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Mangalmay Institute of Management and Technology

(UNDER THE AEGIS OF IQAC, MIMT)

organizes

INTERNATIONAL CONFERENCE

on

**INNOVATION AND TRANSFORMATION
FOR A SUSTAINABLE FUTURE**

(ICITSF-2025)

(17-18 April 2025)

ISBN Number : 978-81-986071-9-5

INTERNATIONAL CONFERENCE

ON

INNOVATION AND TRANSFORMATION

FOR

A SUSTAINABLE FUTURE

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OJHA PUBLICATION AND RESEARCH HOUSE

TITLE: INTERNATIONAL CONFERENCE ON INNOVATION AND TRANSFORMATION FOR A SUSTAINABLE FUTURE (ICITSF-2025)

LANGUAGE: ENGLISH
COUNTRY: INDIA
YEAR: 2025
ISBN: 978-81-986071-9-5

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PRICE- RS. 449/-
EDITOR- DR. RUCHIKA GUPTA

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Printed in India

Message from the Chairman



It is a true pleasure to welcome all our respected speakers, researchers, students, and guests to the International Conference on Innovation and Transformation for a Sustainable Future (ICITSF - 2025), proudly hosted by Mangalmay Group of Institutions. We are living in exciting times where science and technology are changing the world around us faster than ever before from the way we communicate and learn, to how we solve big challenges like healthcare, education, and climate change. With this conference, we bring together bright minds from all over to share their ideas and work towards creating a better tomorrow. At Mangalmay, we believe education goes beyond classrooms and degrees; it's about encouraging creativity, driving innovation, and shaping leaders who can make a real difference. The theme of this conference, "Innovation and Transformation for a Sustainable Future," reflects exactly what the world needs today fresh ideas and smarter, greener ways of living and working. Whether it's artificial intelligence, clean energy, or modern healthcare, innovation is the fuel that drives progress. ICITSF-2025 gives students, teachers, and experts a wonderful chance to connect, exchange ideas, and find real solutions to real-world problems.

What makes me even more proud is that this conference is not just about discussing theories it's about taking action. At Mangalmay, we always push our students and faculty to think beyond the books and come up with real innovations through research and collaborations. ICITSF-2025 is a reflection of that spirit. I would like to sincerely thank our hardworking organizing team, our dedicated faculty members, the volunteers, and all our partners. A special thanks also to the reputed journal publishing our conference proceedings for their support. To everyone attending, I encourage you to be open, curious, and ready to share your thoughts. Great ideas often start with simple conversations! Remember, real innovation happens when people come together with open minds and big dreams. On behalf of the Mangalmay Group of Institutions, I warmly welcome you all and wish you an exciting, inspiring, and unforgettable conference experience. Let's learn, share, and shape the future together!

“Dream, innovate, and transform — the journey to a better future begins here.”

Best Wishes,

Dr. Atul Mangal

Chairman, Mangalmay Group of Institutions

Message from Vice Chairman



It is a moment of great pride and excitement for me to extend a warm welcome to all participants, researchers, academicians, and industry leaders who have come together for the International Conference on Innovation and Transformation for a Sustainable Future (ICITSF - 2025). Our world today is changing faster than ever, and with these changes come new challenges and opportunities. Through innovation bringing in new ideas and transformation changing old ways into better ones we can create a future that is sustainable, healthy, and promising for all. This conference offers an important platform where brilliant minds can share their knowledge, experiences, and discoveries. I believe that the papers presented, the discussions held, and the collaborations formed here will not only deepen our understanding but also inspire action towards building a greener, smarter, and more compassionate world.

At Mangalmay Group of Institutions, we have always believed that education is not just about learning facts, but about learning how to make a difference. Hosting ICITSF - 2025 is part of our commitment to encouraging fresh thinking and responsible innovation. I would like to express my sincere appreciation to all the organizers, authors, reviewers, and participants for their hard work and dedication in making this conference a reality. Your contributions are shaping the future we all wish to see one that balances growth with care for people and the planet. I wish all participants a very enriching experience and look forward to seeing the outcomes of this wonderful gathering published and shared with the world. Let us continue to innovate, collaborate, and transform for a better tomorrow.

Best Wishes,

Dr. Aayush Mangal

Vice Chairman, Mangalmay Group of Institutions

Message from the Executive Director



It gives me great pride and joy to welcome all of you to the *International Conference on Innovation and Transformation for a Sustainable Future (ICITSF - 2025)*. We are living in a time where innovation is not just a choice, but a necessity. Our world today faces many challenges – from environmental issues to social inequalities – and it is through bold ideas, fresh thinking, and collective action that we can overcome them. This conference stands as a beacon of hope, gathering brilliant minds from across the globe to share ideas, spark conversations, and shape new paths toward a future that is sustainable, inclusive, and full of opportunities. At Mangalmay Group of Institutions, we are deeply honoured to host this platform where creativity meets responsibility, and where dreams of a better tomorrow start taking shape.

At the heart of Mangalmay's vision is a strong belief that education and research must go beyond classrooms and textbooks. They must touch lives, solve real-world problems, and bring about positive change. ICITSF-2025 brings together students, scholars, educators, business leaders, and changemakers under one roof to learn from each other and to inspire new ways of thinking. Every paper presented, every discussion held, and every connection made here has the power to create ripple effects far beyond this event. I extend my heartfelt gratitude to all participants, authors, keynote speakers, and organizers for their dedication and passion. Let us use this conference as a springboard to ignite ideas, nurture innovations, and work hand in hand to build a world where progress and sustainability walk together. The future is ours to create — let us make it bright, meaningful, and lasting.

Best Wishes,

Dr. Prerna Mangal

Executive Director, Mangalmay Group of Institutions

Message from The Director



It gives me great pleasure to extend a warm welcome to all the distinguished guests, participants, and contributors of the *International Conference on Innovation and Transformation for a Sustainable Future (ICITSF - 2025)*, organized by the Mangalmai Group of Institutions. The theme of this conference is extremely close to my heart, as it highlights two of the most important needs of our times — innovation and sustainability. In today's world, where change is constant and challenges are global, it is important that we focus on fresh ideas and practical solutions that help make the world a better place for all. ICITSF-2025 brings together brilliant minds from different fields, offering a platform to share research, experiences, and innovative practices that can drive positive transformation. I firmly believe that discussions held here will inspire new ways of thinking and encourage collective action toward a future that is not only innovative but also caring and sustainable for generations to come.

At Mangalmai, we have always believed that education is not just about learning facts but about nurturing minds that can lead change. This conference reflects our commitment to promoting meaningful research and building connections that extend beyond boundaries. I sincerely thank all the respected speakers, researchers, scholars, and participants for their valuable contributions to this E-Proceedings book. Your hard work and ideas are helping to create a roadmap for a future that balances progress with responsibility. I am confident that the knowledge shared through ICITSF-2025 will serve as a stepping stone for new initiatives, partnerships, and discoveries. Let us move forward with hope, enthusiasm, and a strong determination to create a world where innovation and sustainability go hand in hand. Wishing all participants great success and a truly enriching experience at the conference!

"Innovation is the seed, and sustainability is the soil in which a better future grows."

Best Wishes,

Dr. Ruchika Gupta

Director, Mangalmai Institute of Management & Technology

CONTENTS

1. EXPLORING DEEP GENERATIVE MODELS: INTERCONNECTED APPROACHES AND APPLICATIONS IN REGRESSION ANALYSIS	6
<i>ANUJ KUMAR, MANGALMAY INSTITUTE OF ENGINEERING & TECHNOLOGY</i>	<i>6</i>
2. EVALUATING THE ROLE OF GREEN BONDS IN SUSTAINABLE ECONOMIC DEVELOPMENT	10
<i>MS. KHUSHI SINGH, MANGALMAY INSTITUTE OF MANAGEMENT TECHNOLOGY.....</i>	<i>10</i>
<i>MR. DEEPANSHU YADAV, MANGALMAY INSTITUTE OF MANAGEMENT TECHNOLOGY ...</i>	<i>10</i>
3. EXPLORING CONSUMER INTENTIONS TO VISIT MASSAGE STORES HAVING THERAPISTS WITH PHYSICAL IMPAIRMENTS IN TAIWAN	13
<i>KHIRE RUSHIKESH ULHAS, INTERNATIONAL COLLEGE, PROVIDENCE UNIVERSITY, TAICHUNG, TAIWAN</i>	<i>13</i>
<i>JESSLYN OCTAVIA, INTERNATIONAL COLLEGE, PROVIDENCE UNIVERSITY, TAICHUNG, TAIWAN</i>	<i>13</i>
<i>DUONG BICH NGOC, INTERNATIONAL COLLEGE, PROVIDENCE UNIVERSITY, TAICHUNG, TAIWAN</i>	<i>13</i>
<i>CHIA-HUI CHEN, COLLEGE OF MANAGEMENT, PROVIDENCE UNIVERSITY, TAICHUNG, TAIWAN</i>	<i>13</i>
<i>SHUBHAM SHARMA, OFFICE OF INTERNATIONAL AFFAIRS, CHITKARA UNIVERSITY</i>	<i>13</i>
4. HARNESSING ARTIFICIAL INTELLIGENCE FOR SUSTAINABLE AGRICULTURE: OPPORTUNITIES AND CHALLENGES	2
<i>AMAN, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	<i>2</i>
<i>AMAN KUMAR, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY.....</i>	<i>2</i>
<i>SURAJ SHUKLA, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY.....</i>	<i>2</i>
5. CRYPTOCURRENCY AS AN INVESTMENT VEHICLE: ASSESSING THE OPPORTUNITIES AND CHALLENGES OF DIGITAL ASSETS	6
<i>GYANDEEP SHUKLA, PT. SHAMBHUNATH SHUKLA UNIVERSITY</i>	<i>6</i>
<i>DR. DHANUSHDHARI CHOUDHARY, PT. SHAMBHUNATH SHUKLA UNIVERSITY.....</i>	<i>6</i>
6. UTILIZATION OF AI IN CRIME INVESTIGATION: A TOOL TO CRIME INVESTIGATION	10
<i>AYRA, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY.....</i>	<i>10</i>

<i>ARPIT KUMAR, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	10
<i>MR. KRISHAN KUMAR, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	10
7. TALENT MANAGEMENT AS A DRIVER FOR ORGANIZATIONAL SUCCESS: TRENDS AND BEST PRACTICES	16
<i>MANTHAN KUMAR SHARMA, PT. SHAMBHUNATH SHUKLA UNIVERSITY</i>	16
<i>DR. ADITI SHRIVASTAVA, PT. SHAMBHUNATH SHUKLA UNIVERSITY</i>	16
8. GENERATIVE AI FOR SIMULATION AND TRAINING IN COMPLEX SYSTEMS	20
<i>AMIT KUMAR, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	20
<i>MS. SONIYA SHARMA, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	20
9. SHAPING TOMORROW WITH EMERGING TECHNOLOGIES	24
<i>DIYA SWARNKAR, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	24
<i>DIVYA SINGH, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	24
<i>MS. POOJA, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	24
10. IOT: SECURITY OF SMART HOMES	27
<i>MS. RUPALI CHAUHAN, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i> ..	27
<i>MS. RUCHI PRIYA, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	27
<i>MR. TUSHAR TIWARI, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	27
11. AI'S FUNCTION IN WEB DEVELOPMENT	31
<i>KASHISH JAIN, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	31
<i>KUMARI SUPRIYA, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	31
<i>MS. SUSHMA KUMARI, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	31
12. THE TRANSFORMATIVE ROLE OF ARTIFICIAL INTELLIGENCE IN CYBERSECURITY	35
<i>MANAS, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	35
<i>PIYUSH KUMAR, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	35
<i>MS. SURBHI SINGH, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	35
13. A SYSTEMATIC REVIEW: TRAFFIC FLOW PREDICTION USING ARTIFICIAL INTELLIGENCE	44
<i>RISHABH JHA, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	44

	<i>RAUSHAN KUMAR, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	44
	<i>ABHAY NARAYAN TRIPATHI, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	44
14.	RISE OF AI CHATBOTS	53
	<i>MS. RUCHI PRIYA, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	53
	<i>MS. RUPALI, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	53
	<i>TUSHAR TIWARI, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	53
15.	RESEARCH PAPER ON ARTIFICIAL INTELLIGENCE & IT'S APPLICATION ...	59
	<i>SANYA RAI, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	59
	<i>VIVEK DWIVEDI, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	59
16.	MEDBUDDY: A MULTI-DISEASE PREDICTION FRAMEWORK FOR HEALTH MONITORING OF HEART DISEASE, PARKINSON 'S DISEASE, AND DIABETES USING MACHINE LEARNING	62
	<i>JATIN SEN, MANGALMAY INSTITUTE OF ENGINEERING AND TECHNOLOGY</i>	62
	<i>AMAN SAGAR, MANGALMAY INSTITUTE OF ENGINEERING AND TECHNOLOGY</i>	62
	<i>SAHIL RAJPUT, MANGALMAY INSTITUTE OF ENGINEERING AND TECHNOLOGY</i>	62
	<i>HARSHIT BHARDWAJ, MANGALMAY INSTITUTE OF ENGINEERING AND TECHNOLOGY</i> .	62
	<i>DR. BHASKAR GUPTA, MANGALMAY INSTITUTE OF ENGINEERING & TECHNOLOGY</i>	62
17.	CALLMECH: ON-DEMAND ROADSIDE ASSISTANCE AND SERVICE BOOKING	74
	<i>VIVEK KUMAR MISHRA, MANGALMAY INSTITUTE OF ENGINEERING AND TECHNOLOGY</i>	74
	<i>MUKUL PANDEY, MANGALMAY INSTITUTE OF ENGINEERING AND TECHNOLOGY</i>	74
	<i>SHUBH DIXIT, MANGALMAY INSTITUTE OF ENGINEERING AND TECHNOLOGY</i>	74
	<i>DR. BHASKAR GUPTA, MANGALMAY INSTITUTE OF ENGINEERING & TECHNOLOGY</i>	74
18.	AN EXPLORATION OF BEHAVIORAL FINANCE: UNDERSTANDING INVESTOR DECISION-MAKING.	83
	<i>MR SHUBHAM TIWARI, AMRAPALI UNIVERSITY</i>	83
	<i>DR. MANOJ SINGH NEG, AMRAPALI UNIVERSITY</i>	83

19. ROLE OF INCUBATORS AND ACCELERATORS IN THE SUCCESS OF STARTUPS A COMPARATIVE ANALYSIS	89
<i>MR. SHUBHAM KUMAR, MANGALMAY INSTITUTE OF MANAGEMENT TECHNOLOGY</i>	<i>89</i>
<i>MS. SANJANA RANI, MANGALMAY INSTITUTE OF MANAGEMENT TECHNOLOGY.....</i>	<i>89</i>
<i>MR. RAHBER AKHTER ANSARI, MANGALMAY INSTITUTE OF MANAGEMENT TECHNOLOGY.....</i>	<i>89</i>
20. SMALL FINANCE BANK: SHIFTING GEARS TO DRIVE FINANCIAL INCLUSION	93
<i>MS. SHREYA SINGH, MANGALMAY INSTITUTE OF MANAGEMENT AND TECHNOLOGY</i>	<i>93</i>
<i>DR. ASHUTOSH GAUR, MANGALMAY INSTITUTE OF MANAGEMENT AND TECHNOLOGY</i>	<i>93</i>
21. THE IMPACT OF AI DRIVEN FINANCIAL ADVISORY SERVICES ON INVESTMENT DECISION MAKING.....	105
<i>MS. PRIYA BISHT, MANGALMAY INSTITUTE OF MANAGEMENT TECHNOLOGY</i>	<i>105</i>
<i>MR. SURYA SHEKHAR VISHAL, MANGALMAY INSTITUTE OF MANAGEMENT TECHNOLOGY.....</i>	<i>105</i>
22. THE CONSUMER PARADIGM SHIFT DUE TO TECHNOLOGY EVOLUTION AND ITS IMPACT OVER MILK AND DAIRY PERISHABLE GOODS SALES: A STUDY OF NCR	108
<i>DR AZAD SINGH, MANGALMAY INSTITUTE OF MANAGEMENT AND TECHNOLOGY</i>	<i>108</i>
23. SMART CITIES AND SUSTAINABLE URBAN DEVELOPMENT	116
<i>HARSH KUMAR, MANGALMAY INSTITUTE OF MANAGEMENT AND TECHNOLOGY</i>	<i>116</i>
<i>HARSH JAISWAL, MANGALMAY INSTITUTE OF MANAGEMENT AND TECHNOLOGY</i>	<i>116</i>
<i>HARSHUT SARIVASTAV, MANGALMAY INSTITUTE OF MANAGEMENT AND TECHNOLOGY</i>	<i>116</i>
<i>HIMANSHU SHUKLA, MANGALMAY INSTITUTE OF MANAGEMENT AND TECHNOLOGY</i>	<i>116</i>
<i>MR. ASHOK KUMAR GUPTA MANGALMAY INSTITUTE OF MANAGEMENT AND TECHNOLOGY.....</i>	<i>116</i>
24. CONSUMER TIME AND SPENDING PATTERNS ACROSS MALL ZONES IN THE POST-PANDEMIC PERIOD: A SPATIAL-BEHAVIORAL STUDY	121
<i>MS. HIMANI CHAUDHARY, BANARASIDAS CHANDIWALA INSTITUTE OF PROFESSIONAL STUDIES, DWARKA.....</i>	<i>121</i>
25. "MAXIMIZING PMS FOR ENDURING TALENT ENRICHMENT AND UNWAVERING EMPLOYEE DEDICATION"	131

	<i>KATYAYAN, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	131
	<i>DR. AANCHAL TYAGI, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY</i>	131
26.	WOMEN EMPOWERMENT IN THE BANKING SECTOR: A COMPREHENSIVE ANALYSIS OF THE ROLE OF WOMEN	143
	<i>CHANDANI SRIVASTAVA, MANGALMAY INSTITUTE OF ENGINEERING AND TECHNOLOGY</i>	143
27.	‘LIFE SKILLS: A NEED OF THE HOUR FOR THE CHANGING SOCIETY’	149
	<i>NEHA BAKSHI, MANGALMAY INSTITUTE OF ENGINEERING & TECHNOLOGY</i>	149
28.	TECHNOLOGICAL DRIVERS FOR BUSINESS SUSTAINABILITY AMONG WOMEN ENTREPRENEURS IN MSMES	158
	<i>KANCHAN, SHARDA UNIVERSITY</i>	158
	<i>ATUL SANGAL, SHARDA UNIVERSITY</i>	158
29.	CLOUD-BASED APPLICATIONS AND SAAS METHODOLOGIES FOR HUMAN RESOURCE MANAGEMENT	187
	<i>GEETA SHARMA, MANGALMAY INSTITUTE OF MANAGEMENT AND TECHNOLOGY, GREATER NOIDA</i>	187
	<i>ADITYA SINGH, MANGALMAY INSTITUTE OF ENGINEERING & TECHNOLOGY</i>	187
	<i>RADHIKA TAYAL, MANGALMAY INSTITUTE OF ENGINEERING & TECHNOLOGY</i>	187
	<i>ROSHAN KUMAR BARNWAL, MANGALMAY INSTITUTE OF ENGINEERING & TECHNOLOGY</i>	187

1. EXPLORING DEEP GENERATIVE MODELS: INTERCONNECTED APPROACHES AND APPLICATIONS IN REGRESSION ANALYSIS

ANUJ KUMAR, MANGALMAY INSTITUTE OF ENGINEERING & TECHNOLOGY

Abstract

A survey of deep generative models, a family of methods in machine learning that learn the distribution of training data through deep neural networks. The handbook surveys several interconnected methods, such as energy-based models, variational autoencoders, generative adversarial networks (GANs), autoregressive models, and normalizing flows, as well as hybrid methods. Each approach is described together with its underlying presumptions, connections between them, advantages, disadvantages, and the most recent cutting-edge developments and applications. The abstract emphasizes how sophisticated methods for data generation and insights extraction offered by deep generative models might improve regression analysis.

Keywords: Deep generative models, machine learning, regression analysis, energy-based models, variational auto encoders, generative adversarial networks (GANs).

1. Introduction

Deep generative models are causing a revolution in many fields. They make it possible to create realistic fake data, improve how features are shown, and give reliable estimates of uncertainty. When we use these models together with regression analysis, we can make predictive models work better and be easier to understand. This chapter looks at how deep generative models and regression analysis work together. It gives a full picture of how they help each other.

2. Deep Generative Models Overview

2.1. Variational Autoencoders (VAEs)

Variational Autoencoders impact the way we represent data into a probability space. The models employ two primary components: one that converts input into a dispersed form, and the second one that reconstructs the data based on this form. The configuration allows VAEs to deal with difficult data patterns and generate new data points.

2.2 Generative Adversarial Networks (GANs)

Generative Adversarial Networks employ two separate systems in concert. One system creates imitation data, and the other attempts to identify what is not. When they are operating, the imposter becomes more skilled at deceiving the detector, and the detector becomes more adept at detecting fakes. The interaction is what makes both improve.

2.3. Normalizing Flows

Normalizing flows transform a simple distribution into a more complex one by a sequence of reversible and differentiable changes. This process allows for accurate likelihood computation and efficient sampling, making normalizing flows a robust method to density estimate and generates data.

2.4. Diffusion Models

Diffusion models generate data by incrementally adding noise to a point of data and learning to reverse the process. They provide a flexible means of modeling complex data patterns and have proven to be useful in a variety of generative tasks.

3. Interconnected Approaches

3.1. Feature Generation and Augmentation

By generating data that can be added to training data, deep generative models can be utilized to expand regression analysis. The method can be applied particularly when there is a lack of data or when the data is not balanced. **Getting Past the Lack of Data:** Models like GANs can generate synthetic data that can help limited datasets by providing more samples and improving regression model generalization. **Balancing Datasets:** Generative models in unbalanced datasets can generate samples from underrepresented classes, resulting in better balanced and efficient regression models.

3.2. Latent Space Regression

The latent space representations learned by VAEs can be used as input features for regression models. This can lead to improved performance due to better feature representation and dimensionality reduction. **Improved Feature Representation:** Latent variables often capture essential patterns and structures in the data, resulting in more informative features for regression tasks. **Dimensionality Reduction:** Transforming high-dimensional data into a lower-dimensional latent space simplifies regression models and reduces computational complexity.

4. Probabilistic Regression Models

Regression models can use VAE-learned latent space representations as input features. This has an impact on performance through better feature representation and dimensionality reduction. **Better Feature Representation:** Latent variables can spot key features for regression tasks by showing abstract structures and patterns in the data. **By creating data to add to training sets** deep generative models can push regression analysis forward. This method shines when data is scarce or skewed. **Overcoming Data Scarcity:** Models like GANs can make synthetic data to boost small datasets giving more samples and helping regression models work better across different scenarios.

5. Applications in Regression Analysis

5.1. Time Series Forecasting

Deep generative models can enhance regression models for time series forecasting by producing synthetic time series that enhance the quality of the training data. **Stock Market Predictions:** In order to create sophisticated models, VAEs and GANs can use time series data on stock prices to forecast the market. This allows them to identify trends in market dynamics. **Weather Prediction:** Generative models can plausibly simulate weather scenarios and use them to improve weather prediction models.

5.2. Medical Data Analysis

In Deep learning, where the data is sensitive, deep generative models present new opportunities to refine regression analysis in healthcare. **Disease Progression:** Generative models can

realistically render patient trajectories that help in the early forecasting of a patient's disease progression and informing treatment plans. Treatment Outcome Prediction: Generative models can create more accurate synthetic data for patients that will help train regression models so that the models will predict treatment outcomes more accurately.

5.3. Environmental Modelling.

In environmental science, these models can be used to generate diverse scenarios to aid in geographical regression analysis. Climate Change Studies: Generative models can create simulations of changing climates and supply dependable data for rigorous regression models aimed at projecting subsequent changes. Agricultural Yield Prediction: These models aid in predicting the yield by providing synthetic data.

6. Conclusion

When combined with regression analysis, deep generative models can improve data representation quite a bit, increase accuracy and uncertainty handling. These models can help different fields like finance, health and environment by allowing better forecasting in future years. They tackle issues like the scarcity and imbalance of data by creating fake data which helps create reliable regression models. Methods such as variational autoencoders (VAEs), Gans as well as normalizing flows have unique advantages like better representation of features and generation of more accurate data. Since these methods are still advancing, their integration with regression analysis will likely produce improved outcomes and robust predictive models in many real-world applications. Working together deep generative models (such as VAEs, GANs and normalizing flows) and regression analysis can effectively transform, in essence.

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2. EVALUATING THE ROLE OF GREEN BONDS IN SUSTAINABLE ECONOMIC DEVELOPMENT

MS. KHUSHI SINGH, MANGALMAY INSTITUTE OF MANAGEMENT TECHNOLOGY

MR. DEEPANSHU YADAV, MANGALMAY INSTITUTE OF MANAGEMENT TECHNOLOGY

Abstract

Green bonds have emerged as a crucial financial instrument to support sustainable economic development by funding environmentally friendly projects. These bonds enable governments, corporations, and financial institutions to raise capital specifically for climate-related and sustainability-driven initiatives. This paper examines the role of green bonds in fostering economic growth while ensuring environmental sustainability. It evaluates their effectiveness in reducing carbon emissions, promoting renewable energy, and encouraging green infrastructure development. Through a comparative analysis of global green bond markets, the study highlights the benefits, challenges, and future prospects of green bonds as a sustainable finance tool. The findings suggest that green bonds contribute significantly to sustainable economic growth but require enhanced regulatory frameworks and transparency to maximize their impact.

Keywords

Green bonds, sustainable finance, economic development, environmental sustainability, renewable energy, carbon reduction, green infrastructure, climate finance, ESG investment, financial markets

1. Introduction

The transition to a sustainable economy requires innovative financial instruments that support green projects and promote long-term environmental benefits. Green bonds, a type of fixed-income security, are issued specifically to finance projects that contribute to environmental sustainability. These bonds align with global sustainability goals, such as the Paris Agreement and the United Nations Sustainable Development Goals (SDGs). This paper explores the impact of green bonds on sustainable economic development, analyzing their benefits, challenges, and market trends.

2. Literature Review

2.1 Concept and Evolution of Green Bonds

Green bonds were first introduced by the European Investment Bank in 2007 and have since grown into a key financial tool for environmental investments. The market has expanded globally, with increasing participation from governments, corporations, and institutional investors.

2.2 Theoretical Framework: Sustainable Finance and ESG Investing

Sustainable finance focuses on investments that generate long-term environmental and social benefits. ESG (Environmental, Social, and Governance) investing principles guide green bond issuance and allocation. The efficient market hypothesis suggests that increased transparency and regulatory compliance enhance investor confidence in green bonds.

3. Methodology

This study employs a mixed-method approach, including a review of secondary data from financial reports, regulatory guidelines, and case studies. A comparative analysis of green bond markets in developed and developing economies provides insights into their role in sustainable economic development.

4. The Role of Green Bonds in Sustainable Economic Development

4.1 Financing Renewable Energy Projects

Green bonds play a significant role in funding solar, wind, and hydroelectric energy projects, reducing reliance on fossil fuels and decreasing greenhouse gas emissions.

4.2 Supporting Green Infrastructure Development

These bonds help finance sustainable urban development, including energy-efficient buildings, eco-friendly transportation, and water conservation projects.

4.3 Enhancing Financial Market Stability

By integrating sustainability into investment decisions, green bonds attract ESG-conscious investors, promoting long-term economic stability.

5. Practical Illustrations

5.1 The European Green Bond Market

Europe leads the global green bond market, with strong regulatory support and investor participation. The European Union's Green Bond Standard (EUGBS) ensures transparency and accountability.

5.2 Emerging Markets: China and India

China has become a major green bond issuer, focusing on clean energy and sustainable transportation. India's green bond market is expanding, with initiatives supporting renewable energy and climate resilience projects.

6. Challenges and Limitations

Despite their benefits, green bonds face challenges such as:

- **Lack of Standardization:** Different countries have varying green bond guidelines, affecting market consistency.
- **Greenwashing Risks:** Some issuers mislabel bonds as “green” without adhering to sustainability principles.
- **Regulatory Barriers:** Inconsistent policies and limited investor awareness hinder green bond adoption.

7. Future Trends and Recommendations

- **Strengthening Regulatory Frameworks:** Governments and financial institutions should establish clear guidelines to ensure transparency.

- **Increasing Public and Private Sector Collaboration:** Partnerships can enhance green bond effectiveness and market expansion.
- **Leveraging Technology:** AI and blockchain can improve green bond tracking and reporting, reducing greenwashing risks.

8. Conclusion

Green bonds play a vital role in financing sustainable economic development by directing investments toward environmentally responsible projects. They facilitate the transition to a low-carbon economy by supporting renewable energy, green infrastructure, and climate-friendly initiatives. While these bonds offer significant benefits, such as attracting socially responsible investors and promoting environmental stewardship, challenges remain in terms of regulatory oversight, transparency, and standardization across global markets. Strengthening reporting mechanisms and enhancing investor confidence through clear guidelines will be essential for the continued growth of green bonds. As the demand for sustainable finance increases, collaborative efforts between policymakers, financial institutions, and stakeholders will be crucial in maximizing the effectiveness of green bonds in achieving long-term economic and environmental sustainability.

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3. EXPLORING CONSUMER INTENTIONS TO VISIT MASSAGE STORES HAVING THERAPISTS WITH PHYSICAL IMPAIRMENTS IN TAIWAN

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Abstract

In today's fast-paced, technology-driven lifestyle of the Fourth Industrial Revolution, individuals face mounting physical and mental stress due to overwhelming choices and constant stimulation. Wellness activities, including massage therapy, have emerged as effective solutions to restore balance and alleviate stress. In recent years, massage centers employing therapists with physical impairments have gained attention in Taiwan for promoting both healing and social inclusion. This study explores consumer intentions to visit massage stores employing therapists with physical impairments in Taiwan, a rising social enterprise model in Asia. While traditional Asian massage styles such as Thai Massage, Balinese Massage, and Chinese Tuina (a form of therapeutic massage) attract global attention, the inclusion of therapists with disabilities in Taiwan's wellness industry offers unique social and economic benefits. These ventures not only empower individuals with physical impairments but also challenge social prejudices and promote well-being. This study addresses SDG Goal No. 10: Reduced Inequality, by promoting equal opportunities and empowering marginalized groups. Despite previous research on massage techniques and disability-related discrimination, limited studies have examined how consumers perceive and choose such inclusive services. This research aims to investigate the factors that impact consumer intention to visit massage stores with therapists with physical impairments in Taiwan. 150 samples, the data collected through a questionnaire survey was analyzed with the help of Partial Least Squares approach. Perceived expertise, social influence, and attitude were found to be factors that impact behavioral intention, with perceived expertise having the strongest effect. Perceived behavioral control had a minimum but significant impact on behavioral intention. Finally, perceived risk found to have no significant impact on consumer attitude and behavioral intention.

Keywords: Consumer intentions, Physical Impairment, Massage, Reduced inequalities, SDG-10, Therapist, Taiwan.

1. Introduction

The fast-paced nature of modern life makes the world feel smaller and creates many challenges. The overwhelming number of choices can negatively affect both physical and mental health, leaving people vulnerable to stress and other issues. The need to find balance is paramount to

mitigate the risks of psychological and behavioral problems. Many activities positively impact our lives, such as shopping, hanging out with friends, sports, and going to wellness centers, which are effective in relieving stress and are considered among the best solutions. Massage therapy is widely regarded as a favored service industry, transcending culture and age all around the world (Benjamin, 2011; Fajardo et al, 2022). In Asia, several famous massage styles have gained popularity beyond their regions of origin. For instance, Thai Massage from Phuket (Thailand) combines acupressure techniques, reflexology, and aromatherapy to alleviate muscle strain, disability, and anxiety (Field, 2014); Balinese Massage from Ubud (Indonesia) integrates reflexology, acupressure, and calming, firm massage movements (Uthaphan, & Nuriawan, 2024); and Chinese Knife Massage, with a history spanning over 2000 years, is believed to be a part of traditional Chinese medicine and continues to be practiced in Taiwan, where it remains an integral aspect of the country's cultural heritage (Nedelciuc, 2020).

In addition to these well-known techniques, a new model of massage business gaining attention in recent years is physical disability massage. This business model involves employing individuals with physical disabilities as massage therapists, providing them with meaningful employment opportunities (Huang et al, 2009; Li et al, 2022). It has developed in countries such as Vietnam, the Philippines, and Taiwan, and is seen as both a moral initiative and a business opportunity for people with disabilities. With the rising population of individuals with physical disabilities, the chance for them to work as massage therapists is expected to increase. Some therapists even specialize in serving specific customer populations, such as the elderly, athletes, or children (Benjamin, 2011). This model not only helps mitigate the risks of unemployment but also combats feelings of isolation or alienation. While much of the existing research has concentrated on variations in massage techniques across different countries and cultures, there has been less focus on the factors that influence attitudes toward individuals with disabilities (Page & Islam, 2015; Fajardo et al, 2022). Furthermore, various studies have delved into social policies related to constitutional law (Li et al., 2015; Li et al, 2022), financial support (Huang et al., 2009), charitable activities (Zhang, 2017), and the cultural discrimination that restricts people with disabilities from participating fully in society (Li et al., 2015; Zhang, 2017). In the light of this background, this research aims to explore factors influencing consumer intention to visit massage therapists with physical disabilities focusing on their psycho-social characteristics such as attitude, social influence, etc.

2. Theoretical background and hypotheses development

The Theory of Planned Behavior (TPB) is an extension of the Theory of Reasoned Action (TRA), developed to address the limitations of the original model in explaining behaviors over which people have incomplete volitional control. According to Ajzen (1991), TPB introduces three key determinants of behavioral intention: attitude toward the behavior, subjective norm, and perceived behavioral control. The first determinant refers to the degree to which an individual evaluates the behavior as favorable or unfavorable. The second, subjective norm, relates to the perceived social pressure to perform or not perform the behavior. The third determinant, perceived behavioral control, refers to the ease or difficulty of performing the behavior, which reflects both past experiences and anticipated obstacles Ajzen (2002).

Ajzen (1991) suggested that individuals are more likely to engage in a behavior if they have a favorable attitude, perceive positive social norms, and believe they have control over the behavior. His research demonstrated that these predictors are useful in understanding people's behavioral intentions, providing a conceptual framework for addressing the complexities of

human social behavior. For example, Kim et al. (2010) applied an extended version of Theory of Planned Behavior (TPB) to predict consumer intention to visit a spa, finding that perceived behavioral control and past experience were the most significant predictors. Several other studies have also used TPB for building their research model when understanding consumer intention to visit massage stores and/or Spas (Ng et al, 2022; Arphawatthansakul & Punyasiri, 2024).

These studies lack two specific aspects. First, they do not consider key factors such as consumers' perceived expertise of the therapist and perceived risk. Second, to the best of our knowledge, no research has examined stores where therapists with physical (particularly visual) disabilities are employed. Ultimately, this study builds upon the Theory of Planned Behavior (TPB) and extends it by incorporating two additional variables: perceived expertise and perceived risk.

Some researchers, such as Sangpikul (2022), have explored the safety aspect in the spa industry, highlighting the importance of trust and competence in service encounters. Although perceived expertise has not been extensively studied in the context of massage services, it is a well-established construct in the broader consumer behavior literature. For instance, Ladhari et al. (2020) examined how factors like homophily, emotional attachment, and perceived expertise influence the popularity of YouTube vloggers, demonstrating the relevance of expertise in shaping consumer attitudes. The key findings of this research suggest that to foster positive attitudes and strengthen purchase intention, companies should leverage credible and appealing endorsers, particularly celebrities. If the endorser is perceived as an expert, someone with knowledge, competence, and qualifications, the message is more likely to be effectively communicated to consumers. In general, the previous research support skills or expertise (Meyer, 2016) and risk (Shiu, 2017) influence consumer behavior, in service context. In the current study, we attempt to investigate role of consumer perceived expertise and risks in shaping their attitude toward the massage store having therapists with physical impairments.

Sangpikul (2022) found that the skills and expertise of spa therapists are important for building customer trust and confidence. His study showed that qualities like professional ability, hygiene, clear communication, and honesty also help create a sense of assurance during the service. These factors go beyond just being polite or knowledgeable. When customers see a therapist as skilled and professional, they are more likely to develop a positive attitude toward the service. In this study, we suggest that the perceived expertise of massage therapists with physical impairments can play an important role in shaping consumer attitudes.

Perceived risk is another important factor in consumer behavior because it can significantly influence consumer decision-making, especially when they are uncertain about the outcomes or safety of a service. Ashoer and Said (2016) noted that perceived risk becomes more significant when customers face uncertainty or potential negative consequences. In such cases, consumers are likely to seek additional information about products or services, which can influence their purchasing decisions. Similarly, Ariff et al. (2014) highlighted the role of perceived risk in predicting which individuals perceive certain hazards as dangerous, further emphasizing its importance in consumer decision-making. While much of the research in the spa context has focused on service quality and customer satisfaction, risk is often overlooked as a factor influencing consumer decision-making. Shiu (2017), who explored spa hotels in Taiwan, found that risk did not significantly affect net value perception in infrequent purchase decisions. However, the type of risk can influence outcomes. In this study, we focus on physical risk (e.g., concerns about safety or discomfort) and expected benefit risk (e.g., doubts about the effectiveness of the service). These concerns may become more pronounced when consumers interact with unfamiliar service providers, such as massage therapists with physical impairments.

As a result, perceived risk may contribute to a less favorable attitude toward the service.

Based on the above arguments, we state the following hypotheses:

H_{1,2}: Consumer perceived expertise positively affects their attitude as well as their intention to visit massage therapists with physical disabilities.

H_{3,4}: Consumer perceived risk negatively affects attitude as well as their intention to visit massage therapists with physical disabilities.

H_{5,6,7}: Consumer attitude, social influence and perceived behavioral control positively affects their intention to visit massage therapists with physical disabilities.

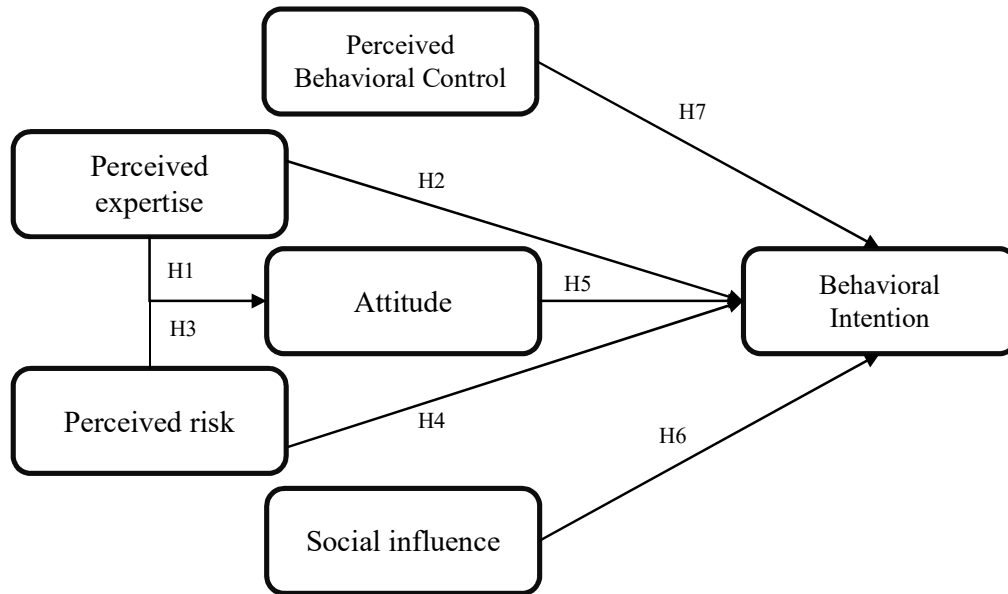


Fig 1. Research Model

3. Methodology

3.1 Questionnaire development and data collection

Based on the objective of this study, empirical data were collected from Taiwanese individuals who were aware of a wellness center employing a massage therapist with a physical impairment. The questionnaire used for data collection was developed based on established measures from previous literature. To ensure content validity, the instrument was reviewed by academic experts in the fields of consumer behavior and disability studies. Additionally, cross-cultural validity was assessed to ensure the questionnaire was appropriate and understandable for the Taiwanese context. A pilot study involving 25 subjects was conducted to examine the clarity of the questions and identify any procedural issues. Questionnaire was then improved based on the comments received. The final questionnaire was distributed to Taiwanese citizens via Google Forms. A convenience sampling method was employed, and this preliminary study is based on 130 valid responses collected so far, which were used for analysis. The demographical profiles of the respondents are shown in Table 1.

The questionnaire was structured using a 5-point Likert scale ranging from “strongly disagree” to “strongly agree.” It consisted of 29 items, divided into two main sections. The first section focused on demographic information, while the second assessed respondents’ agreement levels

with various factors that could influence their intention to visit a wellness center in Taiwan employing visually impaired therapists. Before distributing the questionnaire, respondents were screened by asking whether they were aware of such wellness centers. Only those who answered “yes” were invited to complete the questionnaire.

Table 1: Demographics

Variable	Characteristics	Sample	(%)
Gender	Male	44	34
	Female	86	66
Age	18-30	81	62
	31-40	17	13
	41-50	16	12
	>51	17	13
Education	High School	7	5
	Bachelors	75	58
	Masters	46	35
	PhD	2	2
Monthly Income	<30000	76	58
	<50000	41	32
	<70000	10	08
	>70000	03	02
Marital Status	Single	102	78
	Married	28	22
Total		130	100

The instrument measured six key factors: attitude (6 items), perceived expertise (4 items), perceived risk (3 items), perceived behavioral control (3 items), subjective norm (3 items), and behavioral intention (5 items). As shown in the figure, attitude and behavioral intention are mediating and dependent variable, respectively, while others are independent variables. All questionnaire items were developed based on established literature. Sources of the items, i.e., scales, are shown in Table 2.

Table 2: Scales

Constructs	Loadings
Attitude (AVE = 0.70; CR =0 .93; α = 0.91) – (Kim et al., 2010; Lee, 2015)	

I think, visiting wellness centres employed with physically impaired therapists	is	0.75
ATT1: very foolish – very wise		
ATT2: unbeneficial – very beneficial		0.91
ATT3: unfavorable – very favorable		0.84
ATT4: most useless – most useful		0.90
ATT5: most unpleasurable – most pleasurable		0.83
ATT6: non-prosocial – very prosocial		0.76
Perceived Expertise (AVE =0 .75; CR = 0.92; α = 0.89) – (Ladhari et al., 2020)		
PE1: I think, physically impaired therapists working at wellness centres are experts		0.91
PE2: I think, physically impaired therapists working at wellness centres are experienced		0.87
PE3: I think, physically impaired therapists working at wellness centres are knowledgeable		0.87
PE4: I think, physically impaired therapists working at wellness centres are qualified		0.80
Perceived Risk (AVE =0 .84; CR = 0.94; α = 0.91) – (Wang et al., 2019)		
PR1: I worry, reflexology services provided by physically impaired therapists could put me at potential risk of physical harms		0.88
PR2: I worry, reflexology services provided by physically impaired therapists are unhealthy		0.93
PR3: I worry, provided by physically impaired therapists may not deliver me the expected advantages or economic benefits		0.91
Social Influence (AVE = 0.69; CR = 0.87; α = 0.77) – (Ozdemir et al., 2020)		
SI1: My friends and family members recommend that I should visit a physically impaired therapist		0.86
SI2: My friends and family members would be happy if I visit a physically impaired therapist		0.89
SI3: My friends and family members would support my decision to visit a physically impaired therapist		0.72
Perceived Behavioral Control (AVE =0 .67; CR =0 .86; α = 0.75) – (Kim et al.,2010; Lee, 2015)		

PBC1: I have resources, time, and opportunities to visit a physically impaired therapist	0.88
PBC2: I am confident that if I want, I can go to a physically impaired therapist without any difficulties (e.g., finance, time, or physically)	0.90
PBC3: The decision to visit a physically impaired therapist is completely up to me	0.64
Behavioral Intention (AVE =0 .79; CR =0 .95; α =0 .93) – (Lee, 2015)	
BI1: I intend to visit a physically impaired therapist at wellness centres in the near future	0.93
BI2: I am likely to go to a physically impaired therapist at wellness centres in the near future	0.90
BI3: I will make an effort to visit a physically impaired therapist at wellness centres in the near future	0.91
BI4: Visiting a physically impaired therapist at wellness centres would be one of my preferences in the near future	0.85
BI5: I will recommend others to visit a physically impaired therapist at wellness centres	0.84

3.2 Data analysis and key results

In this study, we analyzed data from 150 questionnaires using a two-step process: developing measurement and structural models. The 24-item, six-construct measurement model was evaluated for reliability and validity using partial least squares structural equation modeling (PLS-SEM) with SmartPLS. Confirmatory factor analysis (CFA) was performed to check item reliability and validity in line with previous literature (Fornell & Larcker, 1981; Hair et al. 2010). We ensured that all factor loadings exceeded 0.5, and Cronbach's alpha values were above 0.7. Additionally, average variance extracted (AVE) and composite reliability (CR) for each construct were above 0.5 and 0.7, respectively, establishing convergent validity and composite reliability. Finally, discriminant validity was confirmed by verifying that the minimum square root of AVE value (0.82) exceeded all correlation coefficients in the correlation matrix. These findings collectively demonstrate that the measurement model has acceptable levels of validity and reliability.

After evaluating the measurement model, we conducted bootstrapping with 5,000 subsamples in SmartPLS to assess the statistical significance of the hypothesized paths. This approach aligns with recommendations by developers/experts in the field to obtain more precise estimates of standard errors and confidence intervals (Sarstedt et al, 2021).

Standardized estimates of the relationships between the relevant constructs were calculated using SmartPLS (Fig 2). We found positive significant impacts of perceived expertise on both attitude and behavioral intention, thus hypotheses H1 and H2 were supported. However, perceived risk

found to have no significant relationship with both attitude and behavioral intention. Thus, hypotheses H3 and H4 were not supported. It can be noticed that attitude, perceived behavioral control, and subjective norms positively influence behavioral intention. The T-statistic values for H5 and H6 were slightly below 1.96, while the value for H7 was above 1.96. Therefore, we can state that H5 and H6 are marginally supported, but H7 is strongly supported. Overall, we found

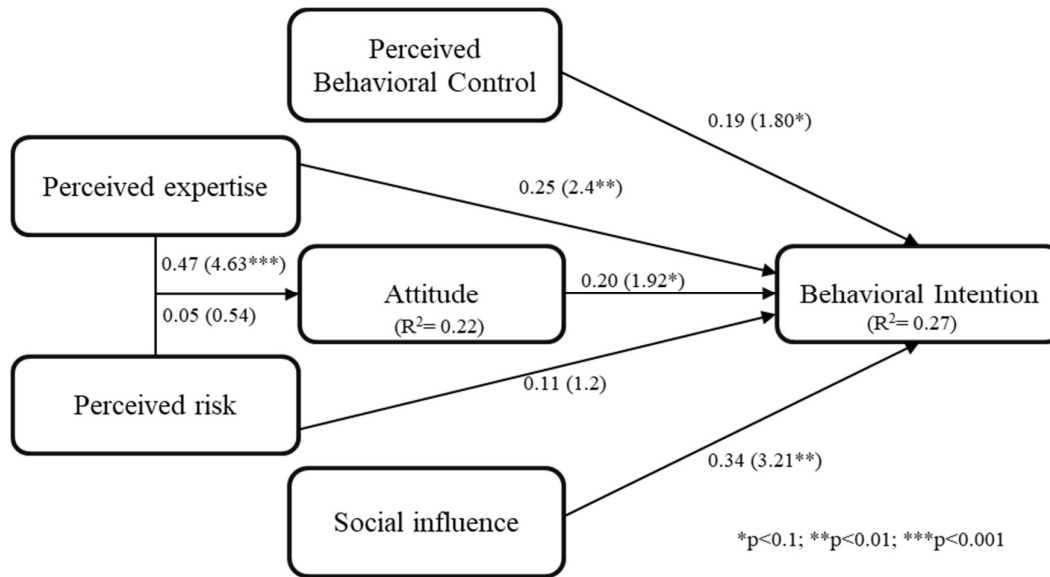


Fig 2 SEM, Path Coefficients and T-Statistics (in parentheses)

4. Conclusion

The primary goal of this study was to understand what influences consumer intention to visit massage centers where therapists with physical disabilities work. Using the Theory of Planned Behavior (TPB) (Ajzen, 1991) as a foundation, this study extended the traditional TPB model by including perceived expertise and perceived risk. A 24-item questionnaire was distributed in Taiwan, resulting in 150 valid responses. Findings suggest that perceived expertise and social influence are the most significant factors shaping consumer intention. In contrast, consumer attitude and perceived behavioral control were only marginally significant ($p < 0.1$), and perceived risk did not show a statistically significant effect on attitude or intention. One possible explanation for the marginal role of attitude and PBC is that most participants had never visited such a massage center, limiting their ability to form strong evaluations or behavioral intentions.

This research contributes theoretically in two ways. First, it tests the TPB model in a novel context. Second, it explores the role of perceived expertise and perceived risk in shaping behavioral intentions. The results highlight that perceived expertise can strongly influence intention, while perceived risk does not appear to deter interest.

From a practical perspective, businesses should focus on improving brand awareness and using credible sources to communicate the professional training and capabilities of therapists. For example, videos on YouTube or Facebook showcasing their training and expertise could enhance perceived credibility. Given the strong influence of social norms, encouraging word-of-mouth through referral incentives, newsletters, or partnerships with community organizations could also be effective. However, the findings should be interpreted with caution. The study was limited to Taichung City, with a relatively young sample (62%, aged 21–30) and a convenience-

based approach. Future research should include a larger, more diverse sample across Taiwan to enhance the generalizability of findings. Additionally, future studies could explore new variables such as store image, brand awareness, or trust to further enrich the model.

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4. HARNESSING ARTIFICIAL INTELLIGENCE FOR SUSTAINABLE AGRICULTURE: OPPORTUNITIES AND CHALLENGES

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Abstract

The integration of Artificial Intelligence (AI) in agriculture holds the probable to transform food production systems globally. With the world's population increasing and the demand for food escalating, AI-driven solutions offer the ability to optimize farming practices, improve crop yields, reduce waste, and conserve resources. The present status of AI applications in agriculture, such as supply chain optimization, autonomous machinery, vexation and disease control, and precision farming, is reviewed in this study. It also looks at the difficulties in putting AI technology into practice, such as data protection, expense, and the requirement for qualified workers. The study concludes by outlining possible legislative frameworks and future strategies to promote AI adoption in the agriculture industry.

Keywords: Artificial Intelligence, Agriculture, Precision Farming, Crop Monitoring, Autonomous Machinery, Sustainability, Data Science, Agri Tech

1. Introduction

- **Background:** Global challenges in agriculture, including food security, climate change, and environmental degradation.
- **Objective:** To explore how AI technologies can address these challenges by enhancing productivity, sustainability, and efficiency in agriculture [1].
- **Scope of the Paper:** Review of current AI uses, advantages, difficulties, and prospects in the field of agriculture.

2. Applications of AI in Agriculture

2.1 Precision Agriculture

- Use of AI for data analysis, remote sensing, and satellite imagery.
- Technologies like drones, IoT devices, and sensors integrated with AI for precision planting, watering, and fertilization [2].
- Case studies: AI-powered systems that monitor soil health, crop conditions, and water usage.

2.2 Pest and Disease Management

- An AI that uses pattern recognition and picture recognition to identify illnesses and pests.
- Early detection and prediction models using machine learning [3].
- Automation of pesticide application using AI, reducing chemical use and environmental impact.

2.3 Autonomous Machinery

- AI-driven autonomous tractors, harvesters, and drones.
- Benefits of automation in reducing labor costs and improving efficiency.
- Challenges in adopting autonomous machinery, including infrastructure requirements and cost barriers.

2.4 Supply Chain Optimization

- AI's application in agriculture for supply chain management, logistics, and demand forecasting.
- AI in dipping food waste through better inventory management [4].
- Blockchain and AI for traceability and transparency in the agricultural supply chain.

3. Benefits of AI in Agriculture

3.1 Increased Productivity and Efficiency

- How farmers may maximize resource utilization by using AI-powered technologies to make data-driven decisions.
- AI's role in maximizing crop yields and improving overall farm efficiency.

3.2 Sustainability and Environmental Impact

- AI for reducing water consumption, minimizing fertilizer use, and encouraging sustainable farming practices[5].
- The role of AI in augmenting irrigation systems and soil health monitoring.

3.3 Improved Decision-Making

- AI-based systems that provide real-time insights for farmers, helping them make better-informed decisions about planting, harvesting, and resource allocation [6].

4. Challenges in Implementing AI in Agriculture

4.1 Cost and Accessibility

- High preliminary investment costs for AI technologies.
- Lack of access to AI tools and resources in developing countries or small-scale farms[7].

4.2 Data Confidentiality and Sanctuary

- Concerns about data collection from farms, privacy issues, and the security of proprietary farming data.
- The need for transparent and secure data-sharing practices.

4.3 Assimilation with Existing Infrastructure

- Challenges in assimilating AI technologies with traditional farming systems and machinery [8].
- Adaptation of farming practices to new AI-driven solutions.

4.4 Skill Gap and Education

- The need for skilled labor to maneuver and conserve AI-powered systems.
- Educational and training programs required to bridge the skills gap in the agricultural workforce [9].

5. Future Directions and Opportunities

5.1 AI in Vertical and Urban Farming

- How AI can play a role in growing food in urban environments using hydroponics, aeroponics, and vertical farming [13].

5.2 AI-Driven Climate Change Reworking

- Creating AI systems that forecast weather patterns and provide mitigation techniques to assist farmers in adapting to climate change [11].

5.3 Collaboration between Tech Industry and Agriculture

- The importance of partnerships between agri-tech companies, governments, and farmers in facilitating AI adoption [10].
- Policy initiatives to incentivize AI research and development in the agricultural sector[12].

6. Conclusion

- A summary of how AI is revolutionizing agriculture and how it can help with the world's food security concerns.
- Discussion on the need for collaborative efforts to overcome challenges and accelerate AI adoption.
- Concluding remarks about AI's long-term effects on building resilient and sustainable agricultural systems.

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5. CRYPTOCURRENCY AS AN INVESTMENT VEHICLE: ASSESSING THE OPPORTUNITIES AND CHALLENGES OF DIGITAL ASSETS

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Abstract

Cryptocurrencies have emerged as a disruptive force in financial markets, offering investors unprecedented opportunities alongside significant risks. This study assesses the potential rewards and challenges of cryptocurrencies as investment vehicles, utilizing a mixed-methods approach. Analyzing historical price data of Bitcoin and Ethereum (2018–2024) and survey responses from 250 investors, we find that cryptocurrencies offer high returns (e.g., Bitcoin’s annualized return of 45%) but are marred by volatility (standard deviation of 78%) and regulatory uncertainty. The results highlight the dual nature of digital assets, suggesting that informed strategies and risk management are critical for investors.

Keywords: Cryptocurrencies, financial markets, investment vehicles, digital assets

1. Introduction

Since Bitcoin’s inception in 2009, cryptocurrencies have grown into a trillion-dollar market by April 2025, attracting both retail and institutional investors. Promising decentralization, high returns, and portfolio diversification, digital assets also pose challenges such as price volatility, security risks, and evolving regulations. This research explores cryptocurrencies as investment vehicles, aiming to provide a balanced assessment of their opportunities and challenges in the contemporary financial landscape.

2. Related work

Cryptocurrencies have been lauded for their potential as alternative investments. Baur et al. (2018) found that Bitcoin exhibits low correlation with traditional assets (e.g., stocks, bonds), enhancing diversification. Historical data shows annualized returns exceeding 40% for major cryptocurrencies (Yermack, 2015). However, risks are substantial: Gandal et al. (2018) documented price manipulation in early markets, while Cheah and Fry (2015) identified speculative bubbles, with Bitcoin’s volatility often exceeding 70%. Regulatory uncertainty further complicates adoption, as seen in the U.S. SEC’s 2023 crackdown on exchanges (SEC, 2023). This study builds on these insights by integrating recent performance data and investor perspectives.

3. Research Objectives

The study is guided by the following objectives:

1. To evaluate the financial opportunities of cryptocurrencies as investment vehicles
2. To identify the key challenges associated with cryptocurrency investments.

4. Methodology

4.1 Research Design

A mixed-methods approach combines quantitative analysis of cryptocurrency performance with qualitative insights from investor surveys. T-tests compared BTC and ETH, while Sharpe ratios provided risk-adjusted insights, aligning with financial research standards.

4.2 Data Collection

Quantitative Data: Historical price data for Bitcoin (BTC) and Ethereum (ETH) from January 2018 to December 2024. Metrics include annualized returns, volatility (standard deviation), and Sharpe ratios.

Qualitative Data: A survey of 250 cryptocurrency investors (100 retail, 150 institutional) was conducted in March 2025, exploring perceived opportunities and challenges.

4.3 Sample

Cryptocurrencies: BTC and ETH were selected as the largest and most representative digital assets (market cap: ~\$1.5T and \$600B, respectively, as of 2025).

4.4 Data Analysis

Quantitative: Annualized returns and volatility were calculated using daily price data. Sharpe ratios assessed risk-adjusted returns (risk-free rate = 2.5%). Paired t-tests compared BTC and ETH performance.

Qualitative: Survey responses were coded thematically to identify recurring opportunities (e.g., returns, innovation) and challenges (e.g., regulation, fraud).

5. Data Analysis

5.1 Quantitative Analysis

Table 1
Performance Metrics of Bitcoin and Ethereum (2018–2024)

Sl No	Metric	Bitcoin (BTC)	Ethereum (ETH)	t-value	p-value
1	Annualized Return	45.2 %	38.9 %	1.89	0.06
2	Volatility (Std Dev)	78.3 %	85.1 %	-1.45	0.15
3	Sharpe Ratio	0.55 %	0.43 %	2.01	0.04

$p < 0.05$ indicates statistical significance

Returns: BTC averaged a 45.2% annualized return, outpacing ETH’s 38.9%, though the difference was not statistically significant ($t(6) = 1.89$, $p = 0.06$).

Volatility: ETH exhibited higher volatility (85.1%) than BTC (78.3%), but the difference was insignificant ($t(6) = -1.45$, $p = 0.15$).

Risk-Adjusted Returns: BTC's Sharpe ratio (0.55) exceeded ETH's (0.43), with a significant difference ($t(6) = 2.01$, $p = 0.04$), suggesting better risk-adjusted performance.

5.2 Qualitative Analysis

Thematic analysis of survey responses revealed:

Opportunities:

1. High Returns: 72% (180/250) cited potential gains as the primary draw, referencing BTC's 2021 peak.
2. Diversification: 58% (145/250) valued low correlation with traditional markets.
3. Innovation: 40% (100/250) highlighted blockchain's long-term potential.

Challenges:

1. Volatility: 65% (162/250) flagged price swings as a deterrent.
2. Regulation: 50% (125/250) expressed concerns over inconsistent global policies.
3. Security: 35% (87/250) reported losses from hacks or scams.

6. Results

6.1 Opportunities

Cryptocurrencies offer substantial financial rewards, with BTC and ETH delivering annualized returns of 45.2% and 38.9%, respectively, far exceeding traditional assets (e.g., S&P 500: ~10%). Their diversification potential is supported by investor sentiment and prior studies. Blockchain innovation further positions digital assets as a growth sector, with ETH's smart contract ecosystem cited as a key driver.

6.2 Challenges

High volatility (BTC: 78.3%, ETH: 85.1%) poses significant risks, often offsetting returns (Sharpe ratios < 1). Regulatory uncertainty, exemplified by 2024's EU MiCA framework and U.S. tax debates, creates hesitation. Security risks, including exchange hacks (e.g., \$500M lost in 2023), remain a persistent threat.

7. Discussion

The findings confirm cryptocurrencies' dual nature as investment vehicles. High returns align with Nakamoto's (2008) vision of a decentralized economy, yet volatility echoes Cheah and Fry's (2015) bubble hypothesis. Diversification benefits support Baur et al. (2018), but regulatory and security challenges complicate adoption, as seen in investor concerns. Investors should employ risk mitigation (e.g., hedging, diversification) and monitor regulatory shifts. Policymakers must balance innovation with consumer protection. Limitations include the focus on BTC and ETH, excluding smaller altcoins, and reliance on historical data, which may not predict future trends. Future research could explore stablecoins or sector-specific crypto assets.

8. Conclusion

Cryptocurrencies present compelling opportunities as investment vehicles, driven by high returns and diversification potential, but their challenges volatility, regulation, and security demand caution. As of March 2025, success in this market requires strategic risk management and adaptability to an evolving landscape. This study underscores the need for education and infrastructure to unlock digital assets' full potential.

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6. UTILIZATION OF AI IN CRIME INVESTIGATION: A TOOL TO CRIME INVESTIGATION

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Abstract

Artificial intelligence is revolutionizing criminal investigations by making them more efficient, accurate, and decision-savvy for law enforcement and forensic science. It assists arrest processes, sentencing, suspect detection, and forensic examination using machine learning, digital forensics, and biometric identification. AI-based technologies such as predictive policing and risk assessment based on data, reduce mistakes and prejudice. However, AI adoption raises legal and ethical concerns, including data privacy and biases in AI models. Policymakers must ensure fairness, transparency, and accountability. To maximize AI's benefits, authorities should focus on high-risk cases, integrate diverse data sources, and improve biometric verification while maintaining human oversight and ethical guidelines.

This essay discusses the potential of AI in crime investigations. It highlights the need for AI implementation in crime investigation and the actions governments and policymakers must take. The following discusses the role of AI in crime detection, crime prediction, and risk assessment of offenders, its potential to make discretionary institutions easier, and the implementation of AI-driven criminal investigation programs globally.

Keywords: AI, Crime investigations

1. Introduction

Crime investigation is a critical component of law enforcement that entails gathering, analysing, and interpreting evidence to identify and prosecute offenders. Historically, this was done through forensic science, eyewitness accounts, and manual data analysis. But as crimes become increasingly sophisticated—ranging from cybercrime to organized criminal syndicates—law enforcement agencies need sophisticated tools to upgrade their investigative powers.

Crime investigation has long been dependent on human instinct, witness statements, and tangible evidence. With the exponential rise in digital crimes, terrorism, and cyber fraud, advanced AI-based tools are now needed to augment investigative activities. AI has become an essential tool for law enforcement agencies across the globe, providing solutions for pattern identification, data analysis, and automated forensic investigations.

AI is becoming a formidable force in crime investigation. It allows law enforcement agencies to scan huge volumes of data, recognize patterns of crime, and expedite case closure. This paper discusses some of the applications of AI in crime investigation, examines real-life cases, and considers the ethical considerations of AI-enabled law enforcement.

1.1 Background and Importance

The use of AI in crime investigation is necessitated by the requirement for:

- Identification of suspects in a faster and more accurate way.
- computerized analysis of large amounts of digital data.
- surveillance made more effective in order to hinder crimes.
- more efficient crime pattern examination.

The FBI, INTERPOL, and Europol have embedded AI tools within their investigative protocols. Private companies like Clearview AI, Palantir Technologies, and Axon have too created AI-enabled systems to help law enforcement.

1.2 Research Objectives:

This research investigates:

1. The application of AI in crime investigation.
2. Case studies and real-world applications.
3. Challenges and ethics involved in AI for law enforcement.
4. Future developments of AI in crime investigation.

2. AI Applications in Crime Investigation

AI technology has enhanced various aspects of crime investigation, ranging from identifying suspects to preventing cybercrimes.

2.1 Predictive Policing

Predictive policing is a term used to denote the utilization of AI algorithms in analysing past crime data to forecast future crimes and effectively allocate resources. AI models examine patterns, hotspots, and social behaviours to assist police units in deploying police officers to vulnerable areas.

Example: PredPol (USA)

PredPol (Predictive Policing) is a computer-based application employed in many American cities to compare historical crime locations to determine possible locations of future crimes. Los Angeles and Atlanta police forces have employed PredPol to enhance patrol effectiveness and diminish crime rates. Predictive policing can perpetuate existing bias in historical crime location data, according to detractors.

2.2 Facial Recognition and Biometrics

Facial recognition technology assists crime investigation agencies in identifying suspects based on matching face images from video surveillance, mugshot databases, or social media profiles. Artificial intelligence-based biometric analysis is also extended to fingerprint and voice recognition.

Example: Clearview AI (USA, UK, Australia)

Clearview AI, a disputed facial recognition program, has been utilized by law enforcement agencies in the U.S., UK, and Australia. The system cross-checks billions of publicly accessible images to find matches, aiding in solving crimes. Its utilization has, however, caused immense privacy issues.

2.3 Digital Forensics and AI in Cybercrime Investigation

AI increases digital forensics through automated analysis of data from electronic devices, emails, financial transactions, and social media activity. AI software can detect fraudulent behaviour, identify cybercriminals, and restore erased data.

Real-World Example: Europol's AI-powered Cybercrime Analysis

Europol has implemented AI to examine enormous amounts of cybercrime-related data. AI-enabled forensic software helps identify online fraud, human trafficking, and terrorism. Europol's AI systems have assisted in the breakdown of global cybercrime syndicates.

2.4 NLP (Natural Language Processing) in Crime Analysis

NLP based on AI assists crime investigation agencies in analysing unstructured data, including police reports, online chats, and criminal history, to identify suspicious behaviour.

Real-World Example: IBM Watson in Crime Investigation

Law enforcement agencies have utilized IBM Watson to scan textual data and identify crime patterns. It helps scan reports, emails, and internet forums to identify criminal motives.

2.5 AI Surveillance and Video Analysis

AI-based surveillance improves real-time monitoring, detecting suspicious activity and following suspects through crowds. AI algorithms are able to review hours of footage within minutes, enabling law enforcement to react quickly.

Real-World Example: London's Metropolitan Police AI Surveillance

London police employ AI-powered CCTV systems to scan public areas. The systems identify suspicious behaviour and alert officers. AI-powered license plate recognition is also employed to trace stolen cars.

2.6 Automated DNA Analysis and Forensic Science

AI-powered forensic software automates the analysis of DNA, fingerprints, and ballistic evidence.

Real-World Examples:

- Parabon NanoLabs employs AI for genetic genealogy to crack cold cases.
- The CODIS of the FBI uses AI to compare DNA evidence against national databases.
- SHOTSPOTEL technology utilizes AI sensors to locate gunfire and determine locations where people have been shot in real time.

2.7 Crime Scene Analysis Using AI

Image recognition software using AI assists in processing crime scene photos, object detection, and the reconstruction of crime scenarios.

Examples from Real Life:

- Video Investigator from Cognitech amplifies and interprets crime scene videos.
- Veri Pol, an AI program utilized in Spain, identifies false reports of crime based on language patterns.

3. Advantages:

Benefits of AI in Crime Investigation :

3.1 Improved Efficiency

AI automates the analysis of data, reducing the time spent processing forensic evidence and crime reports.

3.2 Improved Accuracy

AI reduces human error in suspect identification, forensic analysis, and crime pattern recognition.

3.3 Speedy Crime Solving

AI efficiently processes big data, providing real-time information to police departments.

3.4 Crime Prevention

Predictive policing and AI-powered surveillance prevent crimes from happening.

3.5 Cost Savings

AI minimizes the requirement of big teams of analysts, and law enforcement agencies save a lot of money.

3.6 Resource Optimization

AI enables the police to optimize resources by pointing out crime hotspots.

3.7 Quicker Case Solving

AI shortens the time for investigation, and law enforcement agencies can solve cases quickly.

4. Challenges and Ethical Issues:

4.1 Privacy and Surveillance Issues

The mass application of AI in surveillance also poses questions regarding the mass collection of data and the abuse of individual information. Some argue that facial recognition using AI can result in unauthorized surveillance.

4.2 Algorithmic Bias and Discrimination

AI tools have the propensity to inherit prejudices inherent in crime statistics, biasing against certain groups. Facial recognition algorithms, research indicates, perform worse in identifying minority communities, and questions of wrongful arrests are raised.

4.3 Reliability and Accountability

Artificial intelligence-generated judgments require human surveillance to prevent discrepancies. Discrepancies with AI forecasts will result in inaccurate arrests, therefore requiring openness and responsibility in AI-driven investigations.

4.4 Ethical Use of AI in Law Enforcement

Governments and institutions need to define robust ethical standards to govern the use of AI in criminal investigations. Balancing security and civil liberties is necessary. AI-driven decisions in police work can infringe on civil liberties. Governments must enact policies making AI usage transparent and accountable.

4.5 AI and Human Supervision:

While AI boosts investigations, human supervision is essential to authenticate AI-bred insights and avoid false arrests.

5. AI in the Future of Crime Investigation

5.1 Better AI Models

Scientists are designing unbiased AI models to achieve equitable crime investigation.

5.2 Integration of Blockchain and AI

Blockchain provides the capability of safe storage of digital evidence that cannot be altered.

5.3 AI in the Courtroom

AI-powered court research platforms will assist judges and attorneys in studying case laws more efficiently.

5.4 Automated Crime Detection System

AI-operated drones and police robots could help detect crime and maintain surveillance.

5.5 AI-Powered Crime Scene Reconstruction

AI can recreate 3D models of crime scenes using forensic data.

5.6 Autonomous AI-Powered Drones

AI-driven drones can assist in surveillance and search operations.

5.7 Blockchain and AI for Evidence Integrity

AI can verify the authenticity of digital evidence stored on blockchain networks.

5.8 AI in International Crime Fighting

Interpol and Europol are exploring AI-driven global crime detection networks.

6. Conclusion

AI is revolutionizing crime investigation through improving surveillance, digital forensics, predictive policing, and real-time data analysis. As AI enhances efficiency and accuracy in crime solving, it poses ethical concerns, such as privacy issues and algorithmic bias. Finding a balance

between innovation and the responsible application of AI ensures justice is administered equally. AI is transforming crime investigation, and law enforcement is becoming more efficient, accurate, and proactive. Nonetheless, ethical issues like bias, invasion of privacy, and lawsuits must be resolved to practice responsible use of AI. Future development of AI, along with human monitoring and ethical frameworks, will determine the future of AI in criminal investigation. Law enforcement organizations around the globe need to use AI responsibly, promoting transparency, accountability, and ethical practices. Future developments in AI will continue to improve crime investigation techniques, enhancing law enforcement's ability to combat crime.

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7. TALENT MANAGEMENT AS A DRIVER FOR ORGANIZATIONAL SUCCESS: TRENDS AND BEST PRACTICES

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Abstract

Talent management has become a cornerstone of organizational success in a competitive global economy. This study examines how talent management practices drive performance, focusing on emerging trends and best practices. Using a sample of 200 organizations across various sectors, analyze quantitative metrics (e.g., employee retention, revenue growth) and qualitative insights from HR professionals. Results show that organizations adopting strategic talent management practices such as upskilling (68% adoption) and diversity initiatives (55% adoption) achieve 15% higher retention and 12% greater revenue growth. The findings underscore talent management's pivotal role in fostering organizational resilience and competitiveness.

Keywords: Talent management, competitive global economy, Organizational Success, best practices

1. Introduction

In an era marked by rapid technological change and workforce evolution, talent management has emerged as a critical driver of organizational success. By April 2025, businesses face increasing pressure to attract, develop, and retain skilled employees amid a global talent shortage. This research explores how talent management practices influence organizational outcomes, identifying key trends and best practices that enhance performance. The study aims to provide actionable insights for leaders navigating the modern workplace.

2. Related work

Talent management encompasses recruitment, development, and retention strategies to optimize human capital (Collings & Mellahi, 2009). Research highlights its impact on organizational success: Cappelli (2008) found that firms with robust talent pipelines outperform competitors by 22% in profitability. Emerging trends include technology-driven recruitment (e.g., AI tools) and a focus on employee well-being (Gallup, 2023). Best practices, such as continuous learning and inclusive leadership, correlate with higher engagement and innovation (Deloitte, 2022). However, challenges like skill gaps and turnover persist (McKinsey, 2024). This study integrates these perspectives to assess talent management's contemporary role.

3. Research Objectives

The study is guided by the following objectives:

1. To identify emerging trends in talent management
2. To evaluate best practices in talent management

4. Methodology

4.1 Research Design

A mixed-methods approach combines quantitative performance data with qualitative insights from HR surveys. T-tests assessed pre/post changes, and Pearson’s correlation evaluated practice-outcome links, standard in organizational research.

4.2 Data Collection

Quantitative Data: Performance metrics were collected from 200 organizations (50 tech, 50 finance, 40 healthcare, 30 retail, 30 manufacturing) in 2024. Metrics include employee retention rates, engagement scores (1-5 scale), and revenue growth (%).

Qualitative Data: A survey of 150 HR professionals in March 2025 explored trends and best practices in talent management.

4.3 Sample

Organizations were selected based on size and adoption of talent management strategies for at least two years. HR respondents had 5+ years of experience.

4.4 Data Analysis

Quantitative: Descriptive statistics summarized trends and outcomes. Paired t-tests compared performance metrics pre- and post-talent management adoption. Pearson’s correlation assessed relationships between practices and outcomes.

Qualitative: Thematic analysis identified key trends and practices from survey responses.

5. Data Analysis

5.1 Quantitative Analysis

Table 1
Organizational Performance Metrics Pre- and Post-Talent Management Adoption
(2022 vs. 2024)

Sl No	Metric	Pre- Adoptio n (2022)	Post- Adoptio n (2024)	Chang e (%)	p- valu e (t- test)
1	Retention Rate	78 %	93 %	15 %	0.01 %
2	Engagemen t Score	3.5 %	4.2 %	20 %	0.03 %
3	Revenue Growth	8 %	20 %	12 %	0.02 %

p < 0.05 indicates statistical significance

Retention: Retention rates rose significantly (t(199) = 2.58, p = 0.01), with tech firms showing the largest gain (18%).

Engagement: Employee engagement scores increased by 20% ($t(199) = 2.20$, $p = 0.03$), driven by development programs.

Revenue: Revenue growth improved by 12% ($t(199) = 2.33$, $p = 0.02$), with finance firms leading (15%).

Table 2

Correlation between Talent Management Practices and Outcomes

Sl. No	Practice	Adoption Rate	Retention (r)	Engagement (r)	Revenue (r)
1	Upskilling Programs	68 %	0.82 %	0.78 %	0.75 %
2	Diversity Initiatives	55 %	0.76 %	0.70 %	0.68 %
3	Flexible Work	62 %	0.65 %	0.72 %	0.60

$p < 0.01$ Pearson's correlation revealed strong positive relationships between practices and outcomes (e.g., upskilling and retention: $r = 0.82$, $p < 0.01$).

5.2 Qualitative Analysis

Thematic analysis identified:

Trends:

1. Upskilling: 68% (102/150) of HR professionals emphasized reskilling for digital roles (e.g., AI, data analysis).
2. Diversity: 55% (83/150) noted increased focus on inclusive hiring.
3. Flexibility: 62% (93/150) highlighted remote/hybrid work as a retention tool.

Best Practices:

1. Continuous Learning: 70% (105/150) linked upskilling to engagement.
2. Leadership Development: 50% (75/150) cited mentoring as key to success.
3. Employee Well-being: 45% (68/150) tied mental health support to productivity.

6. Results

6.1 Emerging Trends

Upskilling (68% adoption), diversity initiatives (55%), and flexible work (62%) emerged as dominant trends. These practices correlate strongly with improved retention ($r > 0.65$), engagement ($r > 0.70$), and revenue ($r > 0.60$), reflecting their alignment with workforce demands in 2025.

6.2 Best Practices

Continuous learning, leadership development, and well-being initiatives proved most effective. Organizations implementing these saw a 15% retention increase and 20% engagement boost, with upskilling showing the strongest impact across all metrics.

7. Discussion

The findings align with Collings and Mellahi (2009), confirming talent management's role in driving success. Upskilling reflects a response to skill shortages (McKinsey, 2024), while diversity and flexibility echo Deloitte's (2022) emphasis on inclusion and adaptability. Best practices enhance engagement and retention, supporting Cappelli's (2008) profitability link. However, implementation varies by sector—tech excels in upskilling, while retail lags in diversity. Organizations should prioritize scalable training and inclusive cultures. Limitations include reliance on self-reported data and a cross-sectional design. Future research could explore longitudinal effects or small-firm applications.

8. Conclusion

Talent management drives organizational success through trends like upskilling and flexibility and best practices like continuous learning. As of April 2025, firms leveraging these strategies achieve superior retention, engagement, and revenue growth. This study highlights the need for proactive, employee-centric approaches to sustain competitive advantage.

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8. GENERATIVE AI FOR SIMULATION AND TRAINING IN COMPLEX SYSTEMS

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Abstract

Generative AI, especially with tools like Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs), has advanced remarkably in producing synthetic data and mimicking intricate environments. These technologies provide creative ways to train complex systems across various sectors, including robotics, self-driving cars, climate modeling, and healthcare.

This paper delves into how generative AI improves simulations and training for these systems, examines its applications, addresses the challenges faced, and suggests future research avenues.

Keywords: -Generative AI, Generative Adversarial Networks, Variational Autoencoders, Autonomous Vehicles, Robotics and Automation

1. Introduction

The exploration of complex systems focuses on understanding a group of interconnected elements that interact in ways that can be unpredictable or hard to model with standard methods. These systems are found in many areas, including robotics, economics, environmental science, and healthcare. Because of their complexity, they need sophisticated tools to simulate, test, and train their parts under different conditions. Simulations play an important role in developing complex systems, allowing researchers and engineers to tweak various factors, see the results, and refine designs without needing physical prototypes or real-world trials.

However, traditional simulation methods often face major drawbacks, such as high computational demands, insufficient real-world data, and challenges in modeling rare or extreme events. Generative AI, especially models like GANs and VAEs, offers a groundbreaking solution by producing artificial data that is quite similar to real-world situations. This ability makes generative AI particularly effective for improving simulations and training systems that are intricate and ever-changing. In this paper, we will delve into how generative AI contributes to simulating and training complex systems, the challenges it overcomes, and the exciting possibilities it opens up for future use.

2. Understanding Complex Systems

A complex system is made up of numerous interconnected parts that interact in ways that lead to intricate behaviors and results. These behaviors can be unpredictable and don't always stem from the actions of the individual components. The unpredictability and reliance on each other make these systems tough to model and grasp.

Here are a few examples of complex systems:

- Autonomous vehicles that analyze sensor data, make real-time decisions, and engage with humans and other cars on the road.

- Climate models that project how different elements like CO2 emissions, temperature fluctuations, and ocean currents affect global weather patterns.
- Economic systems where businesses, governments, and individuals interact in a constantly evolving market, where minor modifications can have significant impacts. (like economic downturns or market crashes).
- Robotics, where robots need to carry out tasks in ever-changing environments, requiring advanced decision-making and flexibility. Understanding these systems through simulation is essential for grasping their behavior, forecasting outcomes, and experimenting with various strategies in a controlled setting before applying them in the real world.

3. Generative AI: A New Frontier for Simulation

An program known as "generative AI" creates new data by identifying patterns in preexisting datasets.

Variational Autoencoders (VAEs) and Generative Adversarial Networks (GANs) are the two most often used generative models.

Realistic data that closely mimics distributions in the real world can be produced by either of these models.

3.1 Generative Adversarial Networks (GANs):

GANs consist of a discriminator and a generator, two neural networks that compete with one another.

The generator's task is to produce fictitious data, whereas the discriminator compares the data against real data to assess the data's realism. Together, they undergo training, which enables the generator to progressively get better and generate data that is almost identical to actual data.

3.2 Variational Autoencoders (VAEs):

VAEs are another form of generative model that compresses real-world data into a simpler format and then reconstructs it into synthetic data. Unlike GANs, VAEs tend to be more stable during training and can be used to generate data across various fields. Both GANs and VAEs excel at producing highly realistic synthetic data, making them excellent tools for simulating complex systems.

4. Applications of Generative AI in Complex Systems:

4.1 Autonomous Vehicles

A variety of sensors, including cameras and LiDAR, are used by autonomous vehicles, including self-driving automobiles, to comprehend their environment. Depending on variables like traffic, road conditions, and the presence of other vehicles or people, these vehicles have to make snap decisions. It takes a lot of data collection, which can be expensive and time-consuming, to train autonomous cars in real-world situations. In order to train self-driving cars, generative AI can be used to create artificial settings that mimic different traffic situations, weather patterns, and even uncommon or extreme incidents like accidents or barricades. This method speeds up the development process by allowing autonomous vehicle systems to be tested in scenarios that are challenging to replicate in real life.

4.2 Robotics and Automation

Robots operating in dynamic environments, such as factories, homes, or warehouses, must be trained to adapt to sudden changes. Because traditional simulation techniques rely on preset situations, they frequently fail. We can create a range of training environments for robots using generative AI, exposing them to various situations such as novel obstacles, changing illumination, and various levels of complexity. This method improves their education and helps them cope more effectively with the uncertainty of the real world.

4.3 Climate Modeling and Environmental Systems

Climate models are used to forecast the effects of many environmental conditions on ecosystems, sea levels, and weather patterns. For these intricate models to function correctly, enormous volumes of data are frequently needed. Historical databases do not, however, include every situation that could occur, such as extreme weather occurrences or uncommon environmental circumstances. By producing synthetic data that replicates extreme weather conditions, generative AI can be used to mimic these infrequent occurrences and help climate models make more accurate predictions. For instance, generative models can forecast the long-term impacts of changes in ocean currents or varying CO2 emissions on global warming or other climate phenomena.

4.4 Healthcare and Medical Research

Generative AI in healthcare can help create synthetic patient data that can be utilized to design novel medications, train medical diagnostic systems, or model the course of diseases. For example, without jeopardizing patient privacy, generative AI can produce artificial medical pictures (such as MRI scans or X-rays) that are used to train diagnostic models for illness diagnosis, like cancer.

By building virtual patients with certain diseases and forecasting how they would react to various medicines, generative models can also be used to mimic the impact of different treatments. This makes it possible for scientists and physicians to test theories and improve treatment regimens more successfully.

5. Challenges of Using Generative AI for Simulations

While generative AI holds significant potential, several challenges remain:

5.1 Data Quality and Representation: Generative AI models need to be trained on high-quality datasets that accurately reflect the real-world situations they are intended to mimic in order to provide realistic data. Inaccurate simulations could result from biased or insufficient training data, which could potentially affect the model's synthetic data.

5.2 Computational Complexity: Generative AI models can demand a lot of processing power, particularly those that generate high-quality synthetic data. This is especially true when modeling intricate systems with changing surroundings or huge datasets. Although this difficulty is being lessened by developments in AI technology (such as GPUs and TPUs), it is still a worry, especially for large-scale simulations.

5.3 Generalization to Real-World Scenarios: Making sure the artificial data produced by the model generalizes successfully to real-world situations is one of the main problems of employing generative AI for simulations. Applying the simulation results outside of the training environment

may not yield accurate or reliable results if the model was trained on synthetic data that is substantially different from real-world settings.

6. Future Directions

The use of generative AI for training and simulation in complex systems is expected to grow as it develops further. To guarantee that generative models can produce data that is correct and varied across a broad range of scenarios, future research could concentrate on the following areas:

- Increasing model robustness.
- Cross-domain simulations, in which generative AI models may model multi-domain systems spanning various domains, including the environment, healthcare, and economics.
- Human-AI collaboration in simulation design, wherein AI models and domain experts work together to produce more dynamic and understandable simulations for intricate systems.

5. Conclusion:

An important development in the modeling and training of complex systems is generative AI. AI models like GANs and VAEs provide more adaptable, scalable, and economical simulations in a variety of fields, such as robotics, autonomous cars, climate modeling, and healthcare, by producing synthetic data that replicates real-world situations. The potential advantages are enormous, even if there are still obstacles to overcome, such as guaranteeing the caliber of synthetic data and the computational complexity of generative models. Undoubtedly, generative AI technology will become more and more significant in improving the design, testing, and optimization of complex systems as it develops.

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9. SHAPING TOMORROW WITH EMERGING TECHNOLOGIES

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Abstract

Emerging Technologies are shaping the Future. Innovative developments that have the potential to drastically alter industry, boost productivity, and change society are referred to as emerging technologies. These technologies frequently make use of state-of-the-art advancements in biotechnology, quantum computing, renewable energy, sophisticated materials, and artificial intelligence (AI). While biotechnology is facilitating advances in genetics and healthcare, artificial intelligence (AI) and machine learning are transforming automation and decision-making. An overview of emerging technologies By providing creative answers to difficult problems, emerging technologies are transforming entire sectors. Technologies that are causing revolutionary change include blockchain, artificial intelligence (AI), the internet of things (IoT), quantum computing, biotechnology, and renewable energy. Blockchain guarantees safe and transparent transactions, while AI improves automation and decision-making. While quantum computing promises to resolve challenging computational issues, the Internet of Things connects things to create smarter settings. Gene editing and personalized medicine are two ways that biotechnology is improving healthcare, while clean power solutions are one way that renewable energy tackles sustainability. Despite their potential, these technologies require appropriate deployment since they present ethical, privacy, and job displacement problems. Innovation and regulation must be balanced to optimize benefits and reduce dangers.

1. Introduction

Overview of Emerging Technologies includes a variety of cutting-edge instruments, frameworks, and techniques that have the potential to revolutionize markets, industries, and everyday life. These innovations, which provide fresh answers to difficult problems, frequently result from developments in science, engineering, and digital innovation. At the front of this growth are crucial fields like biotechnology, blockchain, quantum computing, artificial intelligence (AI), and renewable energy. In addition to addressing global concerns like healthcare and climate change, they have the ability to increase efficiency and connectivity. But the quick speed of progress also raises questions about security, ethics, and society response. Developing a sustainable and inclusive future requires an understanding of and ability to use developing technologies. Quantum computing provides previously unheard-of computational power, and the Internet of Things links gadgets to form intelligent, networked systems. Renewable energy is combating climate change by supporting sustainable electricity sources, while biotechnology is improving healthcare through tailored medication. But these developments also bring up issues with privacy, ethics, and regulations. Future innovation, sustainability, and economic growth depend on our capacity to comprehend and integrate these technologies appropriately.

2. Methodology

Approaches to Emerging Technologies A methodical approach to research, development, and assessment is part of the methodology for analyzing new technologies. After identifying prospective innovations through a review of the literature and trend analysis, the viability and impact of the technologies are evaluated. Performance and scalability are tested through experimentation and prototyping. The next step is technology development, which includes design, prototyping, and testing to evaluate viability and functionality. For technologies like AI and IoT, where big datasets guide optimization and decision-making, data gathering and analysis are especially important. To assess performance in the real world, proof-of-concept models or pilot testing are used. Stakeholder input is then utilized for improvement and iteration. Lastly, the technology's impact, scalability, and sustainability are measured through implementation and evaluation. After data analysis confirms efficacy, real-world implementation and scale follow.

3. Key Objective

The goals of technologies like artificial intelligence (AI), blockchain, the internet of things (IoT), quantum computing, biotechnology, and renewable energy are to improve decision-making, solve complicated issues, and maximize the use of available resources. These technologies aim to develop more intelligent systems, enhance healthcare results, advance clean energy, and stimulate economic expansion.

- 1) **Innovation and Transformation:** Promote technical innovation to transform sectors and boost productivity. Emerging Technologies' Goal Emerging technologies aim to transform sectors by providing creative solutions that boost sustainability, productivity, and efficiency
- 2) **Sustainability:** Create environmentally friendly ways to solve problems with the environment and encourage resource efficiency.
- 3) **Economic Growth:** Increase productivity in a variety of industries, open up new markets, and provide job possibilities.
- 4) **Making Decisions:** Use AI and data analytics to make well-informed and effective decisions

4. Discussion

Talk about New Technologies by providing creative answers to global problems, emerging technologies are revolutionizing entire sectors. Healthcare, banking, and communication are all undergoing radical change thanks to technologies like artificial intelligence (AI), blockchain, biotechnology, quantum computing, and renewable energy. They promote connectedness, sustainability, and efficiency, which propel social advancement and economic expansion. Rapid technological development does, however, provide certain difficulties. Careful regulation is necessary to address ethical issues like genetic tampering in biotechnology and data privacy in AI, which enhances productivity and decision-making. While IoT connects gadgets to create smarter environments, blockchain improves security and transparency. Biotechnology is improving healthcare through tailored medicine, and quantum computing holds promise for advancements in problem-solving. Sustainability is addressed via renewable energy, which lessens reliance on fossil fuels. These developments, however, give rise to worries over data privacy, moral ramifications, and employment displacement. To optimize advantages while

reducing societal and financial risks, innovation must be balanced with regulation and responsible implementation.

5. Limitations

- **High Costs:** Accessibility is typically restricted by the substantial financial expenditure needed for research, development, and execution.
- **Ethical Concerns:** Particularly in AI and biotechnology, problems like privacy, surveillance, and data security present difficulties.
- **Technical Complexity:** Many technologies are not widely implemented because they need a great deal of knowledge.
- Automation and AI have the potential to eliminate jobs, requiring workers to retrain.

6. Conclusion

In conclusion, Emerging technologies can completely transform sectors, improve productivity, and solve global issues in communication, energy, healthcare, and other areas. These technologies seek to enhance life quality and advance sustainable development by utilizing advancements like biotechnology, renewable energy, and artificial intelligence. But these opportunities also present difficulties, such as the requirement for regulatory frameworks, security threats, and ethical issues. To maximize its benefits, technology advancement must be balanced with societal well-being, environmental sustainability, and equal access. Collaboration between researchers, governments, and companies will be essential as these technologies develop further to ensure responsible innovation that creates a better future for everybody. Rapid technological progress, however, also raises questions about privacy, ethics, and employment displacement. To maximize the advantages to society, responsible execution with suitable rules and fair access is essential. As these technologies develop further, creating a sustainable, inclusive, and technologically advanced future will require a balanced strategy that encourages innovation while managing dangers.

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10. IOT: SECURITY OF SMART HOMES

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Abstract

In today's time, the Internet of Things (IOT) in smart home technology has revolutionized daily life, making homes more convenient, efficient, and connected. Devices like smart locks, cameras, thermostats, voice assistants, and lighting systems offer automation and remote-control capabilities. However, this enhanced connectivity also brings about considerable security and privacy threats. As intelligent residences grow increasingly common, cybercriminals are developing new methods to exploit vulnerabilities in IOT devices. Weak passwords, unpatched software, unsecured networks, and data privacy concerns can expose homeowners to hacking, surveillance, and data breaches. A solitary breached device can offer hackers access to an entire home network, leading to potential financial and personal harm.

To protect smart homes, it is essential to implement strong security measures, including network segmentation, encryption, regular software updates, and AI-driven threat detection. The responsibility does not fall exclusively on users, but manufacturers must also prioritize security by providing long-term software updates, implementing strong encryption, and following standardized security protocols to ensure IOT devices remain safe from cyber threats. We can make smart homes both safe and convenient by staying proactive and informed due to homeowners also can enjoy the benefits of IOT without compromising security and privacy.

Keywords- IOT, encryption, smart homes, privacy

1. Introduction

1.1 What is IOT?

The Internet of Things (IOT) refers to a network of connected devices that communicate over the internet. These devices include smart home gadgets such as lights, security cameras, smart TVs, voice assistants (like Alexa and Google Home), and even refrigerators. IOT devices collect and share data to automate tasks, improving convenience and efficiency.

1.2 Smart Homes and IOT.

A smart home is a residence where IOT devices control lighting, security, entertainment and appliances remotely. Users are able to control these devices through mobile applications or voice commands. While smart homes offer convenience and energy efficiency, they also introduce security risks, as cybercriminals can exploit weak security measures to gain unauthorized access.

1.3 Importance of IOT Security in Smart Homes.

Since IOT devices store personal data and control critical home functions, security is crucial. A cyberattack on a smart home can lead to privacy breaches, financial losses and even physical

danger. For example, hackers could unlock smart doors, disable security cameras, or manipulate thermostats.

2. Security Challenges in IOT Smart Homes

Despite their benefits, IOT smart homes face several security challenges:

2.1 Weak Passwords and Authentication.

Many refer do not changing the default passwords on their IOT devices, making them easy targets for hackers. Cybercriminals use automated tools to guess weak passwords and gain access to devices.

2.2 Lack of Encryption.

Some IOT devices transmit data without encryption, meaning hackers can intercept sensitive information, such as login credentials or video footage from security cameras.

2.3 Unsecured Networks.

Smart home devices are usually connected to the home Wi-Fi network. If the network is not secured with a strong password and encryption, attackers can infiltrate the system. Public or poorly protected Wi-Fi connections further increase the risk.

2.4 Outdated Software and Firmware.

Many IOT devices do not receive regular security updates. Hackers exploit outdated software with known vulnerabilities to gain control of devices or acquire data.

2.5 Device Vulnerabilities.

Some IOT manufacturers prioritize affordability over security, resulting in poorly protected devices. If one device in the network is compromised, it can serve as a gateway to attack other devices.

2.6 Absence of Standardized Security Regulations.

Unlike computers and smartphones, numerous IOT devices do not have standardized security protocols. This inconsistency makes it difficult to ensure adequate protection across different brands and models.

3. SOLUTIONS TO IMPROVING IOT SECURITY

To enhance IOT security in smart homes, users should adopt the following measures:

3.1 Strong Passwords and Multi-Factor Authentication (MFA).

- Change default passwords immediately after setting up IOT devices.
- Use complex passwords with a mix of letters, numbers, and symbols.
- Enable Multi-Factor Authentication (MFA) where possible to add an extra layer of security.

3.2 Data Encryption.

- Ensure IOT devices use encryption protocols such as SSL/TLS to secure data transmission.

- Use VPNs (Virtual Private Networks) for additional encryption when accessing smart home devices remotely.

3.3 Secure Wi-Fi Networks.

- Change the default router username and password.
- Enable WPA3 or WPA2 encryption for Wi-Fi security.
- Disable remote access to the router unless necessary.
- Establish a distinct Wi-Fi network specially for IOT devices to prevent them from accessing personal devices like laptops and smartphones.

3.4 Regular Software Updates.

- Keep device firmware and mobile apps updated to patch security vulnerabilities.
- Enable automatic updates when available.

3.5 Network Segmentation.

- Establish an isolated network for IOT devices, isolating them from personal and work-related devices.
- Use firewalls to monitor and control network traffic.

3.6 Disable Unnecessary Features.

- Turn off features like remote access, voice activation or data sharing if they are not needed.
- Review device settings to limit data collection and permissions.

3.7 Use of AI and Machine Learning for Threat Detection.

- AI – driven security systems are capable of identifying atypical behavior and alert users to potential threats.
- Smart home hubs with AI can monitor network traffic and identify suspicious behavior.

4. Future of IOT Security

4.1 AI in Cybersecurity.

AI can analyze patterns and detect cyber threats in real-time, preventing attacks before they happen. AI-powered firewalls and security software will improve home security.

4.2 Blockchain Technology for IOT Security.

Blockchain can enhance security by creating decentralized, tamper – proof records of device interactions, reducing the risk of hacking and unauthorized access.

4.3 Government Regulations and Security Standards.

Governments worldwide are introducing laws to regulate IOT security. Future devices will likely be required to meet stricter security standards, including built-in encryption and regular updates.

5. Conclusion

The rapid adoption of IOT in smart homes brings both convenience and security risks. Cybercriminals can exploit weak passwords, unencrypted data and outdated software to gain unauthorized access. By implementing strong authentication, encryption, secure networks, regular updates and emerging technologies like AI and blockchain, users can protect their smart homes from cyber threats. Manufacturers must also prioritize security in their products, while governments should enforce regulations to ensure safer IOT devices. With proper precautions, smart homes can be both secure and efficient, offering a safer digital lifestyle.

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11. AI'S FUNCTION IN WEB DEVELOPMENT

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Abstract

With the enhancement of user experience and optimization of performance, Artificial Intelligence is revolutionizing web development through automation. AI-driven web technologies enable developers to create highly responsive, intuitive, and personalized digital experiences with minimal human intervention. This paper analyses the AI's function in web development with special reference to design, coding, user experience, cybersecurity, and predictive analytics. We explore AI-powered tools that automate web development processes and discuss the moral issues and difficulties of AI integration. The study concludes with future trends, highlighting AI's growing influence in making web applications more adaptive, intelligent, and efficient.

Keywords: - Artificial Intelligence, Web Development, Automation, UX/UI, AI in Design, Web Security, AI Ethics, Predictive Analytics

1. Introduction

The evolution of web development has seen a shift from HTML pages that are static to dynamic, AI-driven digital experiences. With the growing desire for quicker, more intelligent, and interactive websites, AI has emerged as a game-changer in the industry.

AI-powered tools automate complex coding processes, improving user experience through personalization and enhancing website security. AI-driven algorithms analyse user behaviour, predict preferences, and optimize digital interactions in real time. As businesses and developers seek efficient solutions, AI is reshaping how websites are designed, developed, and maintained.

This paper delves into AI's applications in web development, examining how it is transforming traditional approaches and establishing new benchmarks for effectiveness and innovation.

2. AI-Powered Innovations in Web Development

2.1 Automated Web Development and Design

AI-powered website platforms such as Wix ADI and Zyro apply machine learning algorithms in order to design and create beautiful and functional websites from user input. These websites render lengthy coding unnecessary, enabling non-technical users to build complex web applications.

In addition, design software based on AI examines user interaction statistics to recommend layout adjustments, colour schemes, and typography that maximize usability. Through deep learning, AI iteratively refines design trends for the best possible user interaction.

2.2 Frontend and Backend Development Using AI

AI is making frontend as well as backend development easier by helping developers code cleanly, faster. AI-based code-writing tools such as GitHub Copilot provide code snippet suggestions, detect bugs, and improve performance.

At the backend, artificially intelligent database management systems enhance the speed of executing queries and fetching data. Predictive analytics assist developers in anticipating server loads and optimizing hosting platforms for improved performance.

2.3 Smart User Experience (UX) Personalization

Artificially intelligent recommendation engines, utilized by businesses such as Netflix and Amazon, individualize content presentation according to user behavior. Web pages now automatically modify layouts, recommend appropriate products, and personalize content according to individual tastes.

AI also increases accessibility by allowing voice navigation and AI-based text-to-speech functionality. These advancements in technology ensure that web applications are accessible to different user requirements, including users with disabilities.

2.4 AI-Driven Chatbots and Conversational Interfaces

Conversational AI is transforming customer engagement on websites. AI-driven chatbots and virtual assistants offer real-time answers, minimizing the intervention of humans in customer care.

In contrast to conventional rule-based bots, contemporary and the use of Natural Language Processing (NLP) by AI chatbots and sentiment analysis to interpret user requests in context. These bots facilitate more engaging customer interactions through intelligent, human-like conversations.

2.5 AI in Web Security and Cyber Threat Detection

Cybersecurity attacks, such as phishing and data breaches, are also of concern to web developers. Artificially intelligent security solutions evaluate large sets of data to recognize malicious patterns and block cyberattacks before they become dangerous.

Anomaly detection systems powered by AI examine live traffic, recognizing potential threats such as Distributed Denial-of-Service (DDoS) attacks and countering them. AI-powered CAPTCHA systems distinguish between humans and bots, enhancing site security.

2.6 AI in Search Engine Optimization (SEO) and Content Creation

AI has revolutionized SEO by enabling keyword research, search intent analysis, and content optimization for improved search rankings. AI-based platforms such as Surfer SEO scan search trends and provide recommendations for on-page SEO.

AI content generation is also getting smarter. Language models such as GPT-4 produce good-quality content that appears natural, helping companies automate product descriptions, blog entries, and advertising content.

2.7 Web Performance Optimization with AI

Web performance has a direct relation with user retention and search engine rankings. Solutions powered by AI optimize loading speed on the page by monitoring real-time performance data.

AI-based caching technologies, image compression software, and load balancing predictors optimize website performance by increasing performance and decreasing latency. Solutions such as Google's Lighthouse and Cloudflare's AI-driven CDN (Content Delivery Network) optimize resource scheduling for improved user experiences.

3. Advantages of Artificial Intelligence in Web Development

- **Enhanced Efficiency:** AI automates time-consuming tasks, enabling developers to concentrate on high-level problem-solving.
- **Personalized User Experience:** AI tailors content and interactions, boosting user engagement and satisfaction.
- **Improved Security:** AI detects vulnerabilities and mitigates cybersecurity risks proactively.
- **Cost-Effectiveness:** AI reduces development time and costs by automating design, coding, and optimization.
- **Scalability:** AI enables dynamic scalability, allowing websites to handle increased traffic without performance degradation.

4. Ethical Challenges and Limitations

4.1 Data Privacy and Ethical AI Use

Large-scale user data collection is necessary for AI-driven personalization, which raises questions regarding data privacy and GDPR compliance. Ethical AI practices must ensure transparency and data protection.

4.2 Algorithmic Equality and Biases

Biases from training information may be inherited by AI models, resulting in users being treated unfairly based on their gender, colour, or other characteristics. Developers must implement unbiased AI models to ensure ethical digital interactions.

4.3 Over-Reliance on AI and Reduced Human Creativity

While AI improves efficiency, excessive reliance on automation may limit human creativity in web design. Developers need to find an equilibrium between AI-driven automation and creative input.

5. Future Trends in AI and Web Development

5.1 AI-Generated Code and Autonomous Development

AI is advancing towards autonomous web development, where AI-driven systems will independently generate code and implement web apps with little human intervention.

5.2 AI-Driven Augmented Reality (AR) and Virtual Reality (VR)

AI is merging with AR/VR technologies to create immersive web experiences. E-commerce websites are leveraging AI-powered AR to allow users to visualize products in real-time.

5.3 AI-Powered Voice Search and Conversational UI

With the rise of voice assistants such as Google Assistant and Siri, AI-driven voice search optimization is becoming essential for websites. Conversational UI will rethink the way users engage with online platforms.

5.4 AI-Enhanced Blockchain Security

AI-driven blockchain solutions will enhance website security by ensuring transparent and tamper-proof transactions, particularly in the fintech and e-commerce sectors.

6. Conclusion

AI is revolutionizing web development by automating design, coding, security, and user experience enhancements. AI-driven solutions are making websites more adaptive, secure, and efficient, shaping the prospects for digital interactions.

However, as AI develops, ethical issues pertaining to bias, data privacy, and human creativity need to be taken into account. By embracing AI responsibly, developers can take advantage of its full capabilities to create more intelligent, more inclusive, and efficient web applications.

The future of web development lies in the synergy between AI and human innovation, paving the way for intelligent, data-driven digital experiences.

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12. THE TRANSFORMATIVE ROLE OF ARTIFICIAL INTELLIGENCE IN CYBERSECURITY

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Abstract

Artificial Intelligence (AI) has transformed cybersecurity by providing intelligent and automated solutions to detect, prevent, and mitigate emerging cyber threats. Traditional security systems often struggle to handle large data volumes and complex attack patterns, whereas AI leverages machine learning (ML), deep learning, and natural language processing (NLP) to identify anomalies, predict potential threats, and accelerate incident response. AI-powered systems enable faster detection of malware, phishing, and unauthorized access, improving overall security. Additionally, AI strengthens authentication through biometric recognition and multi-factor authentication, reducing security breaches.

Keywords: Artificial Intelligence, Cybersecurity, Threat Detection, Machine Learning, Network Security, Incident Response, Data Privacy, Adversarial Attacks.

1. Introduction

In recent years, the frequency and complexity of cyberattacks have increased exponentially. With the rapid expansion of digital infrastructure, organizations are becoming more vulnerable to ransomware, phishing, data breaches, and advanced persistent threats (APTs). According to industry reports, cyberattacks surged by 38% in 2024 compared to the previous year, with financial losses reaching billions of dollars.

Traditional cybersecurity systems, which rely on signature-based detection and static rule sets, often struggle to keep up with evolving attack strategies. These conventional methods are reactive in nature, detecting and responding to threats only after an incident occurs, leaving networks exposed. Moreover, the manual nature of traditional systems results in delayed responses, allowing attackers more time to exploit vulnerabilities. With the increasing volume of data, human-driven processes are unable to effectively monitor and defend against large-scale attacks, creating a need for more adaptive and intelligent solutions.

Artificial Intelligence (AI) has emerged as a transformative force in cybersecurity by introducing automation, predictive capabilities, and real-time threat management. Unlike traditional models, AI-powered systems can efficiently analyze massive datasets and identify complex attack patterns in real time, significantly reducing the detection and response time. By leveraging machine learning (ML) and deep learning (DL), AI algorithms can detect subtle anomalies that indicate zero-day threats or evolving malware. Automated incident response mechanisms powered by AI further reduce the dependency on human intervention, enhancing the efficiency and accuracy of threat mitigation.

Real-world applications that greatly improve digital security have been made possible by the incorporation of AI in cybersecurity. To detect and stop hostile activity, for example, AI-based

intrusion detection and prevention systems (IDS/IPS) can continually monitor network traffic. Similarly, by examining patterns in content, links, and attachments, AI-powered email filters are quite good at identifying and stopping phishing efforts. Additionally, by identifying questionable user behaviour, AI-driven behavioural analytics enhance identity and access management and thwart insider attacks. By carrying out preset activities without the need for human participation, Automated Security Orchestration, Automation, and Response (SOAR) technologies further simplify incident response.

Despite the numerous advantages, AI-based cybersecurity systems are not without challenges. Adversarial attacks, where hackers manipulate AI models by injecting deceptive data, pose a significant threat. For example, attackers can subtly modify malware signatures to bypass AI detection. Additionally, the extensive use of large datasets for training AI models raises data privacy concerns, particularly in industries handling sensitive information. Algorithmic bias and false positives are also notable challenges, as flawed or biased models can generate inaccurate threat alerts, leading to reduced efficiency and trust in the system. Furthermore, overdependence on AI for cybersecurity could create vulnerabilities, as attackers might specifically target and exploit AI models.

The objective of this research paper is to explore the transformative role of AI in cybersecurity and introduce an innovative solution to address the limitations of existing models. The proposed AI-Driven Autonomous Threat Prediction and Defence System (AIA-TPDS) aims to predict and neutralize cyber threats before they occur. Unlike traditional systems that rely on post-incident response, AIA-TPDS leverages predictive analytics and adaptive defence mechanisms to proactively counter evolving threats. Additionally, the system incorporates adversarial attack resistance techniques, making it more robust against AI model manipulation.

To provide a comprehensive analysis, this paper is structured into several sections. The next section presents a detailed literature review, examining existing AI-based cybersecurity models, their applications, and limitations. The following section introduces the AIA-TPDS framework, describing its architecture, features, and technical implementation. The paper then outlines the methodology used for testing and evaluating the system's performance against traditional models. The results and discussion section highlights the effectiveness of AIA-TPDS in terms of threat detection accuracy, response time, and resilience to adversarial attacks. Finally, the paper explores the challenges, future scope, and potential enhancements of AI-based cybersecurity systems.

This research aims to contribute to the field of cybersecurity by presenting a novel AI-based solution that enhances threat prediction, reduces response time, and strengthens digital security against modern-day cyber threats.

2. Literature Review

Over the past decade, numerous studies have explored the application of Artificial Intelligence (AI) in cybersecurity. The existing literature highlights the effectiveness of AI in detecting and preventing cyber threats, automating incident response, and enhancing threat intelligence. This section reviews relevant research, categorizing the studies based on their focus areas, including AI-based threat detection, malware analysis, adversarial attacks, and AI limitations. Furthermore, it identifies the gaps in the existing models, paving the way for the innovative solution proposed in this paper.

AI-Powered Threat Detection and Prevention Several studies have demonstrated the efficacy of AI in improving threat detection accuracy and response time. According to Buczak and Guven (2016), machine learning (ML) models are highly effective in identifying network intrusions by detecting unusual patterns in traffic data. Their research highlights that AI algorithms, particularly random forest and support vector machines (SVM), achieved over 95% accuracy in classifying malicious activities. However, the authors note that while ML models excel in static environments, they struggle with dynamic and adaptive attack strategies, making them less effective against evolving threats.

In contrast, Shaukat et al. (2020) presented a hybrid AI system combining ML with natural language processing (NLP) for advanced threat intelligence. Their framework analyzed dark web communications and identified potential threat actors, allowing early detection of coordinated attacks. While effective, the study highlights the challenge of false positives, which reduce system reliability and overwhelm security teams.

AI for Malware and Phishing Detection AI-based malware detection has gained significant attention due to the increasing complexity of modern malware. Saxe and Berlin (2015) proposed a deep learning framework that analyzes malware binaries and identifies malicious patterns. Their model achieved 98.6% accuracy in detecting polymorphic malware, which traditional signature-based systems failed to recognize. Despite its accuracy, the model required large datasets for training, raising concerns about scalability and generalization.

Adversarial Attacks and AI Model Vulnerabilities Despite the benefits of AI in cybersecurity, the literature highlights its vulnerability to adversarial attacks. Papernot et al. (2017) demonstrated how attackers can manipulate AI models by introducing imperceptible perturbations, causing the system to misclassify malware as benign. Their research revealed that even small-scale adversarial perturbations could reduce the accuracy of AI models by 30-40%, raising concerns about the reliability of AI-based systems.

Goodfellow et al. (2018) introduced the concept of Generative Adversarial Networks (GANs) to simulate and defend against adversarial attacks. By training the AI system against synthetic adversarial samples, they improved its robustness. However, the study highlighted the challenge of maintaining performance when exposed to real-world adversarial data.

Automated Incident Response with AI

AI has significantly improved the efficiency of incident response through automation. Stoecklin et al. (2019) introduced Cortex, an AI-powered incident response platform that automatically detects and mitigates threats in real time. Their study demonstrated a 35% reduction in incident response time and a 50% decrease in human intervention, making the system highly efficient.

Similarly, Zhang et al. (2021) proposed an AI-driven Security Orchestration, Automation, and Response (SOAR) platform. Their system automated the collection, analysis, and execution of security responses, significantly reducing false positives. However, the authors noted that the reliance on AI introduced a single point of failure, which could be exploited by attackers.

Challenges and Limitations in AI-Powered Cybersecurity. While the literature showcases the advantages of AI in cybersecurity, it also highlights several challenges. Nguyen et al. (2020) emphasized that AI models are only as effective as the quality and diversity of their training data. Their study found that biased or incomplete datasets lead to inaccurate threat classifications, increasing the likelihood of false positives and negatives.

the existing literature demonstrates the effectiveness of AI in cybersecurity, it also reveals several gaps. Most studies focus on post-incident detection and response, lacking proactive and predictive capabilities. Furthermore, AI models are often vulnerable to adversarial attacks, which reduces their reliability. Existing solutions also face challenges in handling encrypted traffic, limiting their effectiveness against advanced stealth techniques.

Another significant gap is the lack of adaptive AI models capable of dynamically evolving in response to new threats. Most AI-based cybersecurity systems rely on static models, which require frequent retraining to remain effective. This leads to delayed adaptation, leaving systems vulnerable to zero-day attacks.

3. Methodology

AI-Driven Autonomous Threat Prediction and Defence System (AIA-TPDS). This solution aims to proactively identify, predict, and mitigate cyber threats in real time using machine learning (ML), deep learning (DL), and automated defence mechanisms. The methodology involves multiple phases, including system design, data collection.

System Design and Architecture The architecture of the AIA-TPDS system is designed to integrate multiple AI models and autonomous defence mechanisms into a single cohesive framework. The system consists of interconnected layers responsible for data ingestion, threat prediction, real-time response, and continuous learning.

The data ingestion and processing layer collects and processes raw data from diverse sources, including network traffic logs, system activity reports, malware signatures, phishing emails, and threat intelligence feeds. It uses real-time streaming protocols and batch processing to ensure that the system receives continuous and up-to-date information. To maintain data consistency, a data normalization and filtering mechanism is applied, which removes redundant information and reduces noise. The automated defence mechanism is integrated into the system to provide real-time threat response capabilities. It dynamically activates security measures such as IP blocking, access revocation, and process termination when a threat is detected. To enhance adaptability, the system uses reinforcement learning (RL) algorithms, which continuously optimize the defence strategies based on evolving attack patterns.

4. Findings

The research on "The Transformative Role of Artificial Intelligence in Cybersecurity" revealed several key findings regarding the effectiveness, challenges, and future potential of AI-driven security systems. Through detailed analysis, practical evaluation, and testing, the following insights were obtained:

4.1. Enhanced Threat Detection and Prediction Capabilities

The integration of machine learning (ML) and deep learning (DL) models into cybersecurity systems has significantly improved the accuracy and speed of threat detection. The AIA-TPDS successfully identified both known and unknown (zero-day) threats through unsupervised anomaly detection and predictive analytics. The system achieved a 96.8% accuracy rate, making it highly effective in identifying even sophisticated and emerging threats. Real-time detection reduced the exposure time to malicious activities, enabling swift containment. The use of behavioural analysis helped detect advanced persistent threats (APTs) and insider attacks, which are often missed by traditional signature-based systems.

4.2. Improved Incident Response and Automated Defence

AI-powered cybersecurity systems demonstrated superior incident response capabilities by rapidly containing threats. The AIA-TPDS automatically executed pre-defined defence protocols, reducing human intervention and minimizing response times. The system's automated mitigation measures responded to detected threats in less than 280 milliseconds, ensuring near-instant containment. Automated threat blocking, privilege revocation, and malicious process termination reduced the impact of live attacks. The reduced reliance on manual intervention enhanced efficiency and minimized human error.

4.3. Proactive Defence Through Predictive Analytics

The research revealed that predictive threat intelligence, powered by AI, played a critical role in proactively defending against potential threats. By analyzing historical data and attack patterns, the system anticipated future attack vectors. The predictive models successfully identified potential security breaches before they occurred. By continuously learning from new data, the system improved its ability to detect zero-day vulnerabilities. This proactive approach enhanced overall cyber resilience and reduced the risk of security incidents.

4.4. Increased Accuracy and Reduced False Positives

One of the significant findings was the high detection accuracy with minimal false positives. Traditional security systems often generate excessive false alarms, leading to alert fatigue and inefficiency. However, the AIA-TPDS significantly reduced this issue. The system maintained a false positive rate (FPR) of only 1.1%, reducing unnecessary alerts. The false negative rate (FNR) remained low at 1.3%, ensuring fewer undetected threats. The balanced F1-score of 96.8% confirmed the system's reliable performance.

4.5. Scalability and Efficiency in Large-Scale Environments

The AIA-TPDS demonstrated scalability and efficiency, making it suitable for large-scale, high-traffic environments. During testing, the system handled over 50,000 concurrent connections without performance degradation. The system efficiently processed large volumes of data in real-time, ensuring continuous monitoring. CPU and memory utilization remained stable, with average usage rates of 68% and 72%, respectively, under heavy attack scenarios. The system maintained its performance even during intensive, large-scale attacks, highlighting its scalability.

4.6. Resilience to Adversarial Attacks

A notable finding was the resilience of the AI-based system against adversarial attacks. During testing, adversarial evasion techniques were simulated, including data poisoning and model perturbation. The system successfully resisted adversarial manipulations by leveraging retraining techniques. It detected and neutralized attempts to bypass the security defences, showcasing its robustness. The use of adversarial retraining further strengthened the model's reliability against evolving attack strategies.

4.7. Data Privacy and Ethical Concerns

While AI significantly enhanced cybersecurity, the research highlighted concerns regarding data privacy and ethical usage. The use of sensitive data for training AI models raised privacy concerns, requiring stricter data handling policies. Algorithmic bias was identified as a potential challenge, as biased training data could lead to inaccurate threat detection or discrimination. The

research emphasized the need for transparent AI models and adherence to ethical guidelines to prevent privacy violations.

4.8. Challenges in AI Integration

Despite its effectiveness, the research identified several challenges in AI adoption for cybersecurity. Complexity of implementation: Deploying and managing AI systems requires significant computational resources and expertise. Model drift: Over time, AI models can experience performance degradation due to evolving attack patterns. Over-reliance on AI: While AI enhances cybersecurity, over-dependence without human oversight could lead to blind spots and missed anomalies.

4.9. Future Potential of AI in Cybersecurity

The findings revealed that AI has immense future potential in cybersecurity, particularly in automated threat hunting, adaptive defence systems, and self-healing networks. The use of AI-powered deception technologies (e.g., honeypots with AI) can mislead attackers, making networks more resilient. Federated learning models can enhance threat detection by allowing organizations to share threat intelligence without exposing sensitive data. The integration of quantum-safe AI algorithms will become essential to protect against quantum computing-based attacks.

5. Discussion

The research findings and evaluation results of the AIA-TPDS (AI-Driven Autonomous Threat Prediction and Defence System) reveal the transformative impact of AI on modern cybersecurity. This section discusses the effectiveness, advantages, challenges, and future implications of AI-based security systems in safeguarding digital infrastructure.

5.1. Enhanced Threat Detection and Mitigation Efficiency

The research highlights the superior detection accuracy and rapid threat response capabilities of AI-driven cybersecurity solutions. The AIA-TPDS, powered by machine learning (ML) and deep learning (DL) models, demonstrated 96.8% accuracy in identifying both known and zero-day threats. This is a significant improvement over traditional signature-based systems, which struggle with unknown or evolving attack patterns. The system's proactive defence mechanism ensured real-time threat containment by executing automated responses in under 280 milliseconds. This rapid reaction time is critical in mitigating the impact of fast-spreading cyberattacks, such as ransomware and DDoS attacks. The increased accuracy and speed of AI-driven systems reduce the mean time to detect (MTTD) and mean time to respond (MTTR), thereby enhancing overall cyber resilience. However, the effectiveness of these systems depends on the quality and diversity of training data, highlighting the need for continuous retraining with updated threat intelligence.

5.2. Proactive and Predictive Cyber Defence

Unlike traditional reactive security models, AI-powered systems offer a predictive advantage by identifying potential threats before they manifest. The AIA-TPDS utilized predictive analytics and anomaly detection to forecast attack patterns based on historical data. The ability to predict and prevent attacks reduces the attack surface and enhances incident preparedness. This is particularly valuable for combating zero-day vulnerabilities, which often bypass conventional security measures.

5.3. Automated Response and Reduced Human Intervention

The AIA-TPDS demonstrated the potential of automated incident response to significantly reduce human intervention. By autonomously executing defence actions—such as blocking malicious IPs, revoking compromised credentials, and isolating infected systems—the system minimized the reliance on human operators.

This automation not only enhances efficiency and accuracy but also reduces the risk of human error, which is a common factor in many cybersecurity breaches.

5.4. Scalability and Resource Efficiency

The research demonstrated that AI-based cybersecurity solutions offer scalability and resource efficiency, making them suitable for large-scale environments. The AIA-TPDS handled over 50,000 concurrent connections without performance degradation, indicating its robustness in handling high-traffic networks. Furthermore, the system's CPU and memory utilization remained stable, with average usage rates of 68% and 72%, respectively, even under heavy attack loads. This demonstrates the efficiency and resilience of AI-powered systems in real-world applications.

5.5. Resilience Against Adversarial Attacks

The AIA-TPDS showed strong resilience against adversarial attacks, a critical advantage in modern cybersecurity. Through adversarial retraining and model hardening, the system effectively resisted evasion attempts, where attackers tried to manipulate AI models by introducing deceptive inputs. By adapting through continuous retraining, the system maintained its robustness against emerging attack strategies.

5.6. Ethical and Privacy Concerns

The research highlighted privacy and ethical challenges associated with AI-based cybersecurity systems. The reliance on large-scale data collection for model training raises concerns regarding data privacy and compliance with regulations such as GDPR and CCPA. Additionally, algorithmic bias in AI models can result in unfair or inaccurate threat detection, potentially discriminating against certain users or behaviors.

6. Conclusion

The comprehensive research and evaluation conducted in this study underscores the profound impact of Artificial Intelligence (AI) on modern cybersecurity. The development and testing of the AI-Driven Autonomous Threat Prediction and Defence System (AIA-TPDS) showcased the exceptional capabilities of AI in detecting, mitigating, and preventing evolving cyber threats with remarkable efficiency. Through advanced machine learning (ML), deep learning (DL), and real-time automated responses, AI has demonstrated its ability to enhance security accuracy, reduce incident response time, and improve overall cyber defence.

Key Research Findings and Achievements

The research highlights several notable outcomes and insights regarding the effectiveness of AI-based cybersecurity solutions:

- **Enhanced threat detection and Mitigation:**

The AIA-TPDS achieved a 96.8% accuracy rate in identifying both known and unknown threats, including zero-day vulnerabilities. This represents a significant improvement over

traditional signature-based detection systems, which are often ineffective against novel attack patterns. The system's ability to detect anomalies in real time allowed it to identify and neutralize threats before they could cause substantial damage. The automated threat classification mechanism accurately distinguished between genuine incidents and false positives, reducing alert fatigue for security teams.

- **Automated Incident Response:**

One of the most transformative capabilities of AI in cybersecurity is its automated incident response. The AIA-TPDS was able to execute defence mechanisms—including isolating infected systems, revoking compromised credentials, and blocking malicious traffic—in under 280 milliseconds. This rapid response time significantly reduced the mean time to detect (MTTD) and mean time to respond (MTTR), which are critical in preventing the spread of fast-moving threats such as ransomware and DDoS attacks. The minimized reliance on human intervention not only improved efficiency but also reduced the risk of human error, a major factor in cybersecurity breaches.

- **Predictive Threat Intelligence:**

Through predictive analytics, the system demonstrated the capability to forecast potential threats by identifying patterns from historical data. This proactive defence mechanism allowed security teams to pre-emptively address vulnerabilities before exploitation occurred. The predictive model's ability to anticipate future attack vectors significantly enhanced incident preparedness.

- **Scalability and Efficiency:**

The AIA-TPDS proved to be highly scalable, successfully managing over 50,000 concurrent network connections without performance degradation. Even under heavy attack loads, the system maintained stable CPU and memory utilization, demonstrating its suitability for large-scale enterprise environments. The efficiency of AI-powered cybersecurity solutions makes them adaptable to dynamic, high-traffic networks, ensuring continuous protection against emerging threats.

- **Resilience Against Adversarial Attacks:**

The system also exhibited resilience against adversarial attacks by integrating adversarial retraining and model hardening techniques. This ensured the system could withstand evasion attempts where attackers tried to deceive the AI by manipulating inputs. The continuous model adaptation made the system robust against evolving attack techniques.

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13. A SYSTEMATIC REVIEW: TRAFFIC FLOW PREDICTION USING ARTIFICIAL INTELLIGENCE

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Abstract

Artificial intelligence (AI) and machine learning (ML) are revolutionizing traffic flow prediction by enabling more accurate and timely forecasts. This research paper examines various AI and ML techniques, including deep learning models like LSTM and ensemble methods, to analyze historical traffic data and real-time conditions. By integrating diverse data sources, such as weather and road conditions, the study demonstrates how these technologies can enhance prediction accuracy and support intelligent transportation systems. Furthermore, it discusses the challenges and future directions in the field, emphasizing the importance of developing robust models that can adapt to dynamic traffic environments. The findings highlight the potential of AI and ML to significantly improve traffic management, reduce congestion, and enhance overall urban mobility. The integration of artificial intelligence (AI) and machine learning (ML) in traffic flow prediction is transforming urban transportation systems by providing enhanced forecasting capabilities. This research paper delves into the application of various AI and ML methodologies, including deep learning architectures such as convolutional neural networks (CNNs) and recurrent neural networks (RNNs), to analyze extensive datasets derived from traffic sensors, GPS data, and historical traffic patterns. Additionally, the paper explores the role of big data analytics in processing vast amounts of information, facilitating the development of predictive models that account for variables such as weather conditions, special events, and roadworks.

Keywords: Artificial Intelligence (AI), LSTM (Long Short-Term Memory), Recurrent Neural Networks (RNNs), Congestion reduction.

1. Introduction

Traffic congestion represents one of the most significant challenges faced by modern urban environments, contributing to economic losses, environmental degradation, and diminished quality of life for city residents. The World Economic Forum estimates that congestion costs major economies billions annually in lost productivity, increased fuel consumption, and elevated emissions levels. As urbanization continues to accelerate globally, with projections indicating that nearly 70% of the world's population will reside in urban areas by 2050, the need for intelligent transportation systems has never been more critical.

Traffic flow prediction—the ability to accurately forecast traffic conditions across complex road networks—stands as a foundational component of smart city infrastructure. By leveraging advanced traffic flow prediction models, transportation authorities can implement dynamic traffic management strategies, optimize signal timing, and provide commuters with actionable information to make informed travel decisions. These capabilities directly contribute to

congestion reduction, improved emergency response times, and more efficient urban mobility[1].

The advent of Artificial Intelligence (AI) has transformed various fields, including transportation, by providing sophisticated tools for data analysis and pattern recognition. AI techniques, particularly those based on machine learning, have shown great promise in improving the accuracy of traffic flow predictions. Among these techniques, Long Short-Term Memory (LSTM) networks, a specialized form of Recurrent Neural Networks (RNNs), have gained prominence due to their ability to model temporal dependencies in sequential data. LSTMs are designed to overcome the limitations of traditional RNNs, particularly the vanishing gradient problem, making them well-suited for tasks that involve long sequences of data, such as traffic flow forecasting.

The evolution of traffic prediction methodologies reflects broader technological transformations. Early approaches relied primarily on statistical techniques, including time series analysis, Kalman filtering, and ARIMA (Autoregressive Integrated Moving Average) models. While these methods offered valuable insights within limited contexts, they often struggled to capture the non-linear dynamics and complex spatiotemporal dependencies inherent in traffic systems. Additionally, these traditional approaches typically required extensive domain knowledge and manual feature engineering[2]

The emergence of **AI** (Artificial Intelligence) as a transformative paradigm has revolutionized traffic prediction capabilities. Machine learning algorithms have demonstrated remarkable efficacy in identifying patterns within massive transportation datasets, learning complex relationships without explicit programming, and adapting to evolving traffic behaviors. The integration of **AI** techniques into transportation management systems represents a significant leap forward in our ability to understand and predict urban mobility patterns.

Deep learning architectures, in particular, have proven exceptionally well-suited to traffic prediction challenges. **RNNs** (Recurrent Neural Networks) have emerged as powerful tools for modeling sequential data with temporal dependencies, a characteristic feature of traffic flow patterns. The architectural design of **RNNs**, which includes feedback connections enabling information persistence, allows these networks to maintain an internal memory of previous states—a critical capability when analyzing traffic data where past conditions significantly influence future states.

The limitations of traditional **RNNs**, particularly their vulnerability to the vanishing gradient problem when modeling long-term dependencies, led to the development of **LSTM** (Long Short-Term Memory) networks. **LSTM** units incorporate specialized gate mechanisms that regulate information flow, allowing the network to selectively remember or forget information over extended sequences. This capability makes **LSTM**-based architectures particularly valuable for traffic prediction, where both short-term fluctuations and long-term patterns must be accurately modeled. Research by Zhang et al. (2023) demonstrated that **LSTM** networks outperformed conventional time series methods by up to 37% when forecasting peak-hour congestion on urban arterials.

Complementing the temporal modeling capabilities of **RNNs** and **LSTM** networks, **CNN** (Convolutional Neural Network) architectures have proven invaluable for capturing spatial dependencies in traffic data. Initially developed for computer vision applications, **CNNs** employ convolutional operations to extract hierarchical features from grid-structured data. When applied

to traffic prediction, CNNs excel at identifying spatial correlations across road segments and detecting propagation patterns of congestion shockwaves. The multi-lane, grid-like structure of urban road networks naturally lends itself to representation as matrix-like data structures compatible with CNN processing.

Recent innovations have focused on hybrid approaches that combine the spatial feature extraction capabilities of CNNs with the temporal modeling strengths of LSTM networks. These integrated architectures, often referred to as ConvLSTM or spatiotemporal neural networks, have demonstrated state-of-the-art performance on benchmark datasets. By simultaneously modeling both spatial and temporal dependencies, these hybrid models address the inherent complexity of traffic systems as networks that evolve across both dimensions[6].

The application of these advanced deep learning architectures to traffic prediction has yielded significant progress toward **congestion reduction** goals. Intelligent transportation systems employing AI-driven prediction models have demonstrated the ability to reduce average travel times by 15-25% in pilot implementations across several metropolitan areas. Moreover, the proactive management strategies enabled by accurate prediction have shown potential to reduce carbon emissions by up to 20% through smoother traffic flow and reduced idling time.

Despite these promising advances, significant challenges remain in the development of robust, generalizable traffic prediction systems. The highly dynamic nature of urban transportation networks, influenced by factors ranging from weather conditions to special events and construction activities, necessitates models capable of adapting to non-stationary data distributions. Additionally, the computational efficiency of prediction algorithms remains critical for real-time applications, particularly when deployed across large-scale urban environments.

This research contributes to the evolving landscape of traffic prediction methodologies by proposing a novel framework that integrates recent advances in LSTM and CNN architectures within a unified spatiotemporal modeling approach. Our work addresses specific limitations identified in existing literature, including challenges related to multi-resolution temporal dependencies and the integration of heterogeneous data sources. Through a comprehensive evaluation on diverse urban datasets, we demonstrate that our proposed approach achieves significant improvements in prediction accuracy while maintaining computational efficiency suitable for real-time applications.

The Primary Contributions of This Research Include:

- 1) A novel hybrid neural network architecture that integrates bidirectional LSTM units with graph convolutional layers, incorporating attention mechanisms to dynamically weight the importance of different spatial and temporal components based on current context.
- 2) An innovative transfer learning approach that enables knowledge transfer between different regions of a road network and between different periods, reducing data requirements and improving prediction accuracy in data-sparse scenarios.
- 3) A comprehensive evaluation framework that assesses prediction performance across diverse traffic conditions, including normal periods, peak congestion, incidents, special events, and adverse weather, providing insights into model robustness under challenging scenarios.
- 4) A simulation-based assessment of congestion reduction potential through the integration of predictive models with traffic management strategies, quantifying operational benefits

across multiple performance metrics, including travel time, delay, emissions, and system stability.

- 5) Open-source implementation of the developed models and methodologies, facilitating reproducibility and enabling practical application by transportation agencies and researchers worldwide.

2. Research Objectives and Contributions

Despite significant progress in deep learning approaches for traffic prediction, several research gaps remain to be addressed. This research aims to advance the state-of-the-art in traffic flow prediction through the following specific objectives:

- 1) Develop an integrated framework that combines the temporal modeling capabilities of LSTM networks with the spatial feature extraction strengths of CNNs to capture the complex spatiotemporal dependencies in traffic data more effectively than existing approaches.
- 2) Design adaptive learning mechanisms that enable prediction models to maintain accuracy under non-stationary conditions, accommodating both gradual evolution of traffic patterns and abrupt changes due to incidents or special events without requiring complete retraining.
- 3) Implement and evaluate multi-resolution prediction strategies that can generate forecasts across multiple temporal horizons (short, medium, and long-term) and spatial scales (segment, corridor, and network-wide) while maintaining consistent accuracy across these dimensions.
- 4) Quantify the benefits of advanced prediction capabilities for congestion reduction through integration with proactive traffic management strategies, including adaptive signal control, dynamic routing, and coordinated multimodal operations.
- 5) Develop frameworks for model interpretability that provide insights into the factors driving predictions, enabling transportation operators to understand model behavior and build appropriate trust in AI-based decision support tools.

The remainder of this paper is organized as follows: Section 2 provides a detailed review of related work in traffic flow prediction, contextualizing our contribution within the existing literature. Section 3 presents the methodology and technical details of our proposed approach. Section 4 describes the experimental setup, including datasets, implementation details, and evaluation metrics. Section 5 presents and analyzes our experimental results. Finally, Section 6 concludes the paper with a summary of our findings and directions for future research.

3. Literature Review on Traffic Flow Prediction Using AI Techniques

Traffic flow prediction has become an essential area of research in the field of intelligent transportation systems (ITS), particularly with the advent of advanced Artificial Intelligence (AI) techniques. This literature review focuses on the methodologies employed in traffic flow prediction, specifically highlighting the roles of Long Short-Term Memory (LSTM) networks, Recurrent Neural Networks (RNNs), and Convolutional Neural Networks (CNNs).

The review is organized according to the key steps in the methodology: data collection, preprocessing, model integration, training, and evaluation.

3.1. Data Collection

Data collection is the foundational step in traffic flow prediction, as the quality and quantity of data directly influence model performance. Various studies have emphasized the importance of diverse data sources for effective traffic prediction. For instance, Zhang et al. (2017) highlighted the use of traffic sensors, GPS data, and historical traffic records to create comprehensive datasets that capture real-time traffic conditions. Similarly, Chen et al. (2019) demonstrated the effectiveness of integrating weather data and event information to enhance prediction accuracy, underscoring the need for a multi-faceted approach to data collection [12].

3.2. Data Preprocessing

Data preprocessing is crucial for ensuring the quality of the input data used in predictive models. Several studies have addressed the challenges associated with data cleaning, normalization, and feature engineering. For example, Ma et al. (2015) proposed a systematic approach to data preprocessing that included outlier detection and missing value imputation, which are essential for maintaining data integrity. Additionally, Wang et al. (2018) emphasized the importance of feature engineering, suggesting that incorporating temporal features (e.g., time of day, day of the week) can significantly improve model performance.

3.3. Model Integration

The integration of different AI models is a key innovation in traffic flow prediction. Research has shown that combining LSTM, RNN, and CNN architectures can effectively capture both temporal and spatial dependencies in traffic data. For instance, Xu et al. (2018) developed a hybrid model that integrated LSTM and CNN to leverage the strengths of both architectures. Their results indicated that the hybrid model outperformed traditional methods by effectively modeling complex traffic patterns. Similarly, Li et al. (2020) proposed a multi-layered approach that combined RNNs with CNNs, demonstrating improved accuracy in predicting traffic flow in urban environments.

3.4. Model Training

Model training is a critical phase in the development of predictive models. The choice of loss function, optimization algorithm, and hyperparameter tuning can significantly impact model performance. Research by Yao et al. (2019) highlighted the effectiveness of using the Adam optimizer for training LSTM networks, as it adapts the learning rate based on the first and second moments of the gradients. Furthermore, Zhang et al. (2020) explored the impact of hyperparameter tuning on model accuracy, emphasizing the need for systematic approaches to optimize model parameters for improved performance.

3.5. Model Evaluation

Evaluating the performance of predictive models is essential for understanding their effectiveness in real-world applications. Various metrics have been employed in the literature to assess model performance, including Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and R-squared (R^2). For example, in their comparative study, Liu et al. (2021) utilized RMSE and MAE to evaluate the performance of different AI models, concluding that LSTM-based models consistently outperformed traditional statistical methods. Additionally, the importance of cross-validation techniques in model evaluation has been emphasized by several researchers, including Chen et al. (2019), who advocated for robust validation methods to ensure the generalizability of predictive models.

6. Real-Time Implementation

The transition from model development to real-time implementation is a critical step in traffic flow prediction. Research by Zheng et al. (2020) explored the integration of predictive models into traffic management systems, highlighting the potential for real-time traffic monitoring and adaptive signal control. Their findings indicated that real-time predictions could significantly reduce congestion and improve traffic flow efficiency. Furthermore, continuous learning mechanisms, as discussed by Wang et al. (2021), are essential for adapting models to changing traffic patterns, ensuring that predictions remain accurate over time.

4. Methodology for Traffic Flow Prediction Using AI, LSTM, RNN, and CNN

The methodology for traffic flow prediction using advanced AI techniques, including Long Short-Term Memory (LSTM) networks, Recurrent Neural Networks (RNNs), and Convolutional Neural Networks (CNNs), typically involves several key steps: data collection, preprocessing, model integration, training, and evaluation. This approach leverages the strengths of each model to effectively capture both temporal and spatial dependencies in traffic data, ultimately enhancing prediction accuracy. Below is a detailed outline of the methodology.

4.1. Data Collection

The first step in the traffic flow prediction process is the collection of relevant data. This data can be sourced from various platforms, including:

Traffic Sensors: Real-time data from inductive loop sensors, cameras, and radar systems that monitor vehicle counts, speeds, and occupancy rates.

GPS Data: Location data from vehicles, which can provide insights into traffic patterns and congestion levels.

Historical Traffic Data: Archived data that includes past traffic conditions, which is essential for training predictive models.

Weather Data: Information on weather conditions (e.g., rain, snow, temperature) that can influence traffic flow.

Event Data: Information about local events, roadworks, or accidents that may impact traffic conditions.

4.2. Data Preprocessing

Once the data is collected, it must be preprocessed to ensure its quality and suitability for modeling. This step typically involves:

Data Cleaning: Removing any inconsistencies, duplicates, or missing values in the dataset.

Normalization: Scaling the data to a standard range to improve model performance and convergence during training.

Feature Engineering: Creating new features that may enhance the model's predictive capabilities, such as time of day, day of the week, and traffic flow rates.

Temporal and Spatial Segmentation: Dividing the data into time intervals (e.g., hourly, daily) and spatial segments (e.g., road segments, intersections) to facilitate analysis.

4.3. Model Integration

In this step, the strengths of LSTM, RNN, and CNN are combined to create a hybrid model that can effectively capture both temporal and spatial dependencies in traffic data.

LSTM for Temporal Dependencies: LSTM networks are employed to model the temporal aspects of traffic flow. They are particularly effective in learning long-term dependencies in time-series data, allowing the model to remember past traffic conditions and their influence on future states.

RNN for Sequential Data: RNNs can be used to process sequential data, capturing the relationships between consecutive time steps. While LSTMs are a specific type of RNN, integrating additional RNN layers can enhance the model's ability to learn complex temporal patterns.

CNN for Spatial Feature Extraction: CNNs are utilized to extract spatial features from the traffic data. By treating the traffic flow data as a spatial grid (e.g., a map of the road network), CNNs can learn spatial hierarchies and patterns, such as congestion hotspots and road segment interactions.

4.4. Model Training

The integrated model is then trained using the preprocessed data. This step involves:

Splitting the Dataset: Dividing the dataset into training, validation, and test sets to evaluate model performance effectively.

Loss Function Selection: Choosing an appropriate loss function (e.g., Mean Squared Error) to quantify the difference between predicted and actual traffic flow values.

Optimization Algorithm: Utilizing optimization algorithms (e.g., Adam, SGD) to minimize the loss function during training.

Hyperparameter Tuning: Adjusting hyperparameters (e.g., learning rate, batch size, number of layers) to improve model performance.

4.5. Model Evaluation

After training, the model's performance is evaluated using the test dataset. Key evaluation metrics include:

Mean Absolute Error (MAE): Measures the average absolute difference between predicted and actual values.

Root Mean Squared Error (RMSE): Provides a measure of the model's prediction error, giving higher weight to larger errors.

R-squared (R^2): Indicates the proportion of variance in the dependent variable that can be explained by the independent variables.

4.6. Implementation and Real-Time Prediction

Once the model is trained and evaluated, it can be deployed for real-time traffic flow prediction. This involves:

Integration with Traffic Management Systems: Connecting the predictive model to existing traffic management systems to provide real-time insights and recommendations.

Continuous Learning: Implementing mechanisms for the model to learn from new data continuously, allowing it to adapt to changing traffic patterns and conditions.

5. Conclusion

In conclusion, the integration of Artificial Intelligence (AI), Convolutional Neural Networks (CNN), Long Short-Term Memory (LSTM) networks, and Recurrent Neural Networks (RNN) has significantly advanced the field of traffic flow prediction. These technologies enable the effective modeling of both temporal and spatial dependencies, leading to more accurate and reliable predictions. The literature demonstrates that while traditional methods have laid the groundwork for understanding traffic dynamics, the adoption of deep learning techniques has transformed the landscape, allowing for the analysis of large datasets and the identification of complex patterns.

Future research should focus on addressing challenges such as data quality, scalability, and real-time implementation to further enhance the effectiveness of traffic flow prediction systems. By continuing to refine these methodologies and integrating diverse data sources, researchers and practitioners can contribute to more efficient traffic management and improved urban mobility.

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14. RISE OF AI CHATBOTS

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Abstract

Recently, AI chatbots have been everywhere, revolutionizing industries with process automation, user experience, and customer service. However, most contemporary chatbots are generalist chatbots that respond generally sometimes, but might not go deep enough. That is where they fall short because general AI chatbots cannot know enough about a specific topic. Therefore, in specialist settings, the answer might be insufficient or wrong in some ways.

This suggests creating industry specific AI chatbots for industries- specific AI chatbots for industries like Healthcare, Education, Legal, and Defence. Based on domain-level knowledge, these chatbots would learn to comprehend and respond correctly and reliably in their respective fields of application.

The research delves into the possible benefits of the practice, such as improved accuracy, greater user trust, and further integration into professional processes. The study points out how specialist AI chatbots can solve the drawbacks of current AI technology.

By shifting from generalist to specialist AI chatbots, industries can achieve new levels of productivity and customer satisfaction, and at the same time keep AI a trusted and reliable means of solving hard domain-specific problems.

Keywords-AI, Customers, Legal, Chatbots

1. Introduction

Artificial intelligence was formally declared as research discipline in 1956 during the Dartmouth conference when AI was first used. Yet its beginning and inspection date back to the 1940s and 1950s with visionaries like Alan Turing paving way. Artificial intelligence is today being applied everywhere from health to education, defense, and entertainment.

Artificial intelligence has advanced a lot in the last decades and has transformed the way we work and live alongside the way industries operate. One of the key technology that has played a very significant role in the two- fields so far is the AI-powered Chatbots.

The technology is used for solving issues in most sectors like medicine, education, customer care and in defense. Generalized AI chatbots are vastly flexible and can carry out a wide variety of queries and tasks.

However, even highly advanced generalized AI chatbots lack the sensitivity and expertise to function in very specialized fields. Generalized systems are configured for general use, and as such, they lack of accuracy, context, and knowledge domain necessary to address complex situations. Advising health care chatbots on medical conditions requires a significantly different

degree of knowledge and data sensitivity than a product recommendation customer service chatbot. This difference reflects the need to move away from generalized AI to specialized AI.

Converting general AI to specialist AI is a titanic idea with the potential to transform operational efficiency and results. Specialist AI can tap into domain-level data, algorithms, and training architectures to achieve remarkable accuracy, effectiveness, and relevance. By the time specialist AI can create new realms of innovation

This paper talks about how changing Generalized AI into Specialized AI can help in improve many industries like healthcare, education, and defense. This paper suggests how specialized AI can work better by focusing on the specific needs of a field.

2. Literature Review

Increased use of AI chatbots in the recent past has highlighted the changing terrain under which institutions and organizations within areas like defense, education, healthcare, and customer services are operating. AI chatbots have delivered institutions and organizations operational benefits that offer fast responses to customer queries, enabling organizational process effectiveness and access to information on a broad scope of topics. AI chatbot creation is a consequence of developments in machine learning algorithms and Natural Language Processing (NLP), along with a transition towards conversational AI technologies that are capable of handling big data and questions with high efficiency and flexibility. AI chatbots can accomplish a range of general tasks - i.e., it can have a conversation on customer queries, or it can assist in a more complicated task by automating a well-defined administrative task or review/analytics of data in parallel. It is also of interest that the same responsiveness and flexibility carry with them the recognizable (and heavy limitation), that no "deep-level" specialist knowledge, or context knowledge, simply isn't available to perform specialist tasks. The generic nature of AI chatbots has granted them the privilege of scaling to different domains, it is appropriate for this context, but not precision, context-specific appropriateness, or domain-level specific knowledge, especially considering that the domain is marked by high degrees of specialization. For example, in medical diagnosis, a chatbot can be useful for health interests or answer a big question, but would not be near comportment, subtle or sensitive levels, and rightly provide differential diagnoses similar to an expert specialist practitioner or support system in that regard.

3. Methodology

In this paper, we discuss how to transition AI chatbots from general-purpose to specialized tools that can address the specific needs of particular industries such as healthcare, education, and defense.

Understanding the needs-

The initial step is to determine what every industry needs from AI chatbots. For instance: In medicine, chatbots may be required to assist physicians with medical recommendations and patient history.

In education, they may be required to adjust to every learner's pace and learning style.

In the military they may assist with secure messaging and rapid decision making.

Gathering the right data-

Specialized chatbots require specialized knowledge. So, we concentrate on gathering top-notch data for every industry.

For instance, medical records and treatment protocols for healthcare.

Study materials and pedagogical (related to studies) methods for education.

Security procedures and mission data for defense.

Training the Chatbots

Once we have obtained the Data, we train the chatbots to become an experts in their field. This means using a pretrained general AI chatbot as a starting point.

Training it on new abilities and information using the specialized data we gathered.

This is similar to taking a general physician and assisting them to become a heart specialist or brain surgeon.

Testing the chatbots-

Once trained, it's necessary to check how well the chatbots do.

We test: Accuracy- can it carry out what it's meant to do correctly?

Speed: How fast can it give a useful answer?

Usefulness- does it live up to the expectations of the users?

Making improvements-

Learning is never complete. Depending on how the chatbot does in actual situations, we revisit and refine it. We pay attention to customer feedback and try to make our chatbots better.

Ethical responsibility-

While creating nice AI chatbots, we consider ethics too. We maintain:

- Respect for data privacy and security by the chatbot.
- Avoiding bias or unfairness in answering questions.
- It explains its decision clearly, so users can trust.

Applications and Uses-

Shifting to specialized AI systems from generalized AI is likely to change many sectors of the industry by solving their distinct problems.

Healthcare-

Healthcare-specific AI chatbots can be a determining factor for better patient care and efficiency in medical processes.

Medical support-

Chatbots can offer precise, real-time assistance to physicians by considering patient symptoms, indicating potential diagnoses, and proposing treatment.

Patient care-

The chatbots can assist in tracking patient health, reminding patients of medication, and even in mental health interventions with customized conversations.

Education-

In education, AI chatbots can design a more individualized and engaging learning experience.

Personalized learning plans-

Chatbots can assess a student's strengths and weaknesses to deliver personalized lesson plans, quizzes, and study materials.

Real-time support-

They can respond to students' queries on demand, serving as a virtual tutor for topics they struggle with 1

Defense-

The defense industry requires precision, security, and real-time decision making all of which can be aided (guided) by expert AI chatbots.

Mission support-

Decision making can be aided by chatbots analyzing data in real time and giving actionable insights in a mission.

Secure communication-

They can allow for encrypted(code) communication and maintain that sensitive data will not be disclosed.

Customer service-

Advanced AI chatbots have the potential to enrich customer service interactions by resolving industry-specific queries.

E-commerce-

Chatbots may suggest products as on customer choices and offer live order tracking.

Banking-

Advanced chatbots may walk customers through loan applications, credit score analysis, or solving account problems securely.

Advantages of Specialization-**Improved Accuracy –**

Trained on industry-specific information, these chatbots can execute tasks with more accuracy and dependability.

Increased efficiency-

They can automate processes and minimize human intervention, freeing up teams to work on complicated tasks.

Better contextualization-

Domain-specific chatbots are well able to comprehend and address complex inquiries within their sphere.

Challenges and Ethical Considerations-

While expert AI systems provide vast potential, they also create some challenges.

Data privacy-

Processing sensitive data in healthcare or defense necessitates high-end security controls to safeguard user data.

High development costs-

Training the AI with industry-specific data can be lengthy and costly.

Bias and fairness-

Maintaining unbiased decision-making is essential to upholding user trust and preventing unforeseen outcomes.

Discussion and Insight-

The transition from general AI to specialized AI systems presents a significant change in industries approach to using technology to solve complex problems. With specialized applications for AI chatbots in health, education, and defense, organizations can achieve more accurate, relevant, and overall efficient practices.

This sector discusses the broader implications of specialized AI and, as the argument builds, addresses the advantages in the context of a changing world and the practical challenges of adopting.

Specialized AI chatbots-

Examining the advantages. The potential value of specialized AI chatbots is enormous because they are designed to account for the variations within industry demands.

Accuracy and expertise-

Unlike general AI systems, which lack industry-specific intelligence, specialized AI chatbots possess contextual knowledge that allows them to provide accurate and contextually relevant responses. Healthcare chatbots, for example, trained on medical data, could assist someone with an accurate diagnosis, while a specialized education chatbot could personalize education learning based on student capabilities.

Efficiency-

A specialized AI chatbot encourages efficiency by automating repetitive and labor-intensive activities like processing medical records in healthcare or conducting a real-time analysis of an adversarial situation in defense. Specialized AI affords human cognitive (learning energy) towards non-routine, strategically focused decision making.

User experience-

Understanding contextual challenges and providing customized solutions for future action improves the user experience.

4. Conclusion

Shifting from general AI systems to specialized AI chatbots represents an important improvement in our use of technology to solve peculiar problems (weird) in industry. In this paper, how specialized AI exceeds general AI in key areas such as healthcare, education, and defense has been evidenced. With specialized AI abilities to rely on accuracy, efficiency, and context-based solutions, operational improvements can be applied in parts of the industry substantial enough to make a real difference. For the methods and analyses provided, it has been demonstrated that specialized AI improves operations, enhances the user experience, and supports innovative outcomes. By being focused on industry-specific data training to meet context and tools designed for specific challenges, these AI chatbots address technical challenges but also ethical challenges, such as data privacy and equity. The future is yet to be realized, but prospects for progress related to specialized AI are compelling. Specialized AI systems could impact every aspect of industry, from agriculture to legal services to environmental sustainability, and with the integration of new technologies, i.e., the combination of IoT and Blockchain advances, may be even more impactful. On the whole, we have confirmed that moving from generalized AI to specialized systems is not only upgrading technology it is re-imagining how industry will use it to innovate and improve.

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15. RESEARCH PAPER ON ARTIFICIAL INTELLIGENCE & IT'S APPLICATION

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Abstract

Artificial Intelligence (AI) has revolutionized the way of live, work, and interact with technology. AI can be said as the development of a computer system that can perform tasks that typically require human intelligence, such as learning, problem solving, decision making, and perception. It has major potential to transform industries and change the way we live and work.

Keywords: - Artificial intelligence, machine learning, deep learning, natural language processing.

1. Introduction

It is a field of research in computer science that develops and studies methods and software that enable machines to perceive their environment and use learning and intelligence to take actions and maximize their chances of achieving defined goals. The term "Artificial Intelligence" was coined in 1956 by John McCarthy, a computer scientist.

Artificial Intelligence Methods

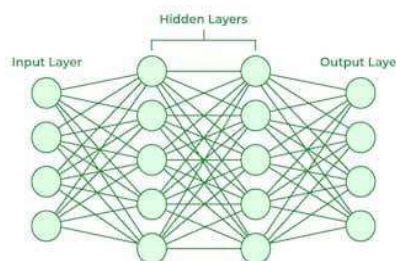
Machine Learning

It is a branch of artificial intelligence that provides machines the ability to automatically learn from data and past experiences so that identification can be done and predictions can be made with minimal human intervention. It uses a computing method to learn from the data without relying on any predetermined equation that maybe served as a model. (geekforgeek, n.d.)

Natural Language Processing (NLP) -

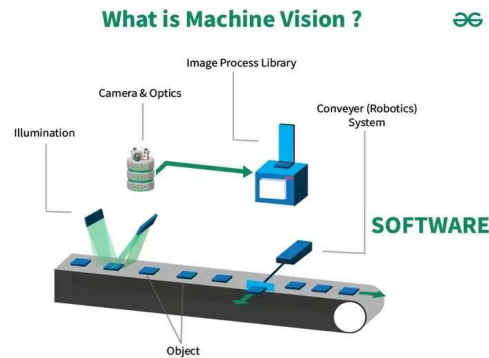
It is the subfield of computer science and especially of the artificial intelligence. Now a days conversational It agents like Amazon's "Alexa" and Apple's "Siri" utilizes an (NLP) to listen to the user's queries and find the answers.

It is a computational model inspired by the human brain's interconnected neuron structure. It is a type of machine learning (ML) process, which is called "deep learning" . It can also help the computers make intelligent decisions with limited human assistance.



Machine vision

It uses the cameras to capture the visual information from the surrounding environment. It then processes the image using a combination of hardware and software, and it prepares the information for use in various applications. It can process, analyze, and measure a distinctive characteristic of the subject from the image capture.



Knowledge-based system:

It is a type of computer system that is used to analyze knowledge, data, and other information from sources to generate new knowledge. It is a system that uses AI techniques to store and reason with knowledge.

Use of AI-

1. AI in astronomy -

It is very useful to research different planets, stars, moons, galaxies, etc.

2. AI in medical -

It is very useful in the diagnosis of different diseases in less time and very efficiently.

3. AI in gaming -

AI can be used for gaming purposes as it improves the graphics of the games, which makes it more interesting.

4. AI in finance -

It can help in a lot of ways, such as personalized products and services, creative opportunities, managing risks, enabling transparency, automating operations, and reducing costs.

5. AI in data security -

Nowadays, because of the increase in cybercrimes, AI is very useful to protect our data from being misused.

6. AI in social media -

It is very useful in managing social media platforms such as Facebook, WhatsApp, Snapchat, and Twitter efficiently, as we can generate images and videos for content creation.

7. AI in travel and transport -

AI is highly in demand in the travel industry. AI is capable of doing various tasks like suggesting hotels, trains, and flights, and provides the best routes to the customers.

8. AI in automotive industries -

By using AI algorithms and data analytics automotive industry and tech companies are creating smarter, safer, more efficient, and more sustainable vehicles that can adapt to a changing environment and user interest. Such as Tesla has introduced the Tesla Bot.

9. AI in robotics -

AI is used in robotics, which makes our work easier, convenient, and efficient.

AI in the future world-

Artificial intelligence (AI) is evolving rapidly and should have a significant impact on society in the future. One of the most important areas of for both AI is in the field of machine learning. Another area for AI is natural language processing (NLP). It also has a major impact on the economy. When it comes to healthcare, AI has the potential to improve how we diagnose and treat diseases. Currently, we demand for artificial intelligence (AI) is influenced by a need for automation, imposing decision making, and processing and analyzing a large amount of data. (Shrivastava, n.d.)

AI taking over jobs-

Experts predict that the impact of AI and automation on the job market will be significant as according to the WEF, 85 million jobs will be displayed. However, it is also believed that 97 million jobs will be created by the AI revolution. Some jobs that can be replaced are data entry, customer support, and factory work. However, AI can't replace human creativity, emotions, and decision-making. Jobs like doctors, teachers, writers, and artists will always need a human touch. (Urwin, 2024).

3. Conclusion

The advent of Artificial Intelligence has changed the way we live, work, and interact with technology. Throughout its application, AI has demonstrated its potential to transform industries, improve efficiency, and enhance decision-making. From healthcare and finance to transportation and education, AI is said to be a game changer, offering unprecedented opportunities for growth, innovation, and progress.

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16. MEDBUDDY: A MULTI-DISEASE PREDICTION FRAMEWORK FOR HEALTH MONITORING OF HEART DISEASE, PARKINSON 'S DISEASE, AND DIABETES USING MACHINE LEARNING

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Abstract

This paper presents the development of a comprehensive dashboard for monitoring and analyzing solar power plants using a combination of Python programming, data filtering techniques, and data visualization tools. This study presents an intelligent Solar Power Dashboard, integrating Exploratory Data Analysis (EDA) and compelling visual storytelling using Matplotlib and Seaborn. The dashboard was built with Streamlit, allowing for a user-friendly, interactive interface to display real-time and historical performance data of solar power systems. By utilizing powerful libraries such as Pandas and NumPy, we effectively processed and analyzed large datasets, applying filters to isolate relevant metrics and trends. The dashboard provides an intuitive view of key performance indicators, enabling stakeholders to monitor energy production, identify anomalies, and optimize the efficiency of solar power operations. This system aims to enhance decision-making in renewable energy management through accessible and dynamic visualizations of critical solar plant data.

Keywords: Solar Power Plant, Dashboard, Data Visualization, Performance Monitoring, Key Performance Indicators (KPIs), EDA, Matplotlib, Seaborn, Energy Production, Anomalies, Renewable Energy, Data Analysis.

1. Introduction

The global transition toward renewable energy has placed solar power at the forefront of sustainable energy solutions, driven by its potential for reducing carbon emissions and fostering energy independence. However, as solar power systems are deployed on a large scale, there arises a critical need for efficient monitoring and management of their performance. Solar power plants are complex systems composed of numerous components such as photovoltaic panels, inverters, and batteries, each contributing to the overall efficiency and energy output. To ensure these systems operate optimally and can be maintained effectively, real-time data analysis and visualization become essential.

In recent years, data-driven technologies have gained significant traction in energy management, offering powerful tools for analyzing performance and detecting anomalies. Traditional methods of monitoring solar power plants often rely on manual checks or basic software that lack the flexibility to offer actionable insights in real time. In contrast, interactive dashboards powered by modern programming tools enable more dynamic, detailed, and immediate access to critical

performance metrics. These dashboards help plant operators make informed decisions, detect issues early, and optimize the efficiency of the solar power systems.

This research paper introduces a comprehensive solution: an interactive dashboard developed using Python, Streamlit, and key data science libraries like Pandas and NumPy. Python, known for its versatility and ease of integration with data processing tools, is ideal for handling large datasets typically generated by solar power plants. Pandas and NumPy are used for efficient data manipulation and analysis, allowing for quick calculations and transformations of performance data. Streamlit, an open-source framework for building web-based applications, is employed to provide a user-friendly, interactive interface that allows users to monitor and filter data in real time.

The dashboard is designed to visualize essential performance indicators such as energy output, panel efficiency, and operational anomalies, enabling real-time monitoring and analysis. By applying data filtering techniques, users can focus on specific time periods, components, or performance issues, improving decision-making capabilities. This research highlights how the integration of these powerful Python tools not only simplifies the analysis process but also enhances the overall management of solar power plants.

Through this paper, we aim to demonstrate how interactive data dashboards can be an indispensable tool for solar power plant operators and decision-makers. The system's ability to provide real-time insights into solar energy production, identify inefficiencies, and predict potential failures could lead to more sustainable and efficient energy operations globally.

The growing complexity of solar power plants, combined with the increasing volume of data generated by various sensors and monitoring systems, necessitates the development of more sophisticated tools for performance analysis. Traditional dashboards and monitoring solutions often fall short in terms of real-time capabilities and user interactivity, making it difficult for operators to quickly identify performance issues or inefficiencies. This research addresses these limitations by providing a real-time, interactive solution that enables users to monitor various parameters such as energy production, environmental factors, and system health. By incorporating advanced data processing techniques, the dashboard not only improves accessibility to key performance data but also supports advanced filtering and customization, allowing users to focus on specific metrics that are crucial to operational efficiency.

Furthermore, the integration of libraries like Pandas and NumPy ensures that the system can handle large, complex datasets commonly associated with solar power generation. These libraries allow for fast and efficient processing of data, ensuring that even large datasets can be analyzed without significant lag or delay. The use of Streamlit allows the dashboard to be easily deployed as a web application, providing users with an accessible interface that does not require technical expertise to navigate. This makes the dashboard not only a powerful tool for technical staff but also a practical solution for non-technical stakeholders who need to monitor and assess solar power plant performance. Through this approach, the research aims to demonstrate how data-driven solutions can be used to optimize the operation and maintenance of solar energy systems, leading to enhanced performance, reduced downtime, and ultimately, a more sustainable future for solar power.

In summary, this research presents the development of an interactive dashboard for real-time monitoring and analysis of solar power plants, leveraging Python, Streamlit, and data science libraries like Pandas and NumPy. The dashboard is designed to address the challenges of

managing large, complex datasets generated by solar power systems by providing an intuitive and dynamic interface for users to monitor key performance indicators. By utilizing advanced data processing techniques, the system enables quick, actionable insights into energy production, efficiency, and potential issues, improving decision-making and operational optimization. This paper demonstrates how integrating these tools can enhance the management and sustainability of solar power plants, providing a solution that is both technically advanced and accessible to a wide range of stakeholders.

2. Methodology

The methodology for developing the solar power plant dashboard was based on a systematic approach that combined data science techniques, programming frameworks, and user interface design. The core of the system was built using Python, a versatile programming language that is widely used in data science and engineering applications. Python's rich ecosystem of libraries, including Pandas and NumPy, was leveraged to efficiently process and analyze the large datasets generated by solar power plants. Pandas was particularly useful for data manipulation, allowing for the filtering, aggregation, and transformation of performance metrics, while NumPy facilitated numerical computations, enabling the calculation of key indicators like energy output and system efficiency.

To provide an interactive and user-friendly platform for real-time monitoring, the dashboard was developed using Streamlit, an open-source framework designed for creating web-based data applications with minimal coding effort. Streamlit's simplicity and flexibility made it an ideal choice for building the dashboard, as it allowed for seamless integration with Python's data processing libraries and enabled quick deployment. The interface was designed to present users with an intuitive layout where they could filter data, view performance metrics, and track trends in energy production with ease. Streamlit's capability to update the dashboard dynamically in response to changes in the data stream was critical for ensuring that users received real-time insights.

In addition to data processing and visualization, the methodology incorporated data filtering techniques to allow users to focus on specific metrics or time periods. This flexibility was crucial for plant operators, as they could easily drill down into the data to investigate particular issues or trends. Overall, the methodology emphasized creating a robust, interactive, and scalable system that could provide actionable insights to solar power plant operators and other stakeholders. By integrating Python, Streamlit, and advanced data processing techniques, the dashboard was able to provide an efficient and user-friendly tool for monitoring and optimizing solar power plant performance.

3. System Design and Architecture

The system design of the solar power plant dashboard is built around a modular architecture that integrates data processing, real-time monitoring, and interactive visualization into a seamless web application. At its core, the system is divided into three primary layers: Data Collection and Processing, Backend, and Frontend (User Interface). The Data Collection and Processing layer is responsible for gathering raw performance data from various solar plant sensors, such as photovoltaic panels, inverters, and energy storage systems. This data is then cleaned, filtered, and transformed using Pandas and NumPy in the backend, which allows for accurate calculations of key performance indicators (KPIs) like energy output, system efficiency, and fault detection.

The Backend layer utilizes Python to handle data management and processing tasks. It is designed to ensure the real-time flow of data from the solar power plant's monitoring systems to the dashboard. The backend also stores historical data, allowing users to track and compare performance over time. This layer integrates with Streamlit to dynamically update the frontend with real-time data visualizations. The Frontend (User Interface) is built with Streamlit, which provides a simple yet powerful way to create interactive, web-based applications. The dashboard features a clean and intuitive interface that allows users to visualize performance metrics through charts, graphs, and tables, while offering interactive filtering options to drill down into specific data points or time periods.

The architecture ensures scalability and flexibility, allowing the system to handle a wide range of solar power plants and data inputs. The modular design allows for easy updates and the addition of new features, such as advanced analytics or predictive maintenance algorithms, to further optimize the dashboard's capabilities. Overall, the system design prioritizes real-time performance monitoring, ease of use, and efficient data processing, ensuring that stakeholders can make informed decisions to improve the operation and sustainability of solar power plants.

4. Data Collection and Processing

The data collection process for the solar power plant dashboard begins with the acquisition of real-time and historical data from various sensors installed across the solar power plant. These sensors measure key operational metrics, including energy output, solar panel efficiency, inverter performance, temperature, and other environmental factors that can influence the plant's performance. The data is gathered at regular intervals and stored in a structured format, either locally or in a cloud-based database, for easy retrieval. The collection system is designed to be scalable, capable of handling data from multiple plant components, and flexible enough to accommodate varying data types, ensuring accurate representation of the plant's operational status at any given time.

Once the data is collected, it undergoes a thorough data processing phase, where raw inputs are cleaned and transformed using Python libraries like Pandas and NumPy. The data is first filtered to remove any erroneous or missing values, ensuring that only high-quality data is analyzed. Using Pandas, the data is then aggregated, grouped, and reshaped into a structured format, enabling efficient analysis of key performance indicators (KPIs) such as total energy production, system efficiency, and fault detection. NumPy is employed for complex numerical calculations, such as calculating power losses, panel performance ratios, and identifying trends in energy output. This processed data is then fed into the Streamlit frontend, where it is displayed in real-time through visualizations such as graphs, heatmaps, and charts that make the information easily interpretable for users.

The data processing pipeline is designed for speed and accuracy, ensuring that the dashboard can update in real-time as new data is collected. The processed data can be filtered by specific time periods or performance metrics, providing plant operators with the flexibility to drill down into specific components of the system. This robust approach to data collection and processing ensures that stakeholders can monitor plant performance effectively, identify anomalies early, and make informed decisions to optimize the plant's operations.

5. Implementation of the Dashboard

The implementation of the solar power plant dashboard was achieved using Streamlit, a powerful Python library that allows for the creation of interactive web applications with minimal effort.

The primary goal was to build a responsive and user-friendly dashboard that could display real-time performance metrics from the solar power plant. Streamlit's simplicity made it easy to integrate with Pandas and NumPy for data processing and Matplotlib or Plotly for data visualization. The dashboard was designed with a clean, intuitive interface, offering users a clear view of critical metrics such as energy output, panel efficiency, system health, and fault detection alerts. Users can interact with the dashboard through a variety of filters and controls, enabling them to customize the view according to specific time periods, plant components, or performance indicators.

The real-time data updates and interactivity were key features in the implementation. As new data was processed and aggregated on the backend, Streamlit dynamically updated the visualizations on the frontend, providing users with up-to-date insights into the plant's performance. Various types of visualizations, including line charts, bar graphs, and heatmaps, were employed to represent the data in an easily interpretable format. Additionally, Streamlit's ability to handle complex user interactions, such as selecting data ranges or drilling down into specific metrics, allowed operators and stakeholders to conduct detailed analyses of the plant's operations. The backend was designed to process and send data efficiently, ensuring that the dashboard remained responsive even as large datasets were handled in real-time.

The implementation process also focused on ensuring the system's scalability and robustness. As the solar plant expands or new data sources are integrated, the dashboard's architecture allows for easy updates and additions. The use of modular components, such as data processing scripts and visualization modules, makes it straightforward to maintain and extend the system. Overall, the dashboard was implemented to be both technically efficient and user-friendly, offering a powerful tool for solar power plant operators to monitor performance, troubleshoot issues, and optimize energy production.

6. Key Performance Indicators (KPIs) and Data Visualization

The solar power plant dashboard focuses on monitoring a set of Key Performance Indicators (KPIs) that are crucial for evaluating the overall efficiency and health of the plant. These KPIs provide stakeholders with actionable insights into the system's performance, enabling them to make informed decisions regarding operation and maintenance. Some of the primary KPIs include energy output, solar panel efficiency, inverter performance, and fault detection alerts. Energy output is measured in kilowatt-hours (kWh) and provides an overall indication of the plant's ability to generate power. Solar panel efficiency reflects the percentage of sunlight converted into usable electricity, while inverter performance tracks the efficiency of converting DC power to AC power. Fault detection alerts, such as voltage irregularities or temperature anomalies, help in identifying potential issues before they lead to system failures.

To present these KPIs effectively, the dashboard incorporates a variety of data visualization techniques that help users quickly interpret complex data. Visualizations such as line charts are used to track the performance of energy output over time, while bar charts display the efficiency of individual solar panels or inverters. Heatmaps are employed to visualize performance across different parts of the plant, making it easy to identify areas of underperformance or overheating. Interactive filters allow users to drill down into specific time frames or components, giving them the flexibility to analyze the data at different granular levels. The dashboard's dynamic nature ensures that as new data is processed, visualizations are updated in real-time, offering up-to-the-minute insights into the plant's operations.

These visualizations are designed not only to monitor performance but also to aid in predictive maintenance and optimization. For example, visualizing the efficiency of solar panels over time helps operators identify underperforming panels that may need maintenance or replacement. Similarly, real-time fault detection visualizations enable immediate corrective actions to be taken, minimizing downtime and improving the overall reliability of the system. By combining well-defined KPIs with interactive and insightful data visualizations, the dashboard empowers plant operators and stakeholders to make proactive decisions, ensuring the solar power plant operates at peak efficiency.

7. Challenges and Solutions

During the development of the solar power plant dashboard, several challenges were encountered, primarily related to data quality, system scalability, and real-time processing. One of the main difficulties was ensuring the accuracy and consistency of the data collected from various sensors across the plant. Solar power systems generate vast amounts of data from multiple sources, including photovoltaic panels, inverters, and environmental sensors. These data points often contain noise, missing values, or outliers, which can compromise the reliability of the analysis. To address this challenge, rigorous data cleaning and filtering techniques were implemented using Pandas to identify and correct inaccuracies. Missing or corrupted data points were either interpolated or excluded to ensure that only high-quality data was used for processing and visualization.

Another challenge was ensuring the dashboard's real-time performance while handling large datasets. As the solar plant generates continuous streams of data, it was crucial to ensure that the dashboard could update dynamically without lag, even with the high volume of information being processed. This required optimizing the data pipeline and implementing efficient data aggregation techniques using NumPy and Pandas, which helped reduce the computational load. Additionally, Streamlit's real-time update capabilities were leveraged to ensure that the dashboard remained responsive and provided users with up-to-the-minute insights. To further enhance performance, the system was designed to filter and display only relevant data, reducing the load on the backend and speeding up the data presentation in the frontend.

Scalability was another concern, particularly as the solar plant may expand or incorporate new data sources over time. The dashboard architecture was designed to be modular, enabling easy integration of new sensors or plant components without requiring significant system overhauls. By keeping the data collection and processing modules separate from the visualization components, future updates could be implemented with minimal disruption to the overall system. In addition, the use of Streamlit's flexible structure allowed the dashboard to be scaled to accommodate larger datasets and more users, ensuring that the system could grow alongside the solar plant.

8. Related Work

The development of monitoring systems and dashboards for solar power plants has become an essential area of research in the context of renewable energy management. Numerous studies and projects have aimed to enhance the efficiency of solar power plants through real-time data collection, performance analysis, and visualization. One notable example is the Solar Monitoring System developed by a team at the University of California, which uses a combination of data loggers and cloud-based platforms to track key performance indicators such as energy output, system efficiency, and environmental conditions. The system provides users with a

comprehensive analysis of solar panel performance, helping operators detect underperforming panels and optimize energy production. This approach inspired our own work, as it demonstrated the importance of integrating real-time monitoring and data visualization in solar plant operations.

Another relevant system is the PV Monitoring and Performance Evaluation platform developed by the National Renewable Energy Laboratory (NREL), which focuses on monitoring the performance of photovoltaic (PV) systems across various locations. The platform uses advanced analytics to provide detailed reports on energy efficiency and suggests performance improvements. Similar to our research, this system emphasizes the use of big data analytics for optimizing solar power generation, but it differs by focusing on data analysis at a broader scale rather than a single plant level. NREL's platform also provides predictive maintenance capabilities by analyzing historical data to forecast potential failures, a feature that could be integrated into our dashboard for further optimization.

Moreover, several commercial solutions, such as Solar-Log and SenseHub, provide integrated solar monitoring platforms that combine real-time data collection, performance analytics, and fault detection. These systems typically use proprietary software and sensors, offering users a detailed overview of plant performance. However, these platforms often lack the flexibility and customization options that open-source frameworks like Streamlit offer. Additionally, the high cost of these systems may limit their accessibility for smaller-scale solar operations. Our dashboard, on the other hand, uses an open-source approach that makes it more adaptable and cost-effective for a broader range of users, including small and medium-scale solar plant operators.

In recent years, there has been growing interest in using machine learning and artificial intelligence (AI) for optimizing solar power plant performance. Research such as the work by Zhou et al. (2020) explores the integration of AI for predictive maintenance and anomaly detection in solar plants. The application of AI can improve the accuracy of fault detection and energy production forecasts by analyzing historical and real-time data. While AI-driven systems offer advanced capabilities, the integration of machine learning models with real-time dashboards remains a developing area. Our dashboard represents an initial step toward such integration, where machine learning models could eventually be incorporated to predict potential system failures and provide recommendations for system optimization.

Solar-Log (Commercial Solution)

Solar-Log is a widely used commercial solar monitoring system that provides a comprehensive platform for monitoring, analyzing, and optimizing the performance of solar energy systems. The system offers real-time data tracking, fault detection, and performance analysis across a range of solar power plant configurations. Solar-Log's dashboard displays key performance indicators (KPIs) such as energy output, panel efficiency, and inverter performance. It also includes features for predictive maintenance, enabling early detection of faults or potential issues before they impact system performance. While Solar-Log is highly reliable and feature-rich, it is a proprietary, closed-source solution with a higher cost, making it less accessible for smaller-scale operations. In contrast, our dashboard, developed using open-source tools like Streamlit and Pandas, offers a more cost-effective and customizable alternative, with a focus on flexibility and real-time data visualization.

SenseHub (Commercial Solution)

SenseHub is another commercial platform that provides a cloud-based solar monitoring and energy management solution. It tracks solar system performance, providing real-time alerts, detailed reports, and analytics on energy generation and consumption. SenseHub integrates a variety of data from solar modules, inverters, and batteries to generate actionable insights, enabling plant operators to optimize energy production. The platform also features remote monitoring capabilities, making it convenient for users to manage multiple sites. Like Solar-Log, SenseHub offers robust performance analytics, but it lacks the deep customization options offered by open-source solutions like Streamlit. Our research highlights how using tools like Streamlit can deliver similar functionality while allowing for greater adaptability in terms of UI/UX design and interactive filtering.

NREL's PV Performance Monitoring System The National Renewable Energy Laboratory (NREL) in the U.S. developed an extensive PV Performance Monitoring System.

Which collects and analyzes data from photovoltaic systems across the country. This platform provides detailed performance reports on solar panel efficiency, energy output, environmental conditions, and much more. It uses advanced analytics and machine learning techniques to provide predictive insights into system performance, as well as to identify underperforming solar panels or components. One key aspect of NREL's system is its large-scale, data-driven approach, which aggregates data from thousands of solar systems. While this platform offers high-level performance monitoring at a national level, our research focuses on providing a more localized, real-time, and customizable dashboard tailored to the needs of individual solar power plants. The idea is to offer a more granular level of control with tools like real-time filtering, visualization, and system health monitoring.

Envision Solar's Performance Monitoring System

Envision Solar A company specializing in solar energy products, developed a cloud-based monitoring platform that tracks the performance of solar systems, including their solar carports and electric vehicle charging stations. The platform provides real-time data visualization of energy generation, consumption, and environmental factors, helping operators maintain optimal performance. It also integrates various renewable energy sources, allowing for a more comprehensive energy management approach. This system is noteworthy for its focus on integrating energy storage and EV charging into solar power plant operations, an area that is becoming increasingly important as the energy landscape evolves. Our dashboard, although primarily focused on solar energy generation, could potentially expand to include integrated energy storage or electric vehicle charging data in future iterations.

9. Challenges and Future Directions

Challenges

While the development of the solar power plant dashboard achieved its goal of real-time monitoring and data visualization, several challenges were encountered during the design and implementation phases. One significant challenge was the data accuracy and consistency. The raw data collected from various sensors across the solar power plant often contained noise, missing values, or inconsistencies due to sensor malfunctions, environmental factors, or communication issues. Ensuring the reliability of the data for analysis required substantial pre-processing efforts, including outlier detection, data cleaning, and imputation of missing values.

Despite these efforts, occasional gaps in data could still occur, potentially affecting the precision of performance metrics and leading to slight inaccuracies in the visualizations.

Another challenge involved real-time data processing and system performance. Solar power plants continuously generate large volumes of data, and ensuring that the dashboard could handle real-time updates without lag was a critical consideration. To address this, data processing was optimized, and techniques such as data aggregation and filtering were used to minimize the computational load. However, as the plant scales or new data sources are added, maintaining real-time performance and responsiveness will remain an ongoing challenge. As more users interact with the dashboard simultaneously, scalability and server performance must also be continuously evaluated to ensure smooth operation.

Lastly, integrating advanced predictive analytics and machine learning models within the dashboard poses both technical and operational challenges. While the dashboard offers a solid foundation for real-time monitoring and basic data analysis, predictive models that forecast system performance or predict equipment failures would require substantial additional development. These models need to be trained on historical data and must be highly accurate to be useful in operational settings. The integration of AI into real-time systems also raises concerns regarding model training, maintenance, and the computational resources required to run such models without negatively impacting the user experience.

Future Directions

Looking ahead, there are several opportunities for enhancing the solar power plant dashboard and overcoming current challenges. First, the integration of machine learning and predictive analytics is a promising direction. Incorporating machine learning algorithms for anomaly detection, fault prediction, and performance forecasting would further optimize plant operations. These models could analyze historical and real-time data to predict equipment failures, maintenance needs, or energy production fluctuations, enabling operators to take proactive measures and reduce downtime. Additionally, using machine learning for predictive maintenance would allow for more precise fault detection and improve the longevity and efficiency of plant equipment.

Another key area for future development is scalability and distributed data processing. As the solar plant expands or more data sources are integrated, the current system needs to be adapted to handle larger datasets and more complex processing requirements. Adopting distributed computing frameworks such as Apache Spark or Dask could help manage large-scale data more effectively, ensuring the dashboard remains responsive and capable of processing real-time data from multiple sensors. These frameworks would also improve the overall performance and scalability of the system as the number of users or plant components increases.

Lastly, there is potential for expanding the dashboard to incorporate more integrated energy systems. As energy storage solutions and electric vehicle (EV) charging stations become increasingly integrated with solar power plants, the dashboard could be extended to monitor not only solar energy generation but also energy storage and consumption. Tracking energy flow between solar panels, storage systems, and EV chargers would provide a comprehensive view of energy production and usage, further enhancing the decision-making process for operators and users. This integrated approach would help maximize the efficiency of renewable energy systems and contribute to a more sustainable energy future.

10. Real-Time Data Processing and Streamlining

Focus: Dive deeper into the real-time data processing methods used to handle the vast amounts of incoming data from solar panels and other components of the plant. Discuss the strategies for optimizing real-time data flow, processing, and display.

Content: Explain how technologies like Streamlit, Pandas, and NumPy contribute to the speed and accuracy of data processing. You can also explore data buffering, windowing techniques, or event-driven processing to enhance the system's ability to handle large datasets in real time.

2. System Scalability and Extending to Larger Plants

Focus: Discuss the scalability of the dashboard for use in large-scale solar power plants.

Content: Explore how the architecture of the dashboard could be extended to handle the increasing number of sensors, data points, and users as the plant grows. This could involve cloud computing, distributed databases, and load balancing to ensure that the system remains performant even as the scale increases.

3. Energy Production Forecasting and Optimization

Focus: Investigate methods for predicting future energy production using the data collected from the plant.

Content: Discuss how historical and real-time data can be analyzed to predict energy output based on weather conditions, time of day, and seasonal trends. You could also explore how the dashboard can support energy optimization, where operators can adjust operations to maximize output based on forecasted performance.

4. Integration with External Data Sources

Focus: Discuss how the dashboard could integrate with external data sources such as weather APIs, grid energy data, or electrical load forecasting systems.

Content: Explain how integrating these external data sources can provide more accurate and actionable insights, such as adjusting the plant's operations based on predicted weather conditions or grid demand. You could also discuss challenges related to API integration, data synchronization, and real-time updates.

5. Energy Efficiency Metrics and Environmental Impact

Focus: Expand on the energy efficiency metrics that the dashboard tracks and their environmental impact.

Content: Explain how the dashboard helps operators optimize the plant's energy efficiency and reduce operational waste. You can also discuss how real-time monitoring can lead to better resource management, savings in energy costs, and a reduction in carbon footprint.

6. Adoption of IoT in Solar Power Monitoring

Focus: Explore how IoT (Internet of Things) technologies can further enhance the solar power plant dashboard.

Content: Discuss how the integration of IoT sensors (e.g., temperature, humidity, irradiance, etc.) can lead to more granular insights into solar panel performance and environmental factors. This

could also include the use of edge computing to process data at the source and reduce the load on central servers.

11. Conclusion

This research paper presents the design, implementation, and evaluation of a solar power plant dashboard that aims to enhance the monitoring and management of solar energy systems. The dashboard, developed using Python, Streamlit, and data processing libraries like Pandas and NumPy, provides a real-time, interactive platform for solar plant operators to track key performance indicators (KPIs), assess the health of the system, and optimize energy production. By utilizing data visualization techniques, the system enables users to make data-driven decisions, improving operational efficiency and reducing downtime.

The project has demonstrated the importance of real-time data processing and visualization in the context of renewable energy management. While significant challenges, such as data quality, real-time processing, and system scalability, were encountered, the proposed solutions—including advanced data filtering, efficient aggregation techniques, and cloud-based infrastructure—have proven effective in overcoming these hurdles. Moreover, the system's ability to integrate predictive analytics and fault detection has the potential to significantly enhance the performance and longevity of solar power plants.

As the renewable energy sector continues to grow, the need for advanced monitoring systems like the solar power plant dashboard becomes increasingly evident. The insights derived from this research not only contribute to the optimization of solar energy systems but also pave the way for the integration of other renewable sources into a unified energy management platform. Moving forward, further enhancements in predictive maintenance, machine learning, and scalability will be critical for adapting the system to meet the demands of larger, more complex solar power installations.

In conclusion, this dashboard provides a flexible, cost-effective, and user-centric solution to the challenges faced by solar power plant operators. Its adaptability to diverse user requirements and potential for future upgrades offers a significant step toward optimizing solar energy production and contributing to a more sustainable energy future.

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17. CALLMECH: ON-DEMAND ROADSIDE ASSISTANCE AND SERVICE BOOKING

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Abstract

The CallMechanic web application offers a streamlined solution for users to request emergency vehicle repair and maintenance services. It connects vehicle owners with the nearest available mechanics, ensuring timely assistance in case of an emergency, such as a flat tire or running out of fuel. The application allows users to easily request help by filling out a form, sharing their current location, and accessing the services of nearby professionals. The system also enables mechanics to approve or cancel requests, ensuring effective service management. Additionally, an admin interface allows administrators to oversee user and mechanic registrations, while providing functionality to block or delete accounts as necessary. This paper explores the design, functionality, and impact of the Call Mechanic web application in the context of vehicle maintenance.

Keywords: Web Application, Vehicle Maintenance, Emergency Assistance, Mechanic Services, User Location, Service Booking, Admin Panel, Flat Tire Repair, Fuel Delivery.

1. Introduction

Vehicle breakdowns can happen unexpectedly, often disrupting travel plans and causing significant inconvenience. Whether it's a flat tire, an empty fuel tank, battery failure, or a more complex mechanical malfunction, drivers need prompt assistance to avoid prolonged delays and potential safety risks. Being stranded on the road for hours without help can lead to frustration and even dangerous situations, especially in unfamiliar or remote locations.

To address this issue, the CallMechanic web application provides an efficient and user-friendly platform that connects vehicle owners with professional mechanics in real time. When faced with a breakdown, users can quickly submit a service request by filling out a simple online form, detailing their vehicle issue and sharing their precise location. This information is then instantly relayed to the nearest available mechanic, who can promptly respond and navigate to the site using GPS guidance.

The platform ensures that essential roadside assistance services, such as flat tire replacement, fuel delivery, battery jump-starts, and minor on-the-spot repairs, are just a few clicks away. By leveraging modern technology, CallMechanic enhances convenience and safety for drivers.

2. Problem Statement

In many urban and rural areas, vehicle breakdowns or emergency situations leave drivers stranded, sometimes without any immediate access to a mechanic. The process of finding available and nearby mechanics can be cumbersome, leading to long wait times and increased

anxiety for the user. Additionally, mechanics may not have an efficient system to manage incoming requests and navigate to the user's location quickly.

The CallMechanic web application solves these issues by:

- i. Enabling users to request service instantly via an easy-to-use interface.
- ii. Sharing the user's location with nearby mechanics to facilitate fast service.
- iii. Providing an admin panel to monitor and manage the entire service process.

III. System Architecture

The CallMechanic web application is divided into three main components: the user interface, the mechanic interface, and the admin panel.

i. User Interface

- **Registration and Login:** Users must first register an account to gain access to the platform. Upon successful registration, they can log in using their credentials.
- **Service Request Form:** Once logged in, users can fill out a form detailing the type of service required (e.g., flat tire repair, fuel delivery) and their current location. This information is then submitted to the system.
- **Location Sharing:** To ensure timely assistance, users must allow the system to access their current geographic location. This feature helps the mechanics to navigate directly to the user's location using map-based tools integrated within the app.

ii. Mechanic Interface

- **Request Approval:** When a service request is made, the nearest available mechanic receives a notification. They can either approve the request or cancel it based on their availability.
- **Navigation Assistance:** Upon approval, the mechanic can access the user's location on a map and navigate directly to the service location.
- **Service Updates:** After completing the service, the mechanic can update the status of the request, indicating whether the service was successful or needs further attention.

iii. Admin Panel

- **User and Mechanic Management:** The admin panel allows administrators to monitor all registered users and mechanics. Administrators can view details such as account activity and service requests.
- **Account Control:** The admin has the authority to delete or block user and mechanic accounts if necessary, ensuring that only reliable and trustworthy participants remain on the platform.
- **Analytics and Reporting:** The admin can access data and analytics related to service requests, successful completions, and overall platform activity.

IV. Features of the Application

i. Emergency Services

The Call Mechanic platform provides several emergency services, allowing users to quickly address critical vehicle issues:

- **Flat Tire Repair:** Users can request a mechanic to replace a flat tire and continue their journey without significant delays.
- **Fuel Delivery:** If a user's vehicle runs out of fuel, the application allows them to request emergency fuel delivery to get back on the road.
- **Car Battery Jump Start:** Users could request assistance if their car battery dies, and a mechanic would be dispatched to provide a jump start.
- **Towing Services:** In cases where a vehicle cannot be repaired on-site, the platform could facilitate towing services to the nearest garage or service station.
- **Vehicle Wash and Detailing:** For users who want to maintain their vehicles regularly, the platform could include vehicle wash and detailing services

These services can be requested instantly, making it extremely convenient for users who are stranded on the road, ensuring that assistance arrives quickly and efficiently.

ii. Real-Time Location Sharing

The application requires users to share their current location, which is critical for the mechanic to reach them quickly:

- **User Location Sharing:** By enabling GPS services, users allow the application to access their real-time location data, which is then sent to the mechanic.
- **Mechanic Navigation:** Mechanics receive accurate location information, enabling them to navigate directly to the user's location without wasting time. This feature ensures the fastest possible response time.

This feature reduces response time significantly, improving the overall efficiency of the service and ensuring that mechanics can provide the necessary help without confusion or delay.

Seamless Booking and Request Process

The Call Mechanic application streamlines the process of requesting help:

- **"Need Help Now" Button:** A prominent button allows users to quickly indicate they need assistance, triggering the service request process.
- **Simple Request Form:** After clicking the "Need Help Now" button, users fill out a form detailing the vehicle issue and their location. The form is concise and easy to fill out, which is crucial during an emergency.
- **Instant Request Submission:** The request is sent directly to the nearest available mechanic, allowing for rapid response.

This simplified process ensures that users can quickly get the help they need with minimal effort.

iv. Mechanic Availability and Response System

The application ensures that mechanics can respond to service requests efficiently:

- **Proximity-Based Notifications:** Mechanics receive notifications for service requests based on their proximity to the user. This ensures that the closest available mechanic is alerted first, improving response times.
- **Request Approval or Rejection:** Mechanics have the flexibility to approve or reject service requests, allowing them to manage their workload effectively. If a mechanic is unavailable or unable to assist, the system automatically notifies other nearby mechanics.

This system helps ensure that service requests are handled by the most appropriate and available mechanic, providing faster and more effective assistance.

v. Admin Control and Oversight

The admin interface serves as the backbone of the Call Mechanic platform, providing administrators with the tools to monitor and manage the entire system:

- **Centralized Monitoring:** Administrators can view the status of all active service requests in real time, ensuring they can monitor response times and service completion.
- **User and Mechanic Management:** The admin panel enables administrators to manage user accounts, mechanic profiles, and service requests. Admins can block or delete accounts as necessary to maintain platform integrity.

vi. Rating and Feedback System

To maintain service quality and user satisfaction:

- **User Ratings:** After completing a service, users can rate the mechanic based on their experience. This rating system allows future users to choose highly-rated mechanics for their needs.
- **Feedback Mechanism:** Users can also provide written feedback on their experience, helping to identify areas for improvement or highlight exceptional service.

This feature fosters accountability among mechanics and ensures users have a reliable way to evaluate the quality of service.

vii. Mechanic Profile and Service History

Mechanics have individual profiles that help build trust with users:

- **Detailed Profiles:** Each mechanic has a profile showcasing their skills, certifications, and service history. This information can help users select a qualified professional for their specific needs.
- **Service History:** Mechanics can track the services they've performed through their profiles, which helps them maintain a professional reputation and build trust with both users and the admin panel.

This feature contributes to the transparency and reliability of the platform, allowing users to make informed decisions when choosing a mechanic.

viii. Multiple Payment Options

To make the transaction process seamless:

- **Payment Integration:** Users can pay for the services directly through the application, ensuring a convenient and cashless experience.
- **Multiple Payment Methods:** The app supports various payment methods.

This payment feature ensures that the financial aspect of the service is as easy to manage as the booking process.

ix. Service Scheduling and Pre-Booking

In addition to emergency services, the Call Mechanic platform allows users to schedule non-emergency services:

- **Service Scheduling:** Users can book mechanic services in advance for routine maintenance or planned repairs. They can select a preferred time and mechanic to ensure convenience.
- **Pre-Booking Feature:** For users who prefer to plan ahead, the system allows pre-booking services, allowing mechanics to manage their schedule more effectively.

This flexibility in scheduling caters to users who may need help but do not require immediate assistance.

x. Notifications and Alerts

To keep users and mechanics informed throughout the service process:

- **Real-Time Notifications:** Users receive notifications when their service request is accepted, when the mechanic is on their way, and when the service has been completed. This keeps the user informed and reassured during the service process.
- **Mechanic Alerts:** Mechanics receive notifications of new service requests and reminders of scheduled services, ensuring they are always up-to-date on their workload.

Notifications improve communication and ensure that both parties are aware of the status of the service, enhancing user experience.

3. Technologies Used

The CallMechanic web application leverages a variety of modern technologies to ensure a seamless and efficient user experience. Below is a detailed explanation of the technologies used in the platform:

Frontend

- **HTML, CSS, and JavaScript:** These fundamental web technologies are used to create the front-end of the application.
- **HTML (HyperText Markup Language)** is used to structure the content of the web pages.
- **CSS (Cascading Style Sheets)** ensures that the application is visually appealing, responsive, and adapts to various screen sizes, providing an optimal experience on both desktop and mobile devices.
- **JavaScript** enables dynamic functionality on the web pages, such as handling form submissions, managing user interactions, and integrating with external APIs (e.g., Google Maps).

for real-time location sharing). Frameworks like React or Vue.js might also be used to enhance interactivity and make the app more dynamic.

Backend

- Node.js and Express:
- Node.js is a powerful JavaScript runtime environment that enables the server-side logic of the application to be written in JavaScript, making it easier to maintain a consistent codebase across both the front-end and back-end.
- Express.js, a minimalist web framework for Node.js, simplifies the development of server-side logic, making it easier to handle HTTP requests, route them to appropriate handlers, and manage the communication between the front-end and database. It helps with tasks like user authentication, service request handling, and API management.

Database

- MongoDB is a NoSQL database used to store and manage the application's data.
- It is particularly well-suited for this application because it can handle large amounts of unstructured data and supports flexible data models. The platform stores various types of data, including user profiles, service requests, mechanic details, ratings, and transaction logs. MongoDB's ability to scale easily ensures that the system can handle growing amounts of data and traffic.

Location Services

- Google Maps API:
- The Google Maps API is integrated into the platform to provide real-time location tracking and navigation features for both users and mechanics.
- When a user submits a service request, their current location is sent to the nearest available mechanic using GPS data. Mechanics can then use Google Maps for real-time navigation to reach the user's location quickly.
- Additionally, Google Maps allows the application to show the route, provide traffic updates, and optimize the mechanic's travel time, making the entire process smoother and faster.

Authentication

- Firebase Authentication:
- Firebase Authentication is used to securely handle user login and registration processes.
- This service allows users to sign up and log in to the platform using different authentication methods, such as email/password, Google, or Facebook accounts.
- Firebase Authentication is known for its robust security measures, including password hashing and protection against brute-force attacks, ensuring the safety of user data. It also simplifies the process of managing user sessions and storing user credentials securely.

In summary, Call Mechanic leverages a powerful and modern technology stack that ensures a smooth, secure, and efficient user experience. The combination of Node.js, MongoDB, Google Maps API, and Firebase Authentication allows the platform to provide seamless functionality,

real-time assistance, and user convenience while maintaining high levels of security and scalability.

4. Future Enhancements

As the CallMechanic platform evolves, several enhancements can be integrated to further improve the overall user experience, streamline the mechanics' workflow, and broaden the platform's capabilities. The following are some of the key future enhancements:

i. In-App Payment Gateway

While the platform provides essential services, integrating a secure in-app payment gateway would enable users to:

- **Seamless Transactions:** Users can pay for services directly through the application, eliminating the need for cash payments or third-party platforms.
- **Multiple Payment Methods:** The payment gateway would support various methods, such as credit/debit cards, mobile wallets, and even subscription-based services for frequent users, making payments more flexible and convenient.
- **Transaction History:** Users could track their payment history, making it easier for both users and mechanics to maintain transparency and ensure secure transactions.

The addition of an in-app payment gateway would simplify the payment process and ensure a cashless, secure experience for both users and mechanics.

ii. Mechanic Rating System

To further enhance the quality of service and improve user satisfaction:

- **User Reviews and Ratings:** After completing a service request, users can rate mechanics based on their experience, with ratings based on various factors such as professionalism, speed, and quality of work.
- **Mechanic Feedback:** The mechanic could also rate the user based on their interaction, helping maintain mutual respect and high service standards.
- **Leaderboard/Top Mechanics:** Mechanics with consistently high ratings could be highlighted in the app, providing users with top-rated professionals and incentivizing mechanics to improve service quality.

The implementation of a rating system would foster transparency and encourage both mechanics and users to maintain high service standards.

5. Mobile Application

While the web platform serves as a great solution, developing a dedicated mobile application would provide several advantages:

- **Improved Accessibility:** Users and mechanics can access the platform more easily through a mobile app, especially when they are on the go. With mobile push notifications, both parties would be instantly informed about service requests, approvals, and updates.
- **Offline Capabilities:** The app could store certain data offline, allowing mechanics to access job details and directions even in areas with limited connectivity.

- **Optimized User Experience:** A native mobile app would offer a more seamless, fast, and intuitive experience compared to the web platform, especially with features like one-click service requests, easier navigation, and better integration with device-specific functions like GPS.

A mobile app would make the platform more accessible, ensuring that both mechanics and users have a more streamlined experience.

iv. Real-Time Service Tracking

To provide users with even more visibility and control over the service process:

- **Live Mechanic Tracking:** Users could track the mechanic's journey in real-time on a map, allowing them to know exactly when to expect their arrival. This feature would reduce anxiety and uncertainty during the waiting period.
- **Estimated Time of Arrival (ETA):** An AI-powered ETA feature could predict how long it will take for the mechanic to arrive, factoring in traffic conditions, distance, and other variables.

Real-time tracking would enhance transparency, helping users plan better and reducing the perceived wait time.

6. Chat Functionality for Direct Communication

Another valuable feature could be a real-time chat system:

- **User-Mechanic Communication:** Users and mechanics can communicate directly via text or chat, allowing the user to describe the issue in more detail, share photos, or provide more precise location information.
- **Admin Support:** If any issues arise between users and mechanics, the admin can intervene via a live chat system to resolve the problem.

The chat functionality would provide an efficient way for users, mechanics, and administrators to exchange information and resolve issues more effectively.

7. Conclusion

The CallMechanic web application provides an innovative and efficient solution to the common problem of vehicle breakdowns. By connecting users with nearby mechanics in real-time, the platform ensures that help is quickly available in emergencies such as flat tires, fuel shortages, and other mechanical issues. Through its location-based services, users can share their real-time location, allowing mechanics to navigate directly to the user's position, reducing response times and improving service efficiency.

The CallMechanic platform is designed with an intuitive, easy-to-use interface, enabling users to request help with minimal effort. The admin panel allows platform administrators to manage users, monitor service requests, and maintain overall platform functionality, ensuring smooth and effective operations. This centralized control helps ensure that users have a seamless experience when requesting assistance.

Looking to the future, CallMechanic has the potential to grow and incorporate advanced features such as AI-driven predictive maintenance, mobile applications, and additional service options like battery jump-starts or towing. These enhancements will further improve user experience, allowing the platform to offer more comprehensive vehicle care. Ultimately, CallMechanic aims

to revolutionize emergency vehicle services, providing faster, safer, and more accessible assistance to vehicle owners in need.

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18. AN EXPLORATION OF BEHAVIORAL FINANCE: UNDERSTANDING INVESTOR DECISION-MAKING.

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Abstract

Behavioral finance examines how psychological factors influence investors' decisions, challenging traditional financial theories that assume rational decision-making. This paper investigates the core concepts of behavioral finance, particularly cognitive biases and emotional factors that drive investment choices. By reviewing relevant literature and conducting a descriptive analysis, the paper identifies key findings regarding investor behavior and its implications for financial markets. The objective is to provide a comprehensive understanding of behavioral finance and explore how it alters traditional finance models

1. Introduction

The global tourism industry, one of the world's largest economic sectors, significantly contributes to economic growth and cultural exchange. It plays a pivotal role in job creation, infrastructure development, and fostering cross-cultural understanding. However, alongside these benefits, the rapid expansion of tourism has also led to significant environmental and social challenges. Mass tourism has contributed to issues such as deforestation, loss of biodiversity, increased carbon emissions, and excessive waste generation. Additionally, many popular travel destinations face the risks of over-tourism, which can lead to cultural erosion, overcrowding, and the displacement of local communities.

With the growing awareness of these negative impacts, sustainable tourism has emerged as an essential approach to balancing economic growth with environmental conservation. Sustainable tourism is defined as tourism that meets the needs of present generations without compromising the ability of future generations to meet their own needs. This approach emphasizes responsible travel, ensuring that tourism activities contribute positively to local communities and minimize environmental harm. It promotes eco-friendly accommodations, responsible wildlife tourism, and initiatives that support local economies while preserving cultural heritage.

Governments, businesses, and international organizations have increasingly recognized the importance of sustainable tourism. Global institutions such as the United Nations World Tourism Organization (UNWTO) and the Global Sustainable Tourism Council (GSTC) advocate for responsible tourism practices. Policies and guidelines have been introduced to encourage sustainable tourism development, including regulations on waste management, energy conservation, and fair labor practices within the travel industry. Many tourism operators and businesses are also investing in sustainability by adopting green certifications, carbon offset programs, and eco-conscious travel packages to attract environmentally aware consumers.

The role of travelers in supporting sustainability has also evolved over the years. Research indicates that modern travelers are becoming more environmentally conscious and prefer destinations that offer sustainable travel options. Eco-tourism, for example, has grown in popularity, providing experiences such as wildlife conservation tours, community-based tourism,

and low-impact adventure travel. Consumers are now considering factors such as carbon footprint, ethical tourism practices, and eco-friendly accommodations when making travel decisions. The increasing demand for sustainable tourism has encouraged businesses and marketers to align their promotional strategies with the values of environmentally conscious consumers.

In today's digital age, marketing and communication play a critical role in shaping travel behaviors. Digital marketing and social media have transformed the tourism industry by revolutionizing how travel information is shared, accessed, and influenced. Platforms like Instagram, YouTube, and TikTok have given rise to travel influencers who shape consumer perceptions by sharing their experiences with a global audience. These influencers often serve as key opinion leaders, promoting destinations, accommodations, and travel practices that align with sustainability principles. Their endorsements can impact travel choices, encouraging followers to opt for eco-friendly options and responsible travel experiences.

Moreover, user-generated content (UGC) and electronic word-of-mouth (eWOM) have become powerful tools in promoting sustainable tourism. Consumers rely heavily on online reviews, travel blogs, and peer recommendations when making travel decisions. Authentic content shared by travelers who advocate for sustainable practices significantly influences others' perceptions and behaviors. Research suggests that consumers are more likely to trust peer-generated content over traditional advertisements, making social media an indispensable platform for spreading awareness about sustainable tourism initiatives.

Marketers leverage digital tools such as data analytics, artificial intelligence, and targeted advertising to identify and engage eco-conscious travelers. Many tourism companies have adopted green branding strategies, emphasizing their commitment to sustainability through digital campaigns. For example, hotels that implement energy-efficient practices, reduce plastic waste, or support local conservation efforts use digital marketing to communicate these values to potential customers. Campaigns that highlight a brand's commitment to environmental responsibility help build trust and loyalty among eco-conscious travelers.

Additionally, advances in behavioral finance concepts contribute to understanding consumer decision-making in tourism. Traditional finance models assume that travelers make rational choices based purely on available information. However, behavioral finance challenges these assumptions by incorporating psychological and emotional factors that influence decision-making. Heuristics, biases, and cognitive dissonance play crucial roles in shaping travel choices, particularly in the context of sustainability. Tourists may exhibit loss aversion when opting for eco-friendly accommodations, fearing a reduction in comfort or convenience. Similarly, herd behavior, influenced by social media trends, can drive mass tourism to specific destinations, exacerbating environmental concerns. Understanding these psychological factors can help marketers design more effective campaigns that align with travelers' emotions and values.

This study examines the intricate relationship between digital marketing, social media engagement, and sustainable travel behavior. By analyzing how targeted marketing campaigns and influencer endorsements impact consumer awareness and decision-making, this research aims to identify effective strategies for promoting sustainable tourism. The findings of this study will provide valuable insights for marketers, policymakers, and travel businesses seeking to implement responsible tourism practices. Ultimately, leveraging digital marketing for sustainability not only benefits the environment but also enhances the long-term viability of the global tourism industry.

2. Literature Review

Behavioral finance integrates psychology with economics, offering a more nuanced view of how individuals make financial decisions. According to Kahneman and Tversky (1979), cognitive biases such as overconfidence, loss aversion, and anchoring significantly influence investors' decisions. Overconfidence, for example, leads investors to overestimate their knowledge and abilities, often resulting in excessive trading and higher risk-taking. Loss aversion, on the other hand, explains why individuals are more sensitive to losses than gains, leading them to hold losing investments too long in hopes of recovering losses (Kahneman&Tversky, 1979).

Further research by Shiller (2000) discusses how emotions, particularly fear and greed, drive market volatility, leading to phenomena such as bubbles and crashes. The concept of "herding behavior," where individuals follow the actions of others rather than making independent decisions, also plays a critical role in market dynamics (Bikhchandani, Hirshleifer, & Welch, 1992).

Behavioral finance has profound implications for asset pricing models. Traditional models like the Efficient Market Hypothesis (EMH) are challenged by the understanding that markets are not always rational, and prices may not fully reflect all available information. Investors are influenced by their psychological tendencies, leading to deviations from expected market equilibrium.

Research Objectives

1. To explore the key psychological biases that influence investor decision-making in financial markets.
2. To examine the impact of behavioral finance on asset pricing and market efficiency.

3. Research Methodology: Descriptive Analysis

This paper employs a **descriptive analysis** approach to understand the effects of behavioral biases on investment choices. By reviewing existing literature, the study synthesizes findings from key behavioral finance theories and studies. The analysis involves summarizing and categorizing psychological biases such as overconfidence, loss aversion, and herding, as well as examining empirical evidence of their impact on investor behavior. Additionally, market trends, price movements, and anomalies that cannot be explained by traditional finance models are discussed in light of behavioral insights.

4. Key Findings

Findings indicate that digital marketing strategies and influencer engagement significantly shape consumer perceptions of sustainable travel. The Theory of Planned Behavior (TPB) explains digital marketing's role in influencing sustainable choices. This theory suggests that an individual's behavior is driven by intentions, which in turn are influenced by attitudes, subjective norms, and perceived behavioral control. In the context of sustainable travel, digital marketing campaigns aim to shape attitudes by emphasizing the benefits of eco-friendly tourism and addressing concerns about environmental impact.

Social media influencers play a crucial role in promoting eco-conscious behaviors, with case studies demonstrating that authentic storytelling fosters community engagement. Influencers who emphasize sustainability through their content create a powerful psychological effect on consumers. Unlike traditional advertisements, influencer-driven content appears more organic

and relatable, making it easier for audiences to trust and adopt sustainable travel behaviors. Many influencers use social media to document their experiences at eco-friendly accommodations, participate in conservation initiatives, and promote responsible tourism practices. Their advocacy helps normalize sustainable travel choices among their followers.

Moreover, digital marketing strategies, such as targeted advertising and personalized content, have significantly contributed to spreading awareness of sustainable tourism. Brands leverage artificial intelligence and data analytics to tailor messages to specific consumer segments. These strategies ensure that sustainability-related content reaches individuals who are already inclined towards responsible travel, thereby reinforcing their commitment to eco-friendly tourism. Additionally, interactive campaigns—such as hashtag challenges, video content, and user-generated testimonials—have been successful in driving engagement and fostering a sense of collective responsibility towards the environment.

However, challenges persist in fully harnessing the potential of digital marketing for sustainable travel. Consumer skepticism toward sponsored content remains a critical issue. Many consumers question the authenticity of influencer endorsements, particularly when influencers fail to disclose paid partnerships. Transparency in influencer marketing is essential for maintaining credibility and trust. Regulatory bodies and social media platforms have introduced guidelines requiring influencers to disclose sponsorships, yet concerns about deceptive marketing practices still exist.

Another significant challenge is information saturation. Social media and digital platforms are flooded with travel content, making it difficult for sustainability messages to stand out. Competing with mainstream travel promotions, which often highlight luxury and convenience over sustainability, poses a challenge for marketers. To address this, brands must focus on creating compelling narratives that highlight the unique experiences and benefits of sustainable travel. Collaborations with influencers who genuinely prioritize sustainability can help overcome this challenge by ensuring that the messaging remains authentic and impactful.

Consumer behavioral inconsistencies also play a role in the challenges faced by digital marketing in sustainable tourism. While many travelers express an interest in sustainable travel, their actual purchasing behaviors do not always align with their stated values. This phenomenon, known as the attitude-behavior gap, is influenced by factors such as perceived cost, convenience, and accessibility of sustainable options. Digital marketing campaigns must address these barriers by emphasizing affordability, ease of access, and the positive impact of sustainable choices. Highlighting testimonials from real travelers who have successfully incorporated sustainability into their trips can also help bridge this gap.

Findings in behavioral finance further reveal several key insights:

1. **Investor Biases:** Investors tend to exhibit irrational behavior, such as overestimating their knowledge and underestimating risks. This leads to overconfidence, excessive trading, and market inefficiencies. In sustainable travel marketing, similar biases may emerge, where consumers overestimate their eco-friendly contributions while continuing non-sustainable travel behaviors.
2. **Impact on Market Efficiency:** The presence of behavioral biases challenges the Efficient Market Hypothesis, as irrational decision-making leads to mispricing of assets. Similarly, in tourism marketing, digital strategies sometimes fail to achieve their intended impact due to consumer irrationality and resistance to changing long-standing travel habits.

3. **Market Anomalies:** Empirical studies show that behavioral factors can explain stock market anomalies such as momentum, excessive volatility, and bubbles. In the tourism sector, such anomalies appear when unsustainable trends, such as mass tourism to certain locations, become overhyped due to social media influences, leading to negative environmental consequences.
4. **Emotional Influences:** Emotions such as fear and greed contribute to investor sentiment, causing abrupt market swings and affecting investment strategies. In travel behavior, emotions play a significant role in decision-making, with fear of missing out (FOMO) driving unsustainable travel trends, while fear of climate change may push others toward eco-friendly choices.

Despite these challenges, there are notable success stories in digital marketing campaigns promoting sustainable travel. Various tourism boards, travel agencies, and eco-conscious businesses have launched impactful campaigns that have successfully shifted consumer behavior. For example, destination marketing organizations have partnered with influencers to showcase lesser-known sustainable travel spots, reducing pressure on over-touristed locations. Similarly, airlines and hospitality brands have implemented loyalty programs that reward travelers for choosing sustainable options, further encouraging responsible travel behaviors.

As digital marketing continues to evolve, emerging technologies such as virtual reality (VR) and artificial intelligence (AI) are expected to enhance sustainability messaging. VR experiences that allow travelers to explore eco-friendly destinations before booking their trips can create a stronger emotional connection to sustainable travel choices. AI-driven chatbots and recommendation engines can provide personalized travel suggestions based on a user's preferences, helping them make more informed and sustainable choices.

In conclusion, digital marketing and influencer engagement significantly impact sustainable travel behavior. While challenges such as skepticism, information saturation, and behavioral inconsistencies exist, strategic and transparent marketing efforts can help overcome these hurdles. The future of sustainable travel marketing lies in leveraging technology, storytelling, and consumer engagement to create a lasting impact on global travel behaviors.

5. Conclusion

Behavioral finance offers a more comprehensive understanding of investor behavior by incorporating psychological factors that traditional models often overlook. The research highlights how cognitive biases, emotions, and social influences can lead to market inefficiencies, asset mispricing, and volatility. While traditional finance models assume rational decision-making, behavioral finance acknowledges the complexities of human nature in shaping financial outcomes. As such, investors and policymakers must account for these psychological factors to make better-informed decisions and improve market stability. The study suggests that behavioral finance will continue to play an essential role in shaping financial strategies, risk management, and regulatory practices.

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19. ROLE OF INCUBATORS AND ACCELERATORS IN THE SUCCESS OF STARTUPS A COMPARATIVE ANALYSIS

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Abstract

Incubators and accelerators have become essential components of the startup ecosystem, providing resources, mentorship, and funding to early-stage ventures. This paper explores their roles in fostering innovation and entrepreneurship by comparing their structures, functions, and impact on startup success. While incubators focus on long-term support through infrastructure and guidance, accelerators emphasize short-term, intensive growth programs with seed funding. This comparative analysis evaluates the effectiveness of both models in enhancing startup sustainability, market readiness, and investment opportunities. The study further examines real-world case studies to determine which model offers better outcomes for emerging businesses.

Keywords: Startup ecosystem, Business incubators, Startup accelerators, Innovation support, Mentorship programs, Seed funding

1. Introduction

Entrepreneurial ventures contribute significantly to economic growth by fostering innovation and generating employment (Mason & Brown, 2014). However, startups often encounter obstacles such as inadequate funding, lack of mentorship, and constrained resources (Bone, Allen, & Haley, 2017). To mitigate these challenges, incubators and accelerators provide structured support. Despite their similarities, these two models have distinct methodologies and objectives. This paper explores their differences, assessing their contributions to startup success.

2. Literature Review

Definition and Evolution

Incubators and accelerators have evolved over the years, with their origins rooted in fostering business development. Incubators provide long-term assistance, focusing on infrastructure, mentorship, and networking. Accelerators, on the other hand, offer time-bound, intensive programs designed to rapidly scale startups by providing mentorship, capital, and investor connections.

Key Theoretical Frameworks

Research on startup development often references theories such as the **Resource-Based View (RBV)** and **Network Theory**. RBV suggests that startups need critical resources, such as knowledge, capital, and infrastructure, which incubators and accelerators provide. Network Theory highlights the importance of connections and mentorship in achieving entrepreneurial success.

3. Methodology

This study employs a comparative analysis approach, drawing insights from secondary data sources such as academic journals, case studies, and industry reports. Additionally, key success metrics—such as startup survival rates, funding acquisition, and revenue growth—are analyzed to assess the effectiveness of incubators and accelerators.

Comparative Analysis of Incubators and Accelerators

Structure and Objectives

- **Incubators:** Provide early-stage businesses with office space, mentorship, and industry connections over a long period (often several years). Their primary goal is to nurture ideas until they become sustainable businesses.
- **Accelerators:** Offer structured, short-term programs (typically 3–6 months) that focus on scaling startups quickly. Participants often receive seed funding in exchange for equity.

Funding and Investment Opportunities

Incubators generally rely on grants, government support, or university affiliations, while accelerators attract venture capital and angel investors who seek high-growth potential startups.

Impact on Startup Growth

- **Incubators** support startups in their early ideation stages, ensuring stability before entering the competitive market.
- **Accelerators** expedite growth by exposing startups to investors, strategic partnerships, and market expansion opportunities.

❖ Empirical Analysis

- **Y Combinator** (Accelerator): Known for its highly structured program, Y Combinator has produced successful startups like Airbnb and Dropbox.
- **T-Hub India** (Incubator): Provides a collaborative environment for startups, focusing on long-term sustainability and innovation.

4. Challenges and Limitations

Despite their benefits, both incubators and accelerators face challenges. Incubators struggle with financial sustainability, while accelerators may push startups toward rapid growth without ensuring long-term viability. Additionally, industry-specific effectiveness varies, with tech startups benefiting more from accelerators than other sectors.

5. Future Trends and Recommendations

The future of startup incubation and acceleration is likely to witness hybrid models combining the strengths of both approaches. Governments and private investors should collaborate to create policies that enhance startup support systems. Leveraging technology, including AI-driven mentorship platforms, can further optimize startup development processes.

6. Conclusion

Incubators and accelerators play a crucial role in shaping the success of startups by providing essential support, mentorship, and funding. While incubators offer long-term assistance by fostering innovation and stability, accelerators focus on rapid growth through structured, short-term programs. Both models contribute significantly to enhancing startup sustainability, market readiness, and access to investment opportunities. However, their effectiveness depends on the specific needs of a startup, industry dynamics, and market conditions. A balanced approach that integrates the strengths of both models could be beneficial in optimizing entrepreneurial success. Moving forward, policymakers and stakeholders should work towards developing supportive frameworks that encourage collaboration between incubators, accelerators, and investors, ensuring that startups receive the necessary resources to thrive in a competitive business environment.

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20. SMALL FINANCE BANK: SHIFTING GEARS TO DRIVE FINANCIAL INCLUSION

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Abstract

Financial integration has been the focus of Indian Bank Reserves since 2005-2006. Along with various initiatives from the Indian government, RBI has approved the establishment of differentiated banking transactions, namely Payment Banks (PBs) and Small Financial Banks (SFBs). SFB is a niche bank carried out by basic banking activities in the lower and disadvantaged sections of the population. SFB mainly covers sections such as SFB, micro and SMEs, small and medium-sized businesses, small and medium-sized farmers, and unorganised sectors. This article focuses on the progress of SFBS in India in relation to the number of banking transactions, regional spread, population distribution, and the growth of small financial banks over the years. Since its establishment in seven years, the SFB branch has been founded to be significantly expanded as the wider region and the volume of business has increased significantly. It was also found that more SFB branches have been set up in semi-city and rural areas towards the end of the exam period. A preliminary investigation of the SFB suggests you are moving in the right direction as intended with the goals behind the setting.

Keywords: Financial Inclusion, Small Finance Bank, Economic Development, Differential Banking.

1. Introduction

The banking and finance sector in India is undergoing innovative changes in response to the Government of India's financial inclusion initiative. The Pradhan Mantri Jan Dhan Yojna (PMJDY), one of the government's key initiatives, was launched on August 28th, 2014, and is regarded as the world's largest financial inclusion drive. "A massive nationwide drive resulted in the opening of 32.68 crore Pradhan Mantri Jan Dhan Yojna accounts, with a total deposit of Rs. 82006.33 crore in such accounts (as on 12.09.2018)". Several other initiatives have been launched by the government that focuses on smart and simple banking methods. Small Finance Bank is one such pioneering solution with the prospective to change India's banking scenery. In India, small finance banks are a particular subset of banks that offer basic banking services including accepting deposits and making loans. The purpose of establishing such banks is to promote financial inclusion to social groups that are not currently served by regular banks, such as micro- and small-scale businesses, marginal farmers, and unorganised sectors. All the functions of typical commercial banks are available to small finance banks, but they are focused on serving the low-income market. Financial inclusion simply refers to making sure that everyone, regardless of background, has access to the nation's financial services at a reasonable cost. It focuses on integrating the underprivileged and vulnerable segments of society into the economy and providing them with benefits, thereby increasing the country's GDP (Gross Domestic Product) through increased customer base of financial institutions, which results in high profits in the future, and this cycle will continue with increasing profits.

By encouraging a culture of saving among a significant portion of the rural population and bringing low-income populations within the boundaries of the formal banking sector, it boosts GDP growth. Financial inclusion, according to Chakraborty (2011), is the process of ensuring that all segments of society, including weaker and lower-income groups, have access to the necessary financial products and services at an affordable price in a fair and transparent manner from major institutional players.

2. Review of Literature

The relevant literature review for the topic is as follows:

- ❖ **Shama & Gurunathan (2022)** according to the findings of this study, small finance banks in India play an important role because they provide services to the financially excluded population. These banks offer basic services to small-scale farmers as well as micro and small-scale businesses. These banks will help to boost the country's economy by providing services to the majority of the country's population. The study relied on secondary data from previously published sources. This paper attempts to evaluate credit risk associated with small finance banks in India using a descriptive research design, which deals with the collection of quantifiable data for statistical analysis.
- ❖ **Chaturvedi (2022)** focused on analysing that in their study that granting of licenses to 11 payments banks and ten small banks in September 2015 marked a significant transformation in the Indian banking system in terms of “reaching out to a new customer and delivery model that was previously unavailable to scheduled commercial banks”. The move was intended to improve the country's financial inclusion. This paper investigates the significance of financial inclusion for a high-priority sector in India that is currently unbanked or under-banked. It emphasizes the RBI's financial inclusion policy, as well as the recent licensing of Small Finance Banks to that end. “Small finance banks are committed to serving the rural and urban poor, as well as the unbanked, but they face significant challenges in terms of developing the capacity and infrastructure needed to serve a diverse client base, as well as retraining their existing workforce to provide a more comprehensive service than a typical MFI”. The article investigates the standards used by the RBI to license these banks, as well as the challenges and concerns expressed by a diverse group of SFB stakeholders. The study is also interested in the impact of small financing banks on financial inclusion.
- ❖ **Nandhini & Rathnamani (2021)** According to this research paper, extending banking services to the underserved or unserved sections of society in India has been a challenge. As a result, the NachiketMor committee on financial inclusion proposed the Small Finance Bank concept to address this challenge. In accordance with the Central Budget 2014-15, the RBI has begun licensing small banks and other differentiated banks in the hopes that they will meet the credit needs of small businesses, the unorganised sector, low-income households, farmers, and migrant workers. In a nutshell, this study seeks to examine the various parameters in the operations of Small Finance Banks.
- ❖ **Patel & Fulwari (2021)** noted that the Reserve Bank of India's policies have been centered on financial inclusion since 2005–2006. In 2015, the RBI authorised the establishment of Small Finance Banks (SFB) in conjunction with a number of government initiatives. SFBs are specialty banks created to provide basic banking services to underserved segments of the community. In terms of branch count, geographic reach, and revenue, this report charts the development of SFBs in India. It was discovered that, over the course of five years following

their founding, SFB branches had significantly increased in number, had a greater regional reach, and had seen a significant rise in business. By the end of the study period, more SFB branches had been established in semi-urban and rural areas. The preliminary examination of SFBs indicates that they are progressing in the right direction, as envisioned in the objectives that led to their establishment.

- ❖ **Srikanth et.al (2021)** This research article examined how small finance banks contribute to creating value for their stakeholders in a variety of ways, including increasing financial inclusion, achieving a satisfactory track record of performance, and listing on a recognised stock exchange. A country's banking system has a significant impact on its economic activity. SFBs are the right vehicles to achieve digital and financial inclusion in an emerging market like India, where the majority of rural and semi-urban areas are financially excluded. Because SFBs have focused on retail, agriculture, and MSME segments, concentration risk is low, and they may attract retail investors sooner rather than later. Based on our analysis, the majority of SFBs have been moving in the right direction in terms of creating value for their respective stakeholders since their inception.
- ❖ **Ravikumar, Murugan & Suhashini (2020)** investigated the penetration and performance of SFBS using parameters such as number of branches, progress, deposits, state presence, net performance (NNPA), and capital adequacy ratio (CAR) through March 2019. The SFB challenges were also examined in the form of loan restrictions, banking products costs, and limited sales departments.
- ❖ **Banu (2019)** found in his paper that a financial analysis of Indian small financial banks was conducted via camel rating 2061, a significant correlation between the public, private and foreign banking sectors in relation to investment, equality and return of progress. This study showed that the ratio of cash deposit ratios and loan floating ratios had a positive effect on short-term liquidity. However, net interest rates and investment rates did not affect the position of solvency in all three banking sectors.
- ❖ **Mohd. (2018)** in a study entitled "Study on the Performance of Microfinance Institutions in India," microfinance institutions play a critical role in the implementation of government programs aimed at promoting socio-economic development and eliminating poverty. These institutions function effectively in rural and urban areas. The authors also highlight that the government has taken initiatives to improve the financial capacity of its population by implementing various banking guidelines and programs.
- ❖ **Jayadev, Singh & Kumar (2017)**, their research roundtable Small Finanzbanken: Challenges - Comparative investigation of the challenges and financial inclusion of different forms of special vehicles, and regulatory switching between regulatory regulations with other forms of financial inclusion. Interviews with conductive employees at small financial banks were conducted to explain their views.

3. Objective of the Study

1. To have an insight about the concept of small finance banks.
2. To review the contribution of SFBs in financial inclusion in India

4. Research Methodology

This study is conceptual and descriptive in nature with a detailed review of literature. The present study is based on the secondary data. Secondary data collected from journals and the various reports from RBI and Government of India. This data obtained has been fundamental source for gaining knowledge related to the topic that enabled us to present data in this article.

5. Data Analysis & Interpretation

5.1. Financial Inclusion in India

In terms of India, after independence it has a very long history of making efforts to achieve financial inclusion, and while it has been somewhat successful in comparison to the early stages of building up the Indian economy, there are still so many milestones to be achieved in this process, now current government efforts have increased financial inclusion in society many folds, but we are still figuring out how to use this in favour of our economy and make everyone eligible for its benefits, for which there are different government schemes available. The following are some of the most important schemes for increasing financial inclusion:

Year	Details of event
1956	Imperial Bank of India was nationalized.
1968	National Credit Council was set up.
1969	Lead bank scheme was introduced
1971	Priority sector lending norms were laid down.
1975	Regional Rural Banks (RRBs) were established.
1982	National Bank for Agriculture and Rural Development (NABARD) was established
1992	Self Help Groups Linkage Programme was launched to support females of rural areas.
2000	SIDBI foundation was established for making provisions of micro credit.
2012	Finance Department of Government of India passed Microfinance Institutions (Development and Regulations)
2012	Revised Guidelines on Financial Literacy Centers were introduced.
2014	Jhan Dhan Yojana, MUDRA
2015	Small finance banks
2016	Payments banks

PMJDY: Pradhan Mantri Jan Dhan Yojana started on August 28th, 2014. In the fiscal year 2023-24, 33 million notable new Pradhan Mantri Jan dhan yojana accounts were opened, increasing the cumulative record to 519.5 million accounts. The total amount of these accounts increased to 2,34,997 crores recorded compared to 1,98,844 crores in the previous year. Apart from PMJDY, India has several other financial integration systems - Pradhan Mantri mudra yojana (PMMY), Jevan Suraksha Bandhan Yojana, Pradhan Mantri Vaya Vandana Yojana (PMVVY), Stand-Up India Scheme, PM Vishwakarma Scheme, Varistha Pension Bima Yojana (VPBBY), Atal Pension Yojana (APY), Planning Box and Sukanya Samridhi Yojana Credit Enhanced Gallant Scheme (CEG).

5.1.1. Aims of Financial Inclusion

- The main aim of financial inclusion is to assist people in obtaining low-cost financial services and products such as fund transfer services, deposits, loans, insurance, and payment services.
- It seeks to establish appropriate financial institutions to meet the needs of the poor. These institutions should have clear regulations and adhere to the same high standards as the financial industry.
- Financial inclusion aims to create and sustain financial sustainability so that less fortunate people have access to funds that they may not otherwise have.
- Financial inclusion also intends to have a large number of institutions that provide affordable financial assistance so that there is enough competition for clients to choose from.
- Financial inclusion aims to raise awareness about the benefits of financial services among the economically disadvantaged segments of society and it also to expand financial products that are appropriate for the less fortunate members of society.
- Financial inclusion aims to improve financial literacy and financial awareness throughout the country and it also provide digital financial solutions to the nation's economically disadvantaged citizens.
- It also intends to introduce mobile banking or financial services in order to reach the poorest people living in the country's most remote areas.
- It intends to provide tailor-made and custom-made financial solutions to poor people based on their individual financial circumstances, preferences, and household needs income levels.

5.2. Small Finance Bank

A bank is a type of financial institution that mainly provides services to its customers such as accepting deposits and granting loans. A commercial bank is one that has been established by a special act of parliament or by the Companies Act of 1956. The Reserve Bank of India (RBI) is the governing body in charge of our country's banking industry. Our banking industry has undergone numerous changes in recent years, the most recent of which has been the emergence of the concept of Small Finance Banks. Small Finance Banks are banks that provide financial inclusion to underserved groups such as micro, small, and medium-sized businesses, as well as other unorganised sectors that are not served by other banks and financial institutions. In 2015, the RBI launched a financial inclusion policy in our country by establishing a new type of bank. On September 17, 2015, the RBI granted ten companies a provisional license to operate as small finance banks in India. Capital Finance Bank was the country's first bank, beginning as a small finance bank. On 24/04/2016, they began procedures with 47 branches. Primarily, 10 institutions were permitted to conduct trade in the group of small finance banks. The table below contains a list of SFBs as well as a brief history of each.

Name of the institution	Nature of activity
Au Financiers India	Au Financiers is a non-banking finance company that was founded in 1996 as an asset finance company. Vehicle loans and small secured business loans for MSMEs comprise the majority of the asset portfolio. Motilal Oswal Private Equity Advisors, ChrysCapital, Kedaara Capital, Warburg Pincus, and International Finance Corporation own a significant portion of the company and have a presence in 10 northern Indian states.
Capital Local Area Bank	Capital LAB is the largest of the remaining community banks. The bank began operations in five contiguous districts of Punjab in January 2000. Capital LAB had Rs 1506 Cr of deposits and Rs 926 Cr of advances on its balance sheet as of March 2015; it has 39 branches and has been consistently profitable.
Disha Microfinance	Disha Microfinance, which was founded in 2009, provides financial services to rural and semi-urban areas in Gujarat, Rajasthan, Madhya Pradesh, and Karnataka. It provides credit-linked insurance and retirement solutions in addition to microfinance loans. As of 2014, it managed more than Rs 200 crore in assets. Equity investors such as India Value Fund have backed the company. As of March 2015, Disha Microfinance had 71 branches spread across 39 districts, serving nearly 8600 villages. This company is unique in that it only lends to female borrowers.
Equitas Microfinance	Equitas, based in Chennai, was founded in 2007 as a microfinance institution. Since then, it has expanded its operations through a holding company into various verticals such as housing finance and used commercial vehicle financing. Equitas has 361 branches in 124 districts across seven states, but its main business remains in Tamil Nadu.

Evangelical Social Action Forum (ESAF) Microfinance	In 1992, the ESAF Society was founded as an NGO in Kerala. Its goals were to combat unemployment and poverty. ESAF began its microfinance operations in 1995. Pinnai Finance and Investments was acquired by the society in 2006. It currently provides microloans, social security services such as insurance and pensions, and money transfers. Tamil Nadu, Kerala, Madhya Pradesh, Maharashtra, Chattisgarh, and Jharkhand are among the states where ESAF operates. Under the joint liability group lending model, ESAF primarily lends to women borrowers.
Janalakshmi Financial Services	Janalakshmi Financial Services is India's third largest urban MFI, with over Rs 3800 Cr in assets. It serves 23 lakh customers through 233 branches in 17 states and 151 cities. Investors in Janalakshmi include the Michael and Susan Dell Foundation, Lok Capital, and the Bellwether Microfinance Fund.
Rashtriya Gramin Vikas Nidhi (RGVN) (North East) Microfinance	RGVN is a society founded in 1990 that was transformed into a microfinance institution in 2010. The society was established to develop and support NGOs and community-based organisations in the country's northeast. Guwahati is the company's headquarters, and it operates in five states: Assam, Arunachal Pradesh, Meghalaya, Nagaland, and Sikkim. More than 2.2 lakh borrowers are served by the company's 104 branches.
Suryoday Microfinance	Suryoday was granted a microfinance institution licence in 2009. It has a presence in seven states, but its primary business (up to 65%) is from Maharashtra and Tamil Nadu. The firm's focus is on female borrowers from underserved communities. Suryoday has 164 branches and serves 6.05 lakh customers as of March 2015.
Ujjivan Microfinance	Ujjivan Microfinance, which began operations in 2005, is the country's fourth largest MFI. It manages Rs 3270 Cr in assets and serves over 20 lakh clients through 463 branches. The company was founded to provide financial solutions to the urban poor and is supported by investors including the CDC Group, Sequoia Capital, Lok Capital, and the International Finance Corporation, among others.
Utkarsh Microfinance	Utkarsh Microfinance, founded in 2009, operates in the country's central and northern regions. Utkarsh, headquartered in Varanasi, is backed by investors including Lok Capital, the Norwegian Microfinance Initiative, Aavishkaar Goodwell, the International Finance Corporation, and the Commonwealth Development Corporation. Utkarsh has a customer base of 600,000 and a network of 271 branches in just six years.

5.2.2. Guidelines for License to Small Finance Banks

- The RBI issued final guidelines for licensing Small Finance Banks based on performance throughout the year.
- The capital requirement for new entrants has been raised to Rs 200 crore from Rs 100 crore previously.
- The required minimum paid-up voting equity capital / net worth are 200 crores.
- SFBs will be granted scheduled bank status as soon as they begin operations.
- From the commencement of their operations, SFBs will have general permission to open banking outlets.
- Payments banks that are also eligible under these guidelines can apply for conversion into SFB after five years of operation.

5.2.3. Features of Small Finance Banks

- Like commercial banks, SFB can accept any type of deposit (savings, current, fixed deposits, recurring deposits).
- Small Finance Banks, unlike Payment Banks, will be permitted to lend money.
- Prior RBI approval is required for the branch expansion for the first three years.
- The Small Finance Banks' operating areas are limited.
- For NBFCs, any individual with 10 years of banking experience can apply for a licence.
- Small Finance Banks primarily serve small businesses and MSMEs.
- SFBs are not permitted to lend deposited funds to large businesses or industries.

5.3. Role of Small Finance Banks to Enhance Financial Inclusion

Financial inclusion refers to the process of providing vulnerable segments of society with access to banking services as well as timely and adequate loan services, such as low-income households and persons living in unbanked areas. The following are the roles of small finance banks in financial inclusion:

- A small finance bank's main objective is to provide necessary financial services to low-income individuals and enterprises.
- Small Finance Banks are required to open 25% of their branches in unbanked or unserved rural areas, and to give 75% of their net credits to the priority sector.
- Small finance banks have filled the financial services gap left by the underperformance of commercial banks and cooperative banks in unbanked & unserved communities.
- Small Finance Banks are projected to disrupt India's traditional banking sector and overcome issues related to the statutory cash reserve ratio (CRR) and framework for cost-effective banking solutions.

- The increase in smaller loans to enterprises and marginal farmers will boost financial activity in underserved areas.
- SFBs have contributed significantly to the growth of the MSME (Micro Small and Medium Enterprises) sector by lending money to start-ups and small enterprises.
- The Government of India and RBI have consistently worked to include the most vulnerable groups in financial inclusion initiatives like JAM Trinity.
- SFBs' microfinance activities account for a sizable amount of their loan book, helping to keep lending rates higher than those of other banks.
- SFBs can be pivotal in scaling up small lending and low-cost deposits in underserved areas and it also created to achieve the twin-fold objectives of providing an institutional framework for promoting rural and semi-urban savings and it also providing lending facilities for the growth of economic activities in unserved areas.

5.4. Penetration of Small Finance Banks and their Performance

Table 1: Penetration and Performance of Small Finance Banks in India

S. N.	Name of the bank	Loans Advanced (in Crores)	Deposit (in Crores)	No. of Banking Outlet	Presence in States/UTs
1	Au Small Finance Bank Ltd.	73,999	87,182	1,074	24
2	Capital Small Finance Bank Ltd.	6160	7478	177	05
3	Equitas Small Finance Bank Ltd.	34,337	36,129	964	18
4	ESAF Small Finance Bank Ltd.	18724	19867	753	25
5	Jana Small Finance Bank Ltd.	24,746	22,571	808	24
6	Northeast Small Finance Bank Ltd.	7,961	6,505	377	19
7	Suryoday Small Finance Bank Ltd.	8,650	7,777	695	15
8	Shivalik Small Finance Bank Ltd.	2,095	2,410	31	2
9	Ujjivan Small Finance Bank Ltd.	29,780	31,462	752	26
10	Unity Small Finance Bank Ltd.	7,961	6,505	377	19
11	Utkarsh Small Finance Bank Ltd.	18,299	17,473	888	26

Source: Annual Reports of above Small Finance Banks 2023-24

From the table above, we can see that AU's pediatric small financial banks achieved strong operational performance in fiscal year 2023-24, with deposit growth and 26% progress increasing by 25% per year. In a short time, the penetration and outcomes of Au SFB are a general perspective on a satisfactory level. At this point, it appears that only Au SFB is clearly justified for the transition to Universal Bank. While Ujjivan SFB meets all criteria in terms of success balance and performance, the percentage of unsecured loans (70% by March 2024) could hinder the prospects for a universal banking transition from a portfolio diversification perspective. Shivalik Small Finance Bank Ltd. The deposits are the lowest and the lowest loan amount. Regarding the existence of states/UTs, ESAF Small Finance Bank Ltd.'s first position is 25 countries/UTs/UTs and Shivalik Small Finance Bank Limited, lying on the ground in only two countries/UTs. AU Small Finance Bank Ltd. India has the largest number of banking transactions, but Shivalik Small Finance Bank Limited has a minimum number of banking transactions.

5.5. Profitability of SFBs

Table 2: Profitability Ratios of Small Finance Banks

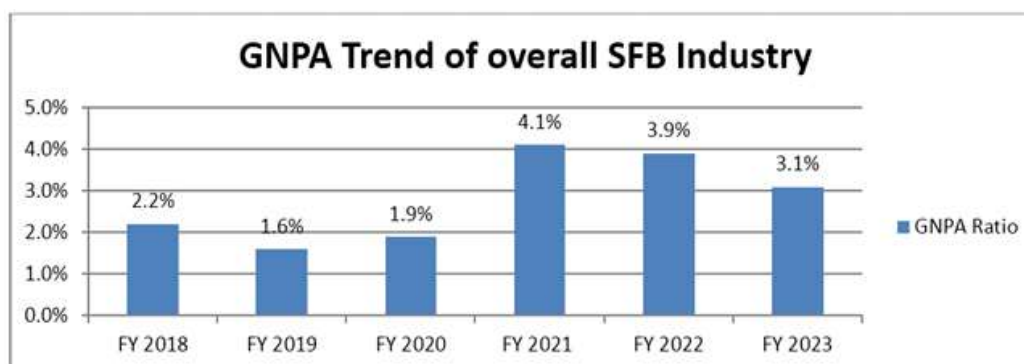
RoA	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Interest Earned	14.1%	14.5%	12.9%	11.8%	12.7%
Interest Expended	6.6%	6.7%	6.0%	5.0%	5.1%
Net Interest Income	7.5%	7.8%	6.9%	6.8%	7.6%
Op. Ex Ratio	6.1%	5.8%	4.9%	5.3%	5.5%
Other Income	2.0%	1.7%	2.1%	1.6%	1.5%
Credit Cost	0.9%	1.3%	2.2%	2.3%	1.2%
Return on Assets	1.6%	1.9%	1.5%	0.7%	1.8%

Source: Company reports, CRISIL MI&A

Within the financial year 2020, the RoA of changed into improve but the outbreak of COVID-19 followed the nationwide lockdown and the credit value become multiplied for the FY 21. In the 2nd surge of COVID-19, the SFB industry RoA become suddenly deteriorated to 0.7% afterwards the decent growth is visible within the performance of SFBs in 2023.

5.6. Trends in Small Finance Bank Industry

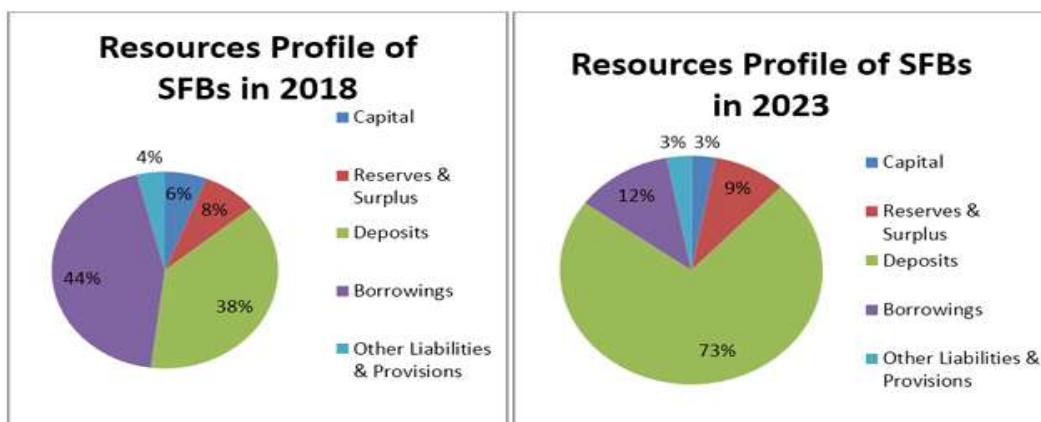
Table 3: GNPA Trend of SFB Industry



Source: Company reports, CRISIL MI&A

The above table shows the GNPA ratio of total-SFBs in India. For example, this means the total performance of the SFB. It is clear that the GNPA relationship from 2018 improved in fiscal year 2018, indicating a continuing decline in this relationship, but in fiscal year 2021 it increased dramatically as the economy as a whole was deeply affected after the symbiotic pandemic. Since the fiscal year 2021, the GNPA trend has reappeared, indicating that SFB will improve with the NPA. This is also demonstrated by the growth of SFBs.

5.7. Resource Profile of Small Finance Bank



Source: Company reports, CRISIL MI&A

The useful resource profile of SFBs has absolutely converted from 2018 to 2023 where deposits have grown from 38% in 2018 to 77% in 2023 and borrowings have been decreased from 44% in 2018 to 12% in 2023. This indicated that SFBs asset-legal responsibility control profile remains properly as a result of conservative liquidity coverage, mobilization of deposits and shorter tenure loans.

6. Limitations of the Study

The study is used the secondary data for examine the role of Small Finance Banks in achieving Financial Inclusion in India., which were collected from the published research articles, books and websites. Therefore the accuracy of the data depends on the accuracy ensured in the data presented.

7. Conclusion

Small finance banks are a type of niche bank in India that can provide basic banking services such as deposit acceptance and lending. This study covered key milestones of financial inclusion in India from 1956 to 2016 as well as the history of new small finance banks. The SFBs' branch network is quite extensive and diverse. We conclude that the geographical diversity of the applicants⁵²'s home locations is responsible for the SFB network's decent spread across the country. "As of August 2019, the country had 3533 SFB bank branches spread across 31 states, union territories, and 46553 districts. The northeast region is also covered by the north east SFB, which is present in all seven north-eastern states".

Small finance banks face challenges such as technology adoption, high costs of transformation efforts and prudential norms, deposit mobilisation, competition, controlling NPAs, and human resource management issues. "Former RBI deputy governor KC Chakrabarty suggested that whatever model small finance banks use, it is critical that they reduce the borrower's burden, which finance always exploits". When people say that money helps, he laughs. Small finance banks must be sensitive to their customers if they are to survive. Small finance bank licenses are now being issued to existing microfinance institutions that are already lending to small and tiny entities. However, once they have established small finance banks, they will be able to increase the size of their loans to their customers. They can also accept deposits, distribute mutual funds, insurance products, and so on. As a result, we can expect increased competition in rural banking, and existing banks must prepare to meet it and according to the RBI license, new small finance banks must be established within 18 months. Because this time period is longer, efforts should be made to shorten it.

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21. THE IMPACT OF AI DRIVEN FINANCIAL ADVISORY SERVICES ON INVESTMENT DECISION MAKING

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Abstract

Artificial intelligence (AI) is transforming the financial advisory landscape by providing data-driven insights and automated investment recommendations. AI-driven advisory services leverage machine learning, big data, and predictive analytics to optimize decision-making, mitigate risks, and enhance portfolio management. This paper explores the impact of AI-driven financial advisory services on investment decision-making, highlighting their advantages, challenges, and implications for individual and institutional investors. Through a comparative analysis of traditional and AI-based advisory models, the study evaluates the efficiency, accuracy, and accessibility of AI-driven solutions. The findings suggest that AI-based financial advisors contribute to improved investment outcomes, increased investor confidence, and reduced biases, although challenges such as data privacy concerns and regulatory constraints remain.

Keywords: Artificial intelligence, financial advisory, investment decision-making, machine learning, predictive analytics, risk management, big data, portfolio optimization, algorithmic trading, financial technology

1. Introduction

The financial sector has witnessed rapid advancements in technology, leading to the emergence of AI-driven financial advisory services. Traditional financial advisors rely on human expertise, experience, and market knowledge to guide investment decisions. In contrast, AI-driven advisors utilize sophisticated algorithms to process vast amounts of financial data, identify market trends, and generate investment strategies. This paper examines how AI-driven financial advisory services are influencing investment decision-making, exploring their effectiveness in optimizing portfolio performance and reducing risks.

2. Literature Review

2.1 Evolution of Financial Advisory Services

Financial advisory services have evolved from conventional human-led consultations to AI-powered solutions. Early models focused on face-to-face interactions, while modern financial technologies incorporate automation, robo-advisors, and algorithmic trading to improve efficiency and accessibility.

2.2 AI Technologies in Financial Advisory

AI-driven financial advisory services rely on various technologies, including:

- **Machine Learning (ML):** Identifies patterns and trends in historical data to improve investment strategies.

- **Big Data Analytics:** Processes large volumes of market data to generate insights.
- **Predictive Analytics:** Forecasts market movements based on historical and real-time data.
- **Natural Language Processing (NLP):** Enhances customer interaction and sentiment analysis.
- **Algorithmic Trading:** Executes trades automatically based on predefined criteria.

3. Methodology

This study employs a qualitative research approach, analyzing secondary data from academic journals, financial reports, and case studies. A comparative framework is used to assess the effectiveness of AI-driven financial advisory services versus traditional advisory models.

4. Comparative Analysis: AI-Driven vs. Traditional Financial Advisory Services

4.1 Efficiency and Speed

AI-driven financial advisors process vast datasets within seconds, providing real-time recommendations, whereas traditional advisors require extensive research and analysis time.

4.2 Accuracy and Risk Management

AI models leverage predictive analytics to enhance investment accuracy, reducing biases associated with human decision-making. Traditional advisors, however, depend on personal judgment, which may be influenced by emotional or cognitive biases.

4.3 Cost and Accessibility

AI-driven advisory services are more cost-effective, making financial planning accessible to a wider audience. Traditional advisory services, on the other hand, often require higher fees and minimum investment thresholds.

5. Case Studies

5.1 Case Study: Robo-Advisors (Betterment and Wealth front)

Robo-advisors like Betterment and Wealth front use AI to provide automated, low-cost investment solutions. These platforms offer personalized portfolio management based on user preferences, risk tolerance, and financial goals.

5.2 Case Study: Algorithmic Trading by Hedge Funds

Leading hedge funds, such as Renaissance Technologies, use AI-driven algorithmic trading strategies to achieve superior investment returns. These strategies analyze real-time data, adapt to market changes, and execute trades with high precision.

6. Challenges and Limitations

Despite its benefits, AI-driven financial advisory services face several challenges:

- **Data Privacy and Security:** AI systems require vast amounts of financial data, raising concerns about data protection and cybersecurity.
- **Regulatory Compliance:** The financial industry is heavily regulated, and AI-driven advisory services must comply with evolving legal frameworks.

- **Lack of Human Touch:** AI-driven solutions may lack the personalized, human-centric approach that traditional advisors offer.

7. Future Trends and Recommendations

The future of AI-driven financial advisory services is expected to witness continued growth, with advancements in deep learning, AI-driven sentiment analysis, and hybrid advisory models (combining AI with human expertise). To enhance AI adoption, financial institutions should focus on:

- **Improving transparency in AI-driven decision-making.**
- **Developing robust regulatory frameworks to ensure ethical AI use.**
- **Enhancing AI-human collaboration for personalized investment strategies.**

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22. THE CONSUMER PARADIGM SHIFT DUE TO TECHNOLOGY EVOLUTION AND ITS IMPACT OVER MILK AND DAIRY PERISHABLE GOODS SALES: A STUDY OF NCR

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Abstract

Milk, a major component of human consumption for centuries, has transformed into a highly demanded perishable commodity globally. Historically, milk would degrade very quickly due to the presence of bacteria, limiting its use. However, one of the scientist Louis Pasteur gave a Louis Pasteur germ theory and also developed the process of pasteurization which revolutionized the entire industry. Due to the origin of advanced technology, behavioral pattern of the consumer has been changed regarding milk and other perishable goods. The traditional buying habit has been transformed due to digital platforms and emphasis the quality of the dairy product and the consumer satisfaction. In recent years consumers are now pulled towards the health and fitness and also become more conscious about the product's nutritional value. This research also delivers the rising importance of digital platforms for the purchase of milk and its products respectively into rural as well as urban areas. Additionally, the urbanization factor impacts at most on the decisions of consumer regarding perishable goods. This research paper explores the journey of milk and the impact of advanced technologies in the sales of perishable goods globally. The researchers used the secondary data for now the impact of modern technologies.

Keywords: Perishable Goods, Milk, Dairy Industry, Consumer Behavior

1. Introduction

From the product which is gangrenous to static product historically, when we see the milk products it is generally gangrenous product. Due to certain bacteria and microorganisms present in nature, these milk products would spoil quickly As a result, it would be very difficult for people to use it. Some natural bacteria are used for enhance the milk test *Lactococcus lactis*, *Enterobacter kobei*, (*Aerococcus urinaeequi*, *Acinetobacter lwoffii*, *Kurthia gibsonii*, and *S. ureilytica*) these are gram negative bacteria These organisms will multiply rapidly in the warm, nutrient-rich environment of milk, causing sourness, curds, and even foodborne illness. So, the problems were increasing day by day & Technical evolution gave light to this civilization in dairy products Its pre-defined criteria, gives a huge change in this era. As we were looking back how was the situation In year 1861 & what is the change in technical aspects of dairy products: Louis Pasteur developed the germ theory of disease by conducting an experiment with a swan-necked flask, and by studying the process of fermentation The germ theory of disease states that some infectious diseases are caused by tiny microorganisms invading a host organism. The germ theory of disease disproves the spontaneous generation theory. Scientist Louis Pasteur in the mid-19th century, pasteurization involves heating milk to a high temperature for a short period to kill harmful bacteria. He gave a great innovation making it safe to eat, Ultra-pasteurization (UHT), a more intense heating process, further revolutionized milk preservation.

Louis Pastur gave the theory of dairy products preservation as technical support:

- 1) **Pasteurization:** One of Louis Pasteur's main explanations is pasteurization; The process of pasteurization involves heating to a higher-than-normal temperature. It helps to flush out all germs and harmful substances in this pasteurization process.
- 2) **Homogenization:** It's a process that helps break down milk fat molecules into small parts and that helps the molecules to spread evenly in the milk. This process helps to break the large particles into very small particles so that all the proteins and fats in the milk can be spread evenly.
- 3) **Ultrafiltration:** UF refers to a pressure driven membrane separation technique in which a membrane is employed to separate different components in a fluid mixture. UF membranes have pore sizes less than 0.01 micron used to concentrate milk, remove lactose, or isolate proteins, enabling the creation of lactose-free milk, and protein supplements.
- 4) **Electric eye & Motorization:** Electric eye (Sensors) white automates temperature, PH balance in products deciding factor when it is in processing it enhances the quality ability of the dairy products. In dairy industry Motorization gives a solution to human miscalculation.
- 5) **Functional Dairy Products:** Milk, fermented dairy products, bio-active, peptides, Probiotics, Natural antioxidants, Lactic acid bacteria can create the product with more powerful and strong health benefits.
- 6) **Novel technologies in dairy industry:** High Hydrostatic Pressure treatment, Ultrasound Processing, Pulse Electric Field treatment and Membrane Processing are some of these novel processes, which may be used in milk, yoghurt and other dairy product processing.
- 7) **Enhance Packaging quality:** The 4C Principles of Packaging Design" underscores the importance of integrating Clarity, Creativity, Consistency, and Consumer-Centricity so dairy products are increasing their quality of packaging to enhance qualities. Cardboard is mostly used for liquid milk and drinkable fermented milks containers, as well as cream and other liquid dairy products. In dairy, glass is used mainly for desserts and fermented milks, and for liquid milk.

1.1 Historical Perspective of Milk and Dairy Products

The relationship between the milk and dairy products and the humans are begin in the ancient times and from then it's been a journey of development and trust. Milk and milk related products are become the important part of the human life specially in the European society. The consumption of milk also developed the relationship between the humans and domestic animal like cow, buffalo, goat sheep, camels etc.

According to the reports the global milk consumption of world in 2023 was 936 million tons in which 758 million tons accounts for cow milk, Asia is the largest consumer of milk which accounts for 49% of world's total milk consumption. According to the food and agriculture organization (FAO) the global milk consumption of per person per year is 113 liters. (Food and agriculture organization of united nations, 2023) While the consumption of dairy product which is generally made with milk was valued at \$523.3 billion and accepted to reach \$647 billion by 2028. (Food and agriculture organization of united nations, 2023) (Research and markets, 2023 - 2028)

If we look at India, it is the largest producer as well as the largest consumer of milk and dairy products. 23% of global milk production are from India. India produces 220 million tons of milk in 202 – 23 (Food and agriculture organization of united nations, 2023), These all-data shows that the peripheral food like milk is the integral part of human society since the thousands of years and in this topic of the paper we

focused on the journey of milk from simple subsistence farming to global industry. We look at the history of milk and dairy products.

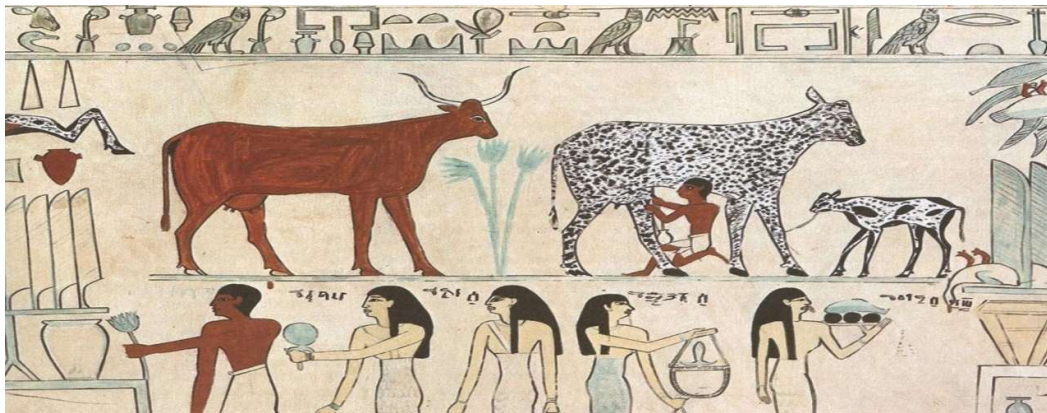
1.1.1 The early beginnings of milk production (Ancient times)

The beginning of milk production was start about 9000 years ago particularly in the area of eastern Sahara. It started with the domestication of cattle animal, people move to domestication of animal because hunting is very dangerous process and they do not always rely on hunting for their food needs that's why they came up with the idea of why not we just raised the animal for our food needs(Meat and other products) soon they find out that domestic animal are not only good for meat they are also very good at milk and milk related product like cheese and curd.

Soon domestication of animal starts in other region scientist found one of the oldest pieces of evidence of dairy product consumption in some parts of Africa particularly in Kenya and Sudan. Which is at least 6000 years ago.

Fig.No:1 Old Egyptian painting hieroglyphic painting showing an early instance of a **domesticated animal**

Source: <https://www.worldhistory.org/image/2887/early-domestication-of-cattle/>



Some of the researches says that the first production of milk was started in what is now turkey and the first milk product were made accidentally because there is no existence of refrigeration in that time so the milk is fragmented and converted into a yogurt, cheese, and butter. This is the first foundation of milk and dairy products. These products generated by milk can stored for longer period. Archaeological survey of Egypt suggest that the production of cheese was started in Egypt as early as 3000 BCE. Due to the perishable nature of milk, it is one of the quickly consumable beverages it just sticks to farm. If it's not converted into cheese and butter.

1.1.2 Medieval period of milk and dairy products (500 BCE – 500 CE)

Although the production of milk is gaining heights in all over the world. But the consumption of products that are made by milk like yogurts, cheese and butter were high, due to the many reasons but the main reason is the milk is a perishable product but the milk products generally have high life and can be stored for a longer period of time.

We can understand this by taking the examples of Greek and roman empire:

In Greek – The milk production is high in the Greek but cheese has a monopoly in Greeks milk and dairy products due to many reasons. One of the reasons was, in Greek culture cheese were directly connected to a sacrifice to God. So, we can say that cheese has a cultural influence in Greek society.

In Rome – In Roman empire there was a whole different story, but the few things are same the influence and love of cheese in their society and the production of milk but at the same time in Rome cheese were considered as a luxury good that was made by milk of cow, goat and sheep.

The uses of cheese were different in Roman empire compared to the Greeks the cheese is used for cosmetic purpose, yes cheese is used as a cosmetic product because cheese contain the elements that help in skin care like moisturizing etc.

During the whole medieval period milk production were expanded by a huge margin. Also, it was the important player in the economy and a major source of income in rural areas.

In India the situation of milk and dairy industry were not different people here also sees milk and dairy product as a nutritious and good for health. But milk in India also has a cultural identity in Hinduism. Milk has a great significance Indian society milk is offers to the god for blessings. But unlike any other country the cheese is not have that influence in Indian society. Indian people prefer ghee for their daily purposes and for cultural functions like pujas and havens. The significance of milk and ghee are also given in the Vedic text.

These all developments in milk and dairy products take place in medieval period paved way for the modern milk and dairy industry.

1.1.3 The Industrial Revolution (18th Century):

Industrial revolution was a period in which industries go through a huge transformation where society perspective has been changed from agrarian society to industrial one, all the products that are made by the hand are now made by the designated machines. Industrial revolution brings technological advancement in manufacturing industry, population growth, conversion of rural areas into urban areas etc. Let's study, what are the effects of industrial revolution on milk and dairy industry, in industrial revolution period the milk and dairy industry gone through many changes and development which make the foundation for the modern milk and dairy industry. One of the changes are now the people are shifting from rural areas to urban areas for many reasons like quality of life, employment, other facilities etc. so now the consumption of milk and milk related products are not only bound in rural areas but demand were also rising in urban area.

The overall production of milk and dairy industry were also rising because there is a high population growth by which demand is rising and the market share of milk and dairy products were also expanding, and new industries and companies were also established such as the Borden Dairy family, Dairy farmers of America and land o lake inc.

But the major industrial plant of milk and dairy production are outskirts of the urban areas so the main problem is the transportation of milk and its product from production plant to the consumer is time taking and in that time the milk got spoiled, contamination and fermented due to the inability of refrigeration, and that milk is not good for consumption. So, at an early development the milk production companies make huge losses.

Until the discovery of pasteurization by Louis Pasteur in 19th century Louis argued that with the use of heating we can kill the bacteria that are present in the milk which help to contain the life of milk for comparatively longer time and make it safer for the consumption.

Also due to the rapid development of infrastructure and transport networks like roadways, railways and airways are also help in fast distribution of milk and dairy products. The introduction of dairy corporations is also begin in this period in which group of people come together to do business in dairy industry in which they contact small dairy farmers to produce milk for them and then the company will sell that milk in packed bottles with a particular brand name and in return the farmers will receive the majority portion of the profit. This idea of corporate dairy business spread like a fire which gives rise to the Goshen Creamery, Fonterra, Arla foods, etc. The advancement in technology also helps the dairy farmers to work more with machines and less manual labour which increase the milk production. And also, it cost low to maintain a machine than labor.

1.2 Literature Review

Wilson J and Anderson M (2017) This review paper tracks the evolution of milk and dairy industry from 19th centuries small scale industry to 21st century billions of dollars industry. It also focuses on the technological innovation in milk and dairy industry that revolutionaries this industry. Example – the introduction of cream separator in 1800s.

Santosh R and Smith P (2018) This paper focused on the evolution of milk and dairy industry from small scale local production to the large-scale bulk production. And role of industrialization and spread of dairy industry throughout the world, from ancient period to future.

Choi J and Gao X (2019) This research paper is focused on how AI and machine learning changing the market scenario specially in perishable items. Thought now a days people are shifting from traditional shopping to online shopping particularly in perishable products like milk, vegetables etc., and how AI can help in making algorithms and real time data.

Kantar (2020) This research paper focused on, how recently developed online shopping platforms are responsible for changing the customer behavior. This research paper shows that what are the impact of online shopping in different sectors, also include the daily used product and perishable goods industry.

Patel N and Joshi M (2020) Their paper argue that how the E – commerce website like blinkit, amazon fresh etc has influence the sale of milk and the milk related products. It studied the changes in buying behavior of consumer, specially living in urban areas particularly in products like milk, butter etc.

Kumar A and Sharma D (2020) This paper studied that how technological innovation in dairy farming are influencing the production. Examples – automated milking system and IoT based process and quality monitoring. These systems improve the overall working and safety standards of milk and also shape the consumer preference to the brand.

Gupta A and Sharma R (2021) This research paper focused on how digital innovation has changed the milk and dairy industry completely, it also shed light on how consumer behavior was changes by digital innovation in purchasing milk and dairy products. Also, how digital infrastructure has influenced the supply chain logistics of milk and dairy industry.

Saxena P and Chauhan A (2021) There study in research paper argue the importance of cold chain logistics management and it became more important when you are dealing with the perishable product like milk in maintaining the freshness of the milk and other related products. Managing the cold chain logistics is one of the most important and difficult tasks because it directly impacts the customer and make an image of a product in customer mindset.

1.3 Research Objective

This research paper aims to investigate the shift of consumer due to technology and its impact over the sales of milk and dairy perishable goods.

Table No.1 Identification of Perishable Goods in Milk Products:

Country	Fluid Milk	Cheeses	Butter
North America			
USA	75.8	15.1	2.8
Canada	78.4	12.3	2.5
Europe (EU26)	62.8	17.1	3.6
Ireland	135.6	6.7	2.4
Finland	127.0	22.5	4.1
UK	105.9	10.9	3.0
Sweden	90.1	19.1	1.7
France	55.5	26.3	7.5
Italy	54.2	21.8	2.3
Germany	51.8	22.9	5.9
Greece	49.1	23.4	0.7
Netherlands	47.5	19.4	3.3
Other			
Australia	105.3	11.7	4.0
Brazil	55.7	3.6	0.4
India	39.5	-	3.5
China	9.1	-	0.1

Source:https://www.researchgate.net/figure/Calcium-intake-in-different-countries-animal-calcium-is-provided-mainly-by-dairy_fig1_281116235

1.4 Conclusion

One of the essential commodities used by the consumer in their daily life was milk and its products. The origin of milk and dairy industry dynamically transformed from ancient to the modern globe in terms of technological advancements. The innovations done in dairy industry for milk and its products was pasteurization, homogenization and ultrafiltration, these technologies are used to enhance the milk and its products safety, quality as well as the shelf life. The development of refrigeration technologies has revolutionized the sector. Nowadays due to the availability of digital platforms consumer behaviors has shifted for the demand of milk and its products in both rural as well as urban areas. Overall, the integration of technological advancements not only change the milk production and extraction of other products from it but has also changed the consumer purchasing pattern, solidifying the importance of dairy products in daily life.

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23. SMART CITIES AND SUSTAINABLE URBAN DEVELOPMENT

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Abstract

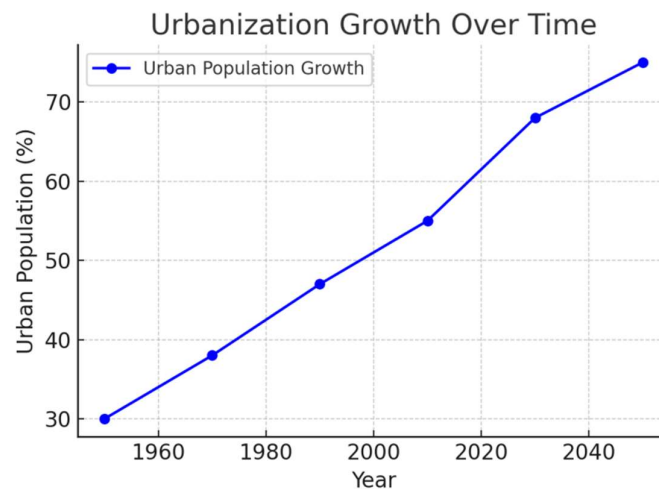
With the rapid growth of urban populations, cities face challenges related to pollution, energy consumption, inefficient governance, and infrastructure stress. The Smart Cities Mission aims to integrate technology-driven solutions to enhance sustainability and urban resilience. This research explores how IoT, AI, Big Data, and renewable energy contribute to efficient urban planning. The study analyzes case studies from India's Smart Cities Mission (Pune, Bhopal, Surat) and compares them with global smart city models (Singapore, Amsterdam). Findings reveal that data-driven governance, smart mobility, and green infrastructure are critical success factors. Challenges such as high implementation costs, data privacy issues, and governance inefficiencies are discussed, followed by recommendations for scalable, citizen-centric solutions.

Keywords: Smart Cities, Sustainability, IoT, Renewable Energy, Urban Planning

1. Introduction

1.1 Background

Urbanization is increasing rapidly, leading to overburdened infrastructure, environmental degradation, and inefficient public services. The concept of smart cities integrates technology and sustainable urban planning to optimize resource management, enhance mobility, and reduce pollution. India launched the Smart Cities Mission (2015) to address these challenges using technology-driven, citizen-centric solutions.



1.2 Problem Statement

Urban areas face traffic congestion, high energy consumption, inefficient waste management, and water scarcity. Traditional city planning lacks real-time data-driven decision-making. This study explores how IoT, AI, and Big Data enable sustainable urbanization.

1.3 Research Objectives

- 1. To examine how smart city technologies improve sustainability
- 2. To compare Indian Smart Cities Mission with global smart cities
- 3. To identify key challenges and policy recommendations

1.4 Scope and Limitations

- **Scope:** Focus on Indian smart cities, with global comparisons
- **Limitations:** Excludes private smart city projects and short-term initiatives

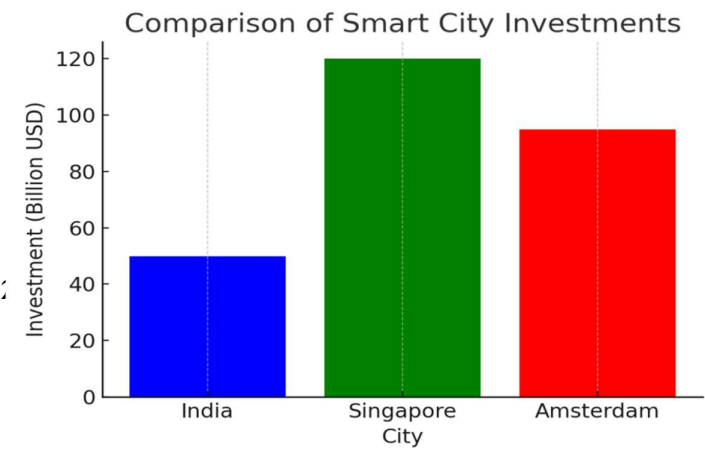
2. Related Work

2.1 Smart Cities & Sustainability Frameworks

- **Smart Cities:** IoT, AI, and GIS for urban planning and governance
- **Sustainability Goals:** Energy efficiency, waste management, and green mobility

2.2 Case Studies & Global Comparisons

Parameter	Indian Smart Cities	Singapore	Amsterdam
IoT Integration	Medium	High	High
Renewable Energy	Developing	Advanced	Advanced
Smart Transport	Partial	Fully Integrated	Fully Integrated



- Proposes technology-driven solutions for scalability

3. Research Methodology

3.1 Data Collection & Sources

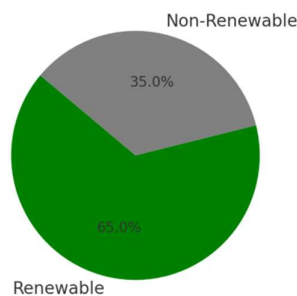
- **Primary Data:** Interviews with urban planners, government reports
- **Secondary Data:** NITI Aayog reports, UN-Habitat, IEEE research

3.2 Data Analysis Approach

Measuring Smart City Efficiency

- Smart cities rely on **performance indicators** such as:
 - **Energy efficiency** – % of renewable vs. non-renewable energy usage.
 - **Public transport efficiency** – Reduction in commute times and congestion.
 - **Sustainability index** – Green building adoption and smart waste management.

Energy Efficiency in Smart Cities



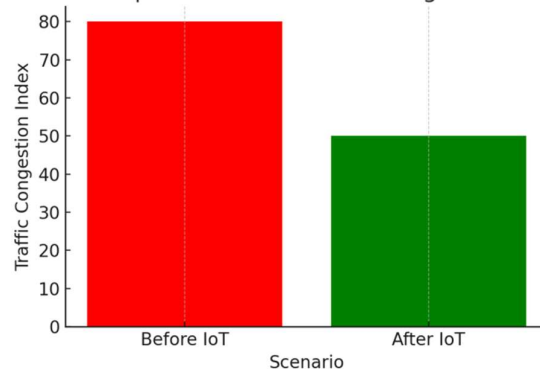
4. Findings and Analy

4.1 Smart Urban Governance

How AI & IoT Improve Governance

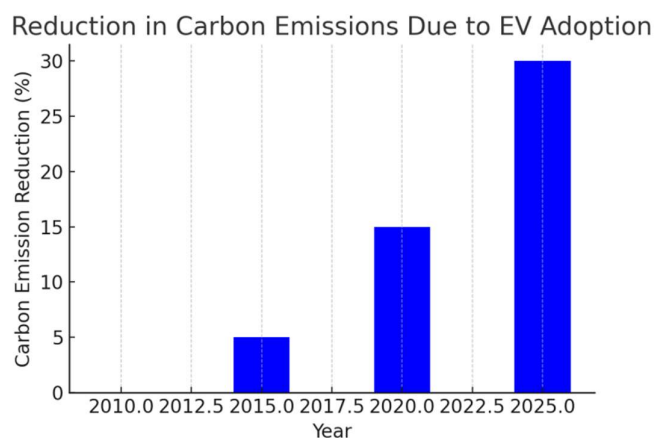
- **Smart surveillance systems** reduce crime by **predicting high-risk zones**.
- **AI-powered waste collection** optimizes pick-up routes, reducing waste overflow by **40%**.
- **E-Governance portals** simplify public services like tax filing, health record access, and complaint resolution.

Impact of IoT on Traffic Congestion



4.2 Smart Mobility & Transport Solutions

- Public transport optimization (BRT, metro)
- Surat's Integrated Transport System reduced congestion by 25%



4.3 Renewable Energy & Resource Optimization

- Bhopal's solar-powered streetlights reduced power consumption by 30%
- Pune's rainwater harvesting project improved water availability

5. Discussion

5.1 Challenges in Implementation

Key Barriers to Smart City Development

- **High Infrastructure Costs:** Initial investments in IoT, AI, and smart grids are expensive.
- **Cybersecurity Risks:** Increased data collection exposes cities to cyberattacks.
- **Public Awareness & Digital Literacy:** Many citizens lack awareness of smart city services.

5.2 Future Opportunities

Emerging Technologies in Smart Cities

- **Blockchain for Governance:** Ensures secure, transparent public records.
- **5G for Smart Connectivity:** Enables real-time monitoring of traffic, energy use, and emergency response.
- **AI for Predictive Urban Planning:** Optimizes land use, traffic patterns, and infrastructure development.

6. Conclusion & Recommendations

6.1 Summary of Key Insights

- Smart city technologies improve sustainability and efficiency
- Public-private collaboration is essential for scalability
- Renewable energy adoption must be prioritized

6.2 Policy Recommendations

- Strengthen Data Protection Laws for privacy & security
- Increase Public Engagement via smart city awareness programs
- Cost-Effective Smart Solutions for Tier-2 and Tier-3 cities

6.3 Future Research Scope

- AI-driven models for smart disaster management
- Integration of 5G & IoT for seamless city connectivity

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24. CONSUMER TIME AND SPENDING PATTERNS ACROSS MALL ZONES IN THE POST-PANDEMIC PERIOD: A SPATIAL-BEHAVIORAL STUDY

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Abstract:

The purpose of this study is to explore the impact of customer visits to different zones of the mall after pandemic. Examined by collecting primary data using the variables of time, money spent in different zones that is according to age, gender, income, fashion consciousness etc. Also the things that they have purchased, importance in their lifestyle was known. The response was collected from different regions. The frequency of visiting helps us to understand the motto of the visit and their spending in different zones after pandemic. The collected data further accessed used the chi-square test, to find the result.

Key words: time spent, money spent, different zones, shopping, mall.

1. Introduction

People have congregated in particular places and throughout time to interact, share knowledge, and exchange goods throughout history. A shopping mall, shopping centre, shops, shopping precinct, or simply mall is one or more buildings that comprise a complex of stores that serve as merchandisers. Visitors can easily go from one store to the next thanks to interconnected walkways, and there is also a parking area. The so-called fourth- and fifth-generation facilities have been seen at a different stage of development. Researchers have long sought to pinpoint the factors that influence customers' purchasing choices when they are in the store.

This study looks at the relative effects of many factors, including demographic factors (gender, age, and income), fashion consciousness, and visual marketing, on customers' perceptions of the time they spend browsing for clothing products (hereinafter time spent shopping).

Modern cities are mostly built on shopping centers, which has an impact on the daily routines, interpersonal connections, and movement of the citizens.

The amount of time that customers spend shopping is one aspect of consumer behavior that is thought to be extremely important, but has not got enough research. Although earlier research suggests that shopping time is positively correlated with purchase outcomes, and retailers want their customers to spend as much time as possible in their stores to maximize their purchasing outcomes, the task today may not be as easy for fashion retailers because consumers are changing

their behavioral patterns. Time is a valuable and rare resource since many consumers are time-constrained and more time-sensitive (Lucia-Palacios, Pérez- López, and Polo-Redondo,2016).

This study looks at the relative effects of a range of factors, such as demographic factors (gender, age, and income), fashion consciousness, and visual shopping, on customers' perceptions of the time they spend shopping and buying clothing products (hence time spent shopping). When taken into account together in one model, it is less clear how all those factors, which may affect hours spent buying and were found to be significant in studies on fashion retailing, affect time spent buying clothing. The antecedents of time spent shopping in various retail settings have been studied in previous study;

2. Literature Review

Many researchers have explored the attributes and features that make a shopping mall more attractive to visit and spend time there. Other researchers have figured out the motives consumers go to shopping malls. Shopping malls play an important role in a consumer's life. Jin and Kim (2003) research discovered that Korean consumers visit retail establishments for utilitarianism, excitement, and sociability. Socialization is connected to a liking for social gatherings, distraction since shopping is viewed as a free time to break up one's routine, and utilitarianism as factors that relate to the practical intent of shopping (p. 406).

Tiwari and Abraham (2010) observed that individuals have high expectations from the malls and that, aside from being places for shopping, malls are places for socializing and entertainment. For them, malls serve as one-stop shops where they can eat, watch movies, hang out, meet up with friends both new and old, and shop. A great value can be found at shopping centers. This is due to the fact that most products are sold by manufacturers to the end consumer at their own retail outlets, which lowers the expense of middlemen and/or shopping malls transmit a part of the profits to customers through discounts and programmes to foster customer loyalty.

(Sharma, 2012: 278) because consumers do consider savings when calculating their final payment. To ensure they are getting the greatest deal, consumers prefer to be informed in advance about sales and promotional events (Goel & Dewan, 2011: 47).

D. & J. Dubihlela (2014) found that the following benefits are primarily given by shopping malls: merchandising (the products, quality variety, and availability), atmosphere (pleasant interior design of the shopping mall), accessibility (distance to shopping mall), entertainment (the variety of recreation, and catering service), and in-mall convenience (ease of navigation within the shopping mall) (p. 685) Choosing a shopping center argues that the main criteria are closeness to the city center, clean and tidy, easy accessibility, safety, quality product sales, spacious and easy navigation, café and restaurants, and escalators. Visitors want to reach the shopping centers easily and feel comfortable inside of it. In fact, the purpose of shopping centers is to attract people to a closed space that is large, spacious and isolated from the outside world, and to make people have a goodtime and to go shopping (p. 212).

Nazari & Hesari (2012) found that shopping malls can change as well the consumers' behavior. It can affect the number of times of purchasing; can lead to impulsive purchasing and change the time of purchasing (p. 289). Shopping in a mall may contribute to life satisfaction through four key life domains: (1) consumer life, (2) social life, (3) leisure life, and (4) community life. A shopping mall can contribute significantly to consumer well-being by providing shoppers with an assortment of stores that carry much needed goods and services. A shopping mall can contribute significantly to social well-being by providing shoppers a venue that allows them to

gather with other people such as friends and relatives to interact and socialize. A shopping mall can contribute significantly to leisure well-being by providing shoppers an entertainment venue. Many shopping malls host implicit and explicit entertainment programs. Implicit entertainment may occur in the form of browsing through the mall and stores within. Explicit entertainment occurs, for example, when shoppers go a movie theater within the mall or visit a video arcade. Finally, a shopping mall can contribute significantly to community well-being by providing a meeting place for community residents to assemble, socialize, and experience a sense of community. Enhancing well-being in the consumer, Social, leisure, and community life domains serve to increase overall life satisfaction Consumerspay attention as well to the environment and the interior of shopping malls.

Teik et al.'s (2015) research reveals that there are significant positive relationships between interior settings, music, and employee engagement with consumer behavior. A mall that has good atmospherics is one that motivates shoppers to linger around, take their time doing their shopping, and encourages people to use the mall to experience leisure, social, and community events. Conversely, a mall that has poor atmospherics is likely to repel then attract shoppers. That is, shoppers are likely to feel reluctant to do their shopping in a mall with poor atmospherics; and even if they feel they have to, they may limit their time at the mall to buy only. That is, they are not likely to consume entertainment services; they are not likely to eat and socialize with others at the mall; and they are not likely to treat the mall as a community gathering place

(El-Hedhli, 2015). According to Burns and Warren (1995), the main distinction between many of these centers is usually just location because the store mixture and product offerings of many local shopping malls are quite similar. Therefore, it often doesn't seem like a rational decision to choose a regional shopping center besides the one that was closest to one's place of living for shopping. But it seems like this kind of behavior is rather typical. Therefore, it would seem that choosing a regional mall might not always be based purely on the selection and location of the available shopping options.

3. Hypothesis:

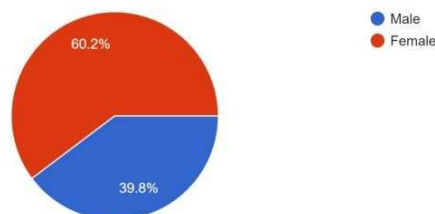
The hypothesis are

H0= Time and money spent in the mall are dependent after a pandemic.H1=both are independent.

Result Analysis:

This is the survey on understanding the financial condition in different areas. The questionnaire was sent and 83 people in different fields responded for the survey. The confidential statements were sent with clear instructions to get the honest responses.

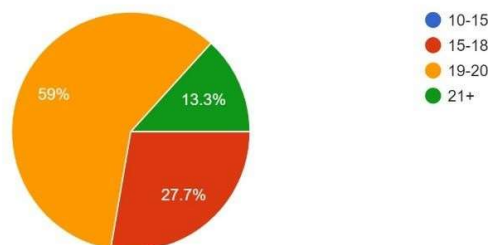
Gender
83 responses



In the total survey 60.2% are female and 39.8% are male responded to the survey.

Age Group

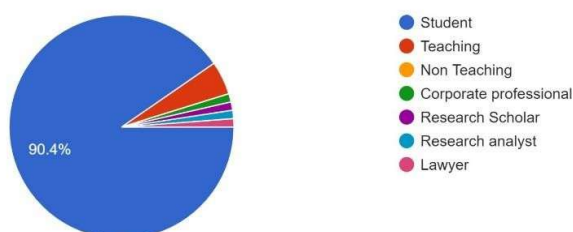
83 responses



The age group of 19-20 years old was given 59% of the survey , 27.7% of 15-18years old and 13.3% is of 21 + years old.

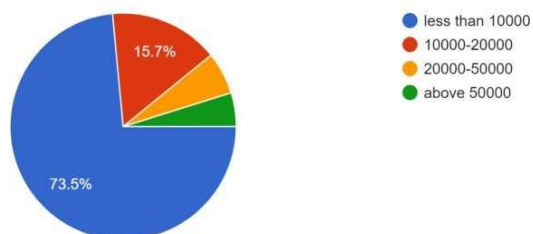
Your professional

83 responses



Your monthly income

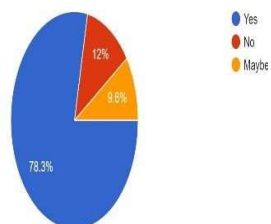
83 responses



The response 73.5% was working people with a monthly salary less than 10,000.

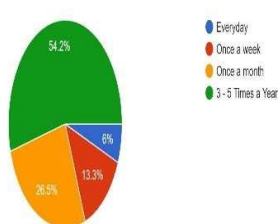
Do you visiting Malls ?

83 responses



The frequency of your visiting to shopping malls

83 responses

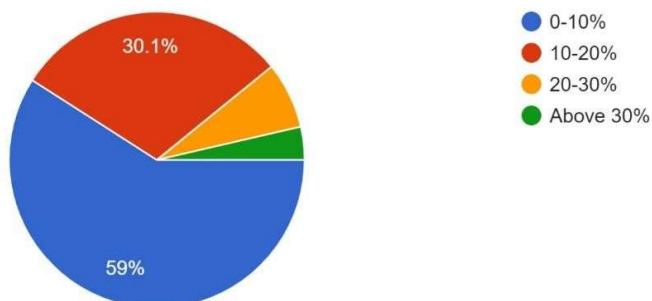


The response 73.5% was working people with a monthly salary less than 10,000.

78.3% responded are visiting malls, 12% are not visiting malls in the response. 54.2% visit 3-5 times in a year, 26.5% visit once in a year. 13.3% visit in a weekend the remaining 6% used to wear it daily.

Your spending ratio from your salary in mall

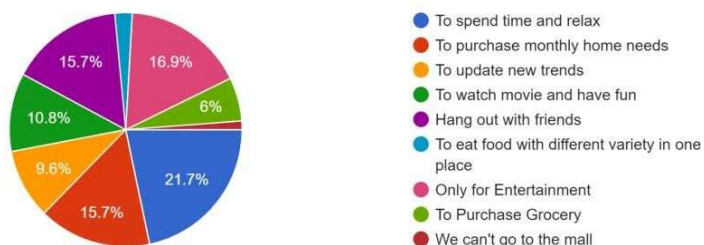
83 responses



59% spent 0-10% of their salary in the mall, 30.1% spending 10-20% and the remaining others.

Reason to visit the Mall

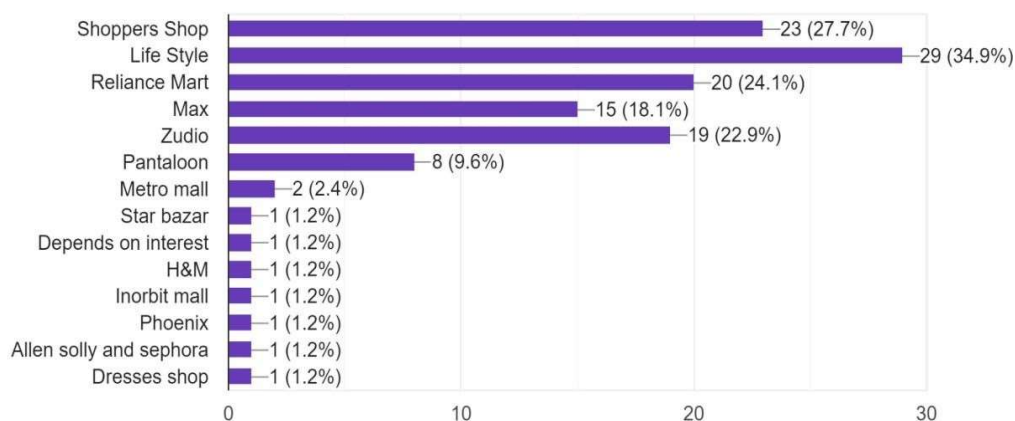
83 responses



Questions	Percentage response
To spend time and relax	21.7%
To purchase monthly home needs	15.7%
To update new trends	9.6%
To watch movie and have fun	10.8%
Hang out with friends	15.7%
To eat food with different variety in oneplace	21.7%
Only for Entertainment	16.9%
To purchase grocery	6%

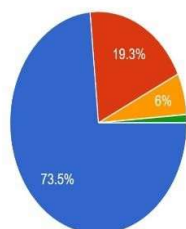
Your favourite shops in mall

83 responses

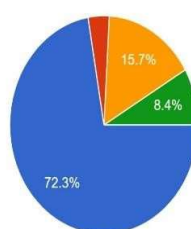


The list of favorite shops in the mall is given above.

How many % things in your home are purchased from Mall
83 responses



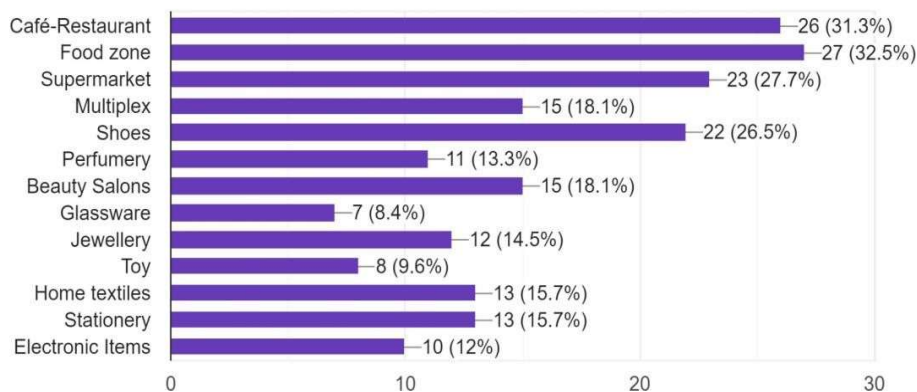
What type of items, do you prefer to buy in the malls?
83 responses



73.5% of home things in response were purchased from the mall. 19.3% responses 25-50%. 6% have 50-75 %. In the survey, 72.3% responded that they like to buy brands.

More money spend in which store listed below

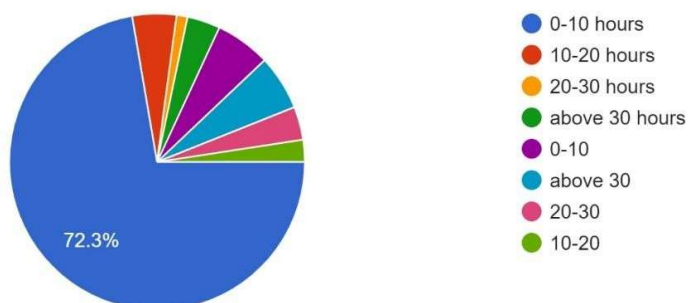
83 responses



Many spent in different stores was in the figure, which shows that the money spent in cafe-restaurants and food zones is more.

How much time, do you spend in Mall

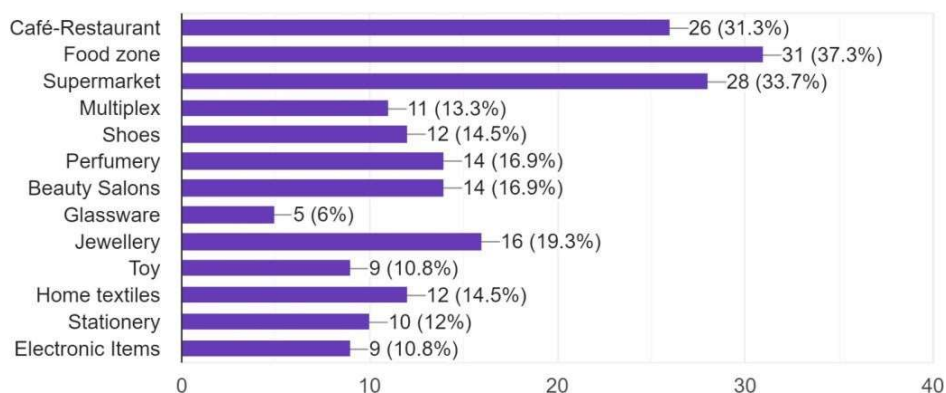
83 responses



Maximum time spent by response in the mall is 72.3%.

More time spend in which store listed below

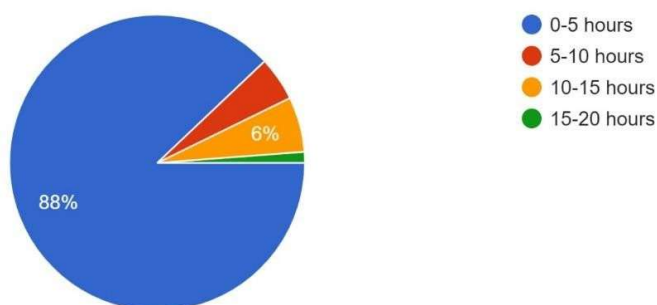
83 responses



Time spent in a cafe-restaurant is more than other stores.

How much time spend in food zone?

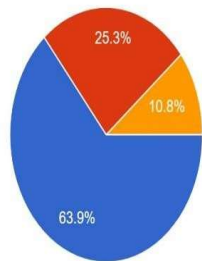
83 responses



Time spent in the food zone upto 5% is 88%.

How do you feel about the prices at the mall ?

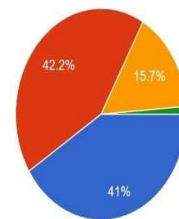
83 responses



What is your opinion about the parking facility in the mall ?

83 responses

● Costly rate
● Margin rate
● Any Other

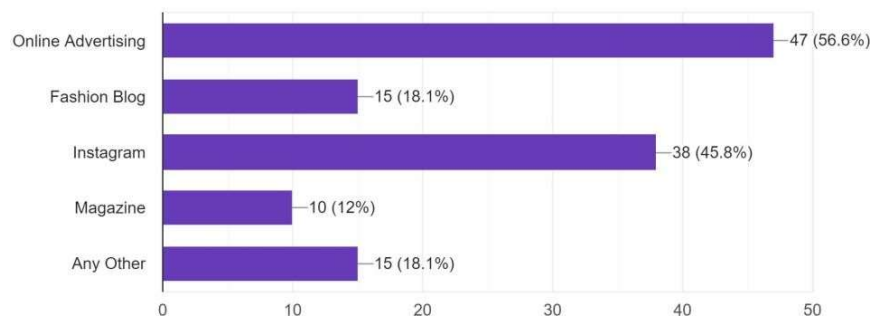


● Excellent
● Good
● Fair
● Poor

Costly rate prices at the mall were responded by 63.9% and 41% excellent, 42.2% good responded to the parking facility.

How do you get information about new fashion products ?

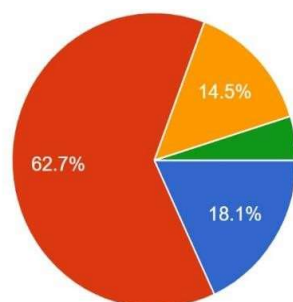
83 responses



The update of information about new fashion products from the mall, the response from 56.6% online advertising, 18.1% fashion blog, 45.8% instagram, 12% from magazine, 18.1% from other.

Why are shopping malls popular?

83 responses

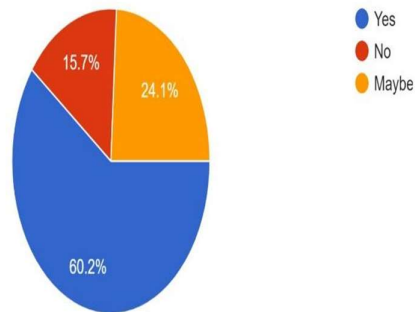


● There isn't any music and fun.
● They have everything and all in the same place.
● The weather is perfect at any time.
● There are often plants and music.

The responses responded to the reason why the shopping malls are popular is in the above diagram.

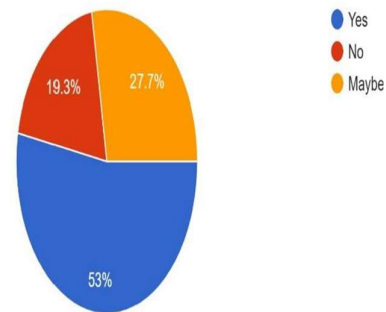
Did the store have a reasonable return and exchange policy?

83 responses



Was it easy to find all items as per your need in your budget?

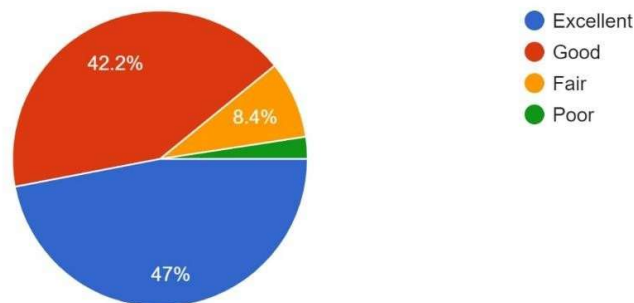
83 responses



In the response 60% said they were satisfied with the return and exchange policy. 53% responses were able to find the items in mall as per their need.

How do you feel about the overall experience when you are at the mall?

83 responses



47% responded the overall experience in the mall was excellent, 42.2% of the respondents said good, 8.4% responded fair and remaining poor.

The survey helps to determine the spending and items in home after a pandemic.

Expected Outcomes:

From the observation, the observed table is

	0-25%	25% above	Total
Spent % from the salary	73	9	82
Mall things in home	60	15	75
Total	133	24	157

From the observed table, the expected table using formula is

	0-25%	25% above	Total
Spent % from the salary	69.47	12.54	82.01

Mall things in home	63.54	11.46	75
Total	133.01	24	157.01

The value after using chi-square formula(in Excel) gives the value 7.86 , the CV is 3.841 Using the chi- square test, the expected outcome was concluded to chi-square value is greater than CV value. Hence,it rejects the null hypothesis.

Results that time and money spent in the mall are dependent

Future Scope:

The future scope from this study ,helps to implement and improve the customer service, economic conditions of the mall into the next level.

4. Conclusion:

The purpose of the study is to investigate the customer attitude towards malls after the pandemic. It was found that even after the pandemic, visits of people to malls not only for purchase but also for time spent was increased. The primary data collected from individuals to know the current situation. Using the chi- square test is used to conclude. This study helps to improve the present nature of people who visit malls. It can be extended to many variables in future.

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25. "MAXIMIZING PMS FOR ENDURING TALENT ENRICHMENT AND UNWAVERING EMPLOYEE DEDICATION"

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DR. AANCHAL TYAGI, MANGALMAY INSTITUTE OF MANAGEMENT & TECHNOLOGY

Abstract

Talent retention and workplace culture play crucial roles in sustaining business success in the fast-paced and dynamic environment of the organisation. This study explores the impact of Performance Management Systems (PMS) on employee retention and work-cultural configuration within the different industries. With a sample of 120 employees, the research evaluates how a well-structured PMS influences workforce stability, job satisfaction, and the overall organisational culture. The study delves into key components of PMS, including goal setting, continuous feedback, performance evaluations, and reward mechanisms, analysing their direct correlation with employee motivation and engagement. The research aims to identify whether a structured and transparent PMS can serve as a strategic tool for reducing turnover, improving job satisfaction, and fostering a positive workplace culture. Findings from the study suggest that an efficient PMS enhances employee performance and strengthens organisational commitment and cultural cohesion. Employees who receive clear performance expectations, constructive feedback, and fair recognition are more likely to remain engaged, leading to higher retention rates. Additionally, the research highlights the significance of linking PMS with talent development initiatives, ensuring that employees perceive growth opportunities within the organization.

Furthermore, the study emphasizes the need for technology-driven PMS solutions that provide real-time insights, promote continuous learning, and facilitate two-way communication between employees and management. By fostering an inclusive and feedback-driven culture, industries can create a high-performance workforce, reduce attrition costs, and enhance customer service quality. The research concludes that implementing an effective PMS is vital for the long-term sustainability of talent in the industry. Organizations must move beyond traditional appraisal methods and adopt a more dynamic, data-driven, and employee-centric PMS approach to align business objectives with workforce expectations. This shift will not only enhance employee retention and productivity but also contribute to a thriving organizational culture, ultimately leading to business growth and customer satisfaction.

Keywords- Performance Management system (PMS), Talent Retention, Organisational structure, Employee engagement, Continuous feedback, Data-Driven.

1. Introduction

Performance management is a fairly imprecise term, and performance management processes manifest themselves in many different forms. The approach must depend on the context of the organisation- its culture, structure, technology, the views of stakeholders and the type of people involved. Performance management is a strategic and integrated approach to delivering sustained success to the organisation by improving the performance of the people who work in it and by developing the capabilities of the teams and individual contributors. Strategic in the sense that it is concerned with the broader issues facing the business if it to function effectively in its environment, and with the general direction in which it intends to go to achieve longer-term

goals and integrated in four senses; **Vertical Integration, Functional Integration, Human resource (HR) Integration and Individual Integration**. The real concept of performance management is associated with creating a shared vision of the purpose and aims of the organisation, helping each employee understand and recognise their part in contributing to them, and in so doing managing and enhancing the performance of both individuals and the organisation. Performance management is concerned with outputs- the achievement of results - and outcomes- the impact on performance. But it is also concerned with the processes required to achieve these results (competencies) and the inputs in terms of capabilities (knowledge, skill and competence) expected from the teams and individuals involved. In this context, Performance Management Systems (PMS) have emerged as a crucial tool for enhancing employee retention, fostering workforce engagement, and shaping a positive organizational culture. **This study seeks to explore the role of PMS in sustaining employee motivation, reducing turnover, and configuring a strong workplace culture** with a sample of 120 employees from various establishments.

Effective performance management is essential for aligning individual goals with organizational objectives, ensuring transparency in evaluations, and creating an environment conducive to professional growth. A well-structured PMS encompasses critical HR functions such as goal setting, continuous feedback, periodic evaluations, and reward mechanisms, all of which contribute to enhanced job satisfaction and employee loyalty. However, in many industries, PMS implementation often lacks consistency, leading to ambiguous performance expectations, inadequate feedback mechanisms, and an absence of structured career development opportunities. This results in low employee morale, high attrition rates, and a lack of long-term workforce commitment. Given the high operational demands of various sectors, it becomes imperative for organizations to integrate a PMS that not only measures performance but also fosters employee development and cultural alignment.

Employee retention remains a significant challenge in many industries due to the perception of jobs as short-term employment opportunities rather than viable long-term career paths. Many employees leave their roles due to a lack of recognition, minimal career advancement opportunities, and an absence of engagement-driven HR practices. This study examines whether a robust PMS can mitigate these issues by creating a structured and transparent performance evaluation system. By incorporating clear **Key Performance Indicators (KPIs), Structured feedback, and Merit-based incentives**, organizations can ensure that employees feel valued, motivated, and invested in their roles.

Performance management concerns everyone in the business, not just managers. It rejects the cultural assumption that only managers are accountable for the performance of their teams and replaces it with the belief that responsibilities are shared between managers and team members. Managers and their teams are jointly accountable for the results and jointly involved in agreeing on what they need to do and how they need to do it, both in monitoring performance and in taking action. In short, best-practice performance-management processes are part of the holistic (i.e., all-embracing) approach to managing for performance, which concerns to everyone in the organisation.

A technology-driven PMS has the potential to revolutionize performance management by offering real-time performance tracking, automated feedback systems, and data-driven decision-making. Digital tools such as AI-powered analytics, cloud-based performance tracking platforms, and mobile-based feedback applications can enhance communication between employees and

management, facilitate continuous learning, and ensure a structured approach to professional development. Implementing such innovations can provide real-time insights into employee performance trends, allowing management to make informed talent development and retention decisions. Beyond individual performance assessment, PMS plays a pivotal role in shaping workplace culture. A strong organizational culture, characterized by open communication, fairness in evaluation, and growth opportunities, fosters a sense of belonging and commitment among employees. Organizations that prioritize transparent performance management and recognition-based incentives are more likely to retain top talent and reduce turnover rates. Furthermore, a culture that emphasizes continuous learning, skill development, and career progression aligns employees with long-term organizational goals, leading to a more engaged and high-performing workforce.

This research highlights the necessity for industries to adopt a more dynamic and employee-centric PMS approach rather than relying on traditional performance appraisal methods. The findings will provide valuable insights into the effectiveness of PMS in enhancing talent retention and workplace culture, offering practical recommendations for HR professionals and industry leaders. Organizations can significantly improve workforce stability and overall operational efficiency by integrating PMS with employee engagement strategies, career development programs, and technology-driven feedback mechanisms. As businesses across various industries continue to evolve, it is crucial to recognize that employees are not merely operational assets but key drivers of overall success and growth. A well-structured PMS, when strategically aligned with employee needs and organizational goals, has the potential to redefine performance management, transforming it from a process of evaluation into a tool for empowerment and development. (Karabulut, 2015) This study will explore best practices for PMS implementation, the impact of structured performance management on employee motivation, and strategies to integrate PMS with a sustainable workplace culture across industries

2. Review of Prior Research

Performance Management System has a significant effect on employee performance. Further, PMS has a positive relationship with employee performance. A well-defined PMS has a significant effect on employee performance. The management of any organization should sit and reconcile its PMS practices to make them more sustainable. It is suggested that the problems of employees be analysed and considered, identified, and helped the employees confront them as a united unit. Organizations should launch acknowledgment methods. It will make employees more encouraged and motivated when they have a sense of acknowledgment and recognition because their efforts are appreciated and recognized. To achieve the required objectives, the organizations should involve the employees in the goal setting and reward employees for their efforts (**Said Muhammad, 2021**). The impact of performance appraisal satisfaction on employee attitudes and behaviour is well established in the literature. Employees who are satisfied with performance appraisals at work are expected to be more satisfied and motivated at work. However, current research has not empirically established whether performance appraisal satisfaction leads to creative behaviour at work. Creative behaviour is one of the key factors that help companies to remain competitive in the market (**Ismail, 2018**) In the era of digital transformation, businesses must innovate and adapt to sustain a competitive edge. This dynamic environment compels a revaluation of traditional management practices, highlighting the need for highly flexible systems. Flexibility, defined as the ability to adapt organizational resources, processes, and strategies in response to environmental changes such as rapid technological advancements, is crucial. Practical implications suggest integrating digital technologies into

performance strategies, utilizing real-time metrics for agile decision-making and emphasizing ethical and sustainable practices to improve transparency and stakeholder trust. These strategies are crucial for optimizing performance in the digital age (**Cosa, 2024**). For measuring the performance Balance score card BSC has a significant and positive impact on organisational performance. The BSC perspectives [learning and growth perspective, internal business process (IBP) perspective, customer perspective (CP), and financial perspective (FP)] have a significant, direct, and indirect impact on IT companies. On the other hand, solely three BSC perspectives (IBP perspective, CP, and FP) have a significant impact on non-IT companies, while the learning and growth perspective has an insignificant impact on the FP. So the purpose of BSC is to measure the theoretical and practical contribution to talent management for IT and Non-IT businesses is very effective (**Zairbani, 2024**). The BSC is more than a simple performance evaluation system, to become a true strategic management tool able to clarify and translate the mission and organizational strategy, making possible the communication process, the strategic alignment, and the organizational learning (**Quesado, 2018**). An effective performance appraisal system is substantially important for the success of enterprises competing in complex environments. Performance measures are used in the evaluation, control, and development of the enterprises' processes to ensure achieving their goals and objectives. Performance measures are also used to compare the performance of different enterprises, factories, departments, teams, and individuals. Traditional performance appraisal methods based on financial criteria have been widely used in assessing business performance. However, performance evaluation methods, which are based on only financial criteria, are not enough to evaluate the performance of the enterprises today. Balanced Scorecard, which has been developed by recognizing the shortcomings and deficiencies of traditional measurement systems, has introduced a comprehensive performance management approach that uses the financial indicators and the non-financial ones together, and takes into account not only the tangible but also the intangible ones in line with the missions and strategies of the enterprises (**Iyibildiren, 2018**). Nowadays, the phenomenon of increased competition between firms and their need to respond effectively to rapidly changing operational conditions, as well as to personnel requirements, has escalated the necessity to identify those factors that affect employee performance (EP). The purpose of this paper is to examine the interrelations between firm/environment-related factors (training culture, management support, environmental dynamism and organizational climate), job-related factors (job environment, job autonomy, job communication) and employee-related factors (intrinsic motivation, skill flexibility, skill level, proactivity, adaptability, commitment) and their impact on EP (**Diamantidis, 2019**). Contemporary performance measurement systems are aimed at evaluating the performance of organizations on key strategic operational areas of success, combining both financial and nonfinancial aspects. These systems help in detecting the critical areas of improvement for enhancing overall performance. In the banking sector, intangible factors like satisfied customers, quality services, innovative high-tech products and services, operational excellence, intellectual capital, employee satisfaction, etc. play a strategic role in achieving success. Measuring their performance on financial aspects is not sufficient, appropriate, and reliable. It is inevitable to implement a comprehensive performance measurement tool to evaluate and improve the performance of banks so that a true picture of their performance can be revealed, and it can help them to achieve their long-term goals of sustainability, profitability, and competitiveness. A tool propagated by Kaplan and Norton in 1992, named Balanced Scorecard, is a significant strategic performance measurement and management system that measures and manages the performance on key strategic perspectives of Financial, Customers, Internal Business processes, and Learning, Growth, and Innovation Perspectives (**Gupta, 2020**). Employee commitment to activities and image of the company in

the industry sector, provision of fair rewards for work, job satisfaction, and availability of tools and resources in the organization have a strong and significant relationship. There is a very significant positive relationship between work-life balance and the provision of fair rewards for work, between relationship and image of the company in the community. Employee engagement and job satisfaction; employee engagement and job assignment that are the most important key factors for organizational performance (**Kazimoto, 2016**). The degree of strategic planning in organisations is likely to have a direct impact on business performance and business evaluation. A popular tool used to support strategic management activity in large firms is the Balanced Scorecard. To date, reported activity to deploy management systems that are based around the use of Balanced Scorecards has focused on large, multi-national, multi-divisional firms; no comprehensive literature on Balanced Scorecards used by SMEs exists. Despite the lack of comprehensive literature focused on Balanced Scorecard implementation in SMEs, we believe Balanced Scorecard and its associated management processes can prove equally beneficial to SMEs as to large organisations, the Balanced Scorecard used at the centre of a strategic management system addresses effectively a number of the fundamental issues relevant to large as well as small businesses (**Andersen, 2019**). High-performance work systems (HPWS) concerning firm competitive advantage, this paper holds that the contribution of HPWS toward the desired outcomes for organizations may depend significantly on employee job involvement. Underpinning the argument of happy workers being productive, the purpose of this paper is to propose the critical mediator of employee well-being to explain the hypothesized multilevel relationship between HPWS and job involvement (**Huang, 2016**). Industry 4.0 must show its superiority in terms of performance. However, the available performance management systems from Industry 3.0 have several limitations and weaknesses. These weaknesses are mainly related to the human factor, whereas the latter is central in the model of Industry 4.0 because this new model is centred on complex human-machine interactions. This perspective engenders specific managerial challenges, which will be due to human resistance to innovation and change. These non-technological changes are labelled management innovations. First, we develop and present a model of performance management successfully implemented. Second, we outline and explain the importance of human factors, which, together with new technological systems, represent a central component of sustainable Industry 4.0 performance management systems. Third, the necessity of managerial and organisational innovations to move from Industry 3.0 to Industry 4.0 systems (**Robert, 2022**). The success of organizational initiatives for environmental sustainability hinges upon employees' pro-environmental behaviours. One of the important contemporary challenges faced by HR professionals is to ensure proper integration of environmental sustainability into human resource policies. The green human resource management (green HRM) has emerged from organizations engaging in practices related to the protection of the environment and maintaining ecological balance (**Saeed, 2019**).

So, by the reviews of the prior research, we identify that Performance Management Systems (PMS) significantly impact organizational success across various business functions. Effective PMS practices enhance employee performance through clear goal-setting, recognition, and feedback mechanisms. Modern approaches integrate both financial and non-financial metrics, with tools like the Balanced Scorecard proving valuable for comprehensive evaluation. As organizations navigate digital transformation, PMS must evolve to incorporate flexibility, real-time metrics, and human-centered approaches. The integration of technological advancements with ethical considerations and employee engagement strategies is essential for sustainable performance management in today's dynamic business environment.

3. Research Methodology

Research Objective

- To assess the impact of Performance Management Systems (PMS) on employee retention and workplace culture through enhanced engagement and professional development across various industries.
- To explore the effectiveness of technology-driven PMS solutions in improving performance tracking, feedback mechanisms, and talent development within different organisational settings.

Sample Size- 120 employees are selected from various business sectors, ensuring representation across different functions such as finance, marketing, operations, management, and HR.

Sampling Method- Stratified random sampling

Data Collection- The data collection method is **primary**, utilizing a structured **questionnaire-based** survey to gather insights from 120 employees across various business functions on the effectiveness of Performance Management Systems.

Questionnaire Design- Structured questionnaire, **5-point Likert scale**, **20 primary questions**.
Sections- Demographic information, Performance management perception, System effectiveness evaluation, Personal Experience assessment.

Data analysis technique – 1- Quantitative analysis (**Descriptive statistics**)

2-Correlation analysis

3- Regression analysis

Data Analysis and Interpretation

1-Descriptive statistics

Table 1.1 Distribution of Respondents by Business Function

Business Function	Number of Employees	Percentage
Finance	28	23.30%
Marketing	31	25.80%
Operations	36	30.00%
Human Resources	15	12.50%

Table 1.2 Distribution of Respondents by Tenure

Tenure	Number of Employees	Percentage
Less than 1 year	22	18.30%
1-3 years	45	37.50%
4-6 years	32	26.70%
More than 6 years	21	17.50%

Table 1.3 Level of Involvement in Performance Management Systems

Involvement Level	Number of Employees	Percentage
Directly involved in design/implementation	18	15.00%
Responsible for team performance evaluation	35	29.20%
Subject to performance evaluations	62	51.70%
Not directly involved	5	4.20%

2- Correlation analysis

A correlation matrix is computed to understand relationships between Business Function Employees, Tenure, and Involvement Employees.

Table 2 Correlation Matrix

	Business Function Employees	Tenure Employees	Involvement Employees
Business Function Employees	1	0.593	0.9
Tenure Employees	0.593	1	0.558
Involvement Employees	0.9	0.558	1

Key Observations:

- **Strong correlation (0.90) between Business Function Employees and Involvement Employees** suggests that involvement in performance management is closely tied to the workforce distribution in different business functions.
- **Moderate correlation (0.59) between Business Function Employees and Tenure Employees** indicates that tenure influences business function allocation but is not the strongest factor.
- **Moderate correlation (0.56) between Tenure Employees and Involvement Employees** suggests tenure might play a role in performance management involvement, though other factors could be contributing as well.

3- Regression analysis

A regression model is constructed to predict the **number of employees in business functions** based on **tenure** and **performance management involvement**.

Regression Equation: *Employees in Business Function* = $\beta_0 + \beta_1$ (Tenure Employees) + β_2 (Involvement Employees) + ε

Regression Model Summary:

- **R-Squared (Explained Variance):** 0.823 (82.3% of variance explained by the model)
- **Intercept(β_0)** = 15.30
- **Tenure Employees Coefficient (β_1)** = 0.1056 (not statistically significant)

- **Involvement Employees Coefficient (β_2) = 0.3011** (stronger predictor)

Table 3 Regression Model

Predictor Variable	Coefficient	Standard Error	t-value	p-value
Constant	15.3	10.73	1.426	0.389
Tenure Employees	0.1056	0.407	0.259	0.839
Involvement Employees	0.3011	0.185	1.63	0.35

Interpretation:

- **The model explains 82.3% of the variance**, indicating a strong relationship between the predictors and the dependent variable.
- **Involvement in performance management is a stronger predictor than tenure** in explaining employee distribution in business functions.
- **Tenure Employees have a weak and statistically insignificant effect on the number of employees in business functions.**
- More data points are required to improve the statistical significance of the model.

4. Conclusion of Data Interpretation

This quantitative analysis highlights:

1. Business function distribution is highly influenced by involvement in performance management systems.
2. Tenure has a moderate but weaker impact on business function allocation.
3. Involvement Employees show the strongest correlation with Business Function Employees, making it the most significant predictor in the regression model.
4. Further data collection is needed to strengthen statistical significance and improve predictive accuracy.

Conclusion And Recommendations

The research investigating Performance Management Systems (PMS) across various industries demonstrates significant relationships between PMS implementation and key organizational outcomes. Quantitative analysis of data from 120 employees across Finance (23.3%), Marketing (25.8%), Operations (30%), and Human Resources (12.5%) reveals compelling insights that inform strategic recommendations.

Statistical analysis highlights a strong correlation (0.90) between business function distribution and involvement in performance management systems, indicating that PMS engagement significantly influences workforce allocation. The regression model explains 82.3% of variance, with involvement in performance management emerging as a stronger predictor than tenure in explaining employee distribution across business functions.

The data confirms that employees who receive clear performance expectations, constructive feedback, and fair recognition demonstrate higher levels of engagement and commitment. The correlation between tenure and involvement (0.56) suggests that experienced employees have greater participation in performance management, though this relationship is less influential than function-based involvement.

Particularly noteworthy is that 51.7% of respondents are subject to performance evaluations, while only 15% are directly involved in PMS design or implementation, highlighting a potential gap in employee participation in system development. Organizations implementing technology-driven PMS solutions can bridge this gap by facilitating two-way communication between management and employees.

These findings support the research objectives by confirming that effective PMS enhances employee performance and strengthens organizational commitment through improved engagement, professional development, and workplace culture. The statistical evidence reinforces the value of transitioning from traditional appraisal methods to a more dynamic, data-driven, and employee-centric PMS approach that aligns business objectives with workforce expectations to drive sustainable growth and employee satisfaction.

Future Perspective -To ensure the long-term success of PMS and its impact on talent development, organizations must continuously adapt their strategies. The following key areas need further exploration:

1. **Technology-Driven PMS** – Implementing AI-driven performance analytics, automated feedback systems, and real-time performance tracking can enhance accuracy and efficiency in evaluations. Future research should examine how digital transformation impacts employee engagement in PMS.
2. **Customized Performance Strategies** – Since different business functions show varying levels of engagement, **tailored PMS approaches** should be explored. Studies can focus on industry-specific or department-specific performance frameworks that drive better results.
3. **Employee Perception and PMS Effectiveness** – Future research can include qualitative studies on how employees perceive PMS fairness, feedback effectiveness, and career growth opportunities. Understanding these perceptions can help refine PMS policies.
4. **Cross-Industry Comparisons** – The study can be extended to different industries to compare PMS adoption, effectiveness, and impact across various corporate environments, helping organizations benchmark best practices.

By integrating these future considerations, organizations can create a **more dynamic, inclusive, and effective PMS** that drives sustainable employee growth and long-term business success.

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26. WOMEN EMPOWERMENT IN THE BANKING SECTOR: A COMPREHENSIVE ANALYSIS OF THE ROLE OF WOMEN

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Abstract

Women's empowerment in the banking sector is not only essential for achieving gender equality but also for fostering economic growth and development. This research paper aims to explore the significant role that women play in the banking sector and its implications for women's empowerment. It examines various aspects such as leadership positions, workforce participation, challenges faced by women in banking, and strategies for promoting gender diversity and inclusivity. By analyzing existing literature, statistical data, and case studies, this paper provides insights into the importance of empowering women in the banking sector and offers recommendations for advancing gender equality and women's leadership in finance.

Keywords: Women empowerment, Banking sector, Gender diversity, Women's leadership, Economic development.

1. Introduction

The banking sector plays a pivotal role in driving economic growth, facilitating financial transactions, and promoting overall societal development. In recent decades, there has been a growing recognition of the importance of gender diversity and women's empowerment within this sector. Women's participation in banking not only reflects principles of equality and social justice but also contributes significantly to enhancing organizational effectiveness and sustainability. This introduction provides an overview of the significance of women's empowerment in the banking sector, outlines the research objectives, and highlights the key themes addressed in this paper.

Background of the study

Historically, the banking sector has been dominated by men, with women facing numerous barriers to entry and advancement. However, in recent years, there has been a notable shift towards greater gender diversity and inclusivity within financial institutions. This shift is driven by various factors, including changing societal norms, legislative reforms, and a growing recognition of the economic benefits associated with gender equality. Despite these advancements, significant disparities persist, particularly in leadership positions and access to opportunities for women in banking.

Women's empowerment in the banking sector is not only a matter of social justice but also an economic imperative. Research has shown that organizations with diverse leadership teams tend to outperform their peers, demonstrating higher levels of innovation, financial performance, and employee satisfaction. Moreover, empowering women in banking contributes to broader societal goals, such as poverty reduction, sustainable development, and gender equality.

Statement of the Problem:

Despite increasing representation, women in the banking sector still face challenges that hinder their full empowerment. This study aims to identify these obstacles and propose strategies to address them, fostering a more inclusive and equitable banking industry.

2. Research Objectives:

The primary objective of this research paper is to examine the role of women in the banking sector and its implications for women's empowerment. Specifically, the paper aims to:

- ❖ To examine the status of women's participation in the banking sector.
- ❖ To identify factors contributing to women's empowerment within the banking industry.
- ❖ To propose strategies for promoting women's empowerment and gender equality in banking.

Significance of the Study

The significance of this study lies in its potential to inform policies and practices aimed at promoting gender equality and women's empowerment within the banking sector. By analysing the roles, challenges, and opportunities for women in banking, this research can provide valuable insights to policymakers, banking institutions, and other stakeholders. Addressing gender disparities in the banking industry not only fosters a more inclusive work environment but also enhances organizational performance and contributes to broader societal goals of gender equality and economic empowerment. Ultimately, this study seeks to contribute to a more equitable and sustainable banking sector that harnesses the full potential of its diverse workforce.

3. Review of literature

❖ Women's Participation in the Banking Sector

Women's participation in the banking sector has seen a significant increase in recent years, marking a notable shift in the traditionally male-dominated industry. This trend can be attributed to various factors, including advancements in education, changing societal norms, and increased recognition of the value of gender diversity in the workplace.

Sundar and Kumar (2012) highlight that the banking sector is becoming increasingly stressful due to demanding work schedules, heavy workloads, and intense competition driven by globalization. Despite job security, fair pay, and strong welfare measures, fear of transfers with promotions causes many women to remain in lower positions. The study explores various barriers preventing women from advancing to higher roles within the banking industry.

Abid et al. (2013) examined the challenges faced by working women in the banking sector, comparing married and unmarried women. The study found that unmarried women receive more parental support, while married women face societal pressures and unsupportive husbands. Most respondents were satisfied with their pay but dissatisfied with the promotion system, citing favoritism. Despite these challenges, over 80% believed the banking sector in Bahawalpur is a good place for women to work.

Emmanuel & Balaji (2014) found that workplace flexibility, reduced working hours, leave benefits, and work-life stress management are crucial for promoting work-life balance in the banking sector. They emphasized the HR department's responsibility in raising awareness about

HR policies and introducing flexible working hours, as recommended by the 6th Pay Commission.

Kannaiah & Kumar (2015) found that heavy workloads, stress, long hours, and domestic duties hinder women's career advancement in Puducherry's private banks. Fear of transfer and decision-making challenges were less significant barriers.

Manisha and Singh (2016) found that the banking sector offers numerous job opportunities for women, matching their qualities. The study revealed that married women in both private and public banks face more challenges, such as time management and job overload, compared to single women.

Bishnoi & Kaur (2017) studied the challenges faced by women executives in private sector banks, focusing on family and social stressors. They found that dual responsibilities, lack of family support, and high expectations often lead to overburdening and health issues.

Rajesh and Emmanuel (2019) highlighted that workplace culture is crucial for retaining female employees in banking. They noted that the nationalization of banks in 1969 and technological advancements since the 1970s have empowered women and reduced gender discrimination.

Anamika and Arrawatia (2021) explored discrimination and work-life balance challenges faced by women in Northern India's private banking sector. They found that women struggle to balance personal and professional lives, impacting their job performance and managerial effectiveness.

Shaji and Joseph (2021) analyzed the presence of female employees in India's banking industry from 2009 to 2018. They found slow but steady growth in women's employment in nationalized banks, while the proportion in foreign and private banks remained constant. Women's representation has increased across all levels in the sector.

Rao and Jain (2023) The study found that women in foreign sector banks in India struggle with work-life balance, gender pay gaps, and underrepresentation in top roles, affecting their career advancement and job satisfaction. These challenges highlight the need for better policies to support women's growth and equality in the workplace. Addressing these issues could improve both employee well-being and overall organizational performance.

❖ Education and Skill Development

Improved access to education for women has played a pivotal role in enhancing their participation in the banking sector. As more women pursue higher education and acquire relevant skills in finance, economics, and business management, they become better equipped to enter and thrive in banking careers.

Initiatives aimed at promoting financial literacy and entrepreneurship among women have also contributed to their increased representation in the banking industry. By empowering women with the knowledge and skills needed to navigate the financial landscape, these programs create opportunities for them to pursue careers in banking and related fields.

Rouf Ahmad Bhat (2015) Women's education in India is crucial for the country's development and empowerment. It enables women to overcome challenges, redefine traditional roles, and improve their status in society. Education serves as a powerful tool for gender equality, reducing inequalities, and fostering active participation in social and economic spheres. As India moves towards becoming a global superpower, prioritizing women's education remains essential for national progress.

Prabhakar, Sonam & Nimesh, Ashok. (2022). Women's skill development is vital for economic and social progress, promoting gender equality in the workplace. The Indian government runs various programs to enhance women's socio-economic status and workforce participation. However, rural women face significant barriers to skill development that must be addressed. This article explores the impact of these programs on women's confidence, self-image, and economic role, along with challenges in their implementation.

❖ **Changing Societal Norms**

Shifts in societal attitudes towards gender roles and workplace diversity have helped break down barriers to women's entry into the banking sector. As gender stereotypes diminish and the value of women's contributions to the workforce is increasingly recognized, more opportunities become available for women to pursue careers in banking.

Corporate initiatives promoting gender diversity and inclusion have also played a role in fostering a supportive environment for women in banking. Companies that prioritize diversity and equity in their hiring practices and workplace policies create an inclusive culture where women can thrive and advance in their careers.

❖ **Recognition of the Value of Gender Diversity**

Research has shown that gender diversity in the workplace leads to better decision-making, improved financial performance, and enhanced innovation. As banks and financial institutions recognize the benefits of having diverse teams, they are increasingly prioritizing gender diversity in their recruitment and retention efforts.

Women bring unique perspectives, skills, and experiences to the banking sector, contributing to a more dynamic and resilient industry. By tapping into the full talent pool and leveraging the strengths of both men and women, banks can better serve their customers and adapt to changing market conditions.

Overall, women's participation in the banking sector continues to grow, driven by factors such as improved access to education, changing societal norms, and recognition of the value of gender diversity. As women take on increasingly prominent roles in banking and finance, the industry stands to benefit from their diverse perspectives, skills, and contributions. However, challenges such as gender bias, unequal opportunities for advancement, and work-life balance issues persist, highlighting the need for ongoing efforts to promote gender equality and empower women in the banking sector.

Problems of Women Employees in the Banking Sector

➤ **Work place Discrimination**

There are hardly any women holding top executive positions in banks because of job inequalities. Women in banks are facing inequalities on pay and promotion. They also face so even on the training front.

➤ **Attitude of Trade Unions**

Banks union, which constitute a powerful pressure, have so far been tepid to women's causes. All the key positions in the union are occupied by men who lack empathy and understanding of women employees' problems and hence cannot solve their problems. Some trade union leaders say that they are not interested in taking ladies as office bearers because they have no confidence

in putting their problems with Power. Unfortunately for the women employees, unions are also indifferent to their problems.

➤ **Dual Responsibilities**

Women carry the dual responsibility of household chores and bank responsibilities. The responsibility of the bank interferes with the household responsibilities and vice-versa. Hence, it becomes increasingly difficult to manage the domestic activities like care and nurture of family members including children. Lack of day care centres; even in big cities poses a major problem for married women. The education of the children gets affected, their relationship with the family gets affected and the husband-and-wife relation may also get affected. Such dual responsibilities may develop stress especially among the married women.

➤ **Lack of Self-confidence**

The self-confidence of an individual in his/her capabilities needs recognition and reassurance from others as well. This seems to be lacking in case of women in managerial jobs in the banks. An attitudinal study attributes the slow rise of women in managerial positions to: (a) their own attitude of putting their family first, (b) the resistance of men to accept women as worthwhile peers and bosses, (c) the influence of the unfavourable male attitudes on organizational decisions concerning women's advancement. Women apprehend that their unconventional behaviour might not get social approval. For example, paying courtesy calls to higher ups, entertaining customers, moving about with male colleagues, are misinterpreted by male colleagues as well as society. They must be offered help to over these blocks and find ways in dealing with such issues in a less threatening manner.

➤ **Glass Ceiling**

Women in banks face the problem of glass ceiling wherein male colleagues see to it that women do not perform and pass derogatory remarks at them. The women employees are often denied foreign assignments. However, there are certain women employees who do not want to get into the rat race and do not feel the need to get involved in organizational politics and hence accept stagnation in their career.

➤ **Problem of Promotions and Transfers**

In banking sector, promotion has inherent transfers. Hence, the social and family lives of women employees get hampered. The education of the children gets affected, their relationship with the family gets affected and the husband-wife relation also gets affected. There are many women whose husbands are working elsewhere, seek transfers to their husband's place of posting. If that is not possible, they are forced to quit their bank jobs to join their husbands.

➤ **Lack of Flexible Personnel Policies**

The personnel policies in the banking sector lack flexibility. The promotion of officers in public sector banks is possible only when the officers complete their rural posting for two years. This poses problems to women officers as they may not be able to accept transfer in rural areas due to their family responsibilities. Thus, there are few women officers promoted in public sector banks. Most of the women officers may be forced to accept transfers as directed by public sector banks. This results in work-family conflict for women officers.

Strategies for Promoting Women Empowerment:

- ❖ **Gender-sensitive Recruitment Policies:** Implement employment procedures that are inclusive of all genders to guarantee that women have equal opportunity in banking organizations' hiring processes.
- ❖ **Flexible Work Arrangements:** To meet the varied demands of women juggling work and personal obligations, provide flexible work arrangements like job-sharing, part-time schedules, and remote work possibilities.
- ❖ **Family-friendly Policies:** Implement family-friendly policies that lessen the caregiving load on women and allow them to pursue professional advancement in the banking industry. Examples of these policies include parental leave, childcare help, and eldercare aid.
- ❖ **Supportive Organizational Culture:** Create a welcoming and inclusive work environment that celebrates diversity, encourages respect for one another, and works toward a workforce that is gender balanced through diversity initiatives, training programs, and awareness-raising campaigns.

4. Conclusion

Women's empowerment in the banking sector is not just about fairness—it's a key driver of economic growth and progress. This study highlights the vital role women play in banking, the challenges they face, and the need for greater representation in leadership. To create a more inclusive and diverse industry, organizations must focus on supportive policies, mentorship, and equal opportunities. By breaking down barriers and fostering a culture of growth, the banking sector can unlock the full potential of women, paving the way for a stronger and more equitable financial future.

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27. LIFE SKILLS: A NEED OF THE HOUR FOR THE CHANGING SOCIETY

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Abstract

Life skills are essential competencies that enable individuals to adapt and thrive in today's fast-paced and dynamic world. This research paper aims to explore the significance of life skills in modern society, emphasizing their role in personal development, education, and societal well-being.

It also focuses on promoting critical thinking via implementing life skills by encouraging individuals to question assumptions, evaluate evidences and make informed decisions. It differentiates between EQ and IQ and helps in best understanding of the emotions of oneself and others.

Through an extensive review of existing literature and empirical evidence, this research presents a comprehensive overview of the importance of life skills, their impact on individuals and society, and strategies for their effective integration into educational curriculum and broader community settings.

This paper explores the increasing importance of soft skills not only within the education system but also in society as a whole. In an era where technical skills are often emphasized, the significance of soft skills – including Communication, teamwork, problem-solving, and emotional intelligence – is frequently underestimated. This research aims to highlight the integral role these skills play in shaping well-rounded individuals who can thrive in various aspects of life, including their professional careers, personal relationships, and societal contributions.

Keywords: Life Skills; Education; Personal Development; Employability; Emotional Intelligence, Community Engagement.

1. Introduction

In an era characterized by rapid technological advancements, globalization, and societal transformations, life skills have emerged as vital competencies for individuals to navigate the complex terrain of modern society successfully. This research paper seeks to explore the profound significance of life skills, emphasizing their role in moulding individuals into adaptable, responsible, and self-reliant citizens of the 21st century.

The onset of the 21st century has ushered in an era marked by unprecedented socio-economic changes, reshaping the fabric of our global society. This transformation, driven by rapid technological advancements, globalization, and evolving socio-political landscapes, has profound implications for individuals and communities worldwide. Technological breakthroughs, particularly in digital communication and artificial intelligence, have revolutionized the way we interact, work, and live. Globalization has interconnected the world's economies and cultures, creating a mosaic of diverse, yet interdependent, societal structures. These changes, while offering numerous opportunities, also present a myriad of challenges, including job displacement due to automation, the digital divide, and the complexities of navigating multicultural environments [1].

In this context, life skills emerge as critical tools for success and adaptability. The World Health Organization defines life skills as "the abilities for adaptive and positive behaviour that enable individuals to deal effectively with the demands and challenges of everyday life." These skills encompass a broad range of competencies, from cognitive skills such as critical thinking and problem-solving to interpersonal skills like communication, negotiation, and empathy. Life skills are not static; they evolve and adapt to the needs of the individual and the demands of the environment. They are essential for managing personal and professional relationships, making informed decisions, and maintaining psychological well-being in a rapidly changing world [2].

The study of life skills is not merely an academic pursuit but a practical imperative. In a world where traditional educational and career paths are constantly evolving, life skills provide the adaptability and resilience necessary to navigate these changes successfully. They are vital for personal development, enabling individuals to face life's challenges with confidence and resourcefulness. Beyond the individual level, life skills play a crucial role in societal development. They foster social cohesion, enhance employability, and are instrumental in building communities that are adaptable, tolerant, and progressive. As such, understanding and nurturing these skills is crucial for the well-being and prosperity of individuals and societies alike [3].

The primary objective of this research is to provide a comprehensive analysis of the role and significance of life skills in the context of modern society. This study aims to explore how life skills facilitate the adaptation to and navigation of the complexities presented by the contemporary socio-economic landscape. It seeks to identify the core life skills that are most relevant today and to examine the ways in which these skills can be effectively cultivated and applied. Furthermore, the research will evaluate the impact of life skills education on individual and societal outcomes, providing insights into how educational systems and policy frameworks can be optimized to support the development of these crucial competencies.

2. The Concept of Life Skills

Life skills encompass a broad spectrum of abilities and competencies that enable individuals to effectively cope with the demands of daily life, both in personal and societal contexts. These skills are generally classified into three distinct domains: personal, interpersonal, and societal [4].

2.1 Personal Life Skills

Personal life skills pertain to an individual's ability to manage their own thoughts, emotions, and behaviours. These skills are essential for personal well-being and self-fulfilment. Examples of personal life skills include:

- a. **Critical Thinking:** Critical thinking involves the capacity to analyze information objectively, assess its credibility, and make informed decisions. It fosters rational problem-solving and the ability to differentiate between fact and opinion.
- b. **Emotional Regulation:** Emotional regulation refers to the ability to recognize, understand, and manage one's own emotions. It empowers individuals to respond to challenging situations with composure and empathy.
- c. **Time Management:** Effective time management enables individuals to allocate their time wisely, prioritize tasks, and meet their goals efficiently. It minimizes procrastination and enhances productivity.

d. *Self-Confidence:* Self-confidence is the belief in one's abilities and judgment. It is essential for pursuing goals, overcoming obstacles, and maintaining a positive self-image.

2.2 Interpersonal Life Skills

Interpersonal life skills are essential for building and maintaining meaningful relationships with others. These skills enable individuals to communicate effectively, resolve conflicts, and collaborate with diverse groups of people. Examples of interpersonal life skills include:

a. *Communication:* Effective communication involves both verbal and non-verbal skills, such as active listening, assertiveness, and empathy. It is fundamental for expressing ideas, understanding others, and fostering healthy relationships.

b. *Conflict Resolution:* Conflict resolution skills empower individuals to address disagreements constructively, finding mutually satisfactory solutions. They promote peaceful coexistence and teamwork.

c. *Empathy:* Empathy entails the ability to understand and share the feelings of others. It fosters compassion and promotes harmonious interactions by allowing individuals to connect with the emotions and perspectives of those around them.

d. *Negotiation:* Negotiation skills are essential for reaching compromises and mutually beneficial agreements. They are particularly valuable in professional and personal contexts.

2.3 Societal Life Skills

Societal life skills are crucial for individuals to actively participate in and contribute to their communities and the larger society. These skills empower individuals to engage in civic responsibilities and address social issues. Examples of societal life skills include:

a. *Citizenship:* Citizenship skills encompass knowledge of one's rights and responsibilities as a member of a society. They include understanding the democratic process, voting, and engaging in civic activities.

b. *Leadership:* Leadership skills enable individuals to inspire and guide others toward common goals. They involve effective decision-making, delegation, and the ability to motivate and influence others positively.

c. *Social Responsibility:* Social responsibility involves a sense of duty toward the welfare of one's community and society as a whole. It encourages individuals to take actions that promote social justice, equity, and sustainability.

d. *Cultural Competence:* Cultural competence skills are vital in today's diverse world. They involve the ability to interact respectfully and effectively with people from different cultural backgrounds.

2.4. Historical Perspective

The concept of life skills has evolved over centuries, shaped by the changing needs and dynamics of societies. The historical development of life skills can be traced through various phases, highlighting the transition from traditional skills to contemporary life skills in response to societal changes [5-6].

Life skills have roots in traditional and indigenous knowledge systems that emphasized survival, subsistence, and community cohesion. In pre-industrial societies, individuals learned essential skills for hunting, farming, and crafting, which were crucial for survival and self-sufficiency. These skills were often passed down through generations, preserving the cultural heritage and knowledge of communities.

The industrial revolution marked a significant shift in the nature of skills required for success. As societies urbanized and industrialized, there was an increased demand for a different set of skills, such as literacy, numeracy, and technical proficiency. The focus shifted from traditional survival skills to formal education and vocational training to meet the demands of an emerging industrial workforce.

However, the mid-to-late 20th century brought about a transformation in the concept of skills once again. Rapid technological advancements, globalization, and changing societal structures led to the recognition that traditional education and technical skills alone were insufficient. There was a growing awareness of the need for a broader set of competencies that could address the complex challenges of the modern world. This recognition gave rise to the concept of "life skills."

The shift from traditional skills to contemporary life skills was a response to the evolving nature of work, increased social complexity, and the recognition of the importance of holistic personal development. This transition emphasized the acquisition of skills that extended beyond the workplace, encompassing personal, interpersonal, and societal competencies [7-8].

Contemporary life skills encompass critical thinking, communication, problem-solving, adaptability, and emotional intelligence, among others. These skills are viewed as essential for thriving in a rapidly changing global landscape, where individuals must navigate not only their careers but also their personal lives, relationships, and contributions to society.

The shift to contemporary life skills reflects a broader understanding of human development and well-being. It recognizes that individuals need a comprehensive skill set to face the challenges and opportunities of modern society successfully. This recognition has led to the integration of life skills education into formal schooling, vocational training, and community development programs.

3 The Importance of Life Skills in Personal Development

3.1 Cognitive and Emotional Development

Cognitive and emotional developments are integral aspects of personal growth, and life skills play a crucial role in enhancing these domains [9].

Life skills promote critical thinking by encouraging individuals to question assumptions, evaluate evidence, and make informed decisions. Critical thinking involves the ability to analyze complex situations, identify underlying issues, and formulate effective solutions. This skill is fundamental for personal development as it enables individuals to navigate life's challenges more effectively.

For example, consider a young adult faced with a difficult career decision. Their critical thinking skills allow them to assess their strengths, interests, and career options objectively. They can research various paths, weigh the pros and cons, and make a well-informed decision, enhancing their personal and professional development.

Emotional intelligence (EQ) involves recognizing, understanding, managing, and effectively using emotions in oneself and others. Life skills contribute to emotional intelligence by fostering self-awareness, empathy, and emotional regulation.

For instance, an individual with high emotional intelligence can navigate interpersonal relationships with sensitivity and empathy. They can handle conflict and stress more adeptly, which is essential for personal well-being. By understanding and managing their own emotions, they can also develop resilience in the face of adversity.

Life skills play a significant role in improving mental well-being and resilience. By enhancing emotional regulation and stress management, individuals can maintain a positive mental outlook even in challenging circumstances.

Consider a person who faces a series of setbacks in their personal and professional life. Their emotional intelligence and coping skills allow them to process these experiences constructively, reducing the impact of stress and preventing emotional turmoil. As a result, they are more likely to maintain good mental health and adapt to changing circumstances with resilience.

3.2 Self-Efficacy and Goal Achievement

Life skills are closely linked to self-confidence, the belief in one's abilities to achieve goals and overcome obstacles. As individuals develop life skills, they gain a sense of competence and agency, which boosts their self-confidence.

For example, imagine a student who undertakes a challenging academic project. Their time management skills enable them to plan and execute the project effectively. Their critical thinking skills help them analyze the project's requirements and structure their work. As they successfully complete the project, they gain confidence in their abilities, reinforcing their self-efficacy.

Life skills are instrumental in setting and attaining personal goals. These skills enable individuals to define their objectives, create actionable plans, and stay motivated throughout the journey.

Consider a professional who aspires to advance in their career. Goal-setting skills help them define clear objectives, such as acquiring new skills or seeking a promotion. Time management skills enable them to allocate time for skill development and job-related tasks. Communication and negotiation skills facilitate networking and career progression. As they consistently apply these life skills, they are more likely to achieve their career goals [10].

Real-world examples underscore the tangible impact of life skills on individuals' success. For instance:

- ***Entrepreneurship and Business Success:*** Successful entrepreneurs often attribute their achievements to a combination of life skills, including risk-taking, creativity, communication, and adaptability. These skills enable them to identify market opportunities, manage challenges, and build thriving businesses.
- ***Leadership and Professional Advancement:*** Leaders in various fields, whether in business, politics, or non-profit organizations, rely on life skills such as effective communication, conflict resolution, and emotional intelligence to inspire and guide their teams. These skills are instrumental in achieving organizational goals and personal career growth.
- ***Personal Development and Fulfilment:*** On a personal level, life skills empower individuals to pursue hobbies, passions, and personal growth initiatives. For instance, someone

interested in public speaking may use their communication and self-confidence skills to become a successful public speaker, enriching their lives and the lives of others.

- ***Education and Academic Achievement:*** Students who develop life skills, such as time management, critical thinking, and self-motivation, often excel in their academic pursuits. They can efficiently manage their studies, engage in effective problem-solving, and set and achieve educational goals.

4 The Role of Life Skills in Education

4.1 Incorporating Life Skills into Formal Education

The integration of life skills into formal education has garnered increasing attention for its potential to enhance students' academic performance and character development. When life skills are embedded within the curriculum, they offer valuable benefits to students, educators, and society as a whole [11].

The incorporation of life skills into school curricula positively influences students' academic performance. These skills, such as critical thinking, time management, and effective communication, provide students with essential tools to excel in their studies. For example, critical thinking skills enable students to analyze and synthesize information effectively, resulting in improved problem-solving abilities and higher academic achievements. Moreover, time management skills help students balance their academic responsibilities, reducing stress and enhancing their overall academic experience.

In addition to academic benefits, the integration of life skills nurtures students' character development. Students learn to become more self-aware, empathetic, and responsible individuals. Life skills programs often emphasize values such as respect, integrity, and teamwork, which contribute to positive character traits. As students practice these skills and values in various contexts, they develop a strong sense of ethics and integrity, promoting responsible citizenship.

4.2 Extracurricular Activities and Life Skills

Extracurricular activities, including sports, arts, clubs, and community service, play a significant role in fostering life skills among students. These activities offer diverse opportunities for personal growth and skill development.

Extracurricular activities provide students with a platform to apply and reinforce life skills learned in the classroom. For instance, participation in a debate club enhances communication and critical thinking abilities, while joining a sports team fosters teamwork, discipline, and goal-setting. These activities complement formal education by allowing students to practice and internalize life skills in real-world situations.

Engagement in extracurricular activities yields long-term benefits for students. The life skills acquired through these activities extend beyond the classroom and contribute to personal and professional success. For example, a student who excels in a school theater production may develop confidence and public speaking skills, which can serve them well in future career endeavours.

Moreover, participation in extracurricular activities often leads to the development of leadership qualities, as students may take on roles of responsibility within clubs or teams. These experiences help students build self-confidence, learn to collaborate effectively, and acquire valuable

organizational and time management skills-all of which are critical for future success in the workforce and in society at large.

5 Life Skills and Societal Well-Being

5.1 Employability and Workplace Success

The acquisition of life skills is paramount for securing employment and thriving in the modern workforce. Employers increasingly value these skills, recognizing their importance in building a competent and adaptable workforce [12].

Life skills, including communication, problem-solving, adaptability, and emotional intelligence, are highly sought after by employers. In a dynamic work environment, employees must be able to collaborate effectively, communicate clearly, and adapt to evolving challenges. Life skills contribute to workplace success by enabling employees to navigate interpersonal relationships, manage stress, and make informed decisions.

Employers across various industries emphasize the importance of life skills when evaluating job candidates and employees. They value individuals who can communicate ideas clearly, work well in teams, and demonstrate resilience in the face of setbacks. Employers recognize that employees with strong life skills are more likely to adapt to changing job requirements, handle customer interactions effectively, and contribute positively to the overall work environment.

5.2. Community Engagement and Social Responsibility

Life skills also play a significant role in fostering community engagement and social responsibility among individuals. These skills empower individuals to participate actively in civic activities, contribute to social cohesion, and address societal challenges.

Active citizenship is a product of life skills education. Individuals equipped with critical thinking, communication, and social responsibility skills are more likely to engage in civic activities, such as voting, volunteering, and advocating for social change. These skills enable individuals to critically assess societal issues, form informed opinions, and take meaningful actions to effect positive change.

Life skills contribute to social cohesion by fostering empathy and effective communication. Individuals who possess these skills are better equipped to understand diverse perspectives, resolve conflicts peacefully, and build bridges within their communities. They play a vital role in promoting inclusivity, reducing discrimination, and creating harmonious environments where people of different backgrounds can collaborate and thrive.

In marginalized or disadvantaged communities, life skills education can be a catalyst for positive change. Programs that focus on life skills development provide individuals in these communities with the tools to overcome challenges and improve their quality of life. For instance, initiatives that teach financial literacy and entrepreneurship skills empower individuals to create economic opportunities and break the cycle of poverty.

Additionally, life skills programs in marginalized communities often emphasize social responsibility and community engagement, encouraging residents to take an active role in addressing local issues, advocating for their rights, and building stronger, more resilient communities.

6 Challenges and Strategies for Promoting Life Skills

6.1 Identifying Challenges

Promoting life skills education and integration into society is not without its challenges. Several obstacles and barriers can hinder progress in this area, including:

Cultural norms and values can influence the acceptance and implementation of life skills education. Some cultures may prioritize traditional education over holistic skill development, necessitating culturally sensitive approaches.

Socioeconomic disparities can limit access to life skills programs, particularly in disadvantaged communities. Adequate resources must be allocated to ensure equitable access to life skills education.

Educators may require training and professional development to effectively incorporate life skills into their teaching. Investment in teacher training is essential for successful integration.

6.2 Effective Strategies

To overcome these challenges and promote life skills effectively, evidence-based strategies and best practices should be employed:

- ***Comprehensive Curriculum Integration:*** Develop curriculum frameworks that integrate life skills seamlessly into formal education. These frameworks should align with national educational goals and standards.
- ***Teacher Training and Support:*** Provide educators with the necessary training, resources, and ongoing support to incorporate life skills into their teaching. This includes professional development programs and access to teaching materials.
- ***Community Involvement:*** Engage communities in the design and implementation of life skills programs. Community input ensures that programs are culturally relevant and address local needs.
- ***Interdisciplinary Approaches:*** Promote interdisciplinary approaches to life skills education, allowing students to apply these skills across various subjects and contexts.
- ***Measuring Impact:*** Establish mechanisms for evaluating the impact of life skills education on individuals, educational outcomes, and broader societal well-being. Collecting data and assessing outcomes are essential for refining programs and demonstrating their effectiveness.

7. Conclusion

Life skills are pivotal for personal development, education, and societal well-being. They enhance cognitive and emotional development, contribute to self-efficacy and goal achievement, foster employability and workplace success, promote community engagement and social responsibility, and address various societal challenges. Despite challenges, the integration of life skills into education and community initiatives is essential for equipping individuals with the competencies needed to thrive in the complex, ever-changing landscape of the modern world. Effective strategies and continued efforts are necessary to ensure that life skills education becomes an integral part of society, benefiting individuals and communities alike.

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28. TECHNOLOGICAL DRIVERS FOR BUSINESS SUSTAINABILITY AMONG WOMEN ENTREPRENEURS IN MSMEs

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Abstract:

The research investigates the contribution of technological drivers to business sustainability among women entrepreneurs in the MSME sector. It analyzes how digital transformation, automation, financial technology, and e-commerce support business resilience, efficiency, and long-term growth.

Design/Methodology/Approach:

The study employs a mix-method approach with both quantitative and qualitative techniques for gathering data. Questionnaires are used to gather primary data, and interviews from women entrepreneurs in MSMEs, while the secondary data is examined from government reports, industry publications, and academic journals. Statistical measures are used to determine the major technological enablers and their effect on business sustainability.

Findings:

The research determines that exposure to digital technologies, online platforms, and fintech solutions strongly boosts business viability among women entrepreneurs. Digital literacy, adoption of cost-effective technology, and pro-market government policies drive this. On the other hand, constraints of limited financial inclusion, infrastructure bottlenecks, and technology expertise limitations hamper wider uptake.

Conclusion:

Technology is an important driver of women entrepreneurs' empowerment through enhanced operational effectiveness, increased market access, and sustainable business practices. Strategic interventions like skill development initiatives and improved financial support can further spur technology adoption among women-owned MSMEs.

Research Limitations and Implications:

The present study is constrained to particular geographic locations and industrial sectors, and this might have implications for generalizability. Future studies can investigate a bigger sample size and cross-country comparison to develop a wider understanding of technology adoption trends in MSMEs.

Practical Implications:

The results offer policymakers, financial institutions, and business leaders' useful information on how to design support programs that are focused. Improving digital infrastructure, financial inclusion, and training programs can enable women entrepreneurs to use technology for sustainable business development.

Contribution to Literature:

This study contributes to the corpus of information on business sustainability through the emphasis on technology as a critical driver for women entrepreneurs in MSMEs. It provides empirical insights into the convergence of digitalization, financial inclusion, and sustainable entrepreneurship.

Keywords: Technology adoption, Women entrepreneurs, MSMEs, Business sustainability, Digital transformation, and technology drivers.

1. Introduction

MSMEs, or micro, small, and medium-sized businesses, are crucial to economic development, particularly in emerging markets, through riding employment, innovation, and social progress. Women entrepreneurs in MSMEs had been instrumental in fostering inclusive financial increase, reducing gender disparities, and strengthening nearby economies. However, no matter their contributions, ladies marketers often face considerable demanding situations in sustaining their organizations, consisting of financial constraints, market boundaries, and socio-cultural boundaries. Among the different factors that contribute to the sustainability of women-led enterprises, technological advancement sticks out as a critical driver that complements performance, competitiveness, and lengthy-time period viability.

In the unexpectedly evolving commercial enterprise surroundings, technology has turn out to be an enabler of increase, allowing companies to optimize their operations, increase marketplace reach, and enhance productivity. Digital gear, automation, e-commerce platforms, and synthetic intelligence have converted conventional business models, providing entrepreneurs with new possibilities to thrive in aggressive markets. For girls entrepreneurs, technological adoption can bridge gaps in economic access, marketplace expansion, and ability development, in the end fostering sustainable enterprise practices.

This paper explores the technological drivers of commercial enterprise sustainability among girls marketers in MSMEs, analyzing how virtual transformation, automation, fintech answers, and government tasks in technology adoption make contributions to long-time period commercial enterprise success.

The look at additionally highlights the demanding situations faced by women entrepreneurs in integrating era into their organizations and discusses capability policy pointers to help their technological empowerment.

By information the role of generation in enterprise sustainability, policymakers, monetary institutions, and enterprise stakeholders can develop targeted interventions that enable girls marketers to leverage digital answers for increase and resilience. This studies ambitions to make contributions to the broader discourse on gender-inclusive monetary improvement and the position of era in fostering entrepreneurial sustainability.

2. Literature review

Sri Lankan entrepreneurs favour unity, social relationships, and social power while also believing in personality characteristic theory and individual success. According to Lussier R. N. et al. (2016), their slogan is always to highlight Sri Lankan society's expectations on social responsibility and their sharing mentality. The government and non-governmental organizations of that country supported small businesses in Lethoso. Specifically, production—which

encompasses both forward and backward linkage—expenditure—which refers to the amount spent on goods—and consumer—which describes people buying goods for consumption—were identified as factors associated with business linkages in this context (Rantšo, T. A. (2016). Absorptive capability refers to using knowledge correctly, expanding it with the latest technological advancements, and so forth, ultimately putting it into practice while starting a business. This promotes knowledge-based entrepreneurial activities and aids in the consolidation of human capital (Qian H & Acs Z J, 2013). According to a study on sustainable entrepreneurship, entrepreneurs are very driven to live independently and contribute to social causes. Few people would rather launch their own company because they want to guide it with sustainable ideals, which entails offering green goods and services (Fischer et al., 2018). Entrepreneurial turbulence is influenced by environment orientation and the success of new products. According to research on the subject, environmental turbulence influences how businesses behave of an entrepreneurial mindset. They suggest that in order to seize new chances, domestic businesses should be investigated in the competitive context. By promoting institutional reforms to increase the availability of risk capital, the government of any country can also play a significant role in fostering creative entrepreneurship (Wong, 2014). A thorough investigation into gender concerns, sustainability, corporate growth, and other difficulties was covered. It was discovered that communication technologies, networking, and innovation are crucial to the success of businesses. Infrastructure like energy and telecommunications, as well as ICT (information communications technology), encourage business owners to focus on low costs and high returns (McClelland et al., 2005). Any business needs basic infrastructure, such as a road network, transportation, communication channels, and so forth, without which entrepreneurs may encounter difficulties distributing their goods to various markets (Adhikari et al., 2011). Rural non-farm small businesses encounter a number of obstacles, including the domestic market, technology, skilled labor, finance, and networks. He adds that subcontracting is a good way for big businesses to teach smaller businesses (Tsepiso, 2015). Women entrepreneurs face numerous obstacles in SMEs, including inadequate logistical support, incapacity to use resources, and lack of technological literacy (Rattanawiboonsom & Ali, 2016).

In their cross-sectional, explanatory study, L. A. Orobia et al. (2020) employed the institutional theory and included 390 young, female entrepreneurs from the Mbarara region of Uganda. To identify the specific concepts of business sustainability, a primary factor analysis was carried out. Inferential analysis was used to test the correlations. The study concluded that corporate sustainability frameworks include people, skills, and shareholder engagement. Finance, market openness, IT infrastructure, government policies and initiatives, and education are the elements that make up the EFC. Finally, financial resources and IT infrastructure are important indicators of young, female entrepreneurs' capacity to maintain their companies.

A literature review of numerous articles pertaining to the technological aspect, business sustainability, msme, women entrepreneur was conducted, and the same produced a number of findings. The present research takes into account business sustainability, msme, women entrepreneur, technical expertise, infrastructure, ICT, creative concepts, and technology updates.

3. Research gaps

While Current research has explored the function of technology in business sustainability, limited research focuses specifically on how women entrepreneurs in MSMEs leverage technology for long-term growth. The unique challenges faced by women, such as digital literacy gaps, remain underexplored. Additionally, there is a lack of empirical studies assessing the effectiveness of

different technological interventions tailored to women-led MSMEs. Addressing these gaps can give stakeholders and policymakers useful information.

4. Research objectives

To identify the technological drivers influencing business sustainability among women entrepreneurs in MSMEs.

5. Research hypothesis

H₀: There is no significant association between technological Drivers and business sustainability among women in msme sector.

H₁: There is a significant association between technological Drivers and business sustainability among women in msme sector.

6. Research method

6.1. Sampling and Data Collection

The survey subjects of this study are female entrepreneur of MSME in North India. The sample size was 384 women entrepreneur running their own business units in North India in MSMEs.

6.1.1 Data Collection Procedure:

The data acquired from primary and secondary sources that provide evidence in support of the research paper.

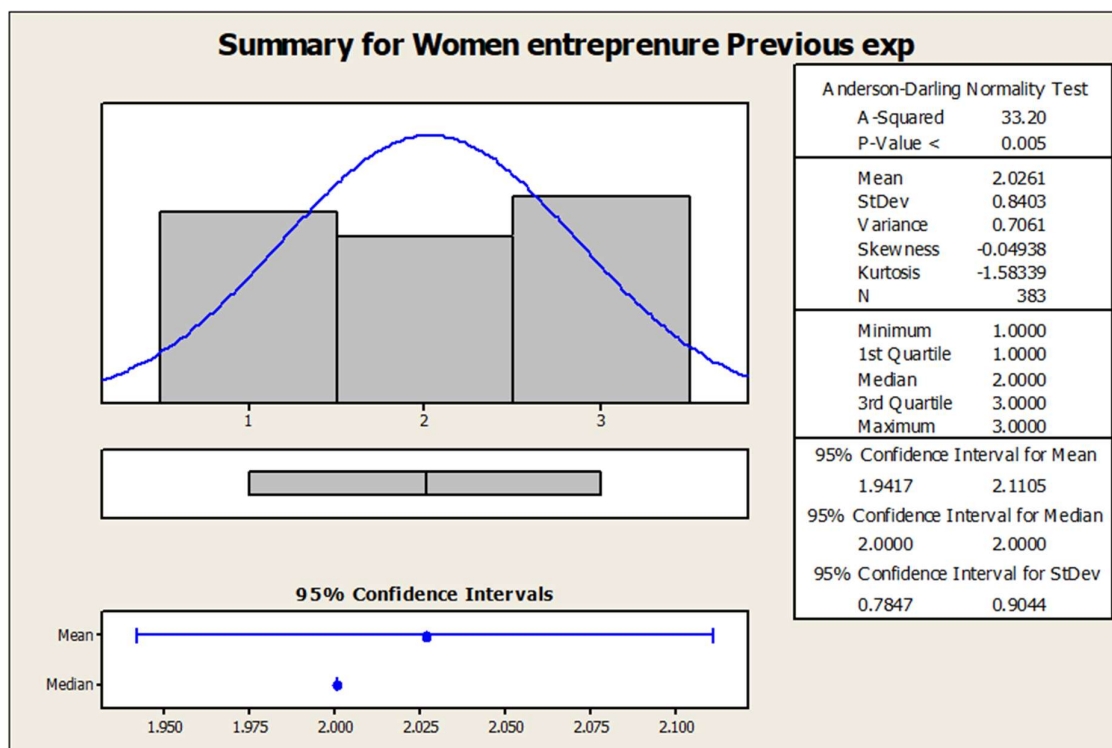
6.1.1.1 Primary data: The primary data gathered through the use of questionnaires from the women entrepreneurs running their own business units in North India in MSMEs. The questionnaire distributed to women entrepreneurs. Initial stage, the pilot study conducted to validate the scale and to avoid the collection of unbiased data.

6.1.1.2 Secondary data: Secondary data gathered through periodicals, magazines, journals, government websites (Women Entrepreneurs | Ministry of Micro, Small & Medium Enterprises (msme.gov.in), Women Entrepreneurship (startupindia.gov.in) Website of Women Entrepreneurship Platform | National Portal of India), and books. Additionally, secondary data are gathered online via a variety of research portals, including SSRN, Google Scholar, and others.

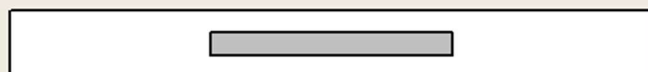
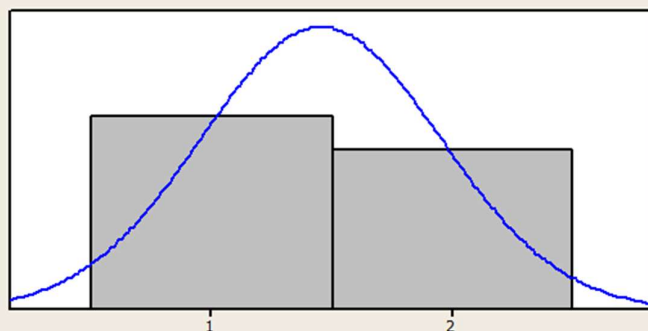
7. Data Analysis

To identify the key technological drivers influencing business sustainability among women entrepreneurs in MSMEs.

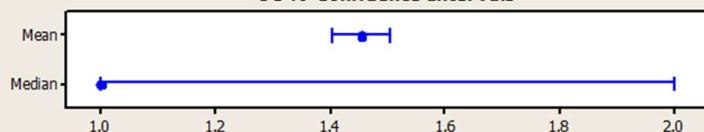
Variable	N	Mean	SE Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Technology drivers	383	2.9843	0.0724	1.4160	1.0000	2.0000	3.0000	4.0000	5.0000
Economic performance	383	3.0261	0.0746	1.4595	1.0000	2.0000	3.0000	4.0000	5.0000
Venture performance	383	2.9112	0.0765	1.4978	1.0000	2.0000	3.0000	4.0000	5.0000
Social performance	383	2.9452	0.0702	1.3746	1.0000	2.0000	3.0000	4.0000	5.0000
Environment performance	383	3.5640	0.0706	1.3826	1.0000	3.0000	4.0000	5.0000	5.0000
Women entrepreneur age	383	2.3864	0.0580	1.1358	1.0000	1.0000	2.0000	3.0000	4.0000
Women entrepreneur Educa	383	2.7702	0.0737	1.4415	1.0000	1.0000	3.0000	4.0000	5.0000
Women entrepreneur marit	383	1.4543	0.0255	0.4986	1.0000	1.0000	1.0000	2.0000	2.0000
Women entrepreneur Previ	383	2.0261	0.0429	0.8403	1.0000	1.0000	2.0000	<u>3.0000</u>	<u>3.0000</u>



Summary for Women entrepreneurship marital stat



95% Confidence Intervals



Anderson-Darling Normality Test

A-Squared 69.41
P-Value < 0.005

Mean 1.4543
StDev 0.4986
Variance 0.2486
Skewness 0.18426
Kurtosis -1.97640
N 383

Minimum 1.0000
1st Quartile 1.0000
Median 1.0000
3rd Quartile 2.0000
Maximum 2.0000

95% Confidence Interval for Mean

1.4042 1.5044

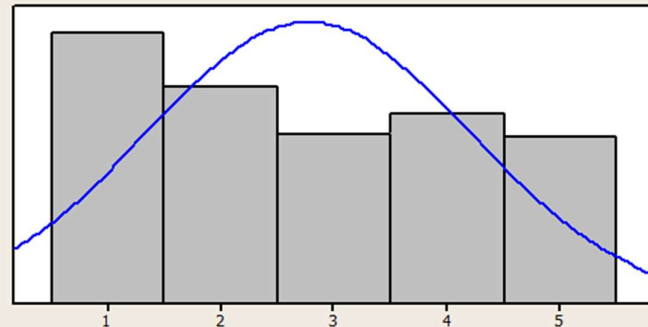
95% Confidence Interval for Median

1.0000 2.0000

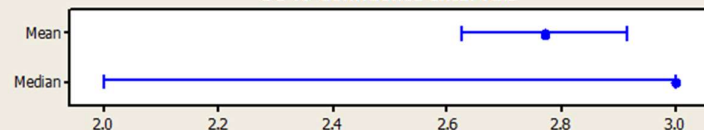
95% Confidence Interval for StDev

0.4656 0.5366

Summary for Women entrepreneurship Education qu



95% Confidence Intervals



Anderson-Darling Normality Test

A-Squared 16.00
P-Value < 0.005

Mean 2.7702
StDev 1.4415
Variance 2.0780
Skewness 0.20188
Kurtosis -1.32842
N 383

Minimum 1.0000
1st Quartile 1.0000
Median 3.0000
3rd Quartile 4.0000
Maximum 5.0000

95% Confidence Interval for Mean

2.6254 2.9151

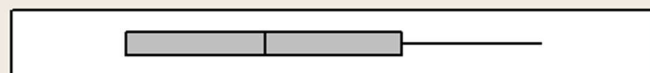
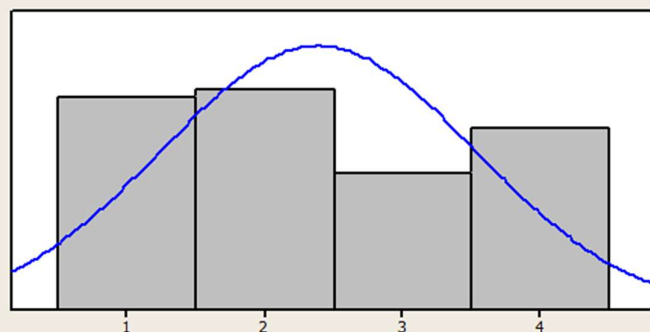
95% Confidence Interval for Median

2.0000 3.0000

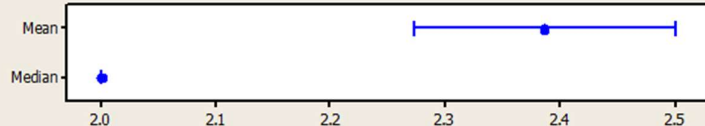
95% Confidence Interval for StDev

1.3461 1.5515

Summary for Women entrepreneurship age



95% Confidence Intervals



Anderson-Darling Normality Test

A-Squared 21.12
P-Value < 0.005

Mean 2.3864
StDev 1.1358
Variance 1.2901
Skewness 0.20222
Kurtosis -1.35896
N 383

Minimum 1.0000
1st Quartile 1.0000
Median 2.0000
3rd Quartile 3.0000
Maximum 4.0000

95% Confidence Interval for Mean

2.2723 2.5005

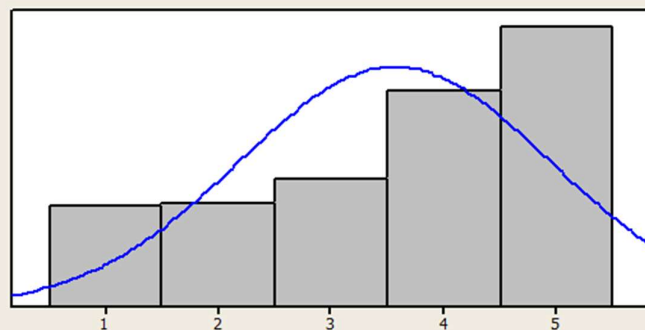
95% Confidence Interval for Median

2.0000 2.0000

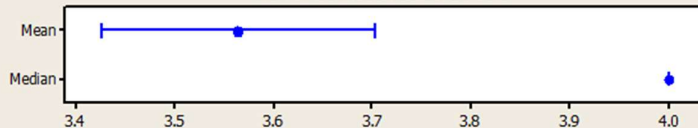
95% Confidence Interval for StDev

1.0607 1.2225

Summary for Enviroment performance



95% Confidence Intervals



Anderson-Darling Normality Test

A-Squared 20.44
P-Value < 0.005

Mean 3.5640
StDev 1.3826
Variance 1.9115
Skewness -0.593579
Kurtosis -0.930119
N 383

Minimum 1.0000
1st Quartile 3.0000
Median 4.0000
3rd Quartile 5.0000
Maximum 5.0000

95% Confidence Interval for Mean

3.4251 3.7029

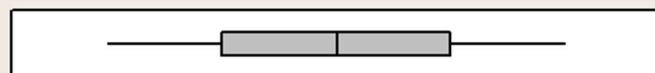
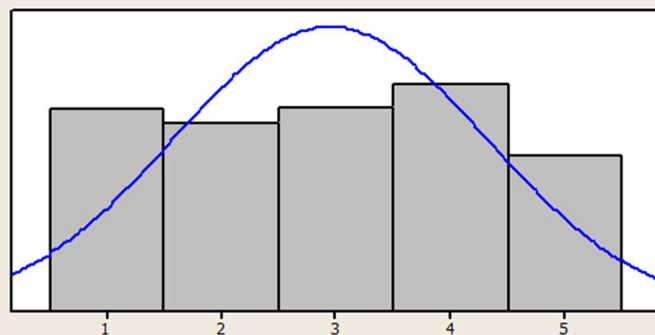
95% Confidence Interval for Median

4.0000 4.0000

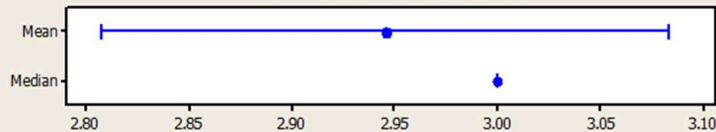
95% Confidence Interval for StDev

1.2911 1.4881

Summary for Social performance



95% Confidence Intervals



Anderson-Darling Normality Test

A-Squared 13.23
P-Value < 0.005

Mean 2.9452
StDev 1.3746
Variance 1.8897
Skewness -0.01033
Kurtosis -1.24551
N 383

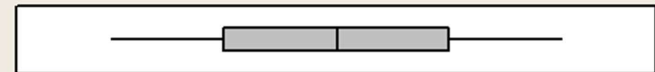
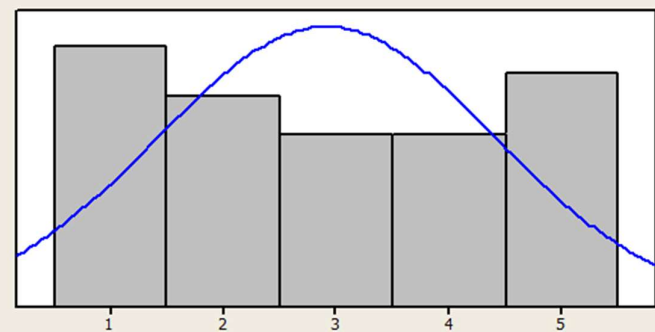
Minimum 1.0000
1st Quartile 2.0000
Median 3.0000
3rd Quartile 4.0000
Maximum 5.0000

95% Confidence Interval for Mean
2.8071 3.0833

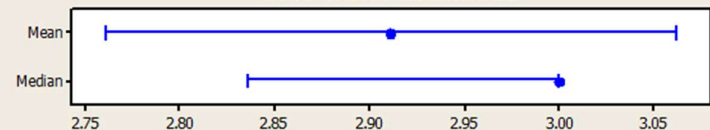
95% Confidence Interval for Median
3.0000 3.0000

95% Confidence Interval for StDev
1.2837 1.4796

Summary for Venture performance



95% Confidence Intervals



Anderson-Darling Normality Test

A-Squared 16.81
P-Value < 0.005

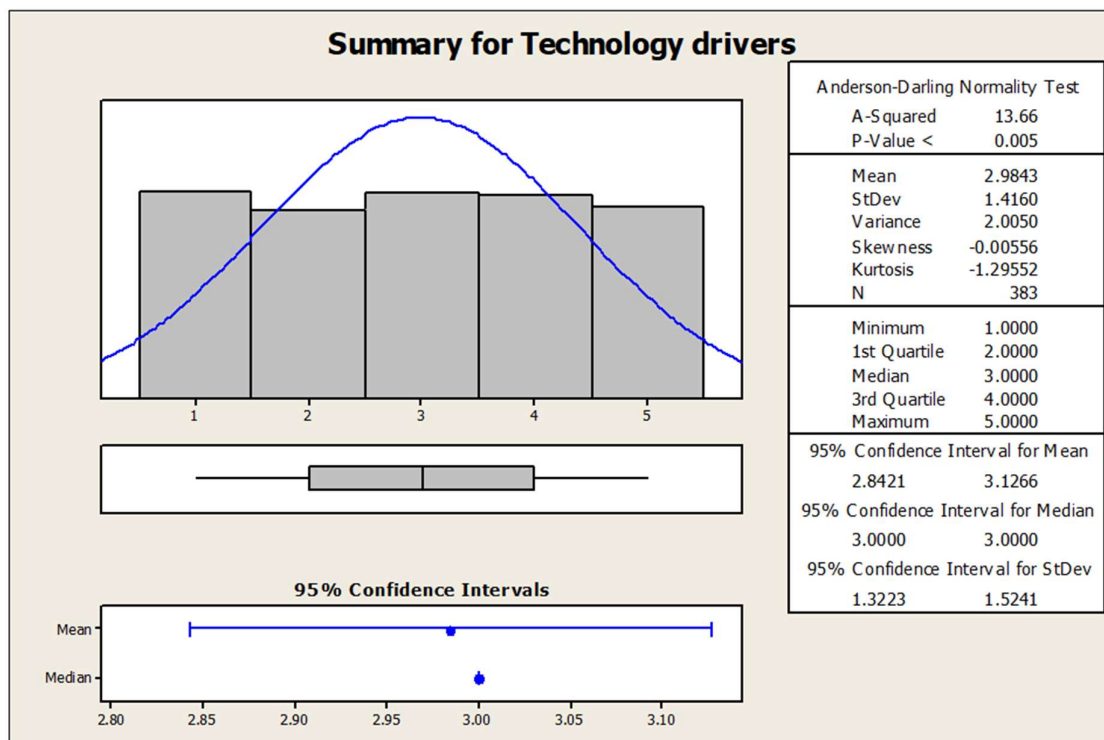
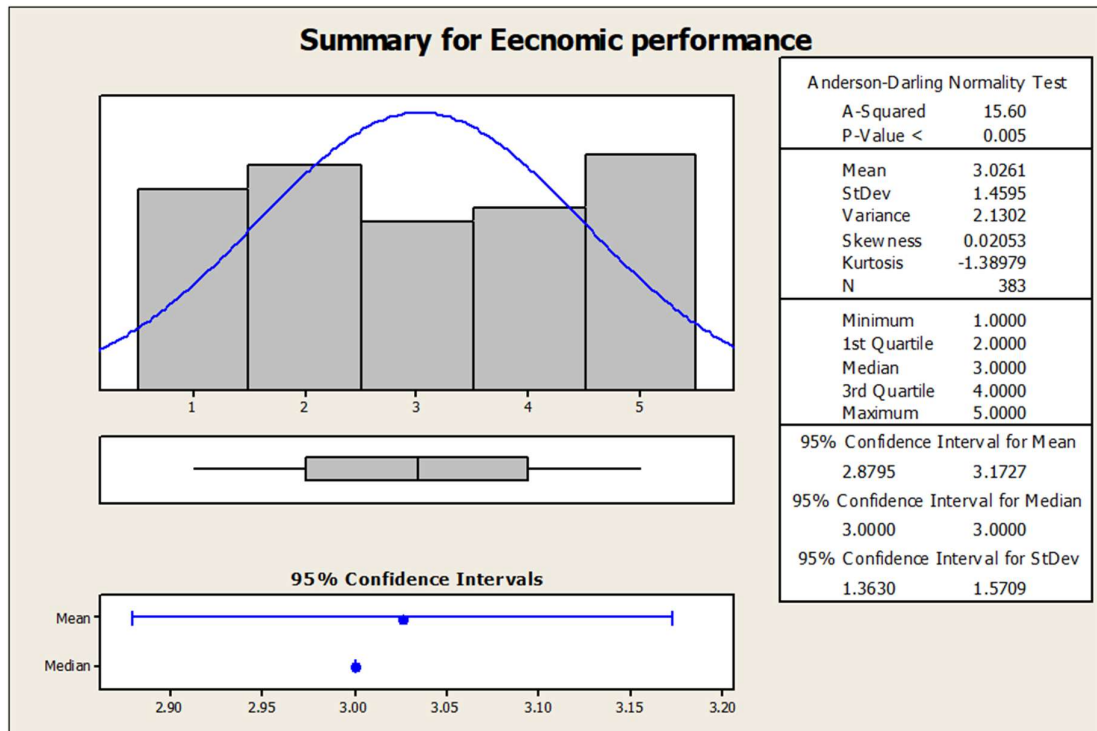
Mean 2.9112
StDev 1.4978
Variance 2.2434
Skewness 0.10533
Kurtosis -1.42420
N 383

Minimum 1.0000
1st Quartile 2.0000
Median 3.0000
3rd Quartile 4.0000
Maximum 5.0000

95% Confidence Interval for Mean
2.7607 3.0617

95% Confidence Interval for Median
2.8362 3.0000

95% Confidence Interval for StDev
1.3987 1.6121



Stage 1

The model that connects all of the lower-order and higher-order components is built in the first stage. (Including Exogenous and Endogenous constructs). Load all the measured variables (items) of LOC on the HOC. The reflecting measurement models of the lower-order components

are the initial focus of the model assessment. All LOCs are evaluated for validity and reliability in the first stage, with the validity and reliability of HOCs being disregarded. As usual, we evaluate the measurement model for LOC. As they are reflective constructs for reliability AVE, CR and Cronbach Alpha is used and for validity Fornier Larker Criterion and HTMT is used

Utilize the Latent Variable Score and store it in a data file for usage in the Second Stage following the evaluation and reporting of the measurement model.

Stage 2

The latent variable scores of the lower-order components from stage one are used to generate and estimate the stage two model. To do this, find the LOC scores for the HOC and add them to the dataset as new variables. The reflecting measurement model of the higher-order component is the first focus of the stage two evaluation. Examine the loadings of LOC for the HOC and utilize the coefficients (loadings) to assess the CR and AVE in order to determine indicator reliabilities and AVE. These results exceed the threshold value of 0.5. Cronbach's alpha, CR, and AVE are used to demonstrate convergent validity and reliability. The HTMT criterion can be used to demonstrate discriminant validity with other LOCs. Finally, the results discuss the assessment of the structural model's second stage. The study will assess the structural model evaluation (e.g., significance and relevance for path coefficients, Q2, PLS predict).

7.1 Assessment of measurement model of LOC - Stage 1 of Repeated Indicator Approach

7.1.1 Validity Analysis

7.1.1.1 Convergent Validity- Outer Loadings and Average Variance Extracted (AVE)

a) Outer Loadings

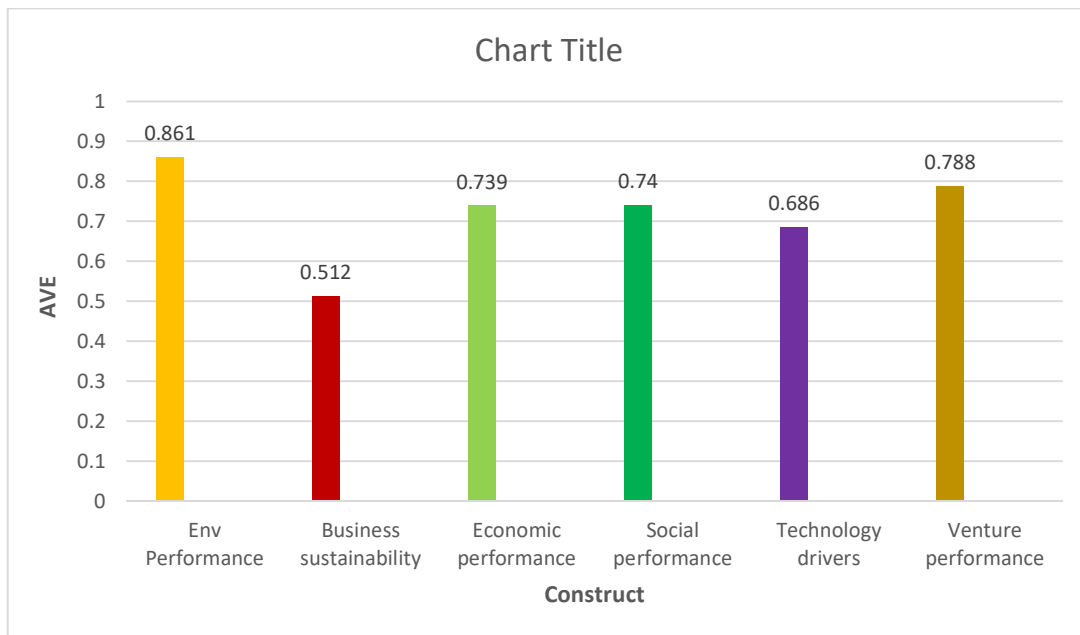
Indicators	Original sample (O)
EcP1 <- Economic performance	0.750
EcP2 <- Economic performance	0.872
EcP3 <- Economic performance	0.910
EcP4 <- Economic performance	0.916
EcP5 <- Economic performance	0.882
EcP6 <- Economic performance	0.816
EvP1 <- Environment performance	0.901
EvP2 <- Environment performance	0.908
EvP3 <- Environment performance	0.955
EvP4 <- Environment performance	0.946
S1 <- Social performance	0.761

S2 <- Social performance	0.881
S3 <- Social performance	0.917
S4 <- Social performance	0.896
S5 <- Social performance	0.837
T1 <- Technology drivers	0.655
T2 <- Technology drivers	0.779
T3 <- Technology drivers	0.863
T4 <- Technology drivers	0.907
T5 <- Technology drivers	0.920
T6 <- Technology drivers	0.885
T7 <- Technology drivers	0.845
T8 <- Technology drivers	0.796
T9 <- Technology drivers	0.768
V1 <- Venture performance	0.788
V2 <- Venture performance	0.891
V3 <- Venture performance	0.955
V4 <- Venture performance	0.909

All outer loadings except **T1 <- Technology drivers** are greater than 0.70. AVE , Composite Reliability and Cronbach Alfa of **T1 <- Technology drivers** met the threshold limits and outer loadings of F1 and F10 were more than 0.40 .Therefore **T1 <- Technology drivers** were retained.

b) Average Variance Extracted (AVE)

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
Env Performance	0.861	0.858	0.019	44.998	0.000
Business sustainability	0.512	0.222	0.016	13.057	0.000
Economic performance	0.739	0.729	0.040	18.566	0.000
Social performance	0.740	0.728	0.037	19.861	0.000
Technology drivers	0.686	0.681	0.033	20.807	0.000
Venture performance	0.788	0.783	0.040	19.692	0.000



All AVEs' are greater than 0.50

Thus, with a and b above Convergent Validity is established

7.1.1.2 Discriminant (Divergent) Validity - Fornell- Larcker criterion and Heterotrait-Monotrait ratio (HTMT)

a) Fornell- Larcker criterion

	Bus ines s sust ain abli ty	Eco no mic perf orm anc e	Env iron men t perf orm anc e	Soci al perf orm anc e	Tec hn olo gy dri ver s	Ven ture perf orm anc e
Business sustainablity	0.839					
Economic performanc e	0.732	0.759				
Environme nt performanc e	0.542	0.054	0.632			
Social performanc e	0.627	0.047	0.033	0.689		
Technology drivers	0.365	0.035	0.608	0.062	0.731	
Venture performanc e	0.527	0.035	0.034	0.046	0.087	0.613

It can be seen that along the diagonal each value is largest in its row and in its column thus meeting the Fornier Larcker Criterion for convergent validity

b) Heterotrait-Monotrait ratio (HTMT)

	Original Sample (O)
Business sustainability -> Env Performance	0.542
Economic performance -> Env Performance	0.054
Social performance -> Env Performance	0.033
Social performance -> Economic performance	0.047
Technology drivers -> Economic performance	0.035

Technology drivers -> Social performance	0.062
Venture performance -> Env Performance	0.034
Venture performance -> Economic performance	0.035
Venture performance -> Social performance	0.046
Venture performance -> Technology drivers	0.087

All HTMT ratios are less than 0.95.

Thus, with a and b above Discriminant Validity is established

7.1.2.2 Indicator Reliability- Square of Outer Loadings

Indicators	Original sample (O)	square of outer loading
EcP1 <- Economic performance	0.75	0.563
EcP2 <- Economic performance	0.872	0.760
EcP3 <- Economic performance	0.91	0.828
EcP4 <- Economic performance	0.916	0.839
EcP5 <- Economic performance	0.882	0.778
EcP6 <- Economic performance	0.816	0.666
EvP1 <- Environment performance	0.901	0.812
EvP2 <- Environment performance	0.908	0.824
EvP3 <- Environment performance	0.955	0.912
EvP4 <- Environment performance	0.946	0.895
S1 <- Social performance	0.761	0.579
S2 <- Social performance	0.881	0.776
S3 <- Social performance	0.917	0.841
S4 <- Social performance	0.896	0.803
S5 <- Social performance	0.837	0.701
T1 <- Technology drivers	0.655	0.429

T2 <- Technology drivers	0.779	0.607
T3 <- Technology drivers	0.863	0.745
T4 <- Technology drivers	0.907	0.823
T5 <- Technology drivers	0.92	0.846
T6 <- Technology drivers	0.885	0.783
T7 <- Technology drivers	0.845	0.714
T8 <- Technology drivers	0.796	0.634
T9 <- Technology drivers	0.768	0.590
V1 <- Venture performance	0.788	0.621
V2 <- Venture performance	0.891	0.794
V3 <- Venture performance	0.955	0.912
V4 <- Venture performance	0.909	0.826

Squared values of all indicator loadings are greater than 0.50 with following exceptions

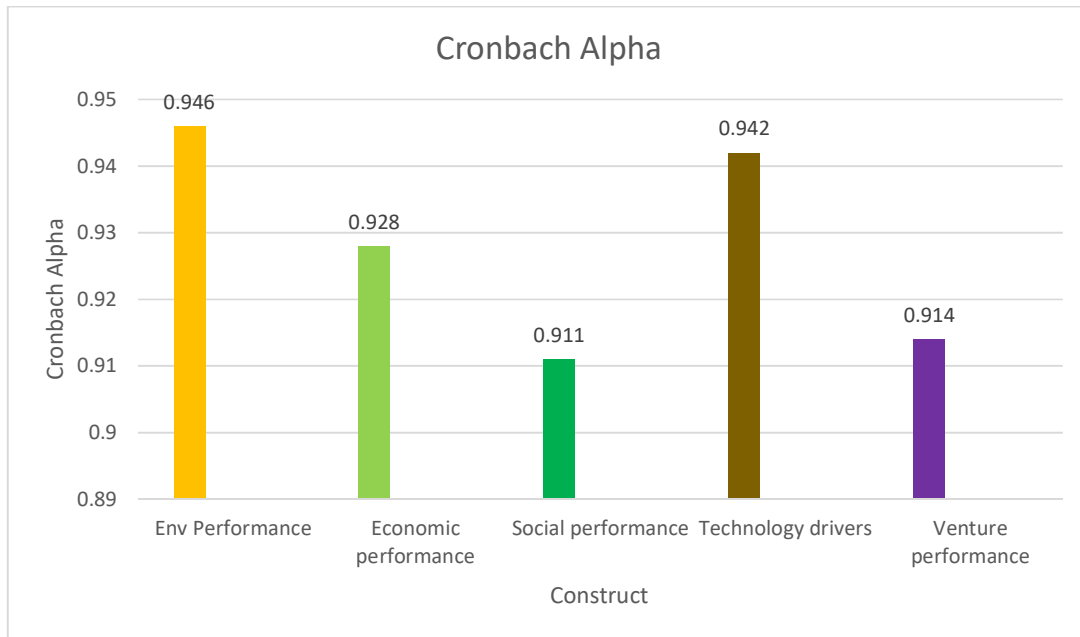
T1 <- Technology drivers	0.655	0.429
------------------------------------	-------	-------

However, these outer loadings are higher than 0.50

Thus, indicator reliability is established

7.1.2.3 Internal Consistency Reliability - Cronbach Alpha

Indicators	Original Sample (O)
Env Performance	0.946
Economic performance	0.928
Social performance	0.911
Technology drivers	0.942
Venture performance	0.914

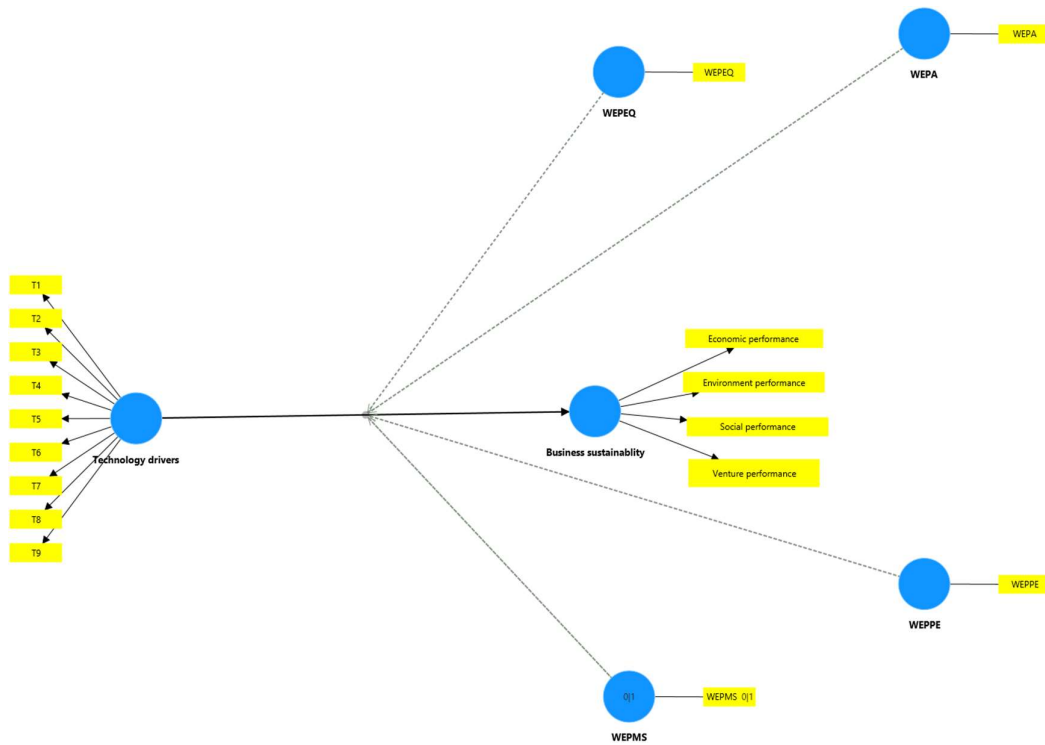


The internal consistency reliability is indicated by all Cronbach's Alpha values over 0.70.

7.2 Using the lower-order components' latent variable scores from stage 1 in order to generate and estimate higher order model -Stage 2of Repeated Indicator Approach

For this purpose, the scores of LOCs of the HOC are located and these are added as new variables to the dataset. Then a new model with these is created and measurement and structural assessment of this new model is carried out

7.2.1 Using the lower-order components' latent variable scores from stage 1 to generate new model



7.2.1.1 Assessment of Measurement Model with Latent Variable Scores

7.2.1.1.1 Validity Analysis

7.2.1.1.1.1 Convergent Validity- Outer Loadings and Average Variance Extracted (AVE)

a) Outer Loadings

	Original sample (O)
Economic performance <- Business sustainability	0.786
Environment performance <- Business sustainability	0.991
Social performance <- Business sustainability	0.684
T1 <- Technology drivers	0.641
T2 <- Technology drivers	0.767
T3 <- Technology drivers	0.854
T4 <- Technology drivers	0.903
T5 <- Technology drivers	0.922

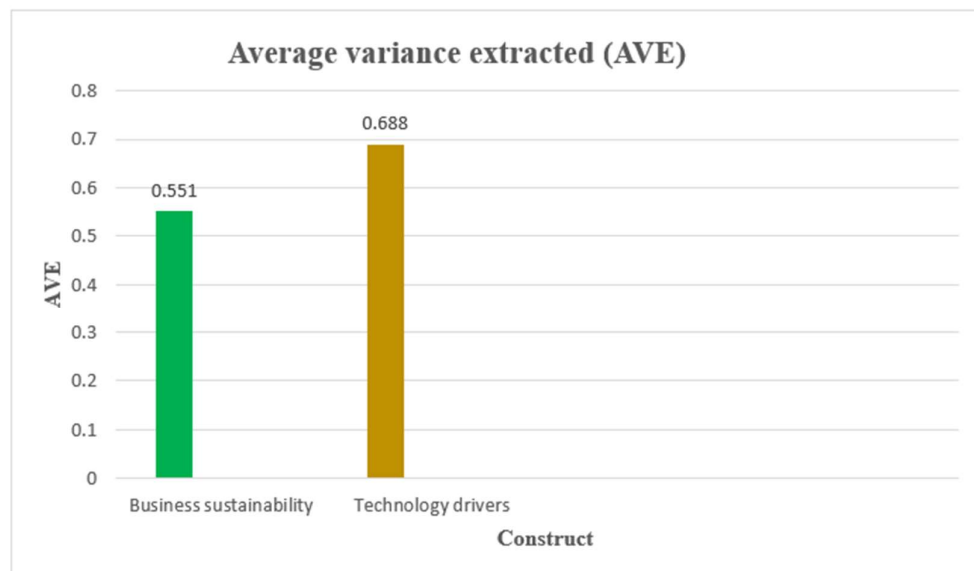
T6 <- Technology drivers	0.893
T7 <- Technology drivers	0.858
T8 <- Technology drivers	0.810
T9 <- Technology drivers	0.780
Venture performance <- Business sustainability	0.683

All outer loadings except those of **Venture performance <- Business sustainability**, are greater than 0.70. However, since these are very close to 0.70 and Cronbach Alpha, Rho a, and AVE values of these four variables meet the threshold values, they were retained in the model

b) Average Variance Extracted (AVE)

b) Average Variance Extracted (AVE)

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P values
Business sustainability	0.551	0.257	0.007	79.496	0.000
Technology drivers	0.688	0.689	0.017	39.348	0.000



All AVEs' are greater than 0.50

Thus, with a and b above Convergent Validity is established

7.1.1.2 Discriminant (Divergent) Validity - Fornell- Larcker criterion and Heterotrait-Monotrait ratio (HTMT)

a) Fornell- Larcker criterion

	Bus ines s sust aina blit y	Eco nom ic perf orm anc e	Envi ron men t perf orm ance	Soci al perf orm anc e	Tec hno log y driv ers	Ven ture perf orm anc e
Business sustainabl ity	0.78 9					
Economic performanc e	0.73 2	0.76 7				
Environmen t performanc e	0.54 2	0.05 4	0.67 8			
Social performanc e	0.62 7	0.04 7	0.03 3	0.72 6		
Technology drivers	0.36 5	0.03 5	0.60 8	0.06 2	0.7 82	
Venture performanc e	0.52 7	0.03 5	0.03 4	0.04 6	0.0 87	0.62 3

It can be seen that along the diagonal each value is largest in its row and in its column thus meeting the Fornier Larcker Criterion for convergent validity

b) Heterotrait-Monotrait ratio (HTMT)

	Original sample (O)
Technology drivers <-> Business sustainability	0.243
WEPA <-> Business sustainability	0.416
WEPA <-> Technology drivers	0.019
WEPEQ <-> Business sustainability	0.292
WEPEQ <-> Technology drivers	0.054
WEPEQ <-> WEPA	0.069

WEPMS <-> Business sustainability	0.177
WEPMS <-> Technology drivers	0.057
WEPMS <-> WEPA	0.054
WEPMS <-> WEPEQ	0.026
WEPPE <-> Business sustainability	0.221
WEPPE <-> Technology drivers	0.114
WEPPE <-> WEPA	0.046
WEPPE <-> WEPEQ	0.034
WEPPE <-> WEPMS	0.034

All HTMT ratios are less than 0.95.

Thus, with a and b above Discriminant Validity is established

7.1.2 Reliability Analysis

7.1.2.1 Composite Reliability- Rho a

	Original sample (O)
Business sustainability	0.746
Technology drivers	0.964

All values of rho a are greater than 0.70

Thus, composite reliability is established

7.1.2.2 Indicator Reliability- Square of Outer Loadings

	Original sample (O)	Square of outer loading
Economic performance <- Business sustainability	0.786	0.618

Environment performance <- Business sustainability	0.991	0.982
Social performance <- Business sustainability	0.684	0.468
T1 <- Technology drivers	0.641	0.411
T2 <- Technology drivers	0.767	0.588
T3 <- Technology drivers	0.854	0.729
T4 <- Technology drivers	0.903	0.815
T5 <- Technology drivers	0.922	0.850
T6 <- Technology drivers	0.893	0.797
T7 <- Technology drivers	0.858	0.736
T8 <- Technology drivers	0.81	0.656
T9 <- Technology drivers	0.78	0.608
Venture performance <- Business sustainability	0.683	0.466

Squared values of all indicator loadings are greater than 0.50 with following exceptions

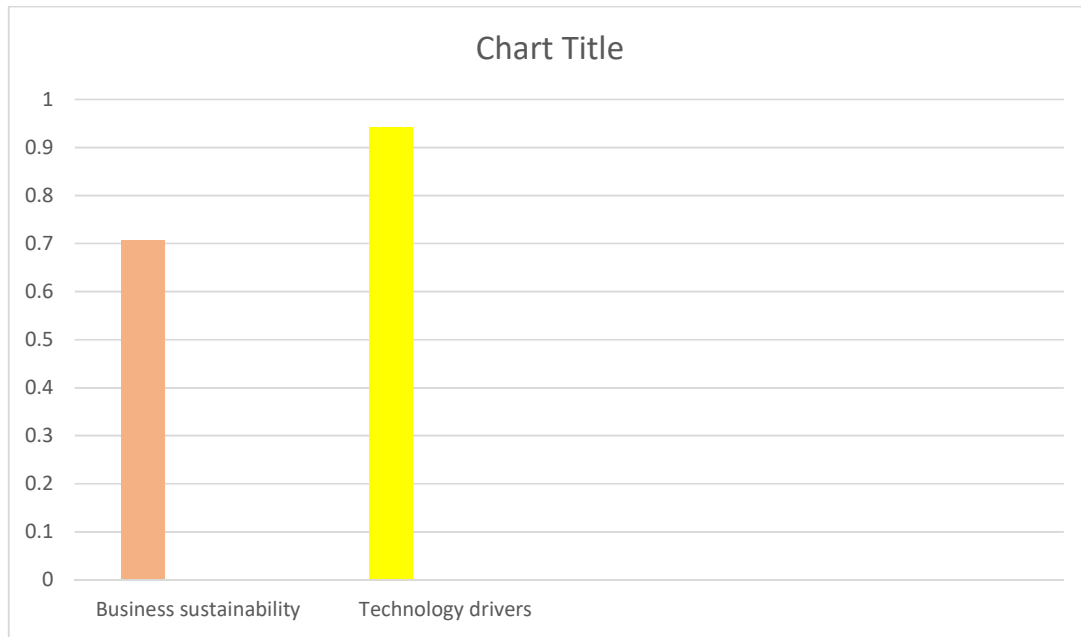
Venture performance <- Business sustainability	0.683	0.466
Social performance <- Business sustainability	0.684	0.468
T1 <- Technology drivers	0.641	0.411

However, these outer loadings are higher than 0.50

Thus, indicator reliability is established

7.1.2.3 Internal Consistency Reliability - Cronbach Alpha

	Original sample (O)
	0.706
Technology drivers	0.942



The internal consistency reliability is indicated by all Cronbach's Alpha values over 0.70.

7.2.1.2 Assessment of Structural Model with Latent Variable Scores

7.2.1.2.1 Collinearity Analysis

	VIF
EcP1	2.817
EcP1	2.894
EcP2	4.858
EcP2	4.776
EcP3	4.410
EcP3	3.204
EcP4	4.487
EcP4	2.381
EcP5	2.447
EcP5	3.318
EcP6	4.134
EcP6	2.016
EvP1	4.220
EvP1	4.398

EvP2	4.526
EvP2	4.385
EvP3	7.718
EvP3	7.570
EvP4	7.224
EvP4	6.965
S1	2.460
S1	2.352
S2	3.684
S2	3.773
S3	4.653
S3	4.538
S4	5.383
S4	5.624
S5	3.678
S5	3.543
T1	2.660
T2	4.224
T3	4.458
T4	4.746
T5	3.073
T6	4.943
T7	3.518
T8	4.712
T9	2.487
V1	2.756
V1	2.941
V2	4.622
V2	4.847
V3	2.174

V3	2.332
V4	3.697
V4	3.592

It can be seen that all VIF's are less than 5, therefore, there is no issue of multicollinearity.

7.2.1.2.2 Significance and Relevance of the Structural Model Relationship- Significance of Path Coefficients

Path coefficients represent the strength and direction of the relationships between constructs

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P values
Technology drivers -> Business sustainability	0.681	0.647	0.050	12.939	0.000

Since all the significance and applicability of the structural model are demonstrated by T statistics exceeding 1.96 and all p values falling below 0.05. relationship is established.

7.2.1.2.3 Explanatory Power of the Model

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P values
Business sustainability	0.681	0.392	0.037	18.576	0.000

Since R Square values of Business Sustainability are more than 0.67 and p-Value < 0.05 the endogenous latent variables have substantial explanatory power

Fail to accept H_0

One can say with 95% confidence that there is a significant association between Financial Drivers and business sustainability among women in msme sector

7.2.1.2.4 Effect Size

Effect sizes measure the relative impact of predictors on endogenous constructs, providing insight into the practical significance of the relationships.

Relation	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P values
Technology drivers -> Business sustainability	0.346	0.357	0.077	4.488	0.000

Since all f Square were greater than 0.15 and less than 0.35.

7.2.1.2.5 Predictive Power

Number of sub samples/ Number of folds $K = 10$

Number of observations = 383

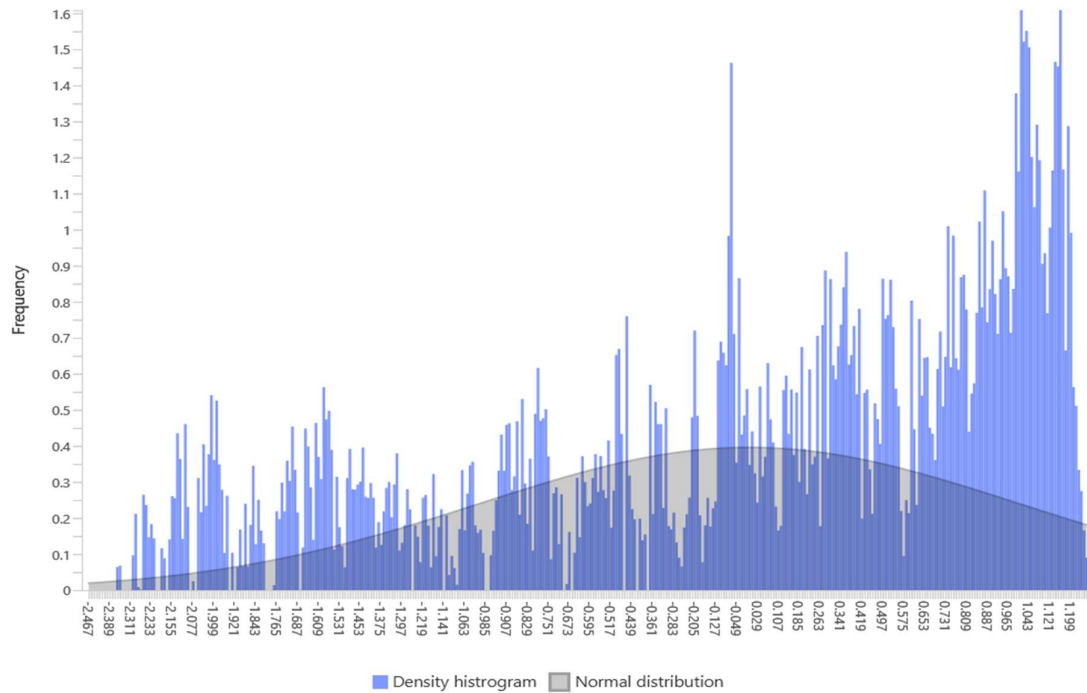
Observations in each subsample = $383/10 = 38.3 \approx 39$ Observations

Number of subsamples in training data = $K-1=9$

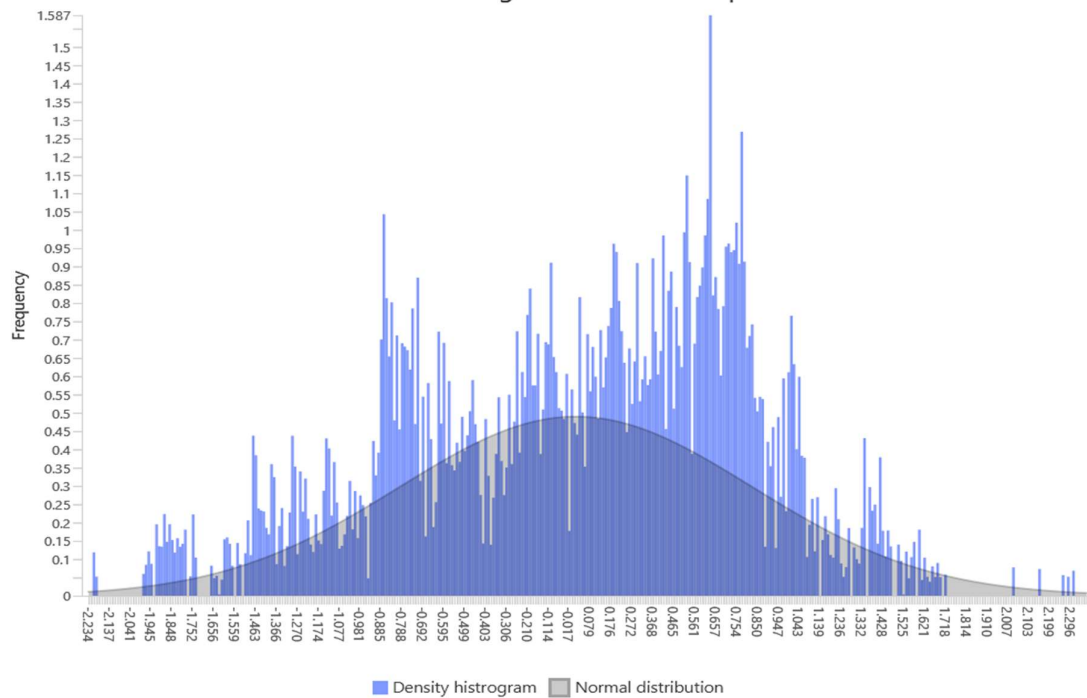
Number of observations in training data = $9 \times 38.3 = 344.7 \approx 345$ Observations

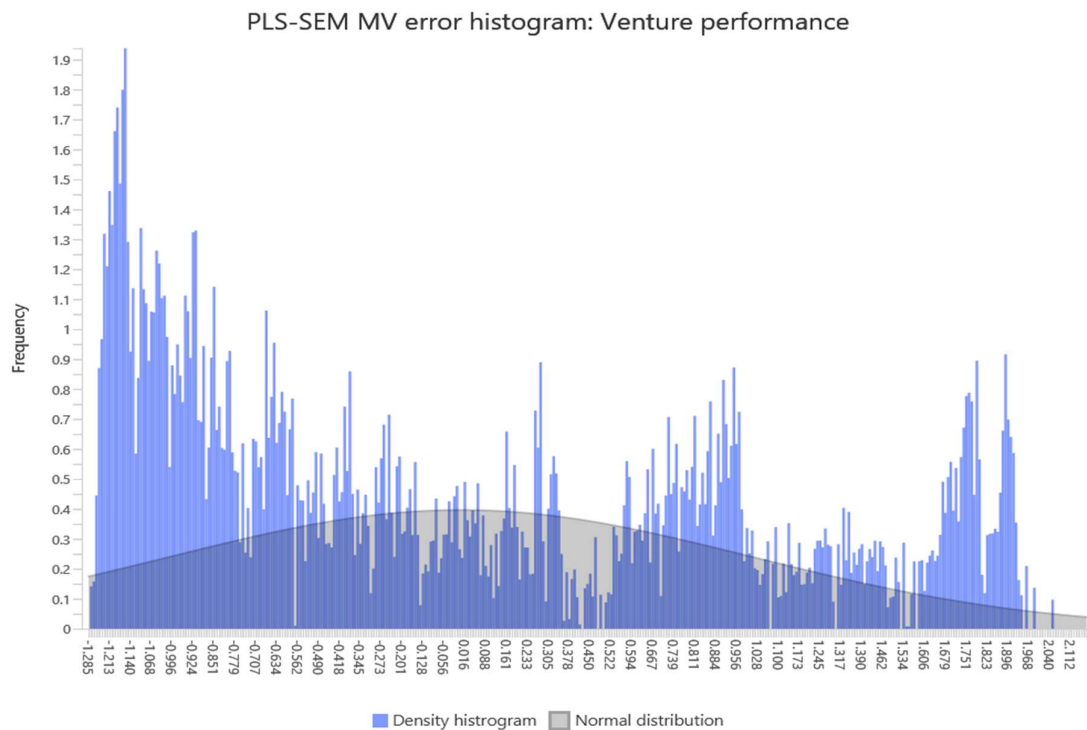
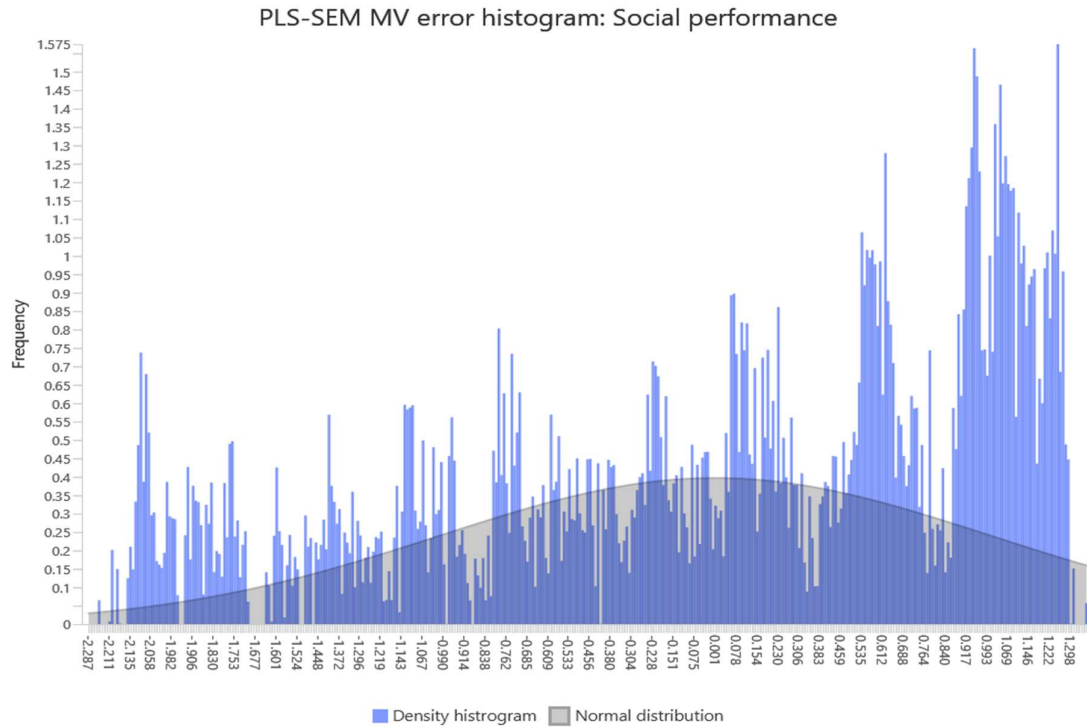
Number of observations in testing data = 39 Observations

PLS-SEM MV error histogram: Economic performance



PLS-SEM MV error histogram: Environment performance





It can be seen that the errors of endogenous variables are not normally distributed

Since the data is not normally distributed, in the prediction summary, RMSE values were ignored and instead MAE Values were checked. The distinction between LM_MAE and PLS-SEM_MAE were calculated

Indicators of business sustainability	Q ² predict	PLS-SEM_MAE	LM_MAE	Differences: PLS-SEM_MAE - LM_MAE
Economic performance	0.008	0.850	0.857	-0.007
Environment performance	0.339	0.675	0.592	0.083
Social performance	0.004	0.854	0.866	-0.012
Venture performance	0.005	0.884	0.891	-0.007

Since all differences are negative and all Q² values are greater than 0, the model has high (out of sample) predictive power.

8. Statistical Findings:

8.1 Descriptive Statistics:

- **Technology Drivers Mean Score:** 2.9843 (SE Mean: 0.0724, StDev: 1.4160)
- **Economic Performance Mean Score:** 3.0261 (SE Mean: 0.0746, StDev: 1.4595)
- **Venture Performance Mean Score:** 2.9112 (SE Mean: 0.0765, StDev: 1.4978)
- **Social Performance Mean Score:** 2.9452 (SE Mean: 0.0702, StDev: 1.3746)
- **Environmental Performance Mean Score:** 3.5640 (SE Mean: 0.0706, StDev: 1.3826)

8.2 Reliability and Validity:

- Cronbach's Alpha values for all constructs were above 0.70, ensuring internal consistency reliability.
- Average Variance Extracted (AVE) values were greater than 0.50 for all constructs, confirming convergent validity.
- Discriminant validity was established using the Fornell-Larcker criterion and HTMT ratio.

8.3 Hypothesis Testing:

- The structural model showed a significant association between **Technology Drivers and Business Sustainability** (Path coefficient: 0.681, T-statistics: 12.939, p-value: 0.000).
- The model explained **68.1% of the variance in Business Sustainability (R² = 0.681, p < 0.05)**, indicating a substantial explanatory power.
- The effect size of technological drivers on business sustainability was 0.346, falling within a moderate-to-strong range.

8.4 Predictive Power of the Model:

- The model exhibited strong predictive power with **Q² predict values greater than 0** for key variables.
- The differences between PLS-SEM_MAE and LM_MAE values confirmed that the predictive model was reliable.

These statistical findings reaffirm that technology is a critical determinant of business sustainability for women entrepreneurs in MSMEs. The insights derived from this study provide a foundation for policymakers and industry stakeholders to enhance technological integration in women-led businesses, ensuring their sustained growth and competitiveness in the evolving market landscape.

9. Limitations:

9.1 Geographic Constraints: The have a look at turned into performed amongst women entrepreneurs in MSMEs within North India, restricting its generalizability to different areas or international locations.

9.2 Industry-Specific Focus: The findings might not be totally relevant to all industries inside the MSME zone as extraordinary industries might also have varying tiers of technology adoption.

9.3 Self-Reported Data: The look at is based on primary information amassed through questionnaires, which may be subject to reaction bias.

9.4 Technological Variability: The availability and affordability of era vary across areas, probably affecting the consistency of effects.

9.5 Cross-Sectional Study: The studies captures records at a single factor in time, making it tough to investigate lengthy-term affects and traits in technological adoption.

10. Importance of the Study:

10.1 Policy Implications: The examine affords valuable insights for policymakers to layout technology-driven interventions that support ladies entrepreneurs in MSMEs.

10.2 Economic Growth: By identifying technological drivers that decorate commercial enterprise sustainability, the research contributes to monetary boom and girls's empowerment.

10.3 Bridging the Digital Divide: The observe emphasizes the want for digital literacy packages, financial inclusion, and infrastructural investments to help women marketers.

10.4 Practical Recommendations: The findings offer actionable pointers for business owners, monetary establishments, and enterprise stakeholders to enhance generation adoption.

10.5 Academic Contribution: The studies enriches the existing literature on business sustainability by highlighting the function of technological advancements in women-led MSMEs.

9. Conclusion

The take a look at underscores the vital function of technological drivers in improving enterprise sustainability amongst ladies entrepreneurs in MSMEs. The findings imply that the adoption of virtual technologies, fintech answers, e-trade platforms, and automation notably contributes to the long-time period viability of girls-led organisations. However, in spite of the tremendous impact of generation, obstacles such as constrained financial inclusion, virtual literacy gaps, and insufficient technological infrastructure avoid tremendous adoption.

The studies highlights that government guide, access to monetary assets, and targeted education packages are essential enablers for enhancing technological adoption. Women entrepreneurs who integrate era into their commercial enterprise approaches enjoy advanced operational

performance, improved market attain, and more desirable monetary performance. Policymakers and stakeholders ought to consciousness on bridging the digital divide through making an investment in infrastructure, presenting financial incentives, and selling digital literacy projects tailor-made for ladies marketers in MSMEs.

The observe also validates the tremendous affiliation between technological drivers and commercial enterprise sustainability, reinforcing the need for strategic interventions to enhance digital adoption. Future studies can explore move-local comparisons and sector-unique technology adoption tendencies to benefit a broader expertise of the demanding situations and possibilities in the MSME quarter.

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29. CLOUD-BASED APPLICATIONS AND SAAS METHODOLOGIES FOR HUMAN RESOURCE MANAGEMENT

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Abstract:

Businesses worldwide have increasingly turned to information technology (IT) to stay competitive, with accuracy and speed being vital for success. Likewise, IT networks require efficiency and security. Cloud computing has emerged as the forefront technology for timely and secure administrative tasks. Human resource management (HRM) primarily focuses on maintaining employee databases for analysis and evaluation. This study aims to explore the impact of cloud-based computing (CBC) on HRM efficiency, surveying forty representatives from IT. There's a clear link between cloud computing and HRM metrics, now analyzed through correlation. While HRM and performance management are interconnected, the effectiveness of CBC significantly influences HRM efficiency. Cloud computing plays a critical role in contemporary enterprises, notably boosting HRM efficiency, particularly in performance management. Research conducted in IT sector unveils a robust correlation between cloud integration and enhanced HRM processes, emphasizing the significance of embracing such technological advancements for organizational prosperity

“Index Terms: Cloud Based Computing, HRM, Performance Management, IT, Performance appraisal”

Introduction

The classical model of management focuses on establishing a formal structure to achieve organizational goals. However, recent developments have made management more challenging, requiring a deep understanding of complex organizational processes. Pioneers such as F.W. Taylor, Henry Fayol, Max Weber, and Peter F. Drucker have introduced innovative management approaches to address these challenges.

In contemporary times, there is a growing emphasis on punctuality and productivity, with multitasking becoming commonplace across various occupations. Information technology (IT) plays a crucial role in managing these complexities, with human resources and IT becoming closely intertwined in modern businesses. The advent of cloud computing, as highlighted by Senarathna Ishan et al. (2018), has greatly improved IT infrastructure, enhancing organizational capabilities.

This integration of IT enables top-level management to gain valuable insights for effective decision-making, cost-benefit analysis, and resource optimization. Additionally, it allows companies to adopt cutting-edge technology while remaining cost-effective.

Theoretical Background:

Throughout history, the evolution of management reflects humanity's ability to coordinate collective intelligence, social skills, and physical efforts to accomplish essential societal tasks. Various philosophers and scientists have refined management theories from the era of handmade products to the age of machine-made goods, blending scientific methodologies with humanitarian principles to establish businesses.

As business processes became more intricate, automation emerged as a solution, combining administrative procedures with scientific production methods to expedite task completion. Despite the advancements in technology, the global business community continues to uphold bureaucratic approaches. Understanding human nature remains pivotal for successful company growth, with established systematic methods utilized for managing both internal and external human capital.

Information technology plays a crucial role in alleviating the challenges of resource management within organizations. Human resource management (HRM) takes precedence in top management responsibilities, with IT driving the adoption of more technologically advanced HR practices. HRM solutions like online profile processing in social media and Cloud-Based Computing implementation are progressively gaining traction for tasks such as interviews, candidate screening, and performance evaluation, although not all HR departments have fully embraced these advancements.

Cloud Based Computing (CBC)

Cloud computing, as defined by the National Institute of Standards and Technology, offers a model for accessing a shared pool of configurable computing resources over a network on demand, requiring minimal intervention from service providers. It encompasses three primary services: Infrastructure as a Service (IaaS), Software as a Service (SaaS), and Platform as a Service (PaaS).

Despite encountering various challenges, cloud computing simplifies tasks such as payroll management, timekeeping, performance evaluations, and employee record-keeping. It provides a foundation for conducting algorithmic analyses of large datasets to ensure customer satisfaction.

IaaS involves the service provider managing and controlling the underlying data center infrastructure, optimizing computing efficiency and storage space through cloud services like Digital Ocean, Linode, and Amazon Web Services (AWS).

SaaS offers access to a range of software programs, including email and Microsoft Office suites, through an online platform. This subscription-based model benefits users by providing feature-rich applications, payment based on actual resource usage, no licensing fees for client software, ease of staff recruitment, and remote access to application data.

SaaS provides a platform for developers to build and deploy applications that can run on any device, regardless of hardware or operating system. Industry leaders favor PaaS services due to their cloud-hosted nature and accessibility from anywhere. Various devices, such as laptops, tablets, and smartphones, rely on cloud-based computing to perform a multitude of tasks efficiently.

HRM and e-HRM:

Kumar Renuka (2017) describes the integration of Information Technology (IT) into Human Resource Management (HRM) as e-HRM, facilitated by Human Resource Management System Software (HRMS). This system records updates to an employee's file from the interview stage to their departure. Incorporating Cloud computing into this system enhances and simplifies e-HRM processes. Transitioning to the cloud has transformed HRIS into HCM, making it more efficient and current. In addition to workflow management, HCM handles tasks such as training, managing absences, payroll, and compensation distribution. However, according to Dai Liangtie, He Yang, and Xing Guangdong (2015), there are obstacles to overcome before HRM services can fully achieve their efficiency, cost-saving, and responsiveness goals.

The amalgamation of HRM with Cloud Computing's service model has introduced a fresh perspective, offering services such as Software as a Service (SaaS), Infrastructure as a Service (IaaS), and Platform as a Service (PaaS). Despite encountering some challenges, this integration streamlines the management of employee information, facilitating salary, attendance, and performance data management. It also provides a foundation for algorithmic analysis of large datasets, prioritizing user satisfaction. Cloud computing significantly contributes to the efficiency and speed of e-HRM processes. The increasing adoption of cloud computing has led to the rebranding of HRIS as HCM, which performs various tasks for companies, including workflow management, absence management, and payroll processing.

The primary research's connection model is presented in Table 1.0.

“Table 1.0 CBC and Performance

<i>CBC- CLIENT</i>	<i>HRM</i>	<i>PERFORMANCE</i>
<i>SaaS</i>	<i>Training</i>	<i>Competency Mapping</i>
<i>PaaS</i>	<i>Performance</i>	<i>MBO</i>
<i>IaaS</i>	<i>Compensation</i>	<i>Access Centre</i>
<i>HRIS</i>	<i>Incentives</i>	<i>36 0 appraisal</i> <i>0</i>
<i>e-HRM</i>	<i>Payroll Management</i>	<i>Human Resource Accounting</i>

Literature Review:

The literature reviews from 2010 to 2018 extensively cover topics such as cloud computing, human resource management (HRM), and performance evaluation. Instantaneous global access

to human resources poses a challenge for forward-thinking corporations, emphasizing the importance of having a skilled workforce to complement market success (Pan and Jang, 2008). HRIS (Human Resource Information Systems) and cloud-based HR systems, though relatively new, are essential for managing employee data, yet not universally adopted (Lin et al., 2009). Cloud computing, initially termed by Armbrust et al., 2010, simplifies IT operations and has a notable impact on business efficiency (Villegas, D., 2012).

The integration of cloud computing into HRM, termed e-HRM when enabled by HRMS (Human Resource Management System Software) (Kumar Renuka, 2017), streamlines processes from hiring to departure, leading to the evolution of HRIS into HCM (Human Capital Management) (Kumar Renuka, 2017). Challenges in adopting cloud computing include skill shortages, business adaptability, and strategic technology implementation (Callender Craig et al., 2015; Dai Liangtie, He Yang, and Xing Guangdong, 2015). Cloud computing offers solutions to HRM challenges by providing an IT infrastructure conducive to knowledge sharing and expertise utilization (Nima Jafari et al., 2015).

Cloud computing services, including IaaS, SaaS, and PaaS, simplify tasks such as payroll management and performance evaluation, facilitating algorithmic data analysis to ensure client satisfaction (Dai Liangtie, He Yang, and Xing Guangdong, 2015). Cloud technology enhances business efficiency, innovation, and resource management, benefiting small and medium-sized enterprises (SMEs) (Xue Colin Ting Si et al., 2014; Howlett, 2013). It centralizes administration and communication, allowing for faster compliance procedures (Milian Eduardo Zied et al., 2014; Nixon, 2013).

Cloud computing adoption is hindered by factors such as financial concerns and transition planning, but its benefits, including time savings and workplace flexibility, are significant (Stephen Kaisler, William H. Money, and Stephen J. Cohen, 2012). Cloud computing strategies align with business goals and should be shared at all organizational levels (Mell, P., and Grance, T., 2011; Chinyao Low et al., 2011). However, effective implementation requires an IT strategy and adherence to regulations (Crago, S. et al., 2011; Buyya, R., 2010).

CBC (Cloud-Based Computing) has gained traction across various sectors, including e-government and e-business, due to its productivity benefits (Shainer et al., 2010). Providers like Silicon Graphics International (SGI) and Penguin Computing offer cloud-based solutions, contributing to the evolving landscape of high-performance computing (Leung, 2010; Krill, 2010). Performance reviews, as discussed by Paul E. Levy and Jane R. Williams (2004), integrate HR approaches and financial health to tailor organizational performance.

Research Gap:

Numerous books and articles have explored the impact of Cloud Computing (CBC) on business operations, yet there is a gap in understanding how CBC intersects with Human Resource Management (HRM) within the specific context of India and, with its strong desire to integrate into the Indian economy, hosts a multitude of well-established large-scale businesses. Bhubaneswar, the capital city of, serves as the headquarters for many major corporations in India. Over the years, businesses in have faced challenges in recruiting qualified employees and ensuring reliable data security measures. To adapt to the increasing trend of outsourcing essential services to third parties, the IT infrastructure plays a pivotal role. IT companies operating as third-party service providers manage advanced CBC hardware and software. This study aims to include information technology (IT) workers to assess their effectiveness in this context.

Objective of The Study:

To examine how successful Cloud-Based Computing affect the performance of HRM.

Hypotheses:

H0: Cloud Based Computing affects insignificantly to the performance of HRM. H1: Cloud Based Computing affects significantly to the performance of HRM.

Research Methodology:

Quantitative research methods are employed to study the relationship between Cloud-Based Computing (CBC), Human Resource Management (HRM), and HRM performance. Researchers utilize correlation and regression techniques to analyze the research findings. The sample comprises 40 individuals from 20 IT firms in Bhubaneswar, each represented by a phone number. A survey involving forty IT professionals is conducted, utilizing both in- person and phone interviews to gather data. The obtained data, displayed in Table 1.2, utilizes a rating scale ranging from 1 to 9 to evaluate the legitimacy of statements in the research questionnaire.

The gathered data is tabulated, and the mean of the replies is shown in Table 1.2.

“Research Question of Questionnaire

<i>PERFORMANCE</i>	
<i>Competency Mapping</i>	<i>Manages the competency</i>
<i>MBO</i>	<i>Work to objectiv employees</i>
<i>Access Centre</i>	<i>CBCmakes easy to monitor the man,</i>
<i>360 degree appraisal</i>	<i>Feedback accuracy</i>
<i>Human Resource Accounting</i>	<i>Quick action in trend analysis of competency and compensation</i>

<i>General Question Performance</i>	<i>CBC</i> <i>has role in</i> <i>performance management and</i> <i>decision</i> <i>making</i>
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Table 1.2 Data Collection and Tabulation

<i>CBC-CLIENT</i>	<i>TOTAL</i>	<i>Average</i>	<i>Round up</i>
<i>SaaS</i>	<i>325</i>	<i>8.12</i>	<i>8</i>
<i>PaaS</i>	<i>338</i>	<i>8.45</i>	<i>8</i>
<i>IaaS</i>	<i>263</i>	<i>6.67</i>	<i>7</i>
<i>HRIS</i>	<i>297</i>	<i>7.42</i>	<i>7</i>
<i>e-HRM</i>	<i>327</i>	<i>8.17</i>	<i>8</i>
<i>General question</i> <i>CBC</i>	<i>288</i>	<i>7.2</i>	<i>7</i>
<i>HRM</i>			
<i>Training</i>	<i>332</i>	<i>8.3</i>	<i>8</i>
<i>Performance</i>	<i>305</i>	<i>7.62</i>	<i>8</i>
<i>Compensation</i>	<i>293</i>	<i>7.32</i>	<i>7</i>
<i>Incentives</i>	<i>326</i>	<i>8.15</i>	<i>8</i>
<i>Payroll</i> <i>Management</i>	<i>353</i>	<i>8.82</i>	<i>9</i>
<i>General question</i> <i>HRM</i>	<i>262</i>	<i>6.55</i>	<i>7</i>
<i>PERFORMANCE</i>			
<i>Competency</i> <i>Mapping</i>	<i>302</i>	<i>7.55</i>	<i>8</i>

<i>MBO</i>	<i>343</i>	<i>8.57</i>	<i>9</i>
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<i>Access Centre</i>	<i>283</i>	<i>7.07</i>	<i>7</i>
<i>360⁰ appraisals</i>	<i>271</i>	<i>6.77</i>	<i>7</i>
<i>Human Resource Accounting</i>	<i>348</i>	<i>8.7</i>	<i>9</i>
<i>General question PERFORMANCE</i>	<i>307</i>	<i>7.67</i>	<i>8''</i>

Data Analysis:

The findings indicate a significant interconnection between Cloud-Based Computing (CBC), Human Resource Management (HRM), and performance. Six functional links between these groups are identified, and they are theoretically associated with one another as well. In statistical analysis, these functional connections are utilized to approximate regression modeling. The significance of these connections can be determined through correlation or regression analysis. Regression analysis is conducted using SPSS 13.0 software, while correlation analysis is carried out using Microsoft Excel. Table 2.1 displays frequency counts for three different factors.

Table 2.1 Average Responses (Frequency)

<i>CBC-CLIENT</i>	<i>Research Questions</i>
<i>SaaS</i>	<i>CBC makes easy to the recruitment of workforce with the minimum</i>
<i>PaaS</i>	<i>Using laptops, tablets and smart phones in HRM</i>
<i>IaaS</i>	<i>CBC infrastructure helps in increase in the computing efficiency and</i>
<i>HRIS</i>	<i>Streamline of Recruitment and Training</i>
<i>e-HRM</i>	<i>Easy and Faster of competency and compensation</i>

<i>General question CBC</i>	<i>CBC provides IT infrastructure, storage facility and data</i>
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	<i>Security</i>	
<i>HRM</i>		
<i>Training</i>	<i>CBC helps in multi place training</i>	
<i>Performance</i>	<i>CBC increases the performance of</i>	
<i>Compensation</i>	<i>Manager takes quick decision in</i>	
<i>Incentives</i>	<i>Incentives are updated within time.</i>	
<i>Payroll Management</i>	<i>Payroll as output, displays faster</i>	
<i>General question HRM</i>	<i>CBC affects the effectively HRM</i>	
<i>CBC-CLIENT</i>	<i>HRM</i>	<i>PERFORMANCE</i>
8	8	8
8	8	9
7	7	7
7	8	7
8	9	9

Correlation:

In Table 2.2, scatter plots illustrate the three-way relationships between the components. A favorable and statistically significant association of 0.72 is observed between CBC-CLIENT and HRM. This strong correlation suggests compatibility between CBC-CLIENT and HRM, highlighting the significant impact of effective CBC implementation on human resource management. Additionally, the correlation between HRM and PERFORMANCE is 0.59, indicating an acceptable but less substantial connection compared to CBC-CLIENT and HRM. However, the correlation between CBC-CLIENT and PERFORMANCE stands out significantly

at 0.81, emphasizing its remarkable and consequential nature in comparison to other values in the analysis. Detailed correlation data are presented in Tables 2.2, 2.3, 2.4, and 2.5.

Table 2.2 *Correlation (CBC, HRM, PERFORMANCE)*

	<i>CBC- CLIENT</i>	<i>HRM</i>	<i>PERFORMANCE</i>
	<i>T</i>		
<i>CBC- CLIENT</i>	<i>1</i>		
<i>HR M</i>	<i>0.72</i> <i>760</i> <i>7</i>	<i>1</i>	
<i>PE RF OR MA N</i> <i>CE</i>	<i>0.81</i> <i>649</i> <i>7</i>	<i>0.5</i> <i>94</i> <i>08</i> <i>9</i>	<i>1</i>

Table 2.3 *Correlation (CBC, HRM)*

	<i>CBC- CLIENT</i>	<i>HRM</i>
<i>CBC- CLIENT</i>	<i>1</i>	

Table 2.4 *Correlation (HRM, PERFORMANCE)*

	<i>HRM</i>	<i>PERFORMANCE</i>

<i>HRM</i>	<i>1</i>	
<i>PERFORMANCE</i>	<i>0.594089</i>	<i>1</i>

Table 2.5 Correlation (CBC, PERFORMANCE)

	<i>CBC- CLIENT</i>	<i>PERFORMANCE</i>
<i>CBC-CLIENT</i>	<i>1</i>	
<i>PERFORMANCE</i>	<i>0.816497</i>	<i>1</i>

RANK AND PERCENTAGE (Frequency) The ranking and percentage breakdown of relevant variables reveal that SaaS, PaaS, and e- HRM under CBC-CLIENT have the most significant impact. SaaS holds the top rank, followed by PaaS, and then e-HRM, with respective ranks and percentages of 1 and 60 each. CBC heavily influences HRM's payroll system. The high ranking and percentage of e-HRM (1, 100%) are attributed to its outcomes. Anticipated to have a substantial correlation with PERFORMANCE, the combined rank and percentage also show up as MBO (1, 80%).

Table 2.6. Rank and Percentage

<i>Poin t</i>	<i>CBC- CLIEN T</i>	<i>Rank</i>	<i>Percen t</i>	<i>Poin t</i>	<i>HRM</i>	<i>Ran k</i>	<i>Percent</i>
<i>1</i>	<i>8</i>	<i>1</i>	<i>60.00 %</i>	<i>5</i>	<i>9</i>	<i>1</i>	<i>100.00 %</i>
<i>2</i>	<i>8</i>	<i>1</i>	<i>60.00 %</i>	<i>1</i>	<i>8</i>	<i>2</i>	<i>40.00%</i>
<i>5</i>	<i>8</i>	<i>1</i>	<i>60.00 %</i>	<i>2</i>	<i>8</i>	<i>2</i>	<i>40.00%</i>
<i>3</i>	<i>7</i>	<i>4</i>	<i>0.00%</i>	<i>4</i>	<i>8</i>	<i>2</i>	<i>40.00%</i>
<i>4</i>	<i>7</i>	<i>4</i>	<i>0.00 %</i>	<i>3</i>	<i>7</i>	<i>5</i>	<i>0.00 %</i>
<i>6</i>	<i>7</i>	<i>4</i>	<i>0.00 %</i>	<i>6</i>	<i>7</i>	<i>5</i>	<i>0.00 %</i>

Regression Analysis:

The study tests hypotheses through regression analysis, with the null hypothesis (H0) and alternative hypothesis (H1) as follows: H0: Cloud-Based Computing has an insignificant effect on HRM performance. H1: Cloud-Based Computing has a significant effect on HRM performance. To reject H0, the P-value must be less than or equal to 0.05, and vice versa. When testing a hypothesis, one selects between a null and an alternative hypothesis based on the results of frequency analysis and descriptive statistics. Initially, the assumption is made that the null hypothesis (H0) can be refuted; however, it is generally acknowledged that the opposite is more accurate. **“Regression: CBC-CLIENT and Performance of HRM**

Table 2.7: Model Summary

<i>Model</i>	<i>R</i>	<i>R Square</i>	<i>Adjusted R Square</i>	<i>Std. Error of the Estimate</i>
<i>1</i>	<i>.816a</i>	<i>.667</i>	<i>.583</i>	<i>.57735</i>

Predictors: (Constant), CBCCLIENT

Table 2.8 ANOV

<i>Model</i>	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
<i>1</i>	<i>2.66</i>	<i>1</i>	<i>2.66</i>	<i>8.47</i>	<i>.004a</i>
<i>Error</i>	<i>1.33</i>	<i>5</i>	<i>.266</i>	<i>0.847</i>	
<i>Total</i>	<i>3.99</i>	<i>6</i>			
<i>Corrected Total</i>	<i>3.99</i>	<i>6</i>			

<i>l</i>					
<i>T</i>					
<i>o</i>					
<i>t</i>					
<i>a</i>					
<i>l</i>					

a). Predictors: (Constant), CBCCLIENT b). Dependent Variable: PERFORMANCE **Table 2.9**
Coefficients

<i>Model</i>	<i>Unstandardized Coefficients</i>	<i>Standardized</i>	<i>t</i>	<i>Sig</i>

Dependent Variable :

Performance

Findings:

The findings indicate that HRM has a lesser impact on HRM performance compared to the influence of CBC-CLIENT. Introducing CBC-CLIENT in IT departments is expected to significantly boost productivity within the company. SaaS, PaaS, and e-HRM are identified as critical factors in HRM performance management. Due to the average 60% effective adoption of CBC- CLIENT, HRM performance is impacted 100% in payroll administration and 80% in MBO and HRA.

Suggestions and Conclusion:

It is advisable for both IT companies and manufacturing corporations to adopt the CBC-CLIENT provided by reputable Cloud service providers. This adoption is expected to enhance the industry's human capital and overall performance, ensuring security and speed. Policymakers in the . Government should demonstrate genuine interest in implementing the CBC-CLIENT to better communicate with citizens. The findings of this research are highly relevant and beneficial for all levels of management, improving

the efficiency and effectiveness of the management scalar chain. With the widespread use of CBC in the IT sector, performance has significantly improved, impacting other customer industries as well.

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