growth of cement production plant and growth of technology and science, rate of hazards and risk always increases. Worker working in these industries also faced increasing risk. The assessment and risk management of these risks requires a management system that reduce these risk, ensure greater safety, employees welfare and last but not the least environmental protection. Every day in production industries workplace there are many incidents that can lead to injury of death. In addition with human risk, the economic and social damages are also very dangerous and reaching millions of dollars. Occupational health and safety was the fourth key performance indicator (KPI) for sustainable manufacturing evaluation in cement industry (Elita Amrina, 2015).

As per record of International Labour Organization (ILO), 5,000 people die every day in the world due to work-related accidents and illnesses. One of the key elements of safety management systems is the identification of hazards. Identifying environmental hazards leads to reasonable decisions to reduce the risk and severity of accidents and incidents.

Cement manufacturing industry is one of the most manpower using industry and have a potentially hazardous industry as compared to other production industries. Therefore, health and safety is the most important priority for the cement industry employees. It is the most critical issue that ensuring a health and safety culture in workplaces. For this purpose, health and safety policy should be adapted with other policies of the company. Additionally, risk management policy of company should be developed, and risk assessment should be performed regularly and efficiently (Simge Taner, 2015).Failure Mode Effects Analysis (FMEA) and Analytic Hierarchy Process (AHP) both methods to were used to determine the Most Important Safety Hazards cement industry. The study was used to identify the risk assessment in cement industry in order to study the roots and realities of the risks and the causes of their occurrence, as well as to find solutions to reduce these risks. (Khorasan Razavi, 2017).

Methodology

Research framework model is composed of selecting 10 different Hazard in cement industry and also describing its possible precaution. Then FMEA and AHP both methods will be apply to rank selected hazards. As Figure 10 shows that, selected hazards, Hazards causes and ways how to prevent/ minimized the hazards risk are already defined. Then, First FMEA method will be apply on cement industry selected hazards using data collected from cement plant employees through interviews and questioners and then AHP method will be used for Ranking of selected hazards. After application of both techniques, results of both techniques will be comparing.

Figure 1: Methodology/Research Framework

Data Collection: To find out most important hazards in cement plant, which was used for research and analysis, data was collected by interviewed cement industry employees, cement plant first aid centre and some some of data was also taken from previous work as hazards are classified and summarize in many research papers (Selcuk Cankaya, 2015)

To apply FMEA and AHP method, data was collected from different employees of Cement industry through questioners and interviews. Data was collection from different designation and department personnel to Highlighted the Hazard in better way.

This data was then analyzed by FMEA and AHP method will be apply for ranking Hazards and at last results of both methods were compared.

Table 1 Questioners and data collection table

Rating for Severity of Failure (S)		Rating for occurrence of Failure (O)		Rating for Detection of failure (D)	
Ratings	Description of Severity	Ratings	Description of occurrence	Ratings	Description of Detection
1	The effect is not noticed by customer	1	Extremely remote	1	Almost certain to detect
2	Very slight effect noticed by customer, does not annoy or inconvenience customer	2	Remote, very unlikely	2	Very high chance of detection
3	Slight effect that causes customer frustration, but they do not seek service	3	Very slight chance of occurrence	3	High chance of detection
4	Slight effect, customer may return product for service	4	Slight chance of occurrence	4	Moderately high chance of detection
5	Moderate effect, customer requires immediate service	5	Occasional occurrence	5	Medium chance of detection
6	Significant effect, causes customer dissatisfaction; may violate regulation or design code	6	Moderate occurrence	6	Low chance of detection
7	Major effect, system may not be operable; elicits customer complaint; may cause injury	7	Frequent occurrence	7	Slight chance of detection
8	Extreme effect, system is inoperable and a safety problem. May cause severe injury	8	High occurrence	8	Remote chance of detection
9	Critical effect, complete system shutdown; safety risk	9	Very high occurrence	9	Very remote chance of detection
10	Hazardous; failure occurs without warning; life threatening	10	Very Very high occurrence	10	No chance of detection; no inspection

S= Severity   O= Occurrence (frequency)   D= Detectability

Section A

Keeping in view, above rating criteria for Severity, Occurrence and Detection of hazards in Cement plant, please mark the rating factor (1, 2, 3….10) of each factor (S, O, D) in relevant box.

Sr #	Hazards		Potential Effect/Harm	Causes	Severity (S)	Occurrence (O)	Detectability (D)	Controls
	Failure mood / Hazards	Description						
1	Slipping (Slip and Trip fall)	Slip: When there is weak friction between walking floor and human footwear. Trips: Trips fall happen when something collide, Strike or hit with foot	Minor injury, Major injury, Fracture, Death	PPE, s, Personnel issue, Cleaning (loose material), Oily surfaces, Contamination, Footwear, Cable obstacles, Poor lightening, Environment, Perception of Risk and Flooring.	1 2 3 4 5 6 7 8 9 10	1 2 3 4 5 6 7 8 9 10	1 2 3 4 5 6 7 8 9 10	Proper lightening Cleaning, Ensuring PPE, s, Good quality shoes and Trainings

Findings: Both FMEA and AHP method were apply by using collected data, results and finding of both methods are as under:

FMEA method: Based upon questioner and interview data average vales of Severity, Occurrence and Detectability were calculated for all KPI, s i.e. Hazards selected and for finding of RPN all these valves are multiplied with each other and thus RPN Numbers are evaluated .Average valves and calculated RPN is shown in following table

Table 2 Evaluation of hazard by FMEA method

S.NO	Hazards	Severity	Occurance	Detectability	RPN
1	Slipping (Slip and Trip fall)	6	5	5	150
2	Work at Height	7	5	5	175
3	Burn	7	5	5	175
4	Dust	6	7	4	168
5	Lifting heavy loads(Manual Handling)	6	5	5	150
6	Noise	4	6	4	96
7	Traffic accident and movement of heavy Vehicle	6	4	5	120
8	Improper use of Equipment (Tools	5	6	6	180
9	Electrical hazard	8	5	6	240
10	Work in confined Space	7	4	5	140

Based upon the above Risk Priority Number (RPN), Assessment and prioritization of the risks of the cement industry is done by FMEA Method as shown in following table:

Table 3 Prioritization of the risks of the cement industry by FMEA

S.NO	Hazards	RPN	Priority
1	Slipping (Slip and Trip fall)	150	5
2	Work at Height	175	3
3	Burn	175	3
4	Dust	168	4
5	Lifting heavy loads(Manual Handling)	150	5
6	Noise	96	8
7	Traffic accident and movement of heavy Vehicle	120	7
8	Improper use of Equipment (Tools	180	2
9	Electrical hazard	240	1
10	Work in confined Space	140	6

Hazards along with associated RPN and Priority Number are shown in above table. Table shows that the most important i.e. sever hazard is Electrical Hazards and Noise is the minimum hazardous hazards in

Cement industry as per research carry out. Risk classification, Risk level and Percentage achieved in this research are shown in following table:

Table 4 Risk classification and level

S.NO	Risk Classification	Risk Level	Percentage Achievement (%)
1	0-150	Acceptable	50
2	150-290	Unacceptable	50
3	290>	Unbearable	0
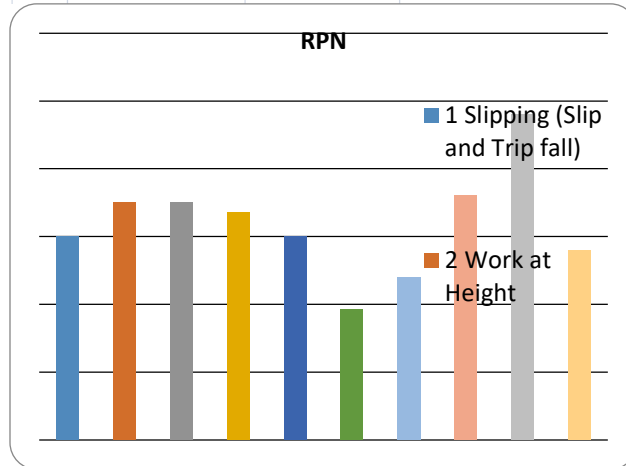
Figure 2: RPN Vs Hazards Graphical representation

AHP method: As per AHP Method the hierarchical Structure is developed as shown in following figure. Relative importance of each hazards with respect to another is already get through Questioner and Interviews. Pair wise comparison matrix, normalized pair wise comparison matrix, Calculation of consistency and consistency ration is calculated.

The pair wise comparison matrix is shown in following figure along with risk prioritization.

Table 5 Pairwise comparisons along with risk prioritization

Figure 5 shows the priorities of each hazard. Electrical Hazards has maximum percentage i.e. 20.8% and ranked at first similarly Noise has 5.1% having minimum hazardous.

Number of comparisons = 45
Consistency Ratio CR = 8.4%
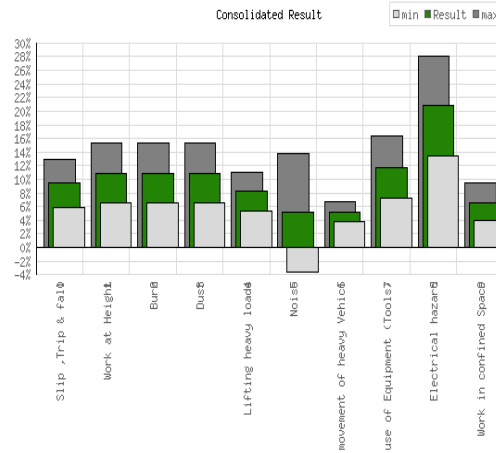
Figure 3 Graphical representation of hazard ranking with AHP

Comparison of FMEA and AHP Method

Priority of selected Hazards is done with both FMEA and AHP method. Both methods results are shown in following table. Priority Number of each Hazard and Its percentage is given foe both Methods. Electrical Hazards has maximum percentage at both Methods having 15% and 20.8% respectively and lying at first Priory. Priority number and percentage of remaining Hazards are shown in following Table.

Table 6 Comparison of FMEA and AHP Methods results

S.NO	Hazards	FMEA Method		AHP Method	
		Priority	FMEA %	Priority	AHP %
1	Slipping (Slip and Trip fall)	5	8.4	6	9.4
2	Work at Height	3	10.9	3	10.9
3	Burn	3	10.6	3	10.9
4	Dust	4	10.5	3	10.9
5	Lifting heavy loads(Manual Hand	5	9.4	7	8.2
6	Noise	8	6	10	5.1
7	Traffic accident and movement	7	7.5	9	5.2
8	Improper use of Equipment (Too	2	11.2	2	11.8
9	Electrical hazard	1	15	1	20.8
10	Work in confined Space	6	8.7	8	6.6

Discussion

FMEA and AHP methods were apply to these risk for ranking and it is revealed that there is 50% of acceptable risk, 50% of unacceptable risk, while 0% of unbearable risk in cement industry. Among the 10 Selected Hazards at Cement industry, Slipping (Slip and Trip fall), Lifting heavy loads (Manual Handling), Noise, Traffic accident and movement of heavy Vehicle, Work in confined Space were identified which are in acceptable rang By FMEA and AHP method and Work at Height, Burn, Dust, Improper use of Equipment (Tools) and Electrical hazard were identified which are lying under unacceptable rang and need

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to take timely action to reduce the impact of these hazards. Popular Reason that causes unacceptable hazards are Bad Equipment design, Lack of Supervision and proper planning , lack of Trainings , unavailability of proper working Standard Operating Procedure (SOP) , less Health education, unavailability of Protective measures, usage of PPE,s, Demotion first-aid measure, Bad housekeeping, unavailability of proper dust suction system, Control stack emission, Control of Fugitive emission, Prevention of leakages, using wrong tool, low quality tools, unsafe Practices, unavailability of fire extinguisher, dirty tools, Training of personnel, Unavailability/Work to permit system, using not insulate tools, Isolation, Faulty Wires and not put into practice Lockout and Tagout(LOTO).Similarly acceptable Hazards have also some reason and cause of unacceptable hazards may be minimized with Facilitate worker with Lifting equipment, Proper Supervision, Trainings and information for Lifting heavy loads(Manual Handling),Good acoustic design, Scheduling of activities, fencing noise source, Green belts, Setting silencer and Exhaust opening for noise control, Specified Traffic ways, Safe Walkways, Proper lightening, speed limits, , Appropriate load, , Personnel Training , Experience drivers, Restricted areas, and Well maintain vehicle for Traffic accident and movement of heavy Vehicle, Proper lightening, Cleaning, Ensuring PPE, s, Good quality shoes and Trainings for Slipping (Slip and Trip fall) hazards and proper Training, Work to permit, Proper supervision, Proper communication, Emergency exit way and plan to reduce Work in confined Space Hazards.

Conclusion

As cement industry is considered to be a rough and tough place for working as compare to other industry having a lot and different typed of hazards. The manufacturing process and activities in this industry are required to work in different conditions such as high altitude, work and communication with dangerous rotating and moving equipment, and high-risk manufacturing processes. It also requires proper controls and structures to protect human capital and machinery and to avoid financial and financial losses. In today's highly aggressive world, enhancing safety in the cement industry is one of the most important factors in achieving the organization's top goals and coverage of legal requirements. Achieving this is due to the creation of management systems that will lead to the identification, prioritization and control of the risks in the activities.

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Utilization of Cement Mortar as Load Bearing Material for Affordable Housing

Hizbullah Khan, Syed Bilal Ahmad Shah

City University of Science & Informtaion Technology, Peshawar,Pakistan

Abstract

Pakistan is going through a phase of population explosion, the rapid increase in population numbers across all the landscapes of the country has posed serious threats in terms of meeting the basic needs of the people. In this context, the Naya Pakistan Housing Scheme intends construction of 5 million houses to meet the basic requirements of communities with very low income. The research is aimed at proportioning of mortar with cement and sand by adding some admixtures of an optimum percentage (SBR). The study conducted utilized 5% of SBR in the mortar samples by weight of cement through a process of trial sampling for attaining the optimum amount (SBR). The behaviour of the specimens was tested for compression, tension as well as for material density. The tests conducted showed promising results in terms of mortar as load bearing material for single story units specialized for its use in the affordable housing project. The cost reduction is about 25% if the material is used on full scale for the construction. The material revealed a compressive strength within the range of 450 to 700psi which is in the proximity of fourth-class bricks. The tensile capacity of the mortar so developed is four times (100psi) than that of adobe structures (25psi) and two times that of brick masonry(50psi).

Keywords:ASCE-07/IBC-2009, UBC-97, Seismic Inputs, Structural Parameters, Seismic Analysis

Introduction

Pakistan is experiencing a rapid increase in population, coupled with unplanned urbanization, resulting in a severe shortage of decent, affordable housing. According to the 2017 census, there were a documented 32.2 million housing units in the country, with 39% located in urban areas. Projections suggest that by 2039, Pakistan's population will rise by 23 million, with an annual increase of 2.3 million, necessitating 360,000 new households (assuming an average of 6.3 individuals per household). The Household Integrated Economic Survey (HIES) 2015-16 revealed that the average Pakistani family, comprising 6.3 individuals, earns PKR 29,150 per month, which falls below the monthly subsistence income level of PKR 39,753 per household..*(Hina Shaikh, 13 Aug 2019)*

After looking all these huge figures, we must feel a need for affordable housing.

Mortar as Load Bearing Material

Mortar is basically a binding agent that is composed of cementitious material, fine aggregates and water. The main purpose of the mortar is to sew masonry units (blocks/bricks) and form a single unit. It is commonly used for plastering.

Mortar's compressive strength is of prime importance if used as a load bearing material. Research studies has been conducted to improve its strength through different means. The industrialized and developing world is facing issues related to new construction specially in term of budget.

Brick masonry is usually used for construction purposes but it is not so economical especially in the developing countries where economy is of prime importance. Thus, for affordable housings there is a need to introduce new material which can be economical in order to replace bricks.

Various researchers have conducted experimental studies on cement mortars in order to make it strong

enough to withstand loads, weathering conditions and to use it as a building material. Several alternatives are used as partial or total replacement of sand in conventional cement-sand mortar in order to improve its strength. Present study also focuses on improving strength and stability of mortar and reducing its cost. In the present study the use of mortar with 5% SBR is assessed as an alternative to bricks in terms of strength, stability and use in load bearing walls.(moladi)

Literature Review

(Mukherjee, Mandal, & Adhikari, 2011) The behavior of mortar under direct compressive load was examined through testing. Mortar cubes were cast and cured for a duration of 7 days. Subsequent tests including apparent porosity, water absorption, UPV, and compressive strength were conducted. Following these initial tests, varying loads were applied to the samples. The results revealed that with increasing loading, water absorption and apparent porosity increased, while compressive strength decreased. This indicates that the quality of mortar specimens generally deteriorates with the application of higher loads.

(Doğan & Bideci, 2016) examined the impact of SBR on concrete. They designed 15 concrete mixtures measuring 150 x 150 x 150 mm, which included variations such as Control (0%), 1%SBR, 3%SBR, 5%SBR, and 8%SBR by weight. Tests including split tensile strength, compressive strength, and UPV were conducted. SBR was substituted for cement in percentages of Control (0%), 1%, 3%, 5%, and 8%, and its effects on strength properties were analyzed. Results indicated that the maximum compressive strength was achieved at 28 days in the sample containing 1% SBR, while the minimum was observed in the sample with 8% SBR. It was concluded that the most significant enhancement in HSC strength was observed in samples containing 1% SBR. Analysis of split tensile strength test results revealed that the maximum value was found in samples with 8% SBR, whereas the minimum value was observed in control samples with 0% SBR.

*(Kamplimath & Joshi, 2015)*Experiments were conducted to improve the compressive strength of mortar by substituting river sand with various materials, including manufactured sand, granulated blast furnace slag, quarry dust, granite powder, LD slag, and cement-lime-soil paste. Mortar cubes were cast, and compressive strength tests were conducted. The findings indicated that CLSP mortar exhibited higher compressive strength. The ratio utilized in CLSP was 1:1:1.5.

(Madurwar, Burile, & Sorte, 2019) Fly ash was substituted for cement at percentages of 5%, 10%, 15%, and 20% by weight to enhance the compressive strength of mortar and improve its cost-effectiveness. Mortar cubes consisting of Cement-Sand mortar in a 1:3 ratio was prepared. These cubes were subjected to curing for durations of 7, 14, and 28 days, followed by compressive strength testing. The results indicated that when fly ash replaced cement up to 5% by weight, the compressive strength was nearly equivalent to that of cement-sand mortar without fly ash. However, any further increase in fly ash content resulted in a reduction of compressive strength.

(*Rai, Kumar, & Satish, 2014)* The research investigated the impact of fly ash and quarry dust on the compressive strength of mortar. Two control mixes were employed: a 1:3 cement-sand mortar mix with varying percentages of partial replacement of natural sand with quarry dust (0%, 20%, 50%, and 100%), and a 1:3 cement-sand mortar mix with 20% partial replacement of natural sand with quarry dust. The latter mix was further modified by replacing different percentages of cement with fly ash (0%, 15%, 20%, 25%, and 30%) by weight. The results indicated that the combined use of quarry rock dust and fly ash demonstrated excellent performance. Replacement of sand up to 20% increased strength, while further increases in quarry dust proportion led to a reduction in compressive strength.

(*Singh & Bansal, 2015)* The impact of silica fume on the strength of cement mortar was investigated. Substituting sand and cement with specific percentages of silica fume resulted in enhanced compressive strength the mortar. Three mix proportions, namely mix 1:3, mix 1:4, and mix 1:6, were utilized, with replacements of 5%, 10%, and 15% of silica fumes for sand and subsequently for cement. The findings revealed that replacing sand led to an increase in compressive strength of up to 40%. Similarly, replacing cement up to 20% resulted in improved compressive strength, while maintaining cost-effectiveness

.(Praveen & Krishna, *2015*) The study focused on assessing the strength and workability of cement mortar incorporating manufactured sand (M-sand). Strength and workability characteristics of 1:6 cement mortar, utilizing both natural sand and M-sand as fine aggregates, were evaluated at replacement levels of 20%, 40%, 60%, and 80%. Results indicated that the workability of cement mortar improved with increasing M-sand content up to 60%, after which it declined. Conversely, the strength of the mortar increased with higher proportions of manufactured sand. Therefore, M-sand is recommended as a viable substitute for natural river sand in cement mortar, and the addition of admixtures can further enhance workability.

(Alsadey & Omran, 2018) Research focused on examining the impact of Plastiment –BV 40 and SP dosage on the properties of cement mortar. Test samples underwent exposure to elevated temperatures ranging from 200°C to 400°C, followed by conducting compressive strength tests. Furthermore, the strength properties of cement mortars were investigated at varying dosages of SP. The findings revealed that an excess dosage of 0.4-0.8% beyond the required amount exhibited improved workability and strength for cement mortar.

(*Nahata, Kholia, & Tank, 2014*) The research investigated the influence of curing methods on the compressive strength of mortar cubes, employing mortar mixes with a cement: sand ratio of 1:2.75 and varying water/binder ratios ranging from 0.45 to 0.60. Field sand, ASTM graded sand, and OPC were utilized in the study. The results of compressive strength under different curing methods were compared, with an aim to understand the efficacy of the adopted curing techniques in comparison to conventional water curing. It was observed that wet curing with a water/cement (w/c) ratio of 0.5 yielded noteworthy results.

Research Methodology

Materials

Cement is widely used in construction as binding material. As the time passes by it achieve its hardness and helps to bind the aggregates together. Its main constituents are Argillaceous or Silicates of Alumina and Calcareous or Calcium Carbonate, in the form of limestone, chalk and marl. In the current study it is also used as a binder.

Local river sand was used in the study. The main and foremost purpose of sand is not to increase the strength of mortar but it is mainly used to increase the volume of mortar for the economy. It helps to prevent mortar shrinkage. It also prevents cracking of mortar during setting.

Styrene Butadiene rubber mainly known as SBR (figure-1) is used widely to enhance the mechanical properties of construction materials such as compressive strength, flexural strength and tensile strength. It is obtained by emulsion or suspension polymerisation of styrene and butadiene monomers. In the current study it is used as admixture.

Figure-1**:** Styrene Butadiene rubber (**SBR)**

Tests on Material

Sieve Analysis of Fine Aggregate: sieve analysis of aggregate was performed according to (ASTM C136 –06).

Fineness modulus $= \frac{summation\ of\ commulative\ percentage\ retained}{100} = \frac{301.4}{100} = 3.014$ (coarser sand)

Specific gravity and water absorption test were performed according to (ASTM C-128) and the results are given in the following table.

Bulk specific gravity (OD) = 2.61

Bulk specific gravity (SSD) = 2.63

Apparent specific gravity = 2.66

Absorption = 0.4%

Moisture content = 2%

3.2.3 Unit Weight Test: Unit Weight of Fine Aggregate was performed according to (ASTM C-29). The mechanical properties of construction materials are mainly depending upon its density. The greater the density of the material the higher will be its compressive strength and lower will be the voids.

Density = mass/volume

Mass = 5.132-1.096 = 4.036kg

Volume = (3.783-1.096)/1000 = 0.002687 m^3

Density = 4.036/0.002687

Density = 1502.05 kg/m^3 (wet)

Dry density = 1472.5 kg/m^3

To facilitate the construction of affordable houses, it is imperative to develop and introduce a cost-effective yet efficient material. However, there is a notable scarcity of technical data regarding suitable mix proportions necessary to produce structural-grade mortar with precise strength requirements and an optimal level of workability for seamless placement into construction formwork. This deficiency poses a significant challenge in constructing load-bearing structural components efficiently.In order to achieve a structural grade mortar of sufficient strength for affordable housing, we have to first go through trial sampling in order to achieve optimum SBR content. A total of 18 cubes of 2in x 2in of 1:8 was casted, 3 each for 0%, 1%, 2.5%, 3%, 4.5% and 5% SBR latex. Which were added by weight of cement. A water to cement ratio 0f 0.5 is used After casting they were left in moulds for 24 hrs. The samples were tested after 14 days of curing. Results show an increasing trend of compressive strength with addition of SBR. Keeping in mind the sensitivity of the project to conform the results 12 cylinders of 6in diameter and 12in height were casted 3 out of which were controlled and in other 3%, 5% SBR were added by weight of cement the results reported shows 9% increase in compressive strength by addition of SBR.

After trial sampling 48 samples were casted of 1:6, 16 each for cylinders, cubes and beams having 5% SBR added by weight of cement. Half of the samples were tested after 14 days of curing while the other half were tested after 28 days of curing.

Before performing destructive tests Ultra-sonic Pulse Velocity test (UPV) were carried out on the samples to have a rough idea about the micro structural background of the material.

After the UPV test the samples we*r*e tested in the material lab of CUSIT. Compressive test, tensile strength and flexural strength test were performed on the samples. The results are given in Chapter 04, results and discussion.

Results and Discussion

Trial Sampling

With addition of SBR the compressive strength of the samples increased. With an increase from 1% to 5% the strength of the trail samples increased from approximately 100psi to 1100psi which is showing a 10 percent increase for a four percent of increment of SBR. Thus 5% SBR content will be added by weight of cement.
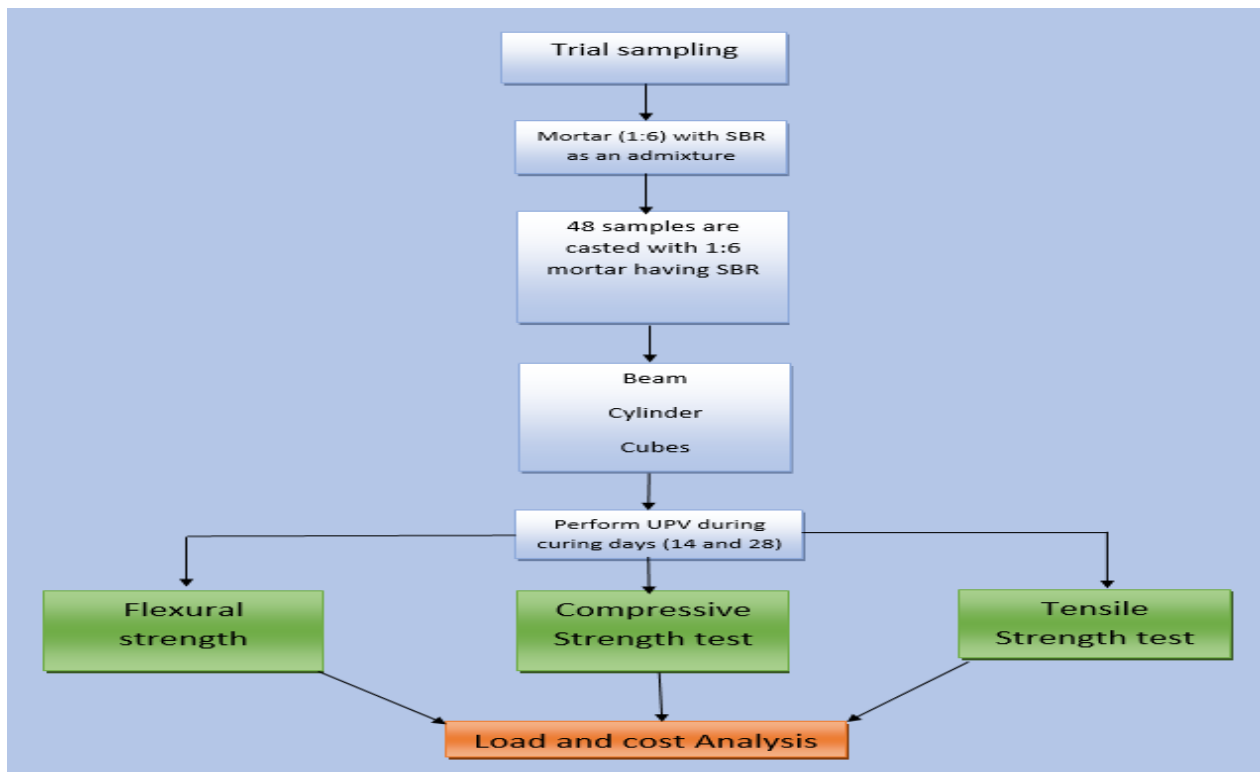
Figure-2: Testing Procedure for Samples

Compression Tests

The compressive strength of mortar cylinders ranges between 400 to 650 psi for cylinders and 400 to 700 psi for mortar cubes (14 & 28 days) which can be clearly seen in table 4,5 and 6, 7. In comparison with ordinary mortar (150psi) (figure-3 & 4) the strength reported from the results is more than 2 times of that. SBR addition has significantly enhanced the compressive strength of mortar. This compressive strength is approximately 50% of that of C-class brick, 65 percent of fourth-class brick which are feasible for use in single units with low demand of gravity as well as dynamic loading. This improvement in the

compressive strength of mortar is resulted from improved bonding between cement and sand by the addition of SBR.
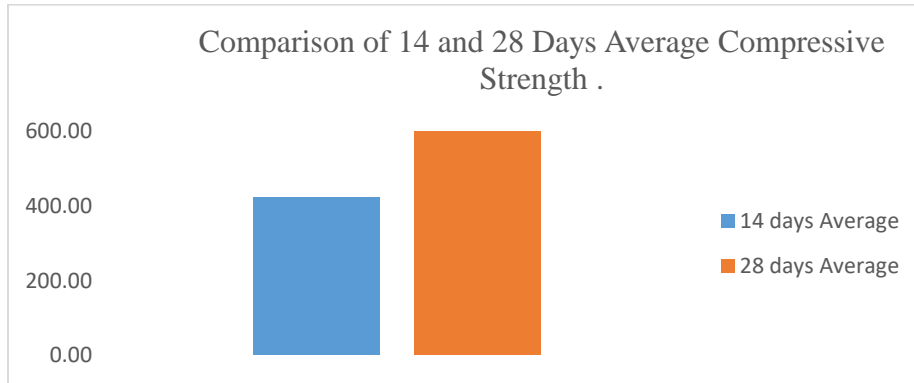
Figure 3. Comparison of 14 And 28 Days Average Compressive Strength
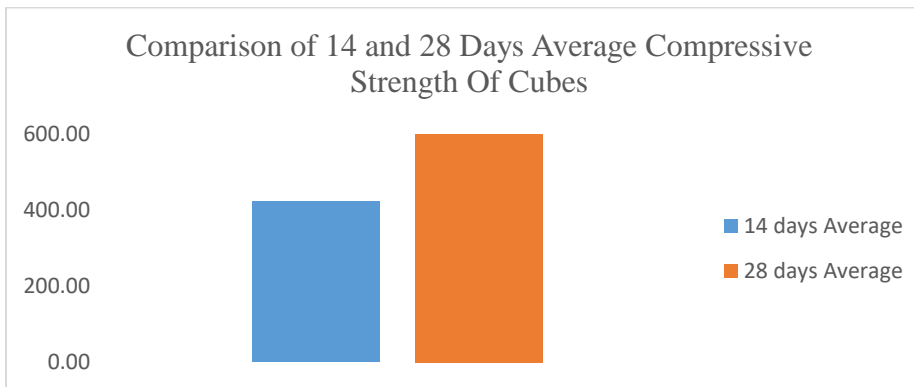
Figure 21. Comparison of 14 and 28 Days Average Compressive Strength of Cubes

Tensile Strength

The tensile strength reported from the experiments is quite promising in comparison to adobe structures as well as C-class bricks. The strength reported (figure-5) is approximately above 95 psi for 14 days. The results so obtained are approximately 4 times greater than the average strength of adobe structures and twice that of bricks.
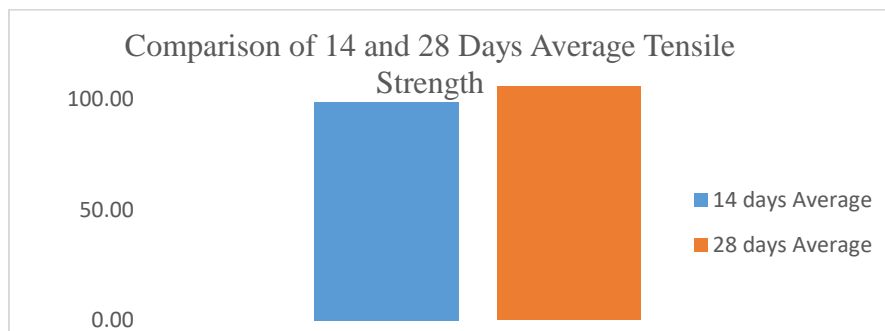
Figure 5. Comparison of 14 and 28 Days Average Tensile Strength

Flexural Strength

Flexural strength is analogous or an indicative of the tensile capacity of mortar. The results of different beams of Mortar enhanced with SBR after curing of 28 days (figure-6) the flexural strength increases from 571.91 to 620.83 psi, the increment is almost 8%. This property of material helps to resist the failure in bending,
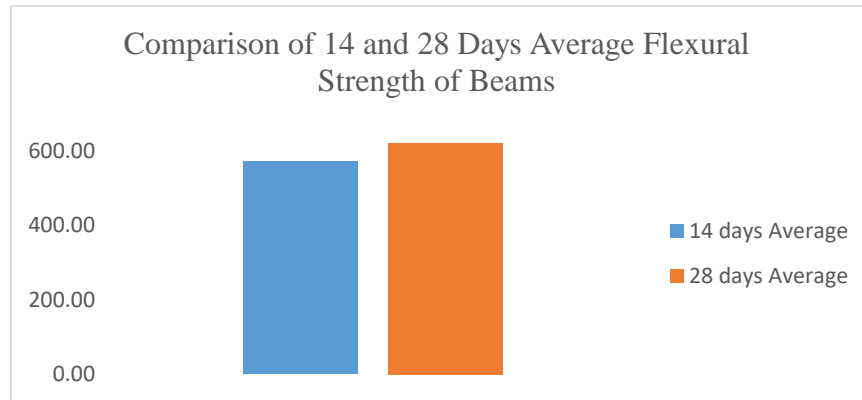
Figure 22. Comparison of 14 and 28 Days Average Flexural Strength of Beams

Ultrasonic Pulse Velocity (UPV)

UPV (non-destructive) tests are carried out on different samples to check the quality of mortar, comparing the values of both 14- and 28-days samples there is no such difference between them however the lower density of the material is a matter of concern and this very aspect of the mortar needs further investigation.

Discussion

The results above show that the material under discussion has the capacity to bear loads and withstand tensile forces up to a reasonable level. The use of improved samples for housing, there is a need to calculate the demand for a single-story unit as demanded in NPHP. The calculation of total load on the base of a single-story house and then we have to compare it with the results of the material under discussion.

The ASCE 7-10 provides load factors and various load combinations for the possible applied loads. For dead load it is 1.2 while for live load it is 1.6.

Taking these factors into considerations and assuming the dimensions are 10 ft x 10 ft for a typical room size of a single-story unit (The loading will be tentatively extended five times based on the configuration of the slab system) and thickness of slab is 6 inches is 3.565 lb./in² + 11.44 lb./in² which when increased 5 times gives us 15.00 Psi.

Increasing the load by a factor of five in case one-way continuous slab systems are opted for in the configuration of single-story units. The total factored load will be 75psi. In some special cases where the housing schemes use continuous slab systems for optimal occupancy in a given area especially in big cities like Karachi and Lahore the load can increase up to 100psi.

Now the results obtained shows that the material under discussion have compressive strength values ranges between 400 to 650 psi for cylinders and 400 to 700 psi for mortar cubes (14 & 28 days). So, it can easily withstand the gravity loads and thus the material can be used in load bearing walls.

Furthermore, the results reported also shows high tensile strength (approximately 100psi) thus it will perform better then bricks and adobe structure by a factor of 2 and 4 respectively which is a significant number when we look at the service loading of single-story units. Moreover, the improved mortar samples should be tested by reinforcing it up to a cost-effective way. In that case the tensile capacity will be further

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improved and it might withstand higher seismic demands reasonably well.*(pak., 2014)*

The improved samples of mortar do give reliable results however, the test results of UPV on all the samples shows a concern of low material density. The improvement in this regard requires microstructural study of the improved samples. Moreover, the consequences of such a limitation should be studied for the longer span of life of materials.

In regard to the use of improved samples of mortar for single units for NPHP the results obtained from experiments are quite promising. In the near future the material has high potential for its use in the project as a very cost-effective alternate in comparison to the conventional materials used.

The 25% reduction in cost for a single room will sums up to a large amount when using the material in large scale projects.

Conclusions and Recommendations

Conclusions

- The results obtained from the experiments are quite promising. From the results of compressive strength of the mortar it is concluded that it is in the proximity of fourth-class brick, thus it can perform better in structures as a load bearing material.
- Tensile strength of the material is also way higher than that of adobe structures as well as brick masonry. From the results we can conclude that tensile strength is 4 times greater than the average strength of adobe structures and twice that of bricks thus it can perform better than adobe structures and fourth-class brick in seismically active regions.
- Apart from the strength it also reduces the cost of a single-story facility by 25% which will make the structure affordable.
- SBR can potentially enhance the mechanical properties of mortar by increasing the binding properties of cement.

Recommendations

- The test results of UPV on all the samples shows a concern of low material density. The improvement in this regard requires microstructural study of the improved samples. Moreover, the consequences of such a limitation should be studied for the longer span of life of materials.
- Environmental hazardous effects of freezing and thawing must be studied on improved samples before recommending for its use as structural material.
- Cost of material are greatly reduced however the cost of formwork is not fixed and can vary the total cost hence there should be a form work which can be used multiple times.

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Enhancing Antiviral Therapies through Optimized Nonlinear Control of Human Immunodeficiency Virus Dynamics

Rimsha Ghias, Atif Rehman, Shabab Saleem, Syed Hassan Ahmed, Iftikhar Ahmad
National University of Sciences and Technology (NUST), Islamabad, Pakistan

Abstract

Human Immunodeficiency Virus (HIV) is a formidable viral agent that targets the human immune system, compromising its ability to safeguard the body against infections and illnesses. Identified as a lentivirus, HIV instigates a prolonged and intricate infection that poses significant challenges in understanding infectious diseases, emphasizing the ongoing necessity for comprehensive research and effective treatment strategies. It's a very complex virus that severely compromises human immune systems, making disease understanding challenging and highlighting the need for additional research and improved treatment options. To better grasp the evolution of the virus, scientists have intricately designed mathematical models focusing on unraveling the intricate interactions among healthy helper T-cells, infected helper T-cells, and viral load. This paper presents various types of controllers, putting a special spotlight on two as sliding mode control (SMC) and super-twisting sliding mode control (STSMC). These controllers are crafted with a clear goal to minimize infected helper T-cells and decrease the viral load while maximizing the count of healthy helper T-cells. The controller's performance has been finely tuned using a genetic algorithm focused on minimizing integral time absolute error. Mathematical analysis includes Lyapunov stability criteria to ensure the stability of these controllers. Simulations conducted using MATLAB/Simulink allow for thorough performance comparisons between different control strategies.

Keywords
Human Immunodeficiency Virus, super-twisting sliding mode control, genetic algorithm, hardware-in-loop

1. Introduction
Human Immunodeficiency Virus (HIV), discovered in the early 1980s, remains a significant global health threat, leading to acquired immunodeficiency syndrome (AIDS). This virus specifically targets and weakens the immune system, particularly by attacking CD4 cells, pivotal in orchestrating the body's defense mechanisms. HIV's intricate behavior has sparked extensive research, public health initiatives, and ongoing medical progress. Its widespread impact spans demographics and regions, driving relentless pursuits for effective treatments, preventive measures, and, crucially, the pursuit of a definitive cure. The intricate interplay between the virus, the immune system, societal influences, and healthcare complexities highlights the depth and urgency in combating this continually evolving viral challenge. Our immune system acts as a complex defense mechanism, comprising a network of proteins, specialized organs like the thymus and spleen, various tissues, and an array of cells, all working cohesively to protect the body's overall health **(Boonyaprapasorn, A. *et al*., 2016)**. When HIV infiltrates the immune system, it targets specific white blood cells, particularly CD4+ T cells, crucial for coordinating immune responses. Once inside these cells, the virus replicates, gradually reducing the population of healthy CD4+ T cells. This decline weakens the immune system's ability to combat infections, leaving the body vulnerable to a spectrum of illnesses, from opportunistic infections to aggressive cancers **(R. Aguilar-Lópvez, *et al.,* 2016)**, **(S. S. Ge, C. C. Hang, *et al.*, 2013).** HIV transmission occurs through various bodily fluids and tissues. It can be transmitted via unprotected sex, where semen and vaginal secretions play a significant role. Additionally, infected blood

from blood transfusions or contaminated needles, tissues from organ transplants, and even breast milk from an infected mother can transmit the virus.

These diverse transmission routes underline the importance of preventive measures and awareness campaigns to curb the spread of HIV **(C.-F. Cheng, *et al.*, 2004)**, **(Jiang, 2009)**. After the initial acute infection and a phase of clinical latency, AIDS represents the advanced and most critical stage of HIV infection. This stage manifests when the count of CD4+T lymphocytes, a crucial type of white blood cell, falls below 200 cells/mm3 **(F. A. Alazabi, *et al.,* 2012).** What's notable is that even if the count of these cells rises above the 200 cells/mm3 threshold, the individual is still categorized as having AIDS, emphasizing the disease's gravity and the complexity of its management. Unfortunately, there exists no definitive cure for AIDS. However, treatment involves intricate strategies aimed at suppressing the vast number of infected cells through medication and employing sophisticated automated control techniques. These approaches aim not only to control the virus but also to bolster the immune system's functionality and overall health in those affected **(I. Ahmad, *et al.*, 2019)**. A prevalent treatment for HIV/AIDS involves antiretroviral therapy, utilizing drug regimens to minimize the proliferation of infected cells **(M. Cupelli, *et al.*, 2014)**, **(B. A. Costa, *et al.,* 2011***)*. Despite numerous control strategies implemented to manage this disease, a significant limitation lies in the simultaneous elimination of uninfected or healthy cells. This drawback stems from the nature of current treatments. Nonlinear controllers have emerged as more efficient in handling uncertain aspects of the system, often overlooked by linear control techniques. They facilitate swift convergence of states towards their intended targets and enhance the accuracy of steady-state outcomes. Several mathematical models have been explored to understand the dynamic behavior of HIV/AIDS **(J. V. Pinheiro, *et.al.,* 2011)**, (**M. Shirazian, *et.al.,* 2010**), (**F. Biafore**, *et.al.,* **2006**), (**H. D. Unbehauen, *et.al.,* 2009**). Among these, optimal control techniques have gained prominence, extensively applied across various HIV/AIDS models to reduce viral load in the bloodstream **(C.-F. Cheng, *et al.,* 2004)**, **(F. A. Alazabi, *et al.,* 2012)**, (**R. Skjetne, *et.al.,* 2009**), (**W. Jasim, *et.al.,* 2004**).

Additionally, discussions in the literature have delved into the utilization of Lyapunov function for HIV control **(W. Jasim, *et.al.,* 2015)** and stability analyses of HIV models **(S. Venkatanarayanan, *et.al.,* 2014)**, **(R. Leyva, *et.al.,* 2006)**. Within the current body of literature, we find instances where Backstepping, Integral Backstepping, and Lyapunov redesign have been formulated using a model representing the human immunodeficiency virus under the influence of antiviral therapies. This study introduces the application of various nonlinear controllers, such as SMC and STSMC, within the HIV model as a potent treatment approach **(A. U. Rahman, *et.al.,* 2022)**. The primary objective is to minimize the population of infected cells and free viruses while preserving as many healthy cells as possible. To optimize controller gains, a genetic algorithm is employed, using the integral time absolute error (ITAE) as the key optimization metric. The stability of these proposed controllers undergoes thorough validation through rigorous mathematical analysis rooted in Lyapunov stability theory. The study conducts comprehensive evaluations, utilizing MATLAB/Simulink simulations and hardware-in-the-loop experiments, to further validate the efficacy of these controllers.

The article's structure is as follows: Section-II provides a detailed explanation of the complex mathematical HIV model being studied. Section-III focuses on introducing the proposed nonlinear controllers. In Section-IV, the simulation process and the outcomes derived from it are discussed. Finally, Section-V concludes the article by summarizing the main findings and emphasizing the significance of the research.

Mathematical Model of HIV Virus

Within the existing literature on HIV infection, mathematical models play a pivotal role in illustrating the dynamic evolution of system states over time. These models exhibit varying characteristics, with some incorporating stochastic elements, while others adhere to determinism **(C.-F. Cheng, *et al.,* 2004)**, **(F. Biafore, *et.al.,* 2006)**. Significantly, the model utilized in our study systematically elucidates the interaction among system states, presenting a detailed representation that eliminates the impact of random variations.

This model operates deterministically, offering a concentrated perspective on the complexities inherent in the system. It consists of a series of first-order nonlinear differential equations, which are outlined as follows

$$\dot{x}_1 = s - dx_1 - bx_1x_3 \qquad\qquad A. \qquad 1$$

$$\dot{x}_2 = bx_1x_3 - wx_2 \qquad\qquad B. \qquad 2$$

$$\dot{x}_3 = kx_2 - ex_3 - u(t) \qquad\qquad C. \qquad 3$$

The variables x_1, x_2, and x_3 denote the concentrations of distinct components within the biological system, specifically referring to healthy helper T-cells, infected helper T-cells, and virus cells, respectively. These concentrations are measured in milligrams per liter (mg/L) within the blood plasma. The system incorporates constants denoted by s, d, w, e, b, and k, each playing a vital role in characterizing the dynamics of the system shown in the Table **1**. In particular, s represents the production rate of healthy helper T-cells, and its assigned value is 50 $mgL^{-1}d^{-1}$. Moving on to the parameters d, w, and e, these signify the natural death rates of healthy helper T-cells, infected helper T-cells, and virus cells, respectively. The specified values for these rates are 0.05 d^{-1}, 0.4 d^{-1}, and 9 d^{-1}, respectively. The infection coefficient, denoted as b, holds a value of $5 * 10^{-4}Lmg^{-1}d^{-1}$. Lastly, the parameter k characterizes the growth rate of viral copies originating from infected helper T-cells, and its assigned value is 40 d^{-1}. These detailed specifications provide a comprehensive understanding of the underlying constants and variables governing the behavior of the biological system.

The system exhibits nonlinearity, primarily due to the term bx_1x_3, representing the infection rate of healthy helper T-cells by virus cells. Notably, Reverse Transcriptase Inhibitors (RTIs) play a crucial role in mitigating this infection rate. These medications disrupt the reverse transcriptase enzyme, compelling the virus to use flawed building blocks during replication. Consequently, the virus is unable to convert its viral RNA into viral DNA, impeding its ability to infect healthy cells.

Recognized as the cornerstone of HIV treatment, RTIs play a pivotal role in managing infection. Protease Inhibitors (PIs) are specifically designed to target the proliferation of viral copies originating from infected cells, as indicated by the kx_2 term in the system model equations (1) - (3). PIs achieve this by inhibiting the protease enzyme of HIV, a crucial step in the virus's budding process, marking the final stage of the HIV life cycle.

The concentration of healthy cells in the blood plasma can be indirectly increased by mitigating the infection rate bx_1x_3 through the administration of medical drug injections. This intervention subsequently lowers the concentration of virus cells in the blood plasma. Furthermore, a reduction in the kx_2 term can result in a decrease in the virus population, indirectly promoting an augmentation in the population of healthy cells. Nonlinear controllers have been developed to curtail the proliferation of viral copies from infected cells, thereby diminishing the overall virus population and establishing system stability with zero steady-state error.

Table 1: Model Parameters

Symbol	Parameters	Values
s	Production Rate of Healthy CD4$^+$ T-cells	$50\ mgL^{-1}d^{-1}$
d	Natural Death Rate of Healthy CD4$^+$ T-cells	0.5 d^{-1}
b	Infection Coefficient	$5 * 10^{-4}Lmg^{-1}d^{-1}$
w	Natural Death Rate of Infected Cells	0.4 d^{-1}
k	Number of Virus Copies produced from Infected Cells	40 d^{-1}
c	Natural Death rate of Free Virus	9 d^{-1}
a	Efficiency of Drug	0.4

Controller Design

The methodology is utilized in formulating nonlinear controllers specifically crafted for systems in strict feedback form. Its efficacy stems from its ability to prevent the elimination of vital nonlinearities, making it instrumental in examining system stability and elucidating physical properties **(F. A. Alazabi, *et al.*, 2012)**, **(H. D. Unbehauen, *et.al.*, 2009)**. In the realm of control system design, a refinement has been incorporated into a nonlinear STSMC based controller. This modification is geared towards enhancing the accuracy of tracking infected cells to their prescribed levels, thereby guaranteeing a complete elimination of steady-state error. The adaptability of this novel control methodology is particularly noteworthy, as it demonstrates its usefulness in continuous-time systems with input-affine nonlinearities following strict feedback structures. Additionally, a STSMC control strategy has been devised for addressing HIV treatment. This approach is intricately designed to alleviate the infection rate of healthy T-cells by strategically administering drug injections to counteract the presence of free virus cells **(R. Aguilar-L´opez, *et al.*, 2016).**

Sliding Mode Control

SMC is a robust control strategy designed to guide a dynamic system along a specified sliding surface, aiming to achieve the desired performance independent of uncertainties or disturbances. This approach entails formulating a control law that directs the system trajectory to reach and maintain the sliding surface, thereby ensuring robust stability and tracking even in the presence of uncertainties.

The terms representing errors are defined as

$$e_1 = x_1 - x_{1ref}$$

$$e_2 = x_2 - x_{2ref}$$

$$e_3 = x_3 - x_{3ref}$$

D.	4
E.	5
F.	6

Taking the time derivative of eqs. (4) – (6) result in the following expressions

$$\dot{e}_1 = \dot{x}_1 - \dot{x}_{1ref}$$

$$\dot{e}_2 = \dot{x}_2 - \dot{x}_{2ref}$$

$$\dot{e}_3 = \dot{x}_3 - \dot{x}_{3ref}$$

G.	7
H.	8
I.	9

To ensure that the error terms are minimized, the sliding surfaces s are expressed as functions of the error

$$s = c_1 e_1 + c_2 e_2 + c_3 e_3$$

J.	10

The expression obtained by differentiating eq. (10) with respect to time is as follows

$$\dot{s} = c_1 \dot{e}_1 + c_2 \dot{e}_2 + c_3 \dot{e}_3$$

K.	11

After substituting the values of $\dot{e}_1$, $\dot{e}_2$, and $\dot{e}_3$ into the expression defined by eq. (11), the resulting mathematical expression takes the following form

$$\dot{s} = c_1(\dot{x}_1 - \dot{x}_{1ref}) + c_2(\dot{x}_2 - \dot{x}_{2ref}) + c_3(\dot{x}_3 - \dot{x}_{3ref})$$

L.	12

To ensure the asymptotic convergence of the sliding surface, the condition $\dot{s} = -k\,|s|\,sgn\,(s)$ is employed. Upon substituting this expression into eq. (12), the resulting expression is obtained

$$-k\,|s|\,sgn\,(s) = c_1(\dot{x}_1 - x_{1ref}) + c_2(\dot{x}_2 - x_{2ref}) + c_3(\dot{x}_3 - x_{3ref})$$

<div style="text-align:right">M.   13</div>

By substituting the values of $\dot{x}_1$, $\dot{x}_2$, and $\dot{x}_3$ from eqs. (1), (2), and (3), the resulting expression is as follows

$$-k\,|s|\,sgn\,(s) = c_1(s - dx_1 - bx_1x_3 - x_{1ref}) + c_2(x_1x_3 - wx_2 - x_{2ref}) + c_3(kx_2 - ex_3 \\ - u(t) - x_{3ref})$$

<div style="text-align:right">N.   14</div>

Rearranging the eq. (14) the following control input is obtained

$$u(t) = \frac{1}{c_3}\Big[-k\,|s|\,sgn\,(s) + c_1(s - dx_1 - bx_1x_3 - x_{1ref}) + c_2(x_1x_3 - wx_2 - x_{2ref}) \\ + c_3(kx_2 - ex_3 - u(t) - x_{3ref})\Big]$$

<div style="text-align:right">O.   15</div>

In order to analyze the stability of the proposed controller, a Lyapunov candidate is selected using the following expression

$$V = \frac{1}{2}s^2$$

<div style="text-align:right">P.   16</div>

The Lyapunov candidate V is selected to serve as a positive definite expression concerning the sliding surface s. To attain the convergence of s to zero, indicating asymptotic stability, it is imperative that the time derivative of V evolves into a negative definite expression. Upon evaluating the time derivative of V, we obtain

$$\dot{V} = s\Big[c_1(s - dx_1 - bx_1x_3 - x_{1ref}) + c_2(x_1x_3 - wx_2 - x_{2ref}) + c_3(kx_2 - ex_3 - u(t) \\ - x_{3ref})\Big]$$

<div style="text-align:right">Q.   17</div>

Using the determined control input value $u(t)$ derived from eq. (15) in eq. (17), the time derivative of the Lyapunov function V is expressed as

$$\dot{V} = -k\,s|s|\,sgn\,(s) \leq 0$$

<div style="text-align:right">R.   18</div>

Simplifying this expression yields

S. $\dot{V} = -k\,|s|^2 \leq 0$ T.   19

Given the positive nature of the constant k, the behavior of $\dot{V}$ distinctly demonstrates negativity, validating the appropriateness of the proposed control input $u(t)$. This result further substantiates the assertion of asymptotic stability, in accordance with the criteria established by Lyapunov.

Super Twisting Sliding Mode Control

STSMC is a nonlinear control strategy specifically crafted to enhance the effectiveness of sliding mode control methods by mitigating the undesirable effects of chattering. It incorporates a super twisting algorithm, which introduces a combination of proportional and integral-like terms to smooth out the control signal. This approach enhances stability and robustness in systems with uncertainties and disturbances.

Applying eqs. (4) – (9) and eq. (10) – (12) of the SMC and setting $\dot{s}$ to zero, we derive the following expressions

U. $\quad 0 = c_1(s - dx_1 - bx_1x_3 - \dot{x}_{1ref}) + c_2(x_1x_3 - wx_2 - \dot{x}_{2ref}) + c_3(kx_2 - ex_3 - $ V.   20
$u(t) - \dot{x}_{3ref})$

Rearranging the eq. (20 following expression is obtained

                                                                             W.   21

$$u_{eq}(t) = \frac{1}{c_3}\left[c_1(s - dx_1 - bx_1x_3 - \dot{x}_{1ref}) + c_2(x_1x_3 - wx_2 - \dot{x}_{2ref}) + c_3(kx_2 - ex_3 - u(t) - \dot{x}_{3ref})\right]$$

To facilitate the asymptotic convergence of the sliding surface, the switching law is defined as $-k_i|s_i|sgn(s_i) - k_i \int_0^t sgn(s_i)\,dt$, where $i = 1$.

     X. $u_{sw}(t) = -k_1|s|sgn(s) - k_2 \int_0^t sgn(s)\,dt$ Y.   22

where

     Z. $u(t) = u_{eq}(t) + u_{sw}(t)$ AA.   23

Inserting the values of u_{eq}(t) and u_{sw}(t) into eq. (23), we obtain

BB. $u(t) = \frac{1}{c_3}\left[c_1(s - dx_1 - bx_1x_3 - \dot{x}_{1ref}) + c_2(x_1x_3 - wx_2 - \dot{x}_{2ref}) + c_3(kx_2 - $ CC.   24
$ex_3 - \dot{x}_{3ref})\right] - k_1|s|sgn(s) - k_2 \int_0^t sgn(s)\,dt$

To perform a comprehensive stability analysis of the proposed controller, we select a Lyapunov candidate expressed in eq. (16) and by taking its derivative eq. (17) is obtained. By utilizing the value of u (t) obtained from eq. (24), the subsequent outcome is as follows

                                                                         DD.   25

$$\dot{V} = -k_1|s|sgn(s) - k_2 \int_0^t sgn(s)\,dt \leq 0$$

EE. $\dot{V} = -k|s|^2 \leq 0$ FF.   26

The confirmation of the negative definite behavior demonstrated by $\dot{V}$ for the utilized control input, within the framework of the STSMC approach, serves to validate the achievement of asymptotic stability.

Genetic algorithm

Arising from the principles of natural selection, the genetic algorithm is a powerful method for optimizing various systems, such as fine-tuning the intrinsic gain parameters of ISMC, and STSMC controllers. When it comes to improving controllers, the genetic algorithm imagines a group of potential gainers as unique individuals. Here, each controller parameter acts like a genetic building block, combining to create a genetic structure that represents a potential solution. The essential cost function F_i, crucial for reducing the error term, is formulated in the following manner:

$$min\, F_i(s) = min \int \tau\,|s_i|\,dt$$

To start its operations, the algorithm begins with an initial set of potential solutions, forming what's known as a population. This population is methodically generated, often with random values confined within

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specific ranges for each gain. The proficiency of each element within this group, as depicted in fig **1**, is evaluated using a fitness function. This measure assesses how effectively each solution, defined by a distinct set of gain values, controls the system. The fitness function primarily considers traits related to transient response, steady-state errors, and other crucial performance indicators inherent to the system's dynamics. The algorithm refines the controller's gain parameters, and these finely tuned values are presented in Table **2.**
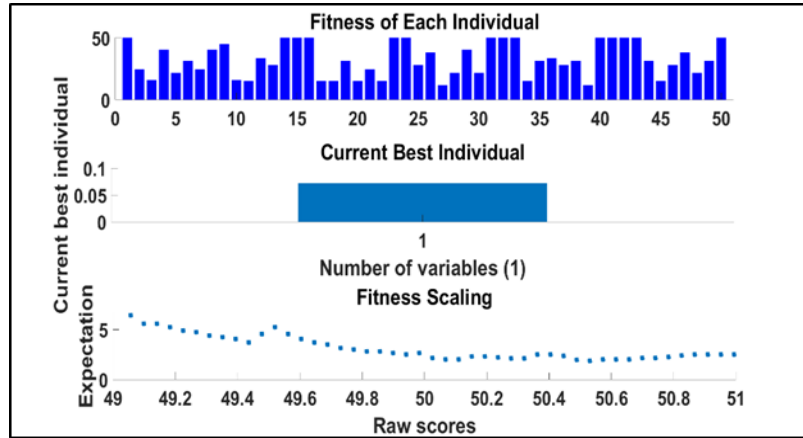
Figure 1: Genetic Algorithm performance for STSMC

Table 2: Controllers Gains Parameter

Controller / Parameters	C_1	C_1	C_1	k	k_1	k_2
SMC	155	500	100000	1	--	--
STSMC	20	1	1.5	--	20000	1

Simulaton and Results

In the conducted research, MATLAB/Simulink simulations were employed to assess the efficacy of controllers specified by equations, (15) and (16) in managing the primary infection stage of the HIV virus. These simulations utilized a one-week sampling period, providing a detailed and dynamic analysis of the system's behavior. The initial conditions for the simulations were set based on empirical data: 350 $\mathbf{mgL^{-1}}$ for healthy helper T-cells, 125 $\mathbf{mgL^{-1}}$ for infected helper T-cells, and 75 $\mathbf{mgL^{-1}}$ for the virus load (**C.-F. CHENG,** *ET AL.*, **2004)**. These values reflect a realistic starting point for the primary infection stage of HIV. To optimize the parameters of the proposed controller, a genetic algorithm was employed, serving as an effective optimization technique to enhance the controller's performance. The primary objective was to ensure that, under these optimized parameter values, the system maintains stability, a critical consideration in control systems to guarantee predictable behavior and avoid undesirable outcomes. This comprehensive methodology, encompassing simulation and optimization, facilitates a thorough evaluation and validation of the effectiveness of the proposed controllers in a realistic and dynamic setting. It represents a rigorous approach aimed at advancing the understanding of control strategies for managing HIV infections.

Comparative Results of SMC and STSMC

Fig. **2** illustrates the performance of T-cell behavior under the proposed control methodologies, demonstrating a rapid increase in the concentration of healthy cells in the blood plasma. Notably, Fig. **2**

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reveals a significantly higher growth rate of healthy cells when employing STSMC compared to conventional SMC. While both controllers demonstrate comparable tracking times for infected cells to reach their specified reference level, Fig. **3** underscores the distinctive advantage of STSMC in achieving zero steady-state error. This feature holds particular significance when contrasted with SMC. This contrast is emphasized in the magnified segment of Fig. **3**. In response to the applied tracking mechanism, the viral cell experiences a gradual reduction, ultimately reaching its minimum value and converging to zero, as demonstrated in Fig. **4**. The dynamics of virus cells, as shown in Fig. **4**, depict a steep decline in viral cells when STSMC is implemented. Notably, the viral load reaches an exact zero value approximately 6 days into the therapy, as indicated by the blue line in Fig. **4**. This underscores a crucial outcome in the effectiveness of the proposed controllers in mitigating viral load, with the STSMC variant exhibiting notable advantages over conventional SMC in terms of minimizing steady-state error.

The dynamics of the control input, specifically the drug injection process, are elucidated through Fig. **5** for the proposed controllers. This detailed comparison sheds light on the influence of incorporating the efficiency of the administered drug within the control law. Upon closer examination, when the control law does not account for the efficiency of the drug, the drug injection exhibits a substantial surge at the initiation of the therapy, as indicated by the distinctive blue line in Fig. **5**. The integration of considerations regarding drug efficiency into the control law, as illustrated by the blue dotted line in Fig. **5**, reveals a nuanced and refined approach. In this scenario, the drug dosage is notably reduced, reaching approximately half of the dosage observed without considering drug efficiency. This observation underscores the crucial role of factoring in drug efficiency within the control strategy, leading to a more optimized and resource-efficient therapeutic intervention.

The observed behavior indicates that the cessation of drug injection promptly occurs once infected cells successfully track their reference value. Specifically, when employing STSMC, it has been observed that the initiation of drug injection involves a higher dosage at the onset of therapy compared to SMC. However, the STSMC demonstrates an early termination of drug injection. The simulation results further confirm that the effectiveness of the drug does not exert any noticeable impact on the concentrations of healthy cells, infected cells, and viral load. This implies that, regardless of the drug's efficiency, the proposed controllers effectively regulate and maintain the desired concentrations of cellular components, showcasing the robustness of the control strategies in the simulated scenario.
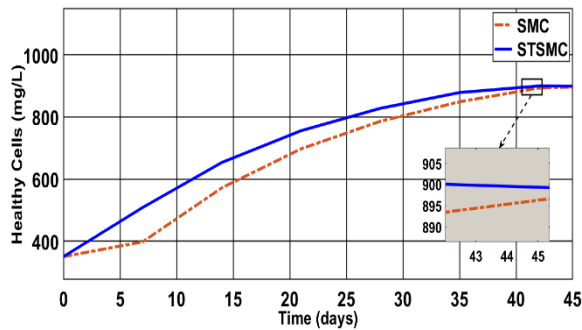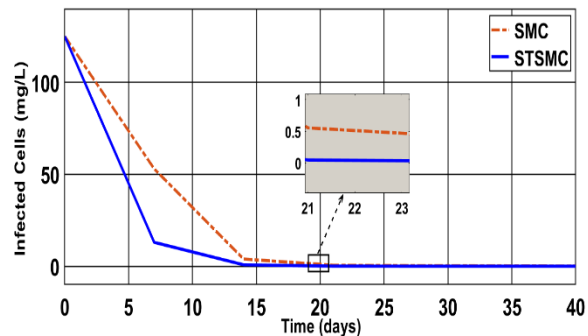

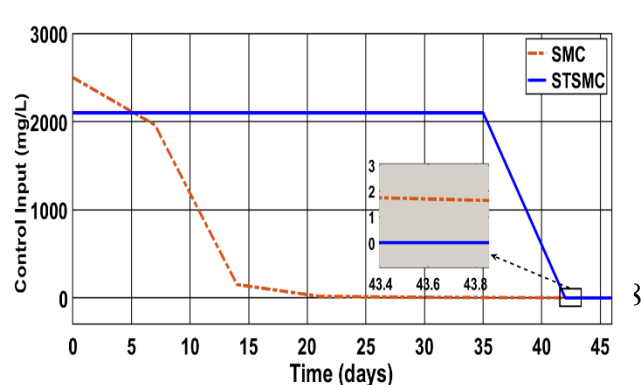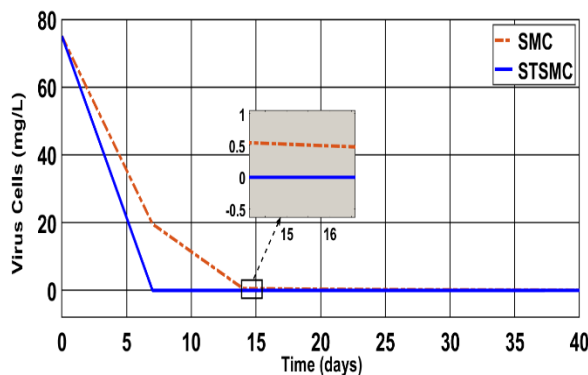Figure 2: Behavior of Healty Cells

Figure 3: Tracking of infected Cells

Figure 4: Behavior of Virus Cells   Figure 5: Control Inputs

Conclusion

The Human Immunodeficiency Virus significantly weakens the immune system, demanding extensive research and innovative treatment methods. Mathematical models, especially focusing on interactions between helper T-cells and viral load, serve as a blueprint for designing controllers like ISMC and STSMC. These controllers aim to minimize infected cells, reduce the viral load, and elevate healthy T-cell numbers. Combining drug doses with these controllers yields promising outcomes, particularly with the STSMC controller demonstrating superior performance in convergence rate and error reduction. The controllers' refinement through a genetic algorithm prioritizing integral time absolute error minimization ensures their precision. Mathematical analyses employing Lyapunov stability criteria guarantee the controllers' stability. MATLAB/Simulink simulations facilitate comprehensive performance evaluations among various control strategies. Transitioning from simulation to real-world validation, experiments involve integrating C2000 Delfino capabilities with the MCU F28379D Launchpad in a hardware-in-loop setup for practical testing.

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Optimizing electric vehicle charger performance using robust nonlinear control techniques for grid to vehicle application

Shabab Saleem, Atif Rehman, Rimsha Ghias, Syed Hassan Ahmed and Iftikhar Ahmad
All Author form: National University of Sciences and Technology (NUST)

Abstract

The integration of grid-to-vehicle (G2V) and vehicle-to-grid (V2G) technologies is essential for advancing efficient and sustainable charging solutions for plug-in hybrid electric vehicles (PHEVs) in the clean energy sector [1]. However, effective management of power flow in this intricate system presents notable challenges, with a primary concern being chattering within power converters. To address this issue, a current-fed converter is implemented to analyze power flow dynamics between the grid and PHEVs, mitigating potential destabilization risks. In terms of control design, this paper proposes a comprehensive strategy for PHEV systems integrating a photovoltaic-based renewable energy system (RES) and battery-based energy storage systems (ESS). The efficient utilization of the PV system is facilitated by employing an artificial neural network (ANN) to determine maximum power points (MPPs). The paper introduces control strategies, including a nonlinear robust super-twisting sliding mode controller (STSMC) and an integral terminal sliding mode controller (ITSMC), optimizing power flow, ensuring grid-PHEVs synchronization, and assessing controller stability through Lyapunov stability analysis. System performance is further enhanced using an improved grey wolf optimization (I-GWO) algorithm for precise control gains adjustment. MATLAB/Simulink simulations compare controller performance, and real-time assessment employs a hardware-in-the-loop (HIL) setup with C2000 Delfino and MCU F28379D Launchpad. This methodology provides valuable insights into real-world controller behavior, aligning with the evolving landscape of electric vehicle charging and energy utilization [2].
Keywords: PHEV, MPPT, ANN, I-GWO, HIL

Introduction

PHEVs are a notable advancement in sustainable transportation, featuring both an internal combustion engine and an electric motor. The onboard battery, charged externally, powers the electric motor. This dual-mode capability enables PHEVs to function in either gasoline-only or electric-only mode, providing users with flexibility in choosing between internal combustion and electric propulsion based on driving conditions, distance, and energy availability (Liu, Chunhua, et al).

This analysis highlights the significance of G2V and V2G technology (Liu, Chunhua, et al). In the G2V mode, PHEVs draw power from the electric grid to charge their batteries. This is particularly advantageous during off-peak hours when electricity demand is low (Liu S, et al). By charging from the grid, PHEVs can maximize their electric driving range, reduce operating costs, and lower emissions. On the other hand, in the V2G mode PHEVs can supply excess stored energy back to the grid when demand is high (Zhou, et al). This enables PHEVs to function as a distributed energy resource, aiding grid stability and potentially generating revenue for vehicle owners through energy sales [4]. Figure [1] shows the direction of energy during operating modes of a battery electric vehicle (BEV) charger.

The key contributions and innovations of the paper is:

Current Fed Converter:

One notable advantage of these power converters compared to voltage-fed converters is their resilience to issues such as shoot-through and half-cycle symmetry, which typically do not lead to device failure or core saturation (Armghan H, et al, 2018). This characteristic is particularly evident in SCR-based converters, and it is a key factor contributing to the enhanced robustness commonly associated with current-fed converters.

Proposed Control Methodology

STSMC is an advanced and effective control method known for its high-performance characteristics, especially when dealing with systems subject to uncertainties and disturbances (Upputuri RP, et al 2023). ITSMC is a robust control technique that uses both integral action and terminal sliding mode to achieve fast and accurate tracking of a system's reference trajectory. Integral action implies that the controller not only considers the current error which is the difference between the desired and actual states of a system but also accumulates past errors over time (Shafique M, et al, 2023). This accumulation helps in eliminating steady-state errors while terminal Sliding Mode is designed to drive the system's state to a desired trajectory in a fast and accurate manner (Trivedi SS, et al, 2022).
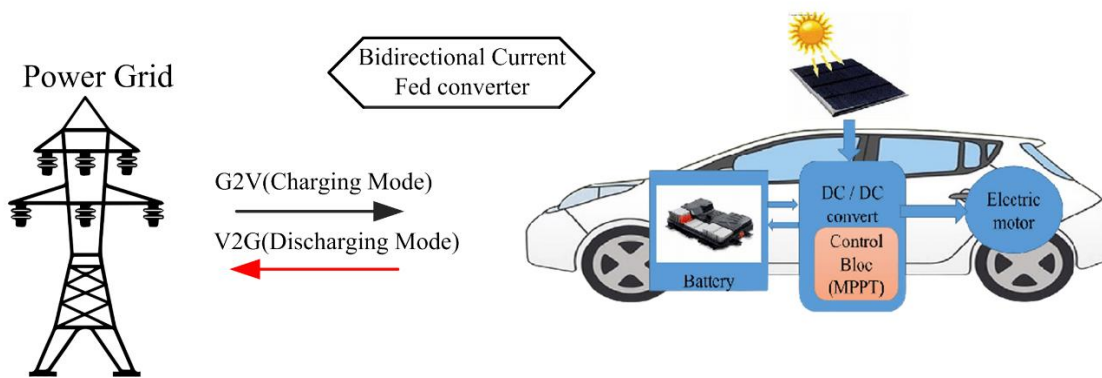
Optimization Algorithm:

Optimization is a metaheuristic algorithm inspired by the social hierarchy where a population of candidate solutions, *representing potential solutions. The fitness function is to minimize the integral of absolute error (IAE) (Jawad RS, et al, 2022). Gray Wolf Optimization is well suited for global Optimization tasks. It has a strong capability to explore* the entire search space, increasing the likelihood of finding the global optimum. GWO is better suited for continuous optimization tasks where the search space is not discrete and requires a smooth exploration.

Expression [42] mean GWO uses this fitness function to guide the search for an optimal solution by iteratively adjusting candidate solutions and evaluating their fitness based on this integral of absolute error. The goal is to find the candidate solution that minimizes the error between the desired and actual behaviors of the system.

Hardware-in-the-loop:

HIL is a simulation method connecting physical components to a computerized environment, enabling testing and validation of electronic systems. Engineers assess real-world hardware performance within a

controlled virtual space, enhancing testing processes. Widely used in automotive, aerospace, and power systems, HIL improves system development efficiency and reliability (Abrazeh S, et al, 2022).

This article adopts a structured approach to effectively convey the outcomes of the research. Section II delves into the system's overview and modeling, while section III engages with the intricacies of the controller design. Section IV presents simulated outcomes for G2V modes coupled with a Hardware-in-the-Loop simulation. Lastly, section V culminates the paper by encapsulating the primary insights and findings drawn from the study.

Modelling of the system

This comprehensive model is a representation of the plug-in hybrid electric vehicle under discussion which is shown in figure [2]. There are a number of equations that may be used to express the average state-space model of the converters employed in this study while taking into account the currents and voltages of the various parts. The behavior of the converters and their function in controlling power flow within the system are defined by these equations which derived from volt second balance and current charge balance (Trivedi SS, et al, 2022). The state variables in equation (1) from (4) i.e. x_1, x_2, x_3, and x_4, stand for the state-space models for the PV, and batt, systems. These variables represent various aspects of the system including PV current i_{pv}, PV voltage v_{pv}, battery current i_{batt}, and battery voltage v_{batt} (Zhou, et al, 2023).

The system also has a bounded disturbance that is represented by the variable d(t) and has the following upper and lower bounds. Where δ_1 and δ_2 are lower and upper limits of the disturbance which is shown in equation [5]. In real terms, the disturbance can appear as converter switching spikes or as any other transient event big enough to evaluate how well the suggested controller's work.

$$\dot{x}_1 = \frac{V_{pv}}{L_{pv}} - \frac{x_2}{L_{pv}} + \frac{2x_2 u_{pv}}{L_{pv}} + d \tag{1}$$

$$\dot{x}_2 = \frac{x_1}{C_{pv}} - \frac{2x_2 u_{pv}}{C_{pv}R} + \frac{x_2}{C_{pv}R} + d \tag{2}$$

$$\dot{x}_3 = \frac{V_{batt}}{L_{batt}} - \frac{x_4}{L_{batt}} + \frac{2x_4 u_{batt}}{L_{batt}} + d \tag{3}$$

$$\dot{x}_4 = \frac{x_3}{C_{batt}} - \frac{2x_4 u_{batt}}{C_{batt}R} + \frac{x_4}{C_{batt}R} + d \tag{4}$$

$$\delta_1 \leq d(t) \leq \delta_2 \tag{5}$$

Design of nonlinear controllers

As seen in figure 3 the ITSMC and STSMC have been designed. Decentralised nonlinear controllers based on STSMC are recommended because they can lessen the effects of external variations and disturbances (Khan MS, et al, 2018).

The following are this framework's goals:

- PV energy systems with MPPT, guaranteeing that RESS is tapped for all of its available power.
- Tracking the state currents of the all the sources to their reference values.
- Achieving system-wide global asymptotic stability. In conclusion, the developed framework integrates intelligent controllers to address control difficulties in PV energy systems, with an emphasis on optimising power extraction, reducing reliance on RESs, and maintaining system stability (Akter F, et al, 2022).

Design of integral terminal sliding mode control

ITSMC is an advanced control strategy that combines integral action with sliding mode control techniques. It effectively addresses the problem of steady-state error, ensuring precise tracking and improved system performance (Yang T, et al, 2023). This approach is particularly valuable in control systems were maintaining accurate and stable control in the presence of uncertainties and disturbances is crucial [10]. We define the following errors:

$$e_1 = x_1 - x_{1\,ref} \tag{6}$$
$$e_3 = x_3 - x_{3ref} \tag{7}$$

Time derivative of equation (6) and (7) are:

$$\dot{e}_1 = \dot{x}_1 - \dot{x}_{1\,ref} \tag{8}$$
$$\dot{e}_3 = \dot{x}_3 - \dot{x}_{3\,ref} \tag{9}$$

Putting values of $\dot{x}_1$ and $\dot{x}_3$ from equation (1) and (3) in equation (8) and (9) respectively we get;

$$\dot{e}_1 = \frac{V_{pv}}{L_p} - \frac{x_2}{L_p} + \frac{2x_2 u_{pv}}{L_p} + d - \dot{x}_{1\,ref} \tag{10}$$

$$\dot{e}_3 = \frac{V_{batt}}{L_{batt}} - \frac{x_4}{L_{batt}} + \frac{2x_4 u_{batt}}{L_{batt}} + d - \dot{x}_{3ref} \tag{11}$$

Sliding surface chosen for the PV and battery are as follows:

$$S_1 = e_1 + \lambda \left(\int e_1 dt \right)^{\frac{p}{q}} \tag{12}$$

$$S_2 = e_3 + \lambda \left(\int e_3 dt \right)^{\frac{p}{q}} \tag{13}$$

Time derivative of equation (12) and (13) are:

$$\dot{S}_1 = \dot{e}_1 + e_1 \lambda \left(\frac{p}{q} \right) \left(\int e_1 dt \right)^{\frac{p}{q}-1} \tag{14}$$

$$\dot{S}_2 = \dot{e}_3 + e_3 \lambda \left(\frac{p}{q} \right) \left(\int e_3 dt \right)^{\frac{p}{q}-1} \tag{15}$$

Putting values of $\dot{e}_1$ and $\dot{e}_3$ from equation (10) and (11) equation (14) and (15) respectively we get;

$$\dot{S}_1 = \frac{V_{pv}}{L_p} - \frac{x_2}{L_p} + \frac{2x_2 u_{pv}}{L_p} + d - \dot{x}_{1\,ref} + e_1 \lambda \left(\frac{p}{q} \right) \left(\int e_1 dt \right)^{\frac{p}{q}-1} \tag{16}$$

$$\dot{S}_2 = \frac{V_{batt}}{L_{batt}} - \frac{x_4}{L_{batt}} + \frac{2x_4 u_{batt}}{L_{batt}} + d - \dot{x}_{3\,ref} + e_3 \lambda \left(\frac{p}{q} \right) \left(\int e_3 dt \right)^{\frac{p}{q}-1} \tag{17}$$

Lyapunov candidate function for the system as:

$$V = \frac{S_1^2}{2} + \frac{S_2^2}{2} \tag{18}$$

$$\dot{V} = S_1 \dot{S}_1 + S_2 \dot{S}_2 \tag{19}$$

Putting value of $\dot{S}_1$ and $\dot{S}_2$ from equation (16) and (17) in equation (19) we get:

$$\dot{V} = S_1 \left(\frac{V_{pv}}{L_p} - \frac{x_2}{L_p} + \frac{2x_2 u_{pv}}{L_p} + d - \dot{x}_{1\,ref} + e_1 \lambda (p/q) \left(\int e_1 dt \right)^{p/q-1} \right)$$

$$+ S_2 \left(\frac{V_{batt}}{L_{batt}} - \frac{x_4}{L_{batt}} + \frac{2x_4 u_{batt}}{L_{batt}} + d - \dot{x}_{3\,ref} + e_3 \lambda \left(\frac{p}{q} \right) \left(\int e_3 dt \right)^{\frac{p}{q}-1} \right) \tag{20}$$

For $\dot{V}$ to be negative definite, assume:

$$-k_{pv}sign(S_1) = \frac{V_{pv}}{L_p} - \frac{x_2}{L_p} + \frac{2x_2 u_{pv}}{L_p} + d - \dot{x}_{1\,ref} + e_1\lambda\left(\frac{p}{q}\right)\left(\int e_1 dt\right)^{\frac{p}{q}-1} \tag{21}$$

$$-k_{\text{batt}}\,sign(S_2) = \frac{V_{\text{batt}}}{L_{\text{batt}}} - \frac{x_4}{L_{\text{batt}}} + \frac{2x_4 u_{\text{batt}}}{L_{\text{batt}}} + d - \dot{x}_{3\,ref} + e_3\lambda\left(\frac{p}{q}\right)\left(\int e_3 dt\right)^{\frac{p}{q}-1} \tag{22}$$

Solving equation (21) and (22) for control inputs u_{pv} and u_{batt} following control laws are obtained:

$$u_{pv} = \frac{1}{2} - \frac{V_{pv}}{2x_2} - \frac{L_p}{2x_2}\left(e_1\lambda\left(\frac{p}{q}\right)\left(\int e_1 dt\right)^{\frac{p}{q}-1} + \dot{x}_{1\,ref} - d\right) - k_{pv}\,sign(S_1) \tag{23}$$

$$u_{\text{batt}} = \frac{1}{2} - \frac{V_{\text{batt}}}{2x_4} - \frac{L_{\text{batt}}}{2x_6}\left(e_3\lambda\left(\frac{p}{q}\right)\left(\int e_3 dt\right)^{\frac{p}{q}-1} + \dot{x}_{3\,ref} - d\right) - k_{\text{batt}}\,sign(S_2) \tag{24}$$

For $\dot{V}$ equation (23) and (24) can be calculated as:
$$\dot{V} = -k_{pv}S_1\,sign(S_1) - k_{pv}S_2 sign(S_2) \tag{25}$$
Equation (25) shows that system is asymptotically stable and errors will converge to zero in finite time.

Design of super twisting sliding mode control

STSMC is particularly effective in applications where high precision and rapid response are essential, making it a valuable tool in control system design for challenging dynamic environments (Adama E., Vol. 455, p. 272.). It incorporates a nonlinear sliding surface and a super-twisting algorithm, providing robustness against chattering and disturbances. Sliding surface chosen for the PV and battery are as follows:
$$S_1 = a_1 e_1 \tag{26}$$
$$S_2 = a_3 e_3 \tag{27}$$
Time derivative of equation (26) and (27) are:
$$\dot{S}_1 = a_1 \dot{e}_1 \tag{28}$$
$$\dot{S}_2 = a_3 \dot{e}_3 \tag{29}$$
Putting values of $\dot{e}_1$ and $\dot{e}_3$ from equation (10) and (11) in equation (28) and (29) respectively we get;
$$\dot{S}_1 = a_1 \cdot \left(\frac{V_{pv}}{L_p} - \frac{x_2}{L_p} + \frac{2x_2 u_{pv}}{L_p} + d - \dot{x}_{1\,ref}\right) \tag{30}$$
$$\dot{S}_2 = a_2 \cdot \left(\frac{V_{\text{batt}}}{L_{\text{batt}}} - \frac{x_4}{L_{\text{batt}}} + \frac{2x_4 u_{\text{batt}}}{L_{\text{batt}}} + d - \dot{x}_{3\,ref}\right) \tag{31}$$
Lyapunov candidate function for the above system as:
$$V = \frac{S_1^2}{2} + \frac{S_2^2}{2} \tag{32}$$
$$\dot{V} = S_1\dot{S}_1 + S_2\dot{S}_2 \tag{33}$$
Putting value of $\dot{S}_1$ and $\dot{S}_2$ from equation:
$$\dot{V} = S_1\left(a_1 \cdot \left(\frac{V_{pv}}{L_p} - \frac{x_2}{L_p} + \frac{2x_2 u_{pv}}{L_p} + d - \dot{x}_{1\,ref}\right)\right) + S_2\left(a_2 \cdot \left(\frac{V_{\text{batt}}}{L_{batt}} - \frac{x_4}{L_{batt}} + \frac{2x_4 u_{batt}}{L_{batt}} + d - \dot{x}_{3\,ref}\right)\right) \tag{34}$$

Following constraint will ensure that the derivative of Lyapunov function is negative definite:

$$\dot{S}1 = -\psi_1|S_1|^{\alpha}\,sat(S_1) - \psi_{\text{pv}}\int sat(S_1)dt \tag{35}$$

$$\dot{S}2 = -\psi_{\text{batt}}\,|S_2|^{\beta}\,sat(S_2) - \psi_{\text{batt}}\int sat(S_2)dt \tag{36}$$

Now plugging the value of $\dot{S}_1$ and $\dot{S}_2$ from equation (10) and (11) in equation (10) and (11) we get:

$$a_1 \cdot \left(\frac{V_{pv}}{L_p} - \frac{x_2}{L_p} + \frac{2x_2 u_{pv}}{L_p} + d - \dot{x}_{1\,\text{ref}} \right) = -\psi_1 |S_1|^\alpha sat(S_1) - \psi_{pv} \int sat(S_1) dt \tag{37}$$

$$a_2 \cdot \left(\frac{V_{batt}}{L_{batt}} - \frac{x_4}{L_{batt}} + \frac{2x_4 u_{batt}}{L_{batt}} + d - \dot{x}_{3ref} \right) = -\psi_{\text{batt}} |S_2|^\beta sat(S_2) - \psi_{\text{batt}} \int sat(S_2) dt \tag{38}$$

Solving equation (37) and (38) for control inputs u_{pv} and u_{batt}.

$$u_{pv} = \frac{L_p}{2a_1 x_2} \left(-a_1 \frac{V_{pv}}{L_p} + a_1 \frac{x_2}{L_p} - a_1 d + a_1 \dot{x}_{1\,\text{ref}} \right) + \frac{L_p}{2a_1 x_2} \left(\psi_{pv} |S_1|^\alpha sat(S_1) + \psi_{pv} \int sat(S_1) dt \right) \tag{39}$$

$$u_{\text{batt}} = \frac{L_p}{2a_1 x_2} \left(-a_2 \frac{V_{\text{batt}}}{L_{\text{batt}}} + a_2 \frac{x_4}{L_p} - a_2 d + a_2 \dot{x}_{3\,\text{ref}} \right) + \frac{L_p}{2a_1 x_2} \left(\psi_{\text{batt}} |S_2|^\beta sat(S_2) + \psi_{\text{batt}} \int sat(S_2) dt \right) \tag{40}$$

For $\dot{V}$ equation (39) and (40) can be simplified as:

$$\dot{V} = -S_1 \left(\psi_{pv} |S_1|^\alpha sat(S_1) - \psi_{pv} \int sat(S_1) dt \right) - S_2 \left(\psi_{\text{batt}} |S_2|^\beta sat(S_2) - \psi_{\text{batt}} \int sat(S_2) dt \right) \tag{41}$$

Equation (41) shows that system is asymptotically stable and errors will converge to zero in finite time.

Enhancing PV efficiency with ANN MPPT

To optimize a solar PV array with ANN for *MPPT, the process begins with data collection from sensors, recording voltage, current, and temperature (Kiran SR, et al, 2022). This data is preprocessed for input into the neural network. An appropriate network architecture is selected, and historical data is used to train the network to predict the MPP. Techniques like backpropagation* and gradient descent fine-tune the network's weights and biases. Once trained, the network operates in real-time, suggesting optimal operating points for the PV array. Control mechanisms adjust duty cycles. Continuous performance monitoring and data collection ensure effective MPPT. The structure of ANN and regression plot is shown in figure [4]. Following are the main steps.

- a. **Data Collection:** Gather irradiance, temperature, and power output data.
- b. **Data Collection:** Training the ANN: Teach the network to predict power based on inputs.
- c. **Model Validation:** Ensure accuracy on new, unseen data.
- d. **Real-Time Operation:** Implement ANN in the PV system for MPPT.
- e. **Feedback Loop:** Continuously adjust the PV panel's operating point.

Improved-grey wolf optimization techniques

I-GWO is a nature inspired metaheuristic algorithm that mimics the hunting behavior and social structure of grey wolves in the wild. In this paper, we propose an enhanced version of GWO, referred to as IGWO. It builds upon the foundation of GWO, aiming to address its limitations and improve its performance in solving optimization problems across various domains.

The mathematical expression of the integral of the absolute error (IAE) is given by:

$$minF_i(s) = min \int_1^t |s_i(e_i)|dt \qquad (42)$$

where $F_i(z)$ is the fitness function and $s_i e_i$ represents the errors. The algorithm steps can be summarized:

  a. **Tracking:** Initialization of the algorithm by setting the initial positions of the search agents (wolves) within the search space limits. The hunt is guided by the alpha wolf.
  b. **Encircling:** Once the search agents have located the prey, they chase it until it stops.
  c. **Attacking:** The search agents will adjust their position in relation to the prey once the prey pauses. To make sure that the revised position is more than just a local solution, dimension learning-based hunting techniques are used to evaluate it.
  d. **Evaluation:** By the end of each iteration, the fittest solution is updated and called the alpha solution, which gives the fittest value corresponding to the fitness function. The results taken by the mentioned algorithm is shown in figure [5].

Simulation Results

Using the MATLAB/Simulink environment, the suggested controllers were validated. Table 1 lists the controller specific parameters. The system includes a disturbance which is shown in figure [6], serving to highlight the STSMC robustness compared to the ITSMC.

Simulation Results

This section aims to evaluate the performance of the designed controllers in G2V mode, in the presence of gaussian noise disturbance, with a reference battery voltage set at 200 V. Figure [7] demonstrates the PV array current. Figure [8] illustrates the satisfactory performance of battery current with disturbance. But it's clear that the sliding mode controller chatters a lot, which is very different from the very little chattering that the super twisting sliding mode controller exhibits, which eventually improves control system precision and stability.

Hardware-in-the-Loop

The developed STSMC controller has also been experimentally verified through the use of hardware-in-loop tests. The controller is validated using a twin core Delfino F283769D microprocessor in G2V modes. The PV array HIL result is depicted in figure [9]. The outcome demonstrates that STSMC functions satisfactorily when perturbations are present and follows the expected trajectory in real world circumstances. The figure [10] displays the STSMC performance for charging current and battery internal voltage. The HIL results closely mirror the simulated results, demonstrating the STSMC suitability for use in real world applications.

Conclusion

This study presents an innovative electric vehicle charger design with two non-linear controllers targeting the persistent chattering issue in power converters, a common challenge in electric vehicle charging systems. A current fed converter has been integrated between the grid and the electric vehicle to ensure smoother and more stable power flow. To optimize controller performance, an enhanced grey wolf optimization algorithm is employed, fine-tuning the controllers for efficiency and improving the system's overall gain, ensuring reliable charging. Hardware-in the loop simulations validate the approach, consistently confirming its effectiveness in eliminating chattering and maintaining stable power transfer. Future work may involve adding additional power sources for diversified energy inputs and exploring more

robust nonlinear controllers, promising further improvements in charger performance and stability. This research marks a significant step in addressing chattering in power converters for electric vehicle charging, with promising prospects for future development.

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Intelligent ANFIS-based robust nonlinear MPPT algorithm for PV system

Bibi Tabassam Gul[1], Omar Zeb[1], Ammar Hasan[1,2], Iftikhar Ahmad[1]
[1]National University of Sciences and Technology (NUST), Islamabad, Pakistan
[2]American University of Sharjah, UAE

Abstract

The growing interest in solar energy in modern distribution energy networks is accelerating due to its environmentally friendly attributes. The output power of photovoltaic (PV) modules demonstrates nonlinearity in response to varying environmental conditions. Enhancing the efficiency of the PV system is achievable by improving the performance of the controller employed for maximum power point tracking (MPPT). Since a PV array is a nonlinear system, employing a nonlinear controller is more appropriate to achieve MPPT and effectively manage system nonlinearities amidst dynamic environmental changes, hence the use of a robust nonlinear controller becomes essential. The effectiveness of MPPT in a PV system relies on the accuracy of the reference for the peak power voltage. For obtaining stable and dependable output power from a PV panel, an efficient mechanism for reference generation is essential. Therefore, this paper introduces an intelligent method for MPPT based on the adaptive neurofuzzy inference system (ANFIS). The proposed ANFIS-based MPPT provides an exceptionally swift dynamic response with high accuracy. The interface between the source and the load is employed by a buck-boost converter which assures quick adaptations to variations in operating conditions. The generated reference for peak power voltage by ANFIS is tasked to the proposed nonlinear controllers for tracking. A robust nonlinear condition-based supertwisting sliding mode controller (CST-SMC), has been designed to effectively achieve MPPT. The proposed controller is evaluated using the MATLAB/Simulink platform and validated through hardware in the loop (HIL) real-time testing environment. Simulation results affirm that the proposed controller demonstrates rapid and precise tracking. A comparative analysis with super twisting sliding mode control (STSMC), ANFIS control and classical perturb & observe controller is included to illustrate the performance of the proposed controller, particularly in response to sudden changes in environmental conditions.
Keywords: ANFIS, MPPT, CSTSMC, STSMC, PO, HIL

Introduction

The extensive utilization of fossil fuels in electricity generation has nearly depleted these finite resources. The objective of transitioning to solar energy is to alleviate the escalating environmental issues linked to the exhaustion of fossil fuel reserves. Solar energy is emerging as an abundant and dependable global energy source. [1]. In the past decade, the utilization of solar energy has considerably simplified the task of fulfilling energy requirements. This trend has led to higher adoption of decentralized production systems relying on renewable energy, thus ensuring that sustainable energy sources are readily available to the general population. The efficacy of photovoltaic cells fluctuates during essential operating periods. Nevertheless, they possess the advantage of being eco-friendly and can be employed directly to fulfill electricity requirements [2]. DC-DC converters play a crucial role in maximizing the power output from PV panels. They accomplish this by operating at the voltage that corresponds to the maximum power point, while simultaneously adjusting the duty cycle of the converter to draw the necessary current and achieve peak power [3]. Buck-boost converters are frequently utilized in the realm of DC-DC converters for renewable energy applications due to their ability to serve as both step-up and step-down converters [4]. The capability to effectively perform both voltage boosting and voltage reduction is advantageous for photovoltaic panels, especially when subjected to fluctuating weather conditions. In recent years, a

considerable number of studies have concentrated on developing robust and efficient MPPT tracking algorithms, employing a variety of control methods.
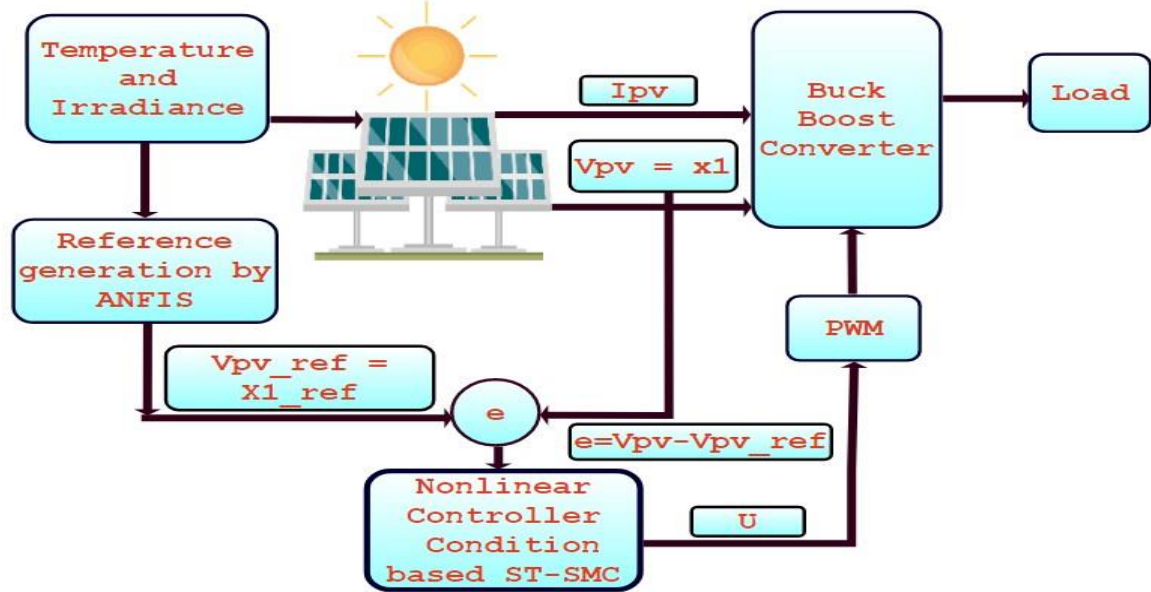

Fig. 1: ANFIS technique for a PV system utilizing maximum power point tracking.

Overall, the objective of these algorithms is to optimize the operation of the photovoltaic cell by adjusting both the current and voltage, thereby enabling the system to extract the maximum available power from it [5].

Standard techniques like perturb and observe are often employed in conjunction with a simple buck-boost converter [6, 7]. The elevation in incremental conductance (INC) method and the application of hill climbing techniques have been implemented [8, 9, 10]. Indeed, these methods are well-known and firmly established for implementation. When integrating a buck-boost converter, these methods are simple and easy to implement. However, it's important to consider that they might exhibit oscillations at the maximum power point (MPP) and demonstrate less than optimal efficiency [11, 12].

In recent years, substantial research has focused on applying adaptive neuro-fuzzy inference systems to track the maximum power point. ANFIS systems, at their core, utilize fuzzy inference systems that are meticulously adjusted through neural networks. This combination seamlessly merges the computational power of neural networks with the logical reasoning capabilities

of fuzzy inference systems. Importantly, ANFIS systems offer the additional benefit of automating the generation of fuzzy rules [13]. Indeed, ANFIS-based MPPT techniques demonstrate remarkable accuracy by efficiently tracking the maximum power point. Unlike conventional MPPT algorithms, they achieve this without the need for circuit interruption, short-circuiting PV module terminals, or engaging in oscillations around the MPP [14]. Numerous ANFIS-based MPPT methods have been suggested in the literature, showcasing effective implementations in achieving maximum power point tracking. However, a notable limitation is that many of these methods are constrained by the utilization of a linearized model for the PV system, thereby overlooking the inherent nonlinearities. In [15] the incorporation of artificial neural networks (ANN) in conjunction with the traditional buck-boost technique for the perturb and observe approach has been utilized to enhance performance. This combination of techniques, leveraging ANN, has proven to be efficient and capable of delivering superior results [16, 17]. The utilization of adaptive fuzzy control has been shown to enhance the performance of both perturb and observe and incremental conductance methods in [18]. A combination is formed by integrating a buck-boost topology, employing a PI controller, and incorporating a control system based on fuzzy logic in [19] hence improving tracking

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efficiency by adjustments to the gains of the PI controller. Offers a comprehensive overview of how intelligent adaptive neuro-fuzzy inference systems, fuzzy logic, and artificial neural networks are applied to enhance the performance of MPPT technology based on classical control methods [20].

Recent research in nonlinear control theory explores the effectiveness of various techniques such as sliding mode and backstepping control for tracking purposes. These approaches have demonstrated success in enhancing the performance of PV systems by optimizing power output [21, 22]. A simple buck-boost scheme is employed, and a control system based on the principles of Lyapunov theory is adopted to regulate the maximum power point in [23] while using a non-inverting buck-boost topology in [24, 25]. In [25] the backstepping system has been improved through the integration of a crucial component, to address inaccuracies throughout the entire system. A robust nonlinear controller is applied in [26, 27, 28, 29]. These controllers demonstrate resilience against fluctuations in external factors such as irradiation and temperature [29].

In this article, a robust condition-based ST-SMC is proposed for tracking MPPT through the utilization of a buck-boost converter hence increasing the overall system dynamic performance. Furthermore, intelligent ANFIS is utilized to generate voltage references to maximize peak power. Furthermore, the enhanced performance of the proposed controller is compared to ST-SMC, ANFIS controller, and perturb & observe for a comprehensive assessment.

Section II presents the proposed methodology and describes the reference generation for the PV system through the utilization of ANFIS. Section IIII outlines the mathematical modelling of the system, while section IV explains mathematical derivation for the proposed nonlinear controller. In section 5, the simulation outcomes of the proposed nonlinear controllers are presented, while section 6 provides the conclusion.

Proposed Approach for Photovoltaic System Implementation

Variations in temperature and light intensity at a particular site will lead to modifications in the characteristic curve of the photovoltaic panel. Precise IV characteristics are essential to ensure the efficient harvesting of available radiation in the PV system. The incorporation of DC-DC power converters further boosts the circuit's efficiency.
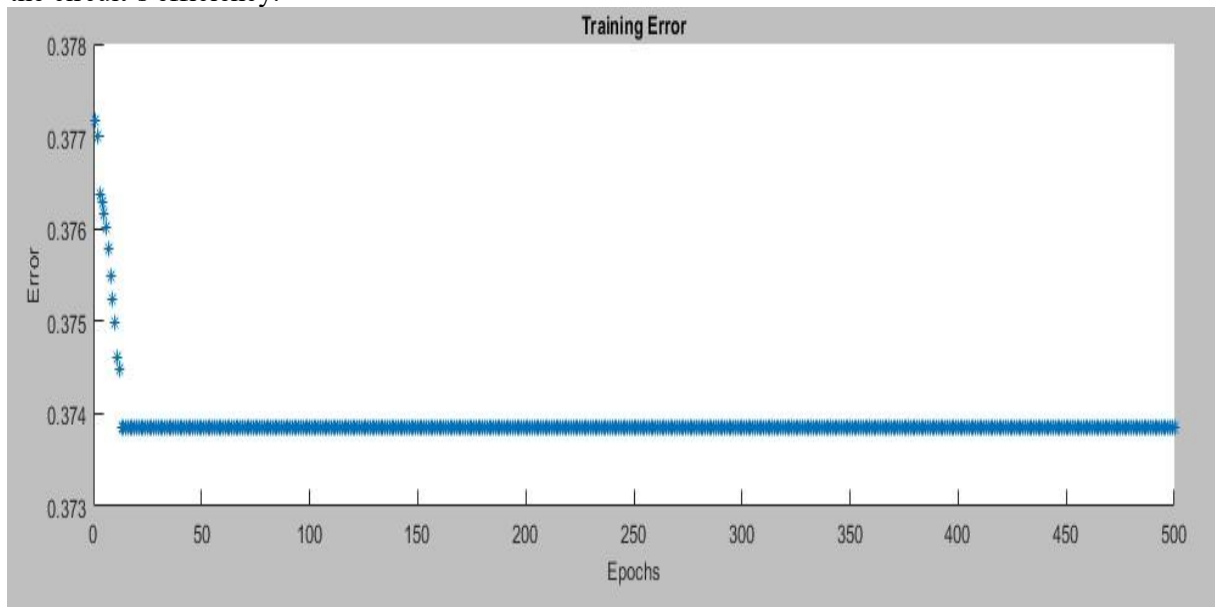

Fig. 2: Training error.

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Traditional MPPT controllers and robust nonlinear controllers employ distinct approaches. In conventional control methods, maintaining a constant slope or gradient is necessary to reach a specific maximum power point, both during the process of reaching the MPP and after it has been attained. Diverse datasets of irradiance and temperature yield distinct values for current and voltage, leading to fluctuations in the position of the maximum point. Several methodologies, including linear regression, fuzzy methods, and a range of intelligence-based techniques, can be applied to establish the correlation between voltage at maximum power point and both irradiance and temperature.

The application of ANFIS in generating voltage references for PV systems offers adaptability, precision, learning prowess, and the capacity to manage uncertainties. The voltage references produced by ANFIS can be smoothly incorporated with robust nonlinear controllers to enhance the overall efficiency and performance of the PV system. A mathematical model for the buck-boost converter is developed and utilized to design a robust nonlinear controller. This controller is designed to align with the standards set by ANFIS for achieving the maximum photovoltaic power. The Fig. 1 illustrates the suggested approach.

PV system reference generation through ANFIS

ANFIS and ANN emulate the structure of biological neural networks by linking diverse parameters to specific data points. These intelligent models remove the need for mathematical equations or complex mathematical foundations. By formation of the dataset containing pertinent information such as irradiance levels, temperature, and the corresponding optimal PV output voltage. This dataset functions as the training data for the ANFIS model, hence a reference voltage is set for each combination of temperature and irradiance values to guarantee the precise maximum power point tracking. In this instance, the inputs for the ANFIS consist of irradiance and temperature, while the output is the intended PV voltage reference. The photovoltaic system is linked via a buck-boost topology, where modifications to the duty cycle of the converter are implemented to synchronize with the system's operation at its maximum power point. The model fine-tunes its parameters through a hybrid learning approach that combines the advantages of fuzzy inference systems and neural networks. The objective of the training process is to minimize the discrepancy between the predicted and actual outputs. When the output values of the ANFIS closely align with the desired values, it becomes viable to anticipate future indicator values by scrutinizing historical data and identifying patterns.

B. Modelling of ANFIS for PV system.

n ANFIS model for a PV system entails establishing a framework that precisely captures the connections developing between input parameters, such as irradiance and temperature, and the intended output, typically the voltage reference. Clearly specifying the input variables and the output variable for the ANFIS model forms the basis of the modelling process. The creation, training, and testing of a Sugano-type fuzzy system were carried out using the MATLAB ANFIS editor. For every input data point within the training set, the ANFIS model calculates an anticipated output using the existing set of parameters. Subsequently, the model determines the disparity between this predicted output and the actual output (target) for each specific data point. The training error for ANFIS with 500 epochs is shown in Fig. 2.
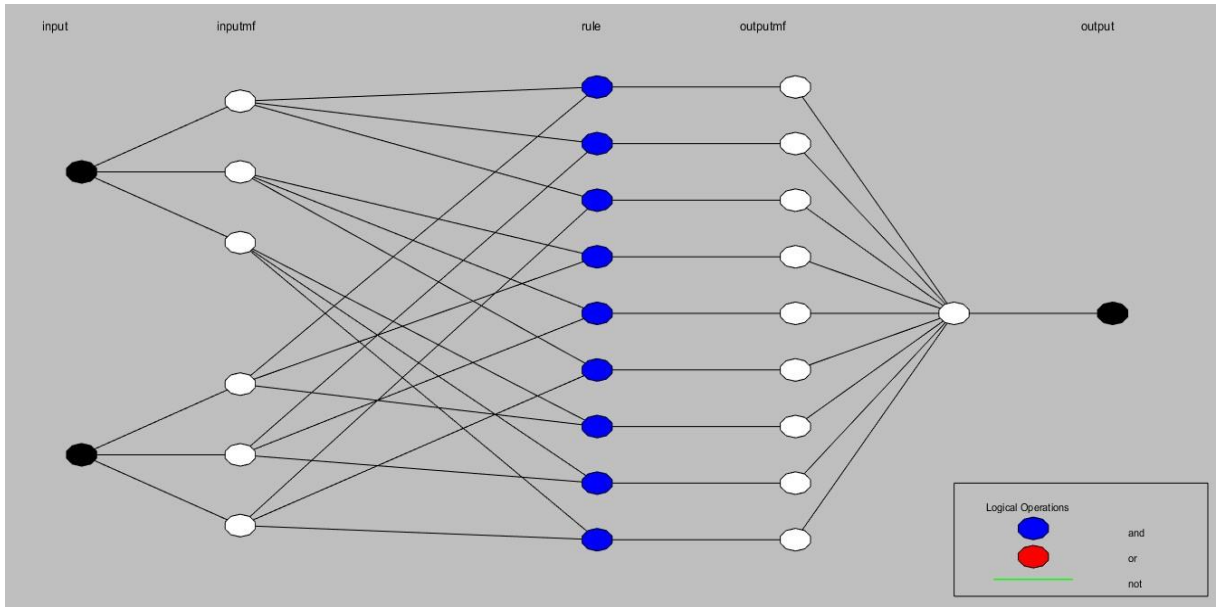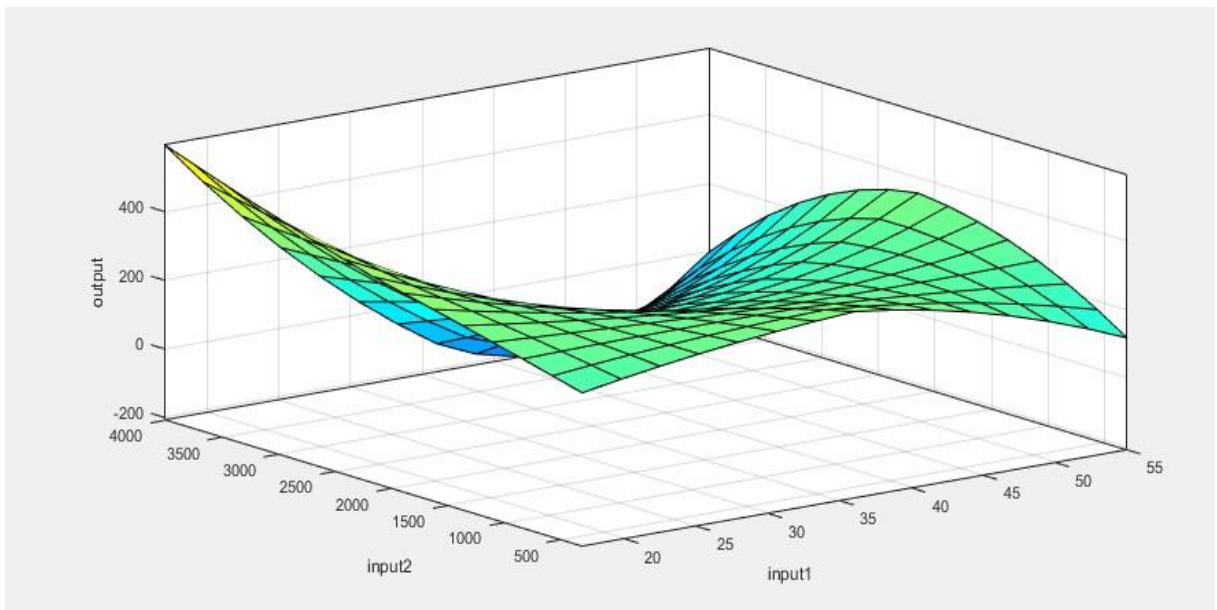
Fig. 3: ANFIS structure.

Fig. 4: Fuzzy surface.

Initially the training, testing and checking data were loaded into the editor, and these data were structured in matrix form to make them compatible with the ANFIS. The adaptive learning process effectively captures intricate patterns present within the dataset. This matrix comprises three columns, with the first two columns containing the input data (irradiance and temperature), and the last column containing the output data (voltage). Subsequently, an initial FIS model was created. This FIS underwent training using the hybrid optimization method, combining the least squares method and the backpropagation gradient descent method. The resulting structure of the ANFIS model is depicted in Fig. 3. The ANFIS surface incorporates a visualization of the input space, illustrating the distribution of different values for input

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variables like irradiance and temperature. The output surface, representing the model's response in terms of the output variable (e.g., voltage reference or VMPP), demonstrates how the model's output varies across the input space. Notably, the values produced by the ANFIS closely align with the target values, highlighting the algorithm's high degree of accuracy and responsiveness clearly shown by Fig. 4. The values yielded by the surface closely approximate the target values, showcasing the high degree of accuracy in the responsiveness of the ANFIS algorithm to perturb and observe (PO) based MPPT techniques as well as linear controllers.
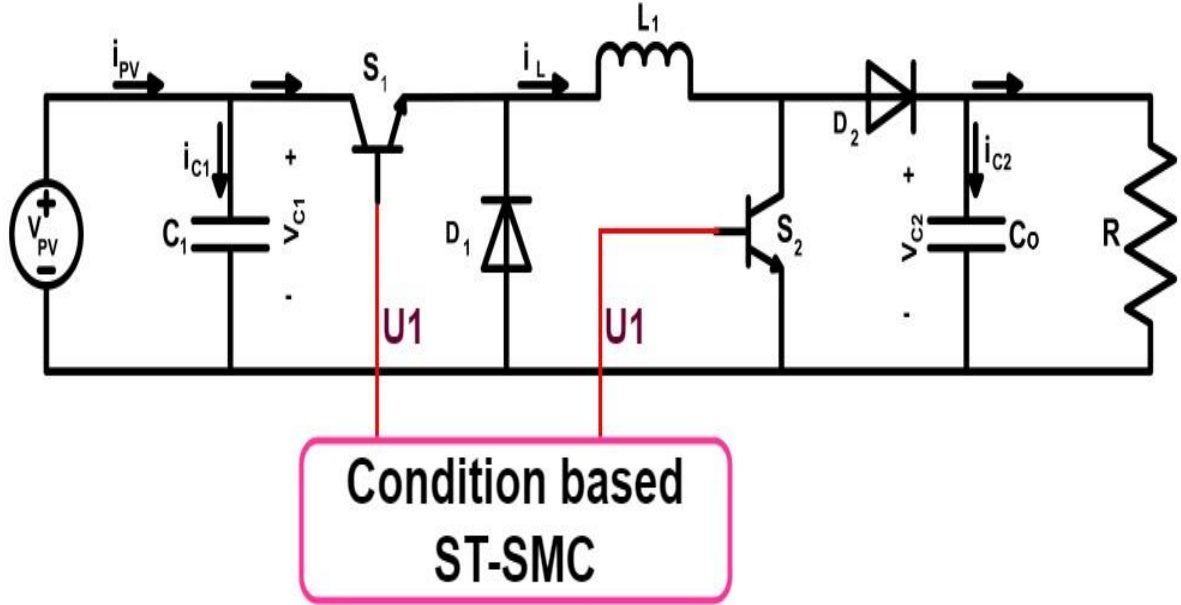
Fig. 5: Buck-boost converter (Noninverting)

Mathematical Modeling

The buck-boost converter's circuit topology in Fig. 5 steps the voltage up or down. The mathematical modelling demonstrated in this section provides the control input necessary for the operation of the converter. The converter works in two different modes.

Mode-1: In this mode S_1 and S_2 are in state of conduction, while diode D_1 is reverse-biased. Applying Kirchoff's law, provides us:

$$i_{c_1} = i_{pv} - i_L \tag{1}$$

$$\frac{dv_{pv}}{dt} = \frac{i_{pv}}{C_1} - \frac{i_L}{C_1} \tag{2}$$

$$v_L = v_{pv} \tag{3}$$

$$\frac{di_L}{dt} = \frac{v_{pv}}{L_1} \tag{4}$$

$$i_c = \frac{-v_o}{R} \tag{5}$$

$$\frac{dv_o}{dt} = -\frac{v_o}{RC_o} \tag{6}$$

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Mode2: During this mode switches S_1 and S_2 are open while the load is connected through D_2 with inductor L_1. By applying Kirchoff's voltage law, we get:

$$i_{c_1} = i_{pv} \tag{7}$$

$$\frac{dv_{pv}}{dt} = \frac{i_{pv}}{C_1} \tag{8}$$

$$v_L = -v_o \tag{9}$$

$$\frac{di_L}{dt} = \frac{-v_o}{L_1} \tag{10}$$

$$i_c = i_L - \frac{v_o}{R} \tag{11}$$

$$\frac{dv_c}{dt} = \frac{i_L}{C_o} - \frac{v_o}{RC_o} \tag{12}$$

For the controller design, we consider the average model throughout a single switching cycle. where z_1, z_2, z_3 and u_1 are the average values of v_{pv}, i_{pv}, v_c and u_1 respectively.

$$\begin{cases} z_1 = < v_{pv} > \\ z_2 = < i_{pv} > \\ z_3 = < v_c > \\ u_1 = < u_1 > \end{cases}$$

By applying volt-second balance and capacitor charge laws to the buck-boost converter, the following model is obtained:

$$\dot{z}_1 = \frac{i_{pv}}{C_1} - \frac{z_2}{C_1}u_1 \tag{13}$$

$$\dot{z}_2 = -\frac{z_3}{L_1} + \left(\frac{z_1 + z_3}{L_1}\right)u_1 \tag{14}$$

$$\dot{z}_3 = \frac{z_2}{C_o} - \frac{z_3}{RC_o} - \frac{z_2}{C_o}u_1 \tag{15}$$

Controller Design

Condition-based ST-SMC is designed for the MPPT tracking purpose of PV array.

Conditioned based ST-SMC

The primary goal of controller design is to track the reference MPPT voltage of the PV module. To track the reference voltage of the error signal is defined as follows:

$$e_1 = z_1 - z_{1ref} \tag{16}$$

where z_{1ref} is the reference value of the voltage of the PV array. By taking the time derivative of eq (16) and putting the value of $\dot{z}_1$, we get:

$$\dot{e}_1 = \frac{i_{pv}}{C_1} - \frac{z_2}{C_1}u_1 - \dot{z}_{1ref} \qquad (17)$$

The sliding surface is defined as follows:

$$S_1 = a_1 e_1 \qquad (18)$$

where a_1 is the design parameter and has any positive value. Taking the time derivative of eq (18), we get:

$$\dot{S}_1 = a_1 \dot{e}_1 \qquad (19)$$

Putting the value of $\dot{e}_1$ from eq (17) into eq (19), we get:

$$\dot{S}_1 = a_1 \left(\frac{i_{pv}}{C_1} - \frac{z_2}{C_1}u_1 - \dot{z}_{1ref} \right) \qquad (20)$$

Switching law for conditioned based ST-SMC can be expressed as:

$$\dot{S}_1 = -k_1 |S_1|^\alpha sign(\frac{S_1}{\phi_1}) - k_2 \int sign(S_1) - v_1 \qquad (21)$$

For stability analysis, the Lyapunov candidate is defined as:

$$V = \frac{1}{2}S_1^2 \qquad (22)$$

Taking the time derivative of eq (22), we get:

$$\dot{V} = S_1 \dot{S}_1 \qquad (23)$$

Putting the value of $\dot{S}_1$ in eq (23), we get:

$$\dot{V} = S_1 \left(\frac{a_1 i_{pv}}{C_1} - \frac{a_1 z_2}{C_1}u_1 - a_1 \dot{z}_{1ref} \right) \qquad (24)$$

By equating the switching control law from eq (21) with eq (20), we get:

$$-k_1 |S_1|^\alpha sign(\frac{S_1}{\phi_1}) - k_2 \int sign(S_1) - v_1 = \left(\frac{a_1 i_{pv}}{C_1} - \frac{a_1 z_2}{C_1}u_1 - a_1 \dot{z}_{1ref} \right) \qquad (25)$$

where k_1 and k_2 are the design parameters and have some positive values. α is a positive constant that has a value between 0 and 1. φ_1 serves to reduce the chattering phenomenon. The parameter v_1 in eq (21) is defined as:

$$v_1 = \int m_1 sign(u_{1sat} - v_1)dt \qquad (26)$$

m_1 is a positive design parameter, and u_{1sat} is constrained within the bounds set by the limit P. This relationship can be expressed mathematically as follows:

$$u_{1sat} = \begin{cases} u_1 & |u_1| \leq P \\ Psign(u_1) & |u_1| > P \end{cases} \tag{27}$$

Putting the value of $\dot{S}_1$ from eq (21) in eq (23), we get:

$$\dot{V} = S_1 \left(-k_1 |S_1|^\alpha sign(\frac{S_1}{\phi_1}) - k_2 \int sign(S_1) - v_1 \right) \tag{28}$$

The presence of the negative sign in the Lyapunov candidate ensures the asymptotic stability of the system. By solving eq (25), the following control input is calculated as:

$$u_1 = \frac{C_1}{a_1 z_2} \left(\frac{a_1 i_{pv}}{C_1} - a_1 \dot{z}_{1ref} + k_1 |S_1|^\alpha sign(\frac{S_1}{\phi_1}) + k_2 \int sign(S_1) + v_1 \right) \tag{29}$$

Simulation Results and Observations

The primary objective of both ANFIS and the nonlinear robust controller is to uphold a balance between the load output and achieve MPPT, irrespective of temperature fluctuations and variations in irradiance conditions. The performance of the proposed controller was assessed and subsequently validated in the MATLAB/Simulink environment, as illustrated in eq (29). The parameters of the photovoltaic panels employed in this paper are presented in Table I. Table II presents the parameters of the controllers.

TABLE I: Parameters of PV array.

Parameters	Values
Parallel strings	1
Series connected module per string	10
Open circuit voltage, V_{OC}	$363V$
Voltage at MPPT, V_{mpp}	$290V$
Short circuit current, I_{sc}	$7.84A$
Current at MPPT , I_{mpp}	$7.35A$
Maximum power	$213.15W$

TABLE II: Parameters of the controller.

Parameters	Values
k_1, k_2	$2500, 5000$
a_1	289.8523
m_1	$2e^{-3}$
α	0.6
ϕ_1	0.8

TABLE III: Parameters of the converter.

Parameters	Values
UC module C_1, C_o	$2000e^{-6}F$
Resistance R	$25e^{-3}ohm$
Inductor L_1	$3.3e^{-3}H$

Table III outlines the electrical parameters connected to the buck-boost converter. These values are chosen to facilitate the operation of the converter in continuous conduction mode. Nevertheless, when

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evaluating the controller's efficacy in a real-world context, it becomes crucial to account for elements like the forward voltage drop and switching losses inherent in the converter. The current response of the PV output, as influenced by the proposed robust ST-SMC, is depicted in Fig. 6. Moreover, the results section is subdivided into several subsections to accommodate the validation of the proposed controllers across a range of environmental conditions. The first section involves simulations of the proposed condition-based ST-SMC with varying levels of irradiance and temperature. Furthermore, a comprehensive discussion is provided to show the supremacy of the proposed controller with the P&O algorithm.
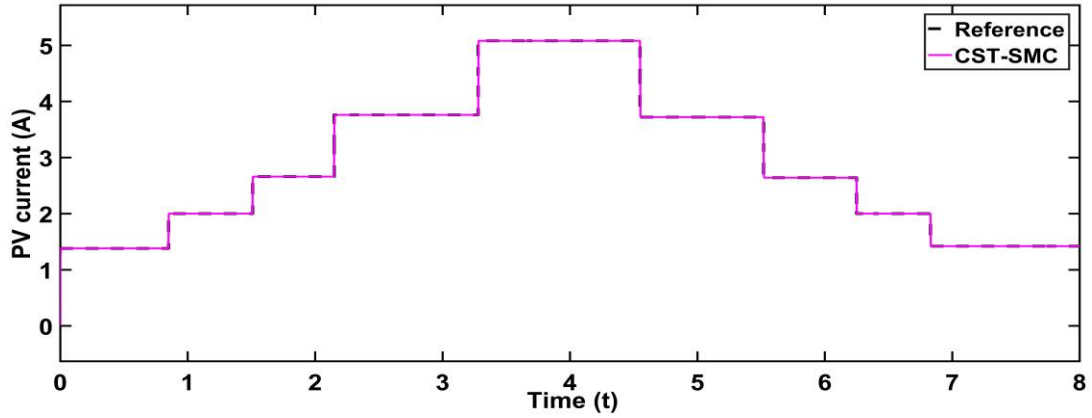
Fig. 6: PV current.
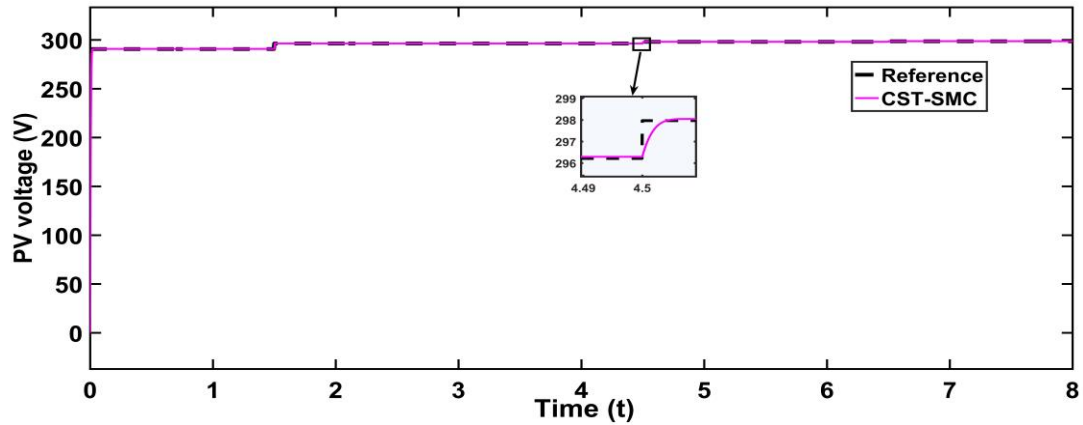
Fig. 7: PV voltage response due to varying irradiance.
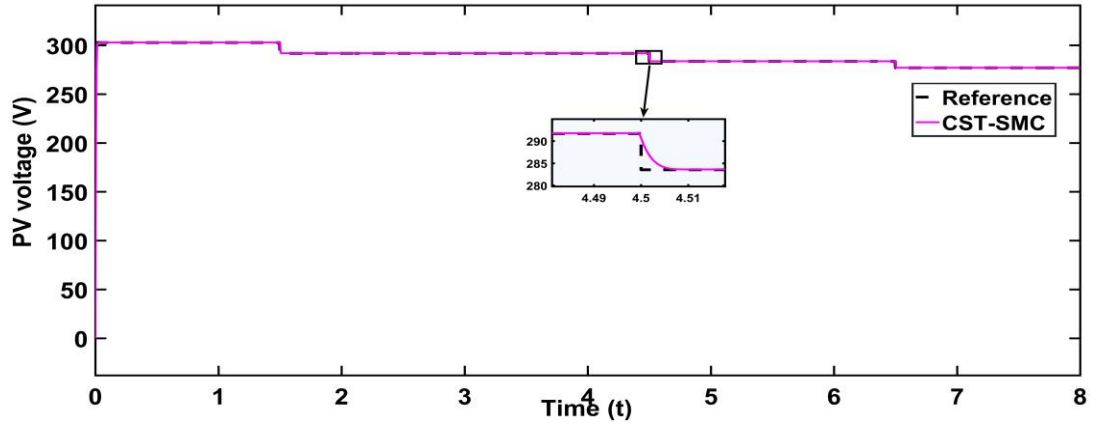
Fig. 8: PV voltage response due to varying temperature.
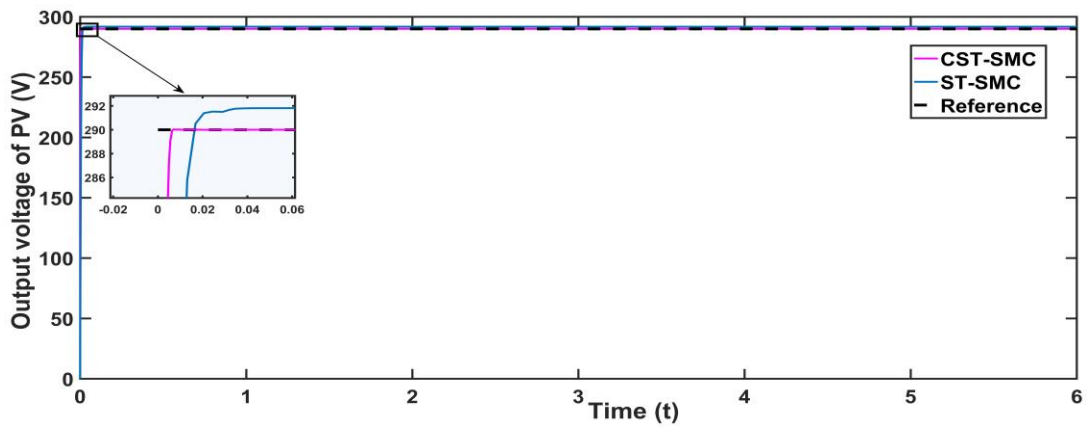
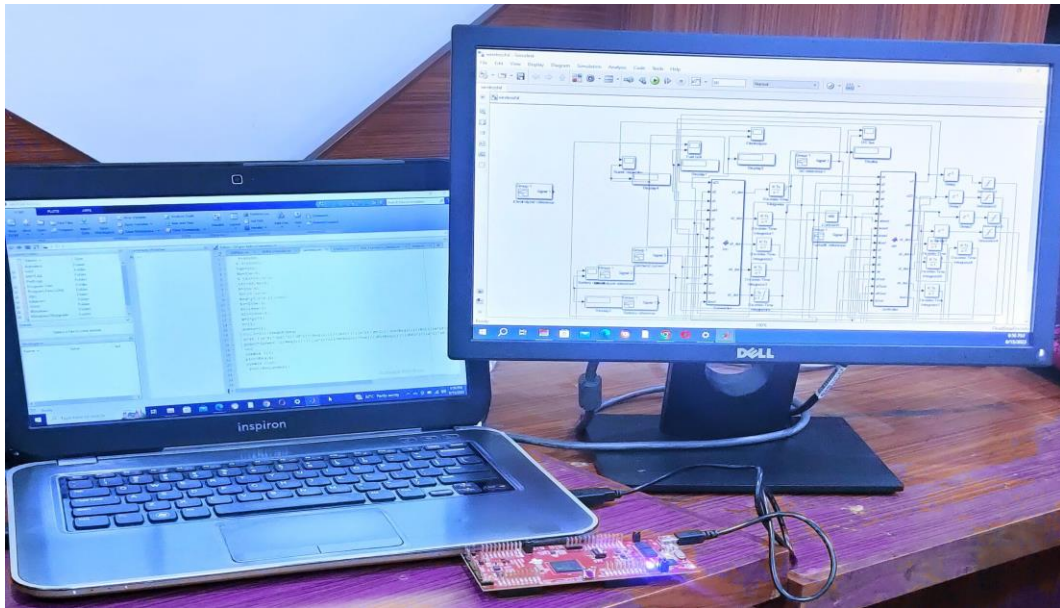Fig. 9: Performance comparison of condition-based ST-SMC versus ST-SMC.
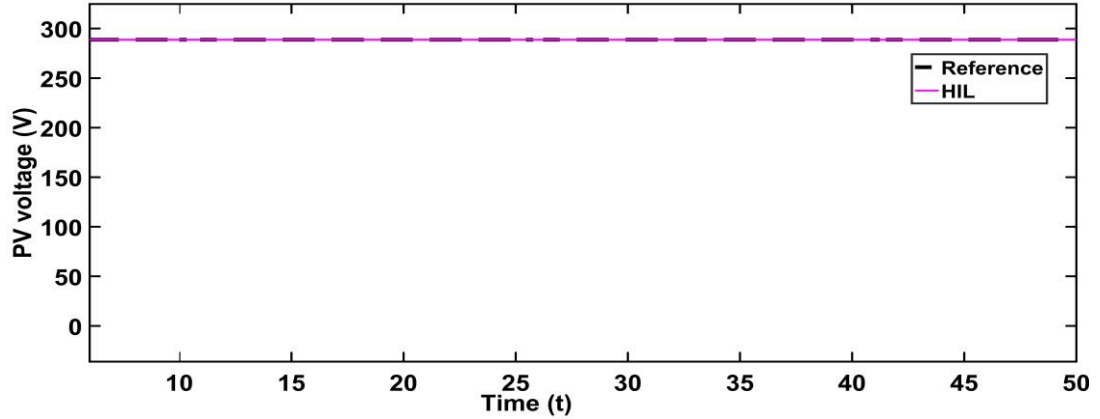

Fig. 10: Experimental HIL Setup

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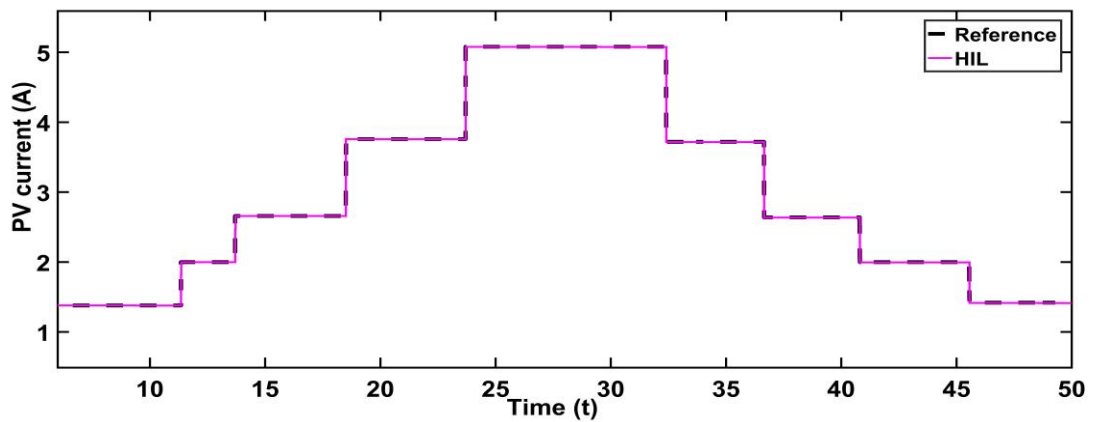Fig. 11: HIL experiment PV output voltage.

Fig. 12: HIL experiment PV output current.

Performance of CST-SMC adapting to varying irradiance

temperature is set at 25°C and the irradiance level was initially fixed at a steady 1000 W/m² at 1.5s, then reduced to 800 W/m² at 4.5s The, and eventually to 500 W/m² at 6.5s. Fig. 7 demonstrates the response of the photovoltaic array to changing irradiance. The controller attains an almost negligible steady-state error, adeptly tracking the reference peak voltage, aligning with the expectations set by the ANFIS architecture. This highlights the robustness of the controller in the presence of diverse environmental factors. Precision is achieved without any undershoot, and the settling time is measured at 2.37 milliseconds. However, in this specific scenario, a slight overshoot of 0.039 volts is observed. The rise time for the condition-based ST-SMC is approximately 2.09 milliseconds.

Effect of varying temperature on the performance of CST-SMC

In this section, the validation of CST-SMC performance is conducted by introducing temperature variations from 1.5s to 4.5s and then to 6.5s. The temperature sequence initiates at 25°C, progresses to 30°C, and eventually reaches 35°C. Throughout this test, the irradiance is held constant at 1000 W/m². Fig. 8 illustrates how the photovoltaic output voltage responds to changes in temperature. The controller closely follows the reference voltage, exhibiting a slight overshoot of 0.033 V with no undershoot. The rise time is 0.014 seconds, and the settling time is 2.21 milliseconds.

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Comparison of CST-SMC with ST-SMC Controller

Fig. 9 Compares the performance standard conditions of temperature and irradiance (25 °C, 1000 W/m²). It is noticeable that the ST-SMC controller demonstrates a small overshoot of 0.668 V, whereas the condition-based ST-SMC controller exhibits a minimal overshoot of 0.0295 V.

Overview of HIL microcontroller experiment

The dynamic model of the controller is implemented on the dual-core microcontroller MS320F28379D. The plant model is simulated in MATLAB Simulink and connected to launchpad. The experimental setup is shown in Fig. 10.
The Fig. 11 shows the PV voltage requirement for maintaining a constant load. Crucially, the result of PV current in the HIL experiment is shown in Fig. 12. The outcomes of the HIL experiments showcase satisfactory performance across demonstrating highly competent robust controller performance.

Comparative evaluation with ANFIS and the perturb and observe algorithm

A comparison is made between the proposed condition-based ST-SMC controller with ANFIS control and the conventional (P&O) algorithm. The findings indicate that the proposed controller consistently surpasses the ANFIS and P&O algorithms. Fig. 13 clearly highlights a contrast in PV output power between the controllers. Noticeably, when the PV array experiences significant parameter variations, the time taken to reach the maximum power point is prolonged with the P&O algorithm The Table IV list the final comparison of the implemented controllers regarding their dynamic responses.
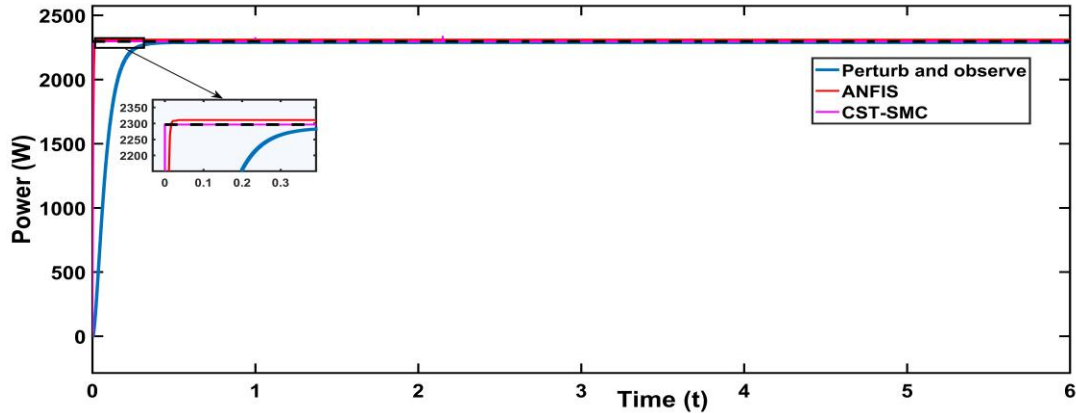

Fig. 13: PV output power comparison of P&O, ANFIS and CST-SMC.

TABLE IV: Dynamic responses for the controllers.

Assessment	P.O	ST-SMC	CSTSMC
The Rise Time (ms)	2.197	2.14	2.09
Time for settling (ms)	—	2.48	2.37
Percent overshoot (V)	34	0.668	0.029
A Steady State error (V)	3.038	0.0812	0.025

Conclusion and Future Work

Maximizing the power output of a PV system while minimizing losses in response to varying environmental conditions remains a continuous challenge. This study introduces a solution in the form of the ANFIS-based robust nonlinear MPPT algorithm for PV systems. The simulation assesses the performance of the proposed nonlinear controllers across changing environmental conditions. The results suggest that CST-SMC exhibits an improved overall dynamic response, achieving control objectives while minimizing losses. Utilizing the Lyapunov stability criteria ensures the guarantee of asymptotic stability for the system.
The effectiveness of the proposed controller has been assessed through comparisons with the ANFIS controller and perturb & observe. The condition-based ST-SMC controller exhibited better performance compared to ST-SMC, effectively eliminating steady-state errors. Hardware-in-the-loop results underscore the superiority of the controller. Future research could include enhancing precision by integrating alternative state-of-the-art artificial intelligence approaches for efficient maximum power point tracking in photovoltaic systems.

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