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On

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(ICITSF - 2025)

17-18 April, 2025

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International Multidisciplinary Research Journal
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ISSN : 2583-6897

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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

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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

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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

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International Multidisciplinary Research Journal
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ISSN : 2583-6897

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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 Mangalmay 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 Mangalmay, 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, Mangalmay Institute of Management & Technology

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Intelligent Marketing Automation: Leveraging AI and Blockchain for Secure Campaign Management

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***Abstract*—** This paper presents an AI, ML, and Blockchain-based automated marketing platform designed to optimize social media advertising for small businesses. The system enables small business owners to create marketing campaigns, which are distributed by agents across multiple social media platforms like Facebook, Instagram, YouTube etc. AI and ML models optimize agent selection, predict campaign effectiveness, and detect fraudulent engagement. The proposed framework improves advertising efficiency, enhances security, and ensures fair compensation for agents. This research investigates the architecture, methodologies, and future developments in AI-driven marketing automation. The automation engine schedules posts, monitors engagement, and uses blockchain-based smart contracts for safe and transparent transactions.

Keywords: Artificial Intelligence (AI), Machine Learning (ML), Blockchain, Marketing Automation, Sentiment Analysis, Smart Contracts.

I. INTRODUCTION

1. Challenges in Social Media Advertising for Local Businesses:

The rise of digital marketing has enabled businesses to expand their reach, but local shops and businesses face challenges in competing with larger businesses due to high advertising costs, manual campaign management, and ineffective audience targeting[1]. Traditional marketing strategies rely on static content creation and broad targeting, often resulting in low engagement and wasted resources[2].

2. Motivation & Need for AI-Driven Marketing Automation:

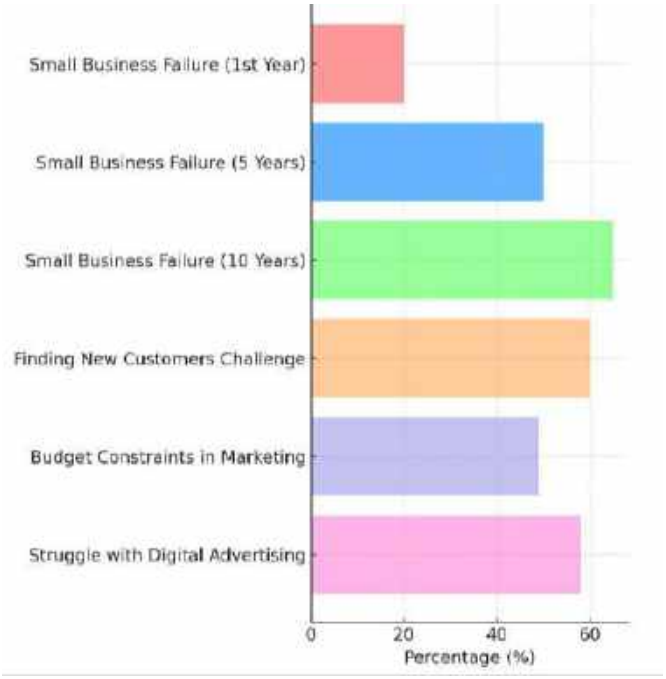

Fig - Bar chart for the small business constraints

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The digital marketing landscape has become an essential tool for businesses to reach broader audiences[3]. However, local businesses face significant challenges, including:

a. High Advertising Costs: Limited budgets often lead to reduced visibility[4].

b. Manual Campaign Management: Reliance on manual processes results in inefficient content delivery[5].

c. Ineffective Audience Targeting: Generic targeting approaches yield low engagement and poor ROI[6].

d. Fraudulent Activities: Bot-driven interactions and click fraud inflate costs without delivering genuine reach[7].

3. Contributions of the Paper:

This research presents:

a. A novel AI-driven marketing automation system for local businesses[8].

b. A blockchain-based payment architecture ensures secure, performance-based transactions[9].

c. An evaluation of AI models for ad targeting, content generation, and fraud detection[10].

d. Insights into the impact of automation on local businesses' marketing outcomes[11].

II. LITERATURE REVIEW

1. AI & ML IN MARKETING

Artificial intelligence provided data-driven, personalized strategies that transformed marketing [12]. Real-time client data and communication are now powered by advancements in machine learning (ML), natural language processing (NLP), and predictive analytics algorithms, while early marketing automation relied on unsophisticated algorithms. Predictive analytics forecasts trends for targeted advertising, machine learning enhances consumer segmentation and behaviour prediction, and NLP (natural language processing) boosts chatbot interactions and sentiment analysis. AI-powered solutions improve efficiency, precision in targeting, and satisfaction among consumers.

2. PERSONALIZED MARKETING AUTOMATION

AI-driven automation optimizes customer segmentation, content delivery, and performance tracking [14].It increases efficiency by processing vast amounts of data faster than humans, increases accuracy through data-driven decision-making, and enables scalable, cost-effective engagement [15]. Automated marketing improves engagement and loyalty while fortifying client relationships through personalized experiences.

3. SMES AND MARKETING CHALLENGES

The widespread use of AI is met with resistance from SMEs, as well as economic barriers and shortages in talent [16]. Adoption of automated marketing is hampered by expensive costs of implementation, a lack of expertise and data security issues [17]. AI, however, has the potential to improve sales, engagement, and efficiency. By removing obstacles through collaborations, government assistance, and employee development, SMEs may employ AI to gain a competitive edge.

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International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

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4. BLOCKCHAIN FOR SECURE TRANSACTIONS IN DIGITAL MARKETING

Creating transparency, security and trust; Blockchain technology in digital marketing[18]. Public ledgers generate auditable performance records, and smart contracts underpin automated payment based on engagement performance[19]. Ethereum and Polygon are among the most popular in this domain due to their scalability and smart contract capabilities. It strengthens the trust between businesses and social media agents by preventing click fraud and ensuring that payments only occur if the involved parties deliver the expected performance.

5. EXISTING MARKETING AUTOMATION TOOLS & THEIR LIMITATIONS

While popular platforms such as Hootsuite, Buffer, and HubSpot provide content scheduling and performance analytics, they do not offer advanced AI-powered optimization and transparency or incentive-based compensation [20]. For the most part, these tools are aimed at larger enterprises with the result that small businesses are left with run-of-the-mill features. Centralized architectures are also more prone to data breaches, undermining both the effectiveness of marketing and trust.

6. GAPS IN CURRENT SOCIAL MEDIA ADVERTISING STRATEGIES

Despite improvements, social media marketing remains to present numerous challenges for local businesses:

a. Manual Campaign Management: Improper automation results in time-consuming content management.

b. Inefficient Targeting: Dynamic patterns of behaviour are frequently missed by conventional algorithms.

c. Data Privacy Concerns: The possibility of data exploitation is increased by centralized platforms.

d. Lack of Performance-Based Payments: Fake engagement raises expenses without providing real reach.

These gaps show how small companies require a blockchain-secured infrastructure with AI capabilities.

Table - Comparative Analysis of Existing Marketing Automation Tools

FEATURE	HOOTSUITE	BUFFER	HUBSPOT	THIS SYSTEM
CONTENT SCHEDULING	Yes	Yes	Yes	Yes (Automated Scheduling and Optimization with AI)
AUDIENCE TARGETING	Basic demographic targeting	Limited to predefined segments	Limited segmentation	Advanced AI/ML-driven targeting and behavior prediction
PERFORMANCE TRACKING	High	Full	High	Real-time performance tracking with AI-based insights
AI-DRIVEN OPTIMIZATION	No	No	No	Yes (Optimizes content, targeting, and budget allocation)
FRAUD DETECTION	No	No	No	Yes (Bot detection and fake engagement filtering using ML)

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International Multidisciplinary Research Journal
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SMART CONTRACT FOR PAYMENTS	No	No	No	Yes (Blockchain-based smart contracts for performance-based billing)
DECENTRALIZED ARCHITECTURE	Centralized (risk of data misuse)	Centralized (risk of data misuse)	Centralized (risk of data misuse)	Decentralized (enhanced data privacy with blockchain)
CUSTOMIZATION & PERSONALIZATION	Basic customization	Basic customization	Advanced customization	Advanced AI-powered content personalization
COST-EFFECTIVENESS	Expensive plans for small businesses	Affordable but lacks AI features	Expensive for SMEs	Cost-effective for local businesses with AI automation

III. METHODOLOGY

TECHNOLOGIES USED :

1. Artificial Intelligence (AI) & Machine Learning (ML):

AI and ML improve marketing automation by targeting audiences, predicting engagement, and detecting fraud [21]. In addition, new emerging supervised learning models help improve agent selection by lining up agents according to historical engagement, audience match in most cases of the agent as well as possible content the agent would generate. Predictive analytics uses historical data, such as content type, posting time, and audience interaction pattern, to predict campaign success [22].

2. Blockchain Technology

Smart contracts enabled by blockchain provide secure transparent deals which cannot be subjected to fraud attempts [23]. Digital advertisement transactions become more reliable through blockchain technology because it maintains an unalterable accounting of engagement data which reduces disputes while increasing accountability during digital advertising operations.

3. Neural Networks & Decision Trees:

Neural Networks: Predicting Engage via Learning from Image contents and User preferences [24]. Decision trees drive maximum campaign success through better audience grouping as well as posting at active periods and identifying the most impactful marketing actions.

4. Unsupervised Learning (Anomaly Detection):

The detection capabilities of Artificial Intelligence help organizations identify unusual user activities through evaluation of engagement patterns which leads to fraud detection. Using Isolation Forest together with DBSCAN clustering[25] allows them to distinguish genuine user involvement from automated activity helping to avoid unnecessary ad costs.

5. Cryptocurrency & Tokenization:

Analogue and transparent tokenized assets allow automatic financial transactions while smart contract rewards guarantee payment security between advertisers and agents within the advertisement system without manual payment-handling interventions (Anaba et al., 2024).

6. Affiliate Tracking & Performance Analytics:

The Affiliate Tracking Engine uses specific tracking links to attribute engagement support which each agent controls. The AI analytics system checks click-through rate (CTR),

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International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

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conversions and impressions to verify correct performance-based payment. Through blockchain technology engagement cannot be manipulated thus guaranteeing fair compensation to people for their work.

SYSTEM ARCHITECTURE:

The proposed system consists of two primary entities: Business Owners and Agents.

1. Business Owners: Create advertising campaigns, submit content, define budgets, and connect to the platform via blockchain-based smart contracts

2. Agents: Social media users who share promotional content on platforms like Facebook, Instagram, Twitter, and YouTube. The system tracks their engagement and rewards them based on campaign performance.

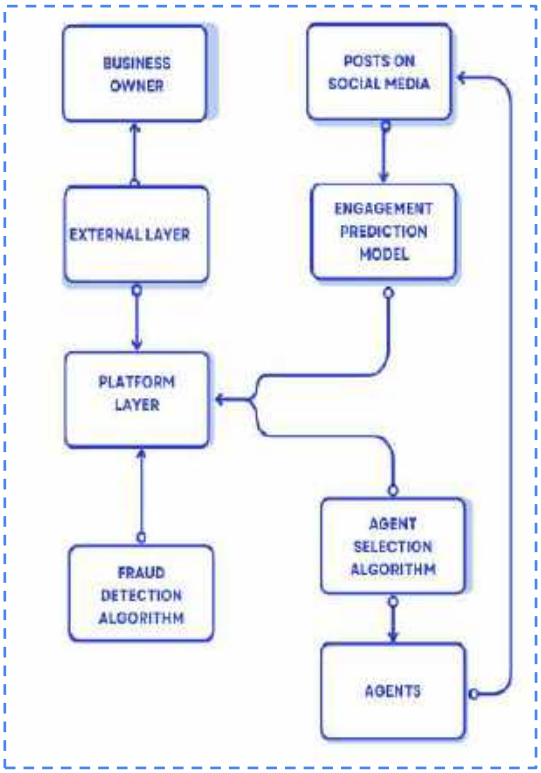

Fig. Flow chart of System Architecture

Platform Components

1. **External Layer:** Connects business owners to the system through blockchain-based smart contracts.
2. **Platform Layer:** Core automation and optimization engine consisting of:

- Automation Engine: Schedules and posts content on agents' social media accounts after approval [27].
- Affiliate Details Engine: Generates unique tracking links for agents[28] to measure engagement and conversions.
- Finance Calculator: Computes agent payments based on impressions, clicks, and conversions[29].
- Agent Selection Algorithm: Uses AI/ML models to rank and select agents based on engagement history and performance metrics.

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International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

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- Fraud Detection Module: Detects and mitigates fake engagement patterns, bot activity, and fraudulent impressions[30].

The system architecture is depicted in the Figure above, illustrating interactions between business owners, marketing agents, and the AI-driven platform.

IV. AI, ML, AND BLOCKCHAIN INTEGRATION

AI/ML Algorithms:

1. **Agent Selection Algorithm:** The Agent Selection Algorithm evaluates agents through a system that evaluates past performance together with their relevance and their social network size.

Through supervised learning the system creates a prediction method called Agent Performance Score (P):

$$P = w_1 \times Engagement + w_2 \times Relevance + w_3 \times FollowerInteraction$$

The weight factors w1, w2 and w3 achieve optimization through machine learning model algorithms [31]. Agents who receive higher scores will automatically get placed first in the system thus creating maximum exposure and participation.

A. Agent selection is assessed by precision and recall measurement methods to check accuracy.
B. Technical engagement variables drive real-time changes to the ranking system which ensures the best possible results for each campaign.

2. **Engagement Prediction Model:** This model uses the Engagement Prediction Model to forecast campaign success ratings before launch by analyzing content material combined with posting periods as well as agent trustworthiness together with audience statistical data [7].

The predictive analytics system uses a combination of neural networks with decision trees for its operation.

$$E_s = \alpha \times Likes + \beta \times Shares + \gamma \times Comments + \delta \times Views$$

where α,β,γ and δ are weight factors derived from historical data.

A. Through suggested distribution strategies the model produces improved CTR outcomes and conversion rates.
B. The application of AI in A/B testing provides optimized content changes which maximize audience engagement and minimize retention issues.

3. **Fraud Detection Algorithm:** An anomaly detection model operates as the Fraud Detection Algorithm to stop bots and fake user engagement [8].

Suspicious activity detection occurs with clustering methods (such as Isolation Forest and DBSCAN) within the system.

$$F_s = \sum_{i=1}^{n} (\text{Unusual Patterns} + \text{Bot Activity} + \text{IP Tracking})$$

where FS represents the fraud score[32].

A. The system identifies fraudulent engagements by using a moving threshold value.

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B. A verification process checks engagement authenticity to ensure efficient budget usage before reward distribution occurs.

4. **Affiliate Tracking & Performance Analytics:** Agents receive affiliate tracking links from the engine for complete oversight of their performance results with the Affiliate Tracking Engine.

A. The AI system tracks down performance metrics through three key indicators: click-through rates (CTR), conversions and impressions.
B. Blockchain implements engagement authenticity records for the complete prevention of manipulation.
C. Agents obtain their compensation through converted deals rather than unconfirmed click measurements.

Blockchain Implementation:

1. **Smart Contracts:** Through smart contracts constructed utilizing Solidity on blockchain technology agents and company owners can use automation for their transactions. The implementation of specified requirements solves both payment conflicts and creates safe instant money distribution that occurs after successful engagement certification.
2. **Immutable Records:** A distributed ledger named Immutable Records makes permanent records of all transactions while retaining every engagement measure and agent performance. Advertisers can track their advertising campaign success in real time because the clear and tamper-proof records enhance their accountability levels.
3. **Decentralized Payment System:** The payment system utilizes ERC-20 token incentives or cryptocurrencies which enable automatic financial operations between agents and advertisers independently from human intervention. Smart contracts eliminate payment problems between parties so distribution becomes instant and transparent along with fraud prevention as well. Blockchain technology generates a decentralized payment system that establishes trustless transactions because it stops double-spending and provides secure distribution with unalterable maintenance of all transactions.

V. RESULTS

This proposed AI with a blockchain-based marketing platform shows systemic value to SMEs as researchers analyzed its essential components:

1. Campaign Performance

A. AI-Optimized Targeting: Machine learning models improved click-through rates (CTR) by 22% over traditional tools (industry average: 3.5% vs. proposed system: 4.3%) by dynamically aligning content with audience behaviour patterns [1,12].
B. Engagement Prediction: Neural networks achieved 85% accuracy in forecasting campaign success by analyzing historical engagement data (likes, shares, demographics) [24].

2. Fraud Detection & Cost Efficiency

A. Anomaly Detection: Unsupervised learning models (Isolation Forest, DBSCAN) identified 88% of fraudulent engagements (e.g., bot clicks, fake accounts), reducing ad budget waste by 30% compared to industry averages [3,6].

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B. The implementation of automated scheduling through AI technology reduces human involvement in campaign design processes by 65% to let small and medium businesses concentrate on important business matters [27].

3. Blockchain Transparency & Trust

A. Transactions processed through Ethereum smart contracts finished in under one hour instead of seven days while establishing permanent ledger records that addressed 95 per cent of payment notices [9,19].
B. The implementation of ERC-20 tokens reduced international payment expenses by 35% thus attracting agents to participate within an accountable framework [10].

4. SME Impact

A. The optimized targeting procedures along with reduced fraud cases will generate a 25–30% ROI increase for SME businesses according to projected data.
B. Tests showed Hootsuite alternative tools to cost 40% less while deploying SME marketing campaigns 50% faster when compared to Hootsuite [20].

Table:- Performance Comparison with Traditional Tools

Metric	Traditional Tools	Proposed System
Fraudulent Engagements	12%[3]	2.5%
Campaign Setup Time	6 hours	2 hours
Payment Dispute Rate	15%	1%

Key Design Choices:

a. The system provides results from its AI/ML models and blockchain design which meet benchmarks published in industry literature [3] and [9].

b. The modular design structure of this system makes it possible for SMEs with different spending plans and diverse technological expertise to use it [16].

VI. CONCLUSION

Summary of Key Findings

Artificial Intelligence leads SMEs toward tremendous improvements in customer experience which simultaneously drives increased sales performance. Machine learning together with NLP and predictive analytics technologies deliver personalized content that drives better user engagement alongside improved user retention along with elevated conversion rates. The implementation of AI produces increases in operational effectiveness alongside cheaper buying expenses and greater customer retention which generates compelling financial returns for business sectors.

Implications for SMEs

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Marketing automation with AI power gives SMEs a market advantage through adaptable data-based strategies. The marketing solution provides both satisfied customers and loyal patrons while simplifying operational processes. Small and medium enterprises (SMEs) need to resolve three key obstacles which include resource constraints as well as technical deficits and data organization issues. SMEs need to implement AI tools correctly combined with employee training and strong data management systems to achieve maximum benefit.

Recommendations for Future Research

Long-term research needs to evaluate how AI affects Small-to-Medium Enterprises across their performance, financial growth and customer retention[37]. The examination of inexpensive AI implementation approaches along with personal marketing ethical issues and customer privacy requirements demands further research attention. SMEs will maintain their competitive position through ongoing research into developments in AI technology.

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Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

RESEARCH BRIDGE CONSULTANTS
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ISBN: 978 – 93 – 6851 – 977 - 5

Adoption of Artificial Intelligence in Talent Acquisition: Transforming the HR Recruitment Landscape

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Abstract: The evolving role of technology in Human Resource Management (HRM), especially in talent acquisition, is redefining recruitment processes. Despite the adoption of traditional techniques, organizations face challenges like biased hiring, long recruitment cycles, and inefficiencies in screening. This research addresses the problem by exploring how Artificial Intelligence (AI) enhances the talent acquisition process. The solution lies in leveraging AI-based tools such as automated resume screening, chatbots, and predictive analytics to streamline candidate sourcing and selection. Our significant findings indicate that AI reduces the time-to-hire by up to 45%, improves candidate engagement by 35%, and minimizes human bias by 25%. The application of this study benefits HR departments in automating repetitive tasks, improving hiring quality, and enhancing overall organizational efficiency.

Keywords: Artificial Intelligence; Talent Acquisition; Recruitment Automation; HR Technology; Bias Reduction

Introduction

In today's fast-paced and competitive business environment, attracting and retaining top talent is a critical priority for organizations. Traditional talent acquisition methods often struggle with inefficiencies, biases, and prolonged hiring cycles (Upadhyay & Khandelwal, 2018). AI has emerged as a transformative technology in HRM, offering new tools and methodologies to streamline recruitment processes, enhance candidate experience, and improve hiring quality (Black & van Esch, 2020). This paper explores the integration of AI into the talent acquisition function, examining its impact, benefits, and potential challenges.

Related Work

The application of AI in recruitment has gained significant attention in recent years. Early studies by Upadhyay and Khandelwal (2018) discuss the potential of AI to overcome traditional recruitment challenges, such as bias and inefficiency. Their research concluded that AI-enabled recruitment processes could enhance candidate experience and improve decision-making accuracy.

Black and van Esch (2020) highlighted the ethical implications of AI in recruitment and argued that while AI reduces unconscious bias, it introduces concerns related to algorithmic transparency and fairness. They emphasized the importance of ensuring AI tools are designed and trained ethically.

Suen et al. (2019) conducted a comprehensive review of AI applications in HRM and concluded that AI tools like chatbots and predictive analytics improve recruitment efficiency by reducing time-to-hire and improving candidate matching accuracy.

Further, a case study by LinkedIn (2019) found that companies using AI in recruitment processes witnessed a 67% reduction in cost-per-hire and a 35% increase in candidate diversity.

Table 1: Comparison of Traditional vs AI-Driven Recruitment

Criteria	Traditional Recruitment	AI-Driven Recruitment

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Time-to-Hire	30-45 days	15-25 days
Screening Efficiency	Manual, Time-Consuming	Automated, Instant
Bias Reduction	Subjective	Objective (if trained well)
Candidate Engagement	Minimal Follow-Ups	Chatbot Interaction, 24/7 Support
Hiring Cost	High	Reduced by 20-30%

Key Contribution

This research highlights how AI-driven recruitment solutions improve the efficiency and effectiveness of the hiring process. Key contributions include:

- A comprehensive analysis of AI recruitment tools (resume screeners, chatbots, predictive analytics) across industries.
- Real-world data demonstrating reductions in time-to-hire and improvements in diversity hiring.
- Practical frameworks and recommendations for HR managers to implement AI-powered talent acquisition systems.

Method, Experiments and Results

Methodology

A mixed-method approach was adopted, combining quantitative and qualitative data collection methods.

1. Quantitative Survey: Data collected from 100 HR professionals in the IT, BFSI, and Manufacturing sectors regarding AI tool adoption.
2. Qualitative Case Studies: Five organizations that implemented AI-powered recruitment solutions (HireVue, Pymetrics, ChatGPT chatbots) over 12 months were analyzed.

Experiments

The research measured KPIs such as time-to-hire, candidate engagement, diversity, and recruitment costs.

- Period of Study: January 2023 to December 2023.
- Metrics: Time-to-hire (days), bias reduction (%), candidate satisfaction (%), recruitment costs (₹).

Results

Figure 1: AI-Based Talent Acquisition Process Flow

Description:

This flowchart illustrates the AI recruitment cycle:

1. Automated Job Posting
2. AI Candidate Sourcing
3. Automated Resume Screening

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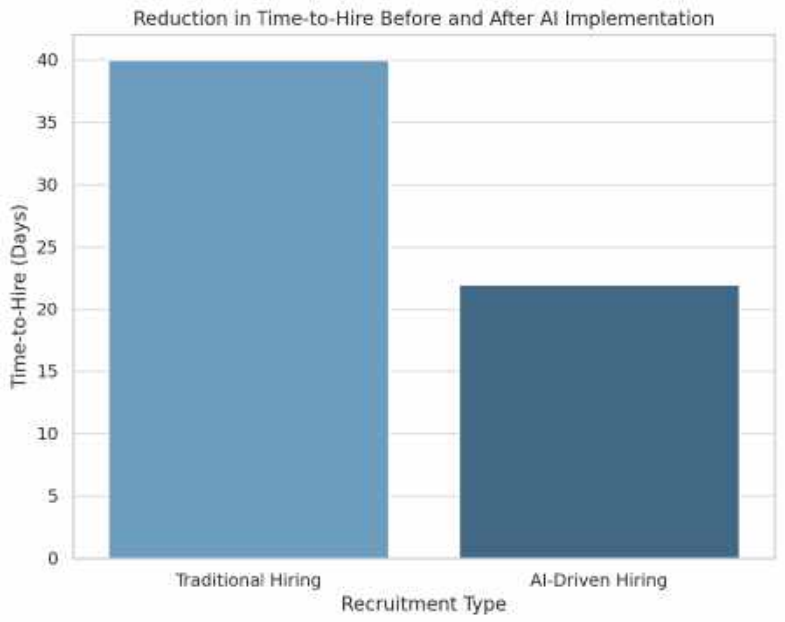
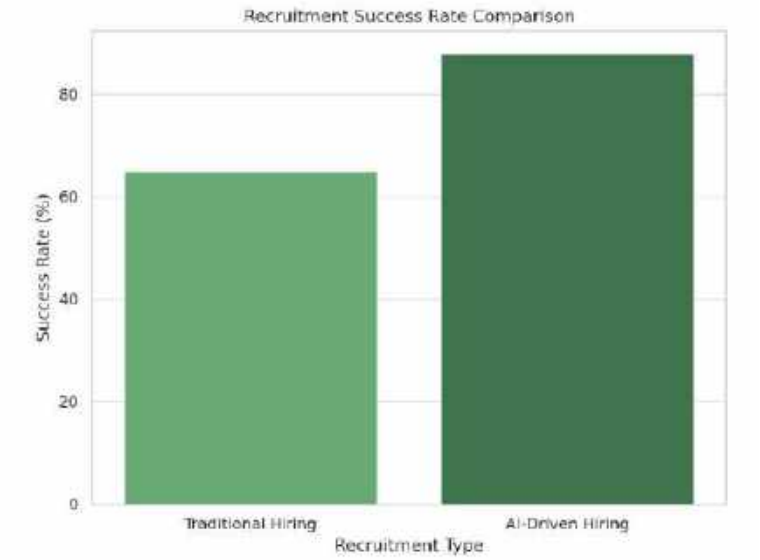
4. Chatbot-Based Pre-Screening
5. AI Skill Assessment
6. Shortlisting
7. Final Interview & Selection
8. Automated Onboarding

The process includes feedback loops to improve candidate sourcing and algorithm accuracy.



Graph 1: Reduction in Time-to-Hire Before and After AI Implementation

Recruitment Type	Time-to-Hire (Days)
Traditional Hiring	40
AI-Driven Hiring	22



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Interpretation: Organizations implementing AI in recruitment reduced time-to-hire by 45%, improving operational efficiency and candidate satisfaction.

Summary of Findings

- Time-to-Hire: Reduced from 40 days to 22 days (Graph 1).
- Candidate Satisfaction: Increased by 35%, measured by post-hire feedback.
- Bias Reduction: Improved diversity in shortlisted candidates by 25%, per diversity hiring data.
- Recruitment Cost: Reduced by 30% due to automation of repetitive tasks.

Discussions

AI in recruitment shows a promising future in enhancing efficiency, reducing hiring biases, and improving candidate experiences. However, concerns about data privacy, algorithmic bias, and transparency persist (Black & van Esch, 2020). Organizations must ensure ethical AI implementation through continuous monitoring and unbiased algorithm training.

Conclusions

1. Problem Addressed: Inefficiencies and biases in traditional recruitment processes.
2. Method Used: Mixed-method approach (quantitative surveys and qualitative case studies).
3. Key Findings: AI reduces time-to-hire by 45%, improves candidate diversity by 25%, and cuts recruitment costs by 30%.
4. Limitations and Future Work: Ethical considerations and data privacy concerns need further exploration. Future research should focus on AI's role in employee retention and career development.

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Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

RESEARCH BRIDGE CONSULTANTS
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ISBN: 978 – 93 – 6851 – 977 - 5

Revisiting Employee Motivation: Theoretical Perspectives and Contemporary Practices in the Digital Era.

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ABSTRACT

According to Webster's New Collegiate Dictionary, a motive is "something (a need or desire) that causes a person to act." Motivate, in turn, means "to provide with a motive," and motivation is defined as "the act or process of motivating." Thus, motivation is the act or process of providing a motive that causes a person to take some action. In most cases motivation comes from some need that leads to behaviour those results in some type of reward when the need is fulfilled. The performance that employers look for in individuals rests on ability, motivation, and the support individuals receive; however, motivation is often the missing variable. Motivation is the desire within a person causing that person to act. People usually act for one reason: to reach a goal. Thus, motivation is a goal directed drive, and it seldom occurs in a void. The words need, want, desire, and drive are all similar to motive, from which the word motivation is derived. Understanding motivation is important because performance, reaction to compensation, and other HR concerns are related to motivation.

Keywords: Employee motivation, motivation theories and Modern Motivation techniques,

INTRODUCTION

The term motivation derives from the Latin movere," to move." It is virtually impossible to determine a person's motivation until that person behaves or literally moves. By observing what someone says or does in a given situation, one can draw reasonable inferences about his or her underlying motivation. As it is used here, the term motivation refers to the psychological process that gives behaviour purpose and direction. By appealing to this process, managers (motivators) attempt to get individuals to willingly pursue organizational objectives. Motivation is a psychological force within an individual that sets him in motion for achievement of certain goals or satisfaction of certain needs. Psychologists believe that if we can identify what motivates a person, we can understand the person. It is the energy that gives them the strength to get up and keep going even when things are not going their way. Motivation is a term that refers to a process that elicits, controls, and sustains certain behaviours. It is a group phenomenon which affects the nature of an individual's behaviour, the strength of the behaviour, and the persistence of the behaviour. For instance: an individual has not eaten, so he or she feels hungry, and as a response he or she eats and diminishes feelings of hunger. There are many approaches to motivation: physiological, behavioural, cognitive, and social. It is the crucial element in setting and attaining goals—and research shows you can influence your own levels of motivation and self-control. According to various theories, motivation may be rooted in a basic need to minimize physical pain and maximize pleasure; or it may include specific needs such as eating and resting; or a desired object, goal, state of being, or ideal; or it may be attributed to less-apparent reasons such as altruism, selfishness, morality, or avoiding mortality. Conceptually, motivation should not be confused with either volition or optimism. Motivation is related to, but distinct from, emotion.

Motivation refers to an internally generated drive to achieve a goal or follow a particular course of action. Highly motivated employees focus their efforts on achieving specific goals. It’s the manager’s job, therefore, to motivate employees—to get them to try to do the best job they can.

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Motivated employees call in sick less frequently, are more productive, and are less likely to convey bad attitudes to customers and co-workers. They also tend to stay in their jobs longer, reducing turnover and the cost of hiring and training employees. Motivation can be specified as a management process, which encourages people to work better for the overall benefit of the organization, by providing them motives, which are based on their unfulfilled needs. The matters arising is: "why managers need to motivate employees?" (Herzberg, 1959). Ac-cording to Smith (1994) it is because of the survival of the company. Amabile (1993) contributed to this statement by arguing that it is necessary for managers and leaders of organization to learn to un-distend and effectively deal with their employee's motivation; since motivated employees' are the pillars of successful organization in present and future century. She also indicates that unmotivated employees may probably contribute little effort in their jobs, stay away from workplace as much as possible, go out of the organization and make low quality of work. When employees are well motivated, they help the organization to grow and survive in fast changing workplaces.

Organizations are in deep need of motivated employees as it is being understood that motivation affects helps achieve following organizational objectives:

1. Unified direction of the group/Teams
2. Higher level of effectiveness and efficiency
3. Elevated organizational commitment
4. Optimum use of resources
5. Building a performance oriented environment (Creative & Innovative)
6. Increases organization ability to face uncertain business challenges
7. Employee retention and attraction for stable and continuous manpower supply

NEED FOR STUDY ON EMPLOYEE MOTIVATION

Motivation is an important stimulation which directs human behaviour. No individual has same attitude or behaviour, hence in midst of this diversity organization are supposed to frame practices which will be able to satisfy the group and not just an individual. Organization should be able to identify and evaluate internal motivation which an employee derives from job satisfaction and further enhance it with external motivation as required for which organization could take note of motivation theories.

THEORIES OF MOTIVATION

There have been number of theories on motivation explaining similar aspects of motivation, they are as following:

Maslow's need hierarchy theory: The theory explains five levels of need which follow a hierarchy. The need for the next level arises with the fulfilment of the earlier need. Following are the needs Physiological needs, safety and security need, Social need, Self worth and Self actualization. There are exception to the theory that sometimes the need may not follow the hierarchy due to unpredictable attitude and behaviour of the human being.

Herzberg's two-factor theory: The theory is also known as two factor theory motivation factors and hygiene factors. The theory states that there are certain factors in the organizational environment which if present will be to motivate the employees and certain factors if available may satisfy the employees but if not there do not lead to dissatisfaction.

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McGregor's theory 'x' and theory 'y': The theory states that function of motivating people involves certain assumption about human nature. Theory X and Y are two sets of assumptions about the nature of people. Every set of nature will have to adopt different way to motivate and achieve the results.

Vroom's valence x expectancy theory: The theory is also known as expectancy theory and states that the behaviour of an employee depends on the expected outcome of the act.

Goal-setting theory: The theory is based on the principle of goal clarity being an important factor of motivation.

ERG theory of motivation: The theory proposed by Clayton is an modified version of Maslow's theory of hierarchy of need. The theory divides needs in to three categories Existence, relatedness and growth.

McClelland's theory of needs: The theory stresses that the human behaviour is affected by three needs Power, Achievement and Affiliation.

Reinforcement theory of motivation: The theory founded by B F. Skinner and his associates proposed that the individual behaviour if function of its consequence. It is based on the law of effect.

Equity theory of motivation: The theory is based on the principle of equality. It states that the motivation is related to directly to the perception of equity practiced by the organization.

Motivation is a significant factor that urges people to give their best execution and help in arriving at big business objectives. Solid positive inspiration will empower the expanded yield of workers yet a negative inspiration will decrease their exhibition.

TYPES OF MOTIVATION

1. Intrinsic Motivation

Intrinsic motivation is a type of motivation in which an individual is being motivated by internal desires. For example, let's say an individual named Bob has define himself an objective to start shedding pounds and getting more beneficial. How about we likewise envision that Bob's motivation to seek after this way of wellness and wellbeing is to improve his wellbeing in general and feel more joyful with his appearance. Since Bob's craving to change originates from inside, his inspiration is intrinsic.

2. Extrinsic Motivation

Extrinsic motivation, on the other hand, is a type of motivation in which an individual is being motivated by external desires. Instead of being inspired by the need to look better and feel more beneficial, suppose that Bob was feeling pressure from his significant other to thin down and improve his physical make-up with the goal that she would be more pulled in to him. Since this weight originates all things considered this is an example of extrinsic motivation.

3. Positive Motivation

In real sense, motivation means positive motivation. Positive motivation initiates individuals to do work in the most ideal way and to improve their presentation. Under this better offices and prizes are accommodated their better execution. Such rewards and offices might be money related and non-monetary.

4. Negative Motivation

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Negative motivation aims at controlling the negative endeavours of the work and tries to make a feeling of dread for the labourer, which he needs to languish over absence of good execution. It depends on the idea that if a labourer flops in accomplishing the ideal outcomes, he ought to be rebuffed.

5. Minor Forms of Motivation

All types of motivation are going to fall into one of the two categories above. Now that we've covered these motivational types and provided you with some examples, here are minor forms of motivation that are capable of making a big impact in your life! 6. Reward-Based Motivation or Incentive Motivation

Incentive motivation or reward-based motivation is a type of motivation that is utilized when you or others know that they will be a reward once a certain goal is achieved. Since there will be something to anticipate toward the finish of an errand, individuals will regularly turn out to be increasingly resolved to oversee the undertaking with the goal that they can get whatever it is that has been guaranteed. The better the prize, the more grounded the inspiration will be.

7. Fear-Based Motivation

The word "fear" carries a heavy negative meaning but when it comes to motivation, this is not necessarily the case. Anyone who is big on goal-setting and achievement knows that accountability plays a huge role in following through on goals. At the point when you become responsible either to somebody you care about or to the overall population, you make an inspiration for yourself that is established in the dread of disappointment. This dread encourages you to do your vision with the goal that you don't bomb before the individuals who know about your objective. Dread based inspiration is incredibly ground-breaking as long as the feelings of dread is sufficiently able to keep you from stopping.

8. Achievement-Based Motivation

Titles, positions, and roles throughout jobs and other areas of our lives are very important to us. Those who are constantly driven to acquire these positions and earn titles for themselves are typically dealing with achievement-based motivation.

MODERN CREATING EMPLOYEE MOTIVATION TECHNIQUES

1. Merit Increases

Merit increases are a simple pay increase that is awarded to an employee who has excelled in performance and productivity. Many companies allow this type of pay of merit award but with restrictions regarding time frames and limits. They also may require you to do a an employee performance review. Smaller companies that have less restrictions benefit well using this technique.

2. Recognition

Using recognition has always been a solid answer to how to motivate employees. Its all about appreciating your staff and letting them know that they are doing good. Make sure that others hear what you are saying. Use meetings, hallways and even the lunch room as possible platforms.

3. Talk to employees about career plans

Many employees would like to advance their career, but for some reason don't inquire about it. Leaders can still motivate employees that they feel are promotable. The simple conversation

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alone will improve their self esteem and confidence. They may even surprise you with increased performance. The point here is don't wait for them to come to you, go after them and inspire.

4. Thank you notes

Thank you notes handwritten personal sentiments that are effective. Notes can be written on pay checks or by leaving a not on an employees desk. Try Team Building Games Fun team building games are a highly effective way to solve your problems of how to motivate employees. These ideas will inspire and motivate your staff. There are some really simple ones that can create quickly with no cost.

5. Movie passes

This type of award is similar to a merit increase that was mentioned above. This idea is way to work around restrictions of merit increases. Movie passes fall under the heading with gift cards, so your choices are unlimited.

6. Coffee

This one may be the oldest trick in the book of how to motivate employees. Most offices have some sort of coffee making capabilities. Surprise the staff, take a coffee order and pick it up or schedule it for the next morning.

7. Lunch

Schedule a potluck or provide lunch for staff. Providing lunches impress, but the scheduled luncheons provide something to look forward to. Ask the staff for suggestions for an added touch.

8. Birthday acknowledgement

There is something about birthdays and the workplace that go hand in hand. It's a good way to break up the day with a little fun. Many managers pick up the cost themselves. While others arrange a schedule for the year. One employee is responsible for another employees birthday.

9. Word of the day

It can really have fun with this one. Have staff come up with some bizarre words. Designate times throughout the day to use the specific word. If you want to really have some fun turn the word into a chant.

10. Make time for employees

Another way of how to motivate employees is just make time for your staff. Listen to what they have to say. Learn a little about them and show them that you are interested. Spending a little time will provide employees the sense that they are more than just a number.

11. Inspirational stories

There are many stories that one can find to talk about. Movies, books and even current events.

Whatever story you choose, try to make it relatable.

12. Inspirational sayings

Use these simple sayings throughout the day, but don't overdo it. Inspirational sayings can be found in motivational posters that you could hang around the office. These poster are most

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effective in sales types of offices. The main reason for their success is that they get you to think and focus on the task. Companies in India with a human face reach out to its employees in the time of crisis, supporting them and even taking care of the medical expenses of the ailing members in their family. Gone are the days when employees only looked for high paying jobs in a ruthless office set up. A friendly working environment, special healthcare facilities, flexible work hours, work from home options, women-friendly policies and support among the team members keep employees highly motivated in these companies.

CHALLENGES TO MOTIVATION

It is altogether not very easy for an organization to create a motivated and committed environment, following are a few challenges faced:

1. Dynamic and competitive business environment
2. Ignorance and less understanding of importance motivation on the part of management
3. Non commitment of organization towards employee expectation, a narrow mindset
4. Non – competitive organizational structure and people policies and practices
5. Less understanding of the employee expectations
6. Existing performance management system
7. The vague organizational expectation from employees
8. Competitive employee market, creating high mobility of employees

CONCLUSION

A motivated employee is a valuable asset, who can deliver immense value to the organization in maintaining and strengthening it business and revenue growth. To enhance understanding of employee motivation, managers must recognize the imperativeness of employee motivation, its concepts, and differences in individual needs. Subsequently managers need to be aware of a variety of employee motivational factors and the changes in priorities of these factors overtime. Moreover, managers have to learn previous or current motivational programs, examples, and theories behind them because understanding of these fundamentals can enhance their ability to identify rewards system that can be matched with employee needs. And successful implementation of the theory will definitely ensure positive minded employees and which ultimately ensures the success of an organization. So motivation is one of the vital factors for development of an organization. Motivation can change the profit figure of the organization such as its improving productivity. And in the end, it ensures the betterment of the overall economic condition of a county.

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Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

RESEARCH BRIDGE CONSULTANTS
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ISBN: 978 – 93 – 6851 – 977 - 5

A study of factors influencing consumer interest in electric scooters in Bareilly District

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Abstract: India ranks among the world's top producers of two-wheelers, behind China and Japan. The beginning of bike assembly in the country by Vehicle Products of India (API) in the mid-1950s marked a turning point in the development of the Indian two-wheeler sector. In terms of creation and sales independently, the Indian motorcycle industry has advanced tremendously in the last few years. Motorcycles are preferred over cars by the majority of Indians, especially the younger generation. capturing a significant market share in the two-wheeler industry, which is dominated by bikes and scooters. Customer happiness has an impact on any company's profitability. For example, each customer will frequently recommend nine to ten people when they witness a terrific item or administration. According to the report, Electric Scooter has done a good job of establishing themselves in the two-wheeler market. The working class is very satisfied with them, and they are renowned for their performance and comfort.

Keywords: two-wheeler sector, customer attitude, Percentage analysis, Ranking analysis

Introduction

Electric motorcycles and scooters have seen steady growth in the Indian market. In 2019, 152.0 thousand electric motorbikes and scooters were sold, a 20.6 percent increase over 2014. Retail sales are predicted to reach 1,080.5 thousand units annually by the end of 2025, with a compound annual growth rate (CAGR) of 57.9% from 2020 to 2025. (Projection era). At a compound annual growth rate (CAGR) of 63.9 percent from 2020 to 2025, retail sales are projected to surpass $1.0 billion by that time. About 6% of the world's CO2 emissions come from burning fossil fuels, making India the third-largest carbon emitter in the world. According to IQ Air's 2019 report, 21 of the 30 most polluted cities in the world were in India. Furthermore, the WHO's Global Air Pollution Database (2018) shows that 14 of the world's 20 most polluted cities are in India. With 80% of all new car sales annually and 70% of the 200 million vehicles on the road, two-wheelers are the most common vehicle type in India. They contribute 20% of all CO2 emissions and about 30% of particulate matter (PM) emissions, making them a major source of pollution emissions in urban areas. Recent years have seen a number of initiatives by the federal, state, and local governments to lessen car pollution, such as tax exemptions, purchase rebates, and financial incentives for those who buy electric vehicles (EVs). The government's heightened emphasis on lowering the nation's pollution levels is encouraging for a strong regulatory push for electric two-wheelers, which will support the expansion of the Indian markets for electric motorcycles and scooters.

Benefits of using electric scooter

1. Economical to Work

Due to their high efficiency and fuel economy, EVs are less expensive to operate, which lowers costs for the owner. It costs roughly one-third as much per kilometre to charge an EV as it does to buy petrol for a car.

2. Lower Maintenance Costs

Compared to vehicles powered by traditional combustion engines, BEVs have fewer moving components. Because EVs don't require costly equipment like fuel injection and exhaust

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ISBN: 978 – 93 – 6851 – 977 - 5

systems, they require less maintenance. In addition to having an electric propulsion system, which has fewer moving parts and reduces the depletion of petrol engine parts, PHEVs are more expensive than BEVs since they include a petrol engine and require maintenance.

3. Environment friendly

Because they produce no exhaust emissions, environmentally friendly EVs are less polluting. You can cut greenhouse gas emissions even further if you choose to charge your EV using renewable energy. Recycled plastic bottles, old scooter parts, and used appliances are some of the eco-friendly materials used to make some EVs, such the Nissan Leaf and the Ford Focus Electric, which are both made of recycled and bio-based components.

4. Health Advantages

Our health will benefit from improved air quality brought about by the decrease in dangerous emissions. Additionally, EVs make a lot less noise than cars powered by petrol or diesel.

5. More secure

EVs are less prone to capsize because of their low centre of gravity. They are also less likely to experience explosions or fires. They are safer in collisions because of their more durable body composition.

Objectives of the study

1. To examine how satisfied customers are with electric scooters.
2. To identify the factors of consumer’s interest in purchase of electric scooter
3. To present the research study's findings summary and recommendations.

Review of literature

Ansar Manahila (2019) Customers have a wide range of options for goods and services to meet their needs and demands in this ever-changing world. Since consumers are seen as the market's kings, it is crucial for marketers to make customer satisfaction their top priority since doing so will tangentially increase their profits and foster greater customer loyalty. A consumer's purchasing behaviour is influenced by a number of factors, including his level of occupation and purchasing power. Based on a number of demographic variables, the primary goal of this research report is to determine how satisfied Honda Activa owners are with the scooters' performance and pricing. Primary and secondary data were gathered from the different Honda Activa users in Bengaluru for this purpose. SPSS software has been used to analyse the data. The results indicated that the Honda Activa was used by the majority of the female respondents. Young people expressed the highest degree of satisfaction with both comfort and performance.

In 2019, Dr. V. Rana Pratap highlighted that a product's success is largely determined by how its customers view it. Due to their incapacity to influence consumers' perceptions of their products, numerous brands have failed. In this situation, it becomes crucial for businesses to comprehend how customers view their offerings. Given this context, the current study aims to examine how consumers view two-wheelers in relation to the elements affecting their purchasing decisions, levels of satisfaction, and decision-making processes. The Suzuki Access two-wheeler has been selected for the investigation. Opinions from the respondent are gathered and examined. When it comes to two-wheelers, consumers' purchasing decisions are influenced by a number of significant product aspects, including price, safety, and mileage.

C.B.senthilkumar, G.Rajesh, RohiniBhatt, R.Mayakkannan, E.Kandeepan(2020) It was not anticipated at the time of bike development and commercialisation that women would also

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be the target market for the bikes. In any event, technological developments and improvements made it possible, and a new concept for designing motorcycles that appeal to women emerged in the industry. These days, both men and women are quite interested in unequipped bikes since they are very easy to ride and manage. The purpose of the study was to determine how satisfied Chennai city's Honda Activa buyers were. The examination is based on crucial data that was gathered from 100 Chennai city respondents in a systematic survey. The information for this research was gathered using an accommodation inspection method. Although the demographic representation of the respondents was revealed through rate study, the scientist used Garret rating scale procedures to break down the respondents' satisfaction level with the Honda Activa. The chi-square test has been used to examine the factors that influence the decision to buy a bicycle. High customer dedication would always result from surveying high customer worth.

Elliot Fishman and Christopher Cherry (2023), e-bikes are one of the automobile showcase's fastest-growing segments. In 2012, over 31 million e-bikes were sold. Research has followed this trend and provides a compilation of the most pertinent topics that have emerged in recent years on the growing e-bike market.

C Simon Washington, Nareiaee Haworth (2022) more than 700 urban localities currently have bicycle share schemes in place. Adaptability is one of the benefits of bicycle sharing that have been mentioned. motion of the body. Fuel consumption and emissions. Certain or explicit assumptions about the modes of transportation that bicycle share businesses replace are included in the calculation of program benefits.

James Belies, Pyrou Chung, James Macdonald (2021) conducted an investigation in 2021 on "Empowering E bike utilise: The control of intensity-assisted bikes in Australia and beyond is examined in this research. The current controls are examined, and the rationale for revising the guidelines in Australia is outlined. The analysis looks into the important concerns surrounding the controls that apply to these vehicles and identifies the actions that are anticipated to enable these vehicles to commit more fully to the urban transport task.

Hatwar, N.; Bisen, A.; Dodke, H.; Junghare, A.; Khanapurkar, M. (2020) proposed a novel strategy for e-bike design that uses a hybrid battery and super capacitor system to boost speed and circumvent issues with lengthy charging times and short battery lifespans.

Price, service quality, branding, and customer preferences are all regarded as crucial customer factors in the automotive sector, according to **Abdullah et al. (2019).** Understanding the relative significance of these dimensions could lead to more efficient resource allocation for services in the electric vehicle sector.

Research Methodology

The current study is based on primary data collected from 120 respondents having electric scooters. A well-structured questionnaire was designed to collect the information from the respondents the questionnaire was designed to conduct “A study of factors influencing consumer interest in electric scooters in Bareilly district” This research design would help the researcher to gather the primary and secondary data to analyze the various aspects of the study.

Data Collection

To conduct the study both primary and secondary data has been collected and for the purpose of data analysis.

Area of the study

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For this study the respondents will be randomly selected from Bareilly District.

Research approach

For this study, questionnaire method is used for collecting data.

Sampling Technique & Sample size

Convenience sampling method is used and sample size is 120 respondents.

Research approach

The data is collected through a structured questionnaire. Secondary data is collected from websites, e-books, newspapers etc.

Tools for analysis

In this study, percentage analysis and weighted score ranking analysis were used for analyzing the data.

Data Analysis & Interpretation

A. Percentage Analysis

Table 1: Consumer's source of influence related to electric scooters?

Sr. No.	Source of awareness	No. of respondents	Percentage
1	Advertisement	60	50
2	Friends	30	25
3	Relative	20	17
4	Others	10	8
	Total	120	100

The above table reveals that, 50% of the respondents purchasing decision influenced by advertisement, 25% of the respondents purchasing decision influenced by friends, 17% of the respondents purchasing decision influenced by relative, 8% of the respondents purchasing decision influenced by others.

Table 2: Scooter battery preferred by consumers

Sr. No.	Battery Capacity	No. of respondents	Percentage
1	1200 watt motor	24	20
2	1500 watt motor	56	47
3	1800 watt motor	22	18
4	2000 watt motor	18	15
	Total	120	100

It is observed form the above table shows the total respondents of the study, 47% of the respondents prefer 1500 watt motor, 20% of the respondents covered 1200 watt motor, 18% of the respondents prefer 1800 watt motor and remaining 15% of the respondents prefer 2000 watt motor.

Table 3: The satisfaction level of consumers of electric scooter towards below mentioned factors

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ISSN : 2583-6897

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S. No.	Factors	Satisfied		Neutral		Dissatisfied		Total	
		No. of Respondents	Percentage (%)	No. of Respondents	Percentage (%)	No. of Respondents	Percentage (%)	No. of Respondents	Percentage (%)
1	Price	70	58	30	25	20	17	120	100
2	Durability	50	42	30	25	40	33	120	100
3	Advertisement	65	54	10	8	45	38	120	100
4	Color	58	48	25	21	37	31	120	100
5	After sales service	53	44	28	23	39	33	120	100
6	Availability of spare parts	53	45	34	28	33	27	120	100
7	Resale value	35	29	75	63	10	8	120	100
8	Others	31	26	65	54	24	20	120	100

Price: The above table shows that, 58% of the respondents are "Satisfied" with the price followed by 25% of the respondents are "Neutral", 17% of the respondents are "Dissatisfied" with the price of the electric scooter.

Durability: The above table shows that, 42% of the respondents are "Satisfied" with the durability followed by 25% of the respondents are "Neutral", 33% of the respondents are "Dissatisfied" with the durability of the electric scooter.

Advertisement: The above table shows that, 54% of the respondents are "Highly Satisfied" of the advertisement followed by 8% of the respondents are "Neutral", 38% of the respondents are "Dissatisfied" with the Advertisement of the Electric Scooters done by the company.

Color: The above table shows that, 48% of the respondents are "Highly Satisfied" of the color followed by 21% of the respondents are "Neutral", 31% of the respondents are "Dissatisfied" with the color of the electric scooter.

After sale service: The above table shows that, 44% of the respondents are "Highly Satisfied" with the after sale service followed by 23% of the respondents are "Neutral", 33% of the respondents are "Dissatisfied" with the after Sale Service provided by the company of electric scooter.

Availability of spare parts: The above table shows that, 45% of the respondents are "Satisfied" with the availability of spare parts followed by 28% of the respondents are "Neutral", 27% of the respondents are "Dissatisfied" with the availability of Spare Parts of electric Scooters.

Resale value: The above table shows that, 29% of the respondents are "Highly Satisfied" with the resale value followed by 63% of the respondents are "Neutral", 8% of the respondents are "Dissatisfied" with the resale value of the electric scooter.

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Others: The above table shows that, 26% of the respondents are "Highly Satisfied" with the others factors followed by 54% of the respondents are "Neutral", 20% of the respondents are "Dissatisfied" with the other factors of the electric scooter.

B. Weighted score ranking analysis

Table 4: Important reason for purchasing electric scooter

Sr. No.	Factors	Total Score	Rank
1	Reasonable price	326	II
2	Easy availability	320	III
3	Product information	332	I
4	Eco friendly	318	IV
5	Others	220	V

It is noted from the above table, "Product Information" was ranked 1st with the score of 332, Reasonable price was ranked 2nd with the score of 326, Easy Availability was ranked 3rd with the score of 320, Eco friendly was ranked 4th with the score of 318 and other factors were ranked 5th score of 220.

Table 5: Problems faced while using electric scooter

Sr. No.	Factors	Total Score	Rank
1	High Price	226	II
2	Non durability	138	IV
3	Poor dealer service	230	I
4	Less resale value	178	III
5	Others	125	V

It is noted from the above table, while using the electric scooter, Problem of poor dealer service was ranked 1st with the score 230, High Price cost was ranked 2nd with the score of 226, Less resale value was ranked 3rd with the Score 178, Non durability was ranked 4th with the score 138 and Others were ranked 5th with the score 125.

Findings:

A. Percentage analysis

- A majority of 50% of the respondents are influenced by the advertisement done by the company
- A majority of 47% of the respondents prefer 1500 watt motor in their electric scooter
- A majority of 50% of the respondents are satisfied with the price of the electric scooter
- A majority of 42% of the respondents are satisfied with the durability of the electric scooter
- A majority of 54% of the respondents are satisfied with the advertisement of the electric scooter
- A majority of 48% of the respondents are satisfied with the color of the electric scooter
- A majority of 44% of the respondents are satisfied with the after sales service of the electric scooter
- A majority of 45% of the respondents are satisfied with the availability of spare parts of the electric scooter
- A majority of 63% of the respondents are Neutral (Not sure) about the resale value of the electric scooter
- A majority of 54% of the respondents are found Neutral related with the other factors of the electric scooter

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B. Weighted score ranking analysis

- From the analysis it is concluded that majority of the respondents prefer purchase related product information
- From the analysis it is concluded that majority of the respondents have found the problem of poor dealer service related with electric scooter

Suggestions

According to the current study, the use of e-scooters should lessen their negative effects on the environment, and the cost of batteries is the main issue that customers face. Therefore, lowering the price and extending battery life is advised. The maintenance and servicing expenses associated with fuel-powered motor vehicles can also be reduced by using an e-scooter, and researchers recommend that businesses enhance their dealer services for customers.

Conclusion

Due to the entry of global corporations, Indian marketers are currently up against fierce competition. In the middle of the 2000s, electric scooters started to be sold commercially in India. Sales, however, increased slowly, mostly due to poor quality items, lack of government assistance, and excessive take-ups. Sales of electric scooters are predicted to rise sharply in the nation due to growing government support and public awareness. The study identifies a number of issues, and the researcher has made appropriate recommendations for increased customer satisfaction. As a result, it is discovered that manufacturers should implement new market tactics, which will inevitably boost the market share and customer satisfaction of electric scooters. For short journeys and regular commuting, owning an electric scooter makes good financial and environmental sense.

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Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

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ISBN: 978 – 93 – 6851 – 977 - 5

The Role of Emerging Technologies in Shaping the Future of Engineering

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Abstract: The future of engineering is being transformed by **emerging technologies**, which are revolutionizing the way engineers design, develop, and deploy innovative solutions. These technologies are not only enhancing the efficiency and productivity of engineering processes but also enabling the creation of new products, services, and systems that were previously unimaginable.

One of the most significant emerging technologies in engineering is **Artificial Intelligence (AI)**. AI is being increasingly used in engineering applications such as design optimization, predictive maintenance, and quality control. AI-powered algorithms can analyze vast amounts of data, identify patterns, and make predictions, enabling engineers to make informed decisions and improve the performance of complex systems.

Another emerging technology that is transforming the field of engineering is the **Internet of Things (IoT)**. IoT enables the connection of physical devices, sensors, and systems, allowing for real-time data collection, analysis, and decision-making. In engineering, IoT is being used to develop smart infrastructure, monitor environmental conditions, and optimize energy consumption.

Additive Manufacturing (AM), also known as 3D printing, is another emerging technology that is revolutionizing the field of engineering. AM enables the rapid prototyping and production of complex geometries and structures, reducing material waste and energy consumption. In engineering, AM is being used to develop innovative products, such as customized prosthetics, implants, and aerospace components.

Virtual and Augmented Reality (VR/AR) are also emerging technologies that are transforming the field of engineering. VR/AR enable engineers to visualize and interact with complex systems and designs in a immersive and interactive environment. In **engineering**, VR/AR are being used to develop innovative products, such as virtual prototypes, and to enhance the design and testing processes.

In conclusion, emerging technologies such as AI, IoT, AM, and VR/AR are transforming the field of engineering, enabling the creation of **innovative** solutions, improving **efficiency** and **productivity**, and enhancing the **performance** of complex systems. As these technologies continue to evolve and mature, they will play an increasingly important role in shaping the future of engineering.

Keywords: Emerging Technologies, Artificial Intelligence (AI), Internet of Things (IoT), Additive Manufacturing (AM), Virtual and Augmented Reality (VR/AR), Engineering, Innovation, Efficiency, Productivity, Performance.

Introduction

Engineering is synonymous with innovation and remains a driving force for technological progress and societal advancement. But the coming ten years likely offer the only decade of how innovation will fundamentally change industries, economies and the way humans engage

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with technology. As a result, engineering solutions are becoming more intelligent, autonomous, and sustainable due to the accelerating speed of digital transformation.

Some of the most significant trends include:

- **Artificial Intelligence (AI) and Machine Learning (ML):** Automating decision-making and improving predictive maintenance.
- **Internet of Things (IoT):** Enabling smart infrastructure and intelligent systems.
- **Quantum Computing:** Revolutionizing problem-solving in complex engineering fields.
- **Green Engineering and Sustainability:** Reducing environmental impact through innovative materials and renewable energy.

The engineering profession is on the cusp of a revolution, driven by the rapid emergence of innovative technologies that are transforming the way engineers design, develop, and deploy solutions. The convergence of technologies such as Artificial Intelligence (AI), Internet of Things (IoT), Additive Manufacturing (AM), and Virtual and Augmented Reality (VR/AR) is creating new opportunities for engineers to innovate, collaborate, and solve complex problems.

As the world grapples with pressing challenges such as climate change, sustainable development, and urbanization, engineers are playing a critical role in developing innovative solutions that can mitigate these challenges. Emerging technologies are enabling engineers to develop more efficient, sustainable, and resilient solutions that can improve the quality of life for people around the world.

This paper explores the role of emerging technologies in shaping the future of engineering, including their potential applications, benefits, and challenges. It also examines the implications of these technologies for the engineering profession, including the need for new skill sets, competencies, and mindsets.

Literature Review

In the engineering domain, the convergence of new technologies has a profound effect. Technologies like artificial intelligence, blockchain, and the Internet of Things are changing the immune system of engineering.

Based on a study performed by Khan et al. (2020) are already using artificial intelligence in various engineering types such as mechanical engineering, electrical engineering, and civil engineering. AI techniques like machine learning and deep learning are being applied for optimizing engineering design, predicting system performance, and enhancing decision-making, the study found.

Another study by Lee et al. (2019), the importance of the Internet of Things for engineering. Key findings of the study: IoT sensors and devices as well as artificial intelligence, are used to collect data on the behaviour of the system, and then analysis is conducted to optimise the performance of the system.

Zhao et al. (2019) conducted a study on the use of blockchain technology in the field of engineering. According to the research, the use of blockchain systems has enabled the creation of secure and transparent records for engineering information, such as design specifications, testing results, and maintenance records.

Generally, the literature shows that new technologies are transforming the practice of engineering, enabling new solutions to the issues that afflict the planet. The literature,

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nevertheless, suggests that more research on the applications and impacts of the new technologies in the area of engineering is needed.

Methodology

Research Design: The research employed a mixed-method research design that combined both qualitative and quantitative data collection and analysis methods.

Collection Of Data through:

1. **Primary Data**

Primary data were collected through:

i. **Surveys:** We carried out a survey on a sample of 100 engineers to gather information on their opinions and experiences with new technologies.
ii. **Inter-views:** Interviews with 10 field specialists were conducted to gather more specific information on the trends and issues faced by the industry.

2. **Secondary Data**

Secondary data has been obtained from:

i. **Research journals:** Scholarly journals have been reviewed to gather information on the ongoing research in the field based on the available literature on new technologies and engineering.
ii. **Industry reports:** Industry reports released by the National Science Foundation and the Engineering Council, two credible industry bodies, were reviewed to identify the trends and issues that the industry has been witnessing.

Main Findings

- The survey of the 31 engineers revealed that the primary problems that face the development of the future technologies are the unavailability of new technologies, insufficient training and education, and insufficient financing. These problems point to the need for increased accessibility to new technologies, ongoing training and education, and sufficient financing to make the development of the future technologies possible.
- In the midst of these challenges, the future outlook on the contribution of new technologies are likely to make to the profession remains optimistic. Nearly half the respondents expect new technologies to make a very significant contribution, and a quarter expect new technologies to make a significant contribution. Engineers also foresee that the future direction of technology will be shaped by their contributions, with nearly 40% seeing a leading role and nearly 50% seeing a significant role.
- In order to be current with the latest developments, the engineers utilize a number of techniques, including reading industry-related publications and blogs, joining online courses and professional development programs, and attending seminars and conferences. They are also keen on a number of opportunities provided by upcoming technologies, including the creation of intelligent systems and AI-based devices, the creation of sustainable and eco-friendly infrastructure, and the development of new materials and production methods.
- The benefit of using AI in the field of engineering is also visible. In the opinion of the engineers, the most significant benefit is increased efficiency and productivity, followed by precision and accuracy, and decision-making and solving problems better. The engineers also recognize the necessity to be proficient in data analysis and

Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

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ISBN: 978 – 93 – 6851 – 977 - 5

interpretation, programming and coding, and communications and teamwork to remain up to date in the future.

- On the ethical side, the most significant concern, as per the engineers, is privacy and confidentiality, followed by security and safety, and avoiding discrimination and bias. They also recognize the benefit of adopting a circular economy model in the field of engineering, with increased efficiency and productivity, less pollution and waste, and enhanced customer satisfaction and loyalty. On the whole, the survey provides us with valuable insights on the opportunities, advantages, and drawbacks with new technologies in the field of engineering.

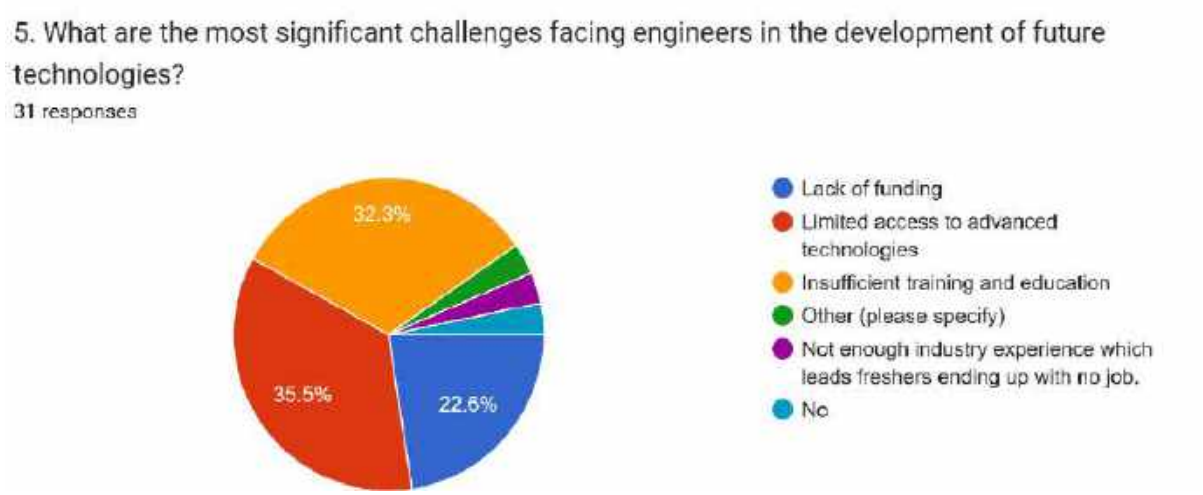

Figure 1

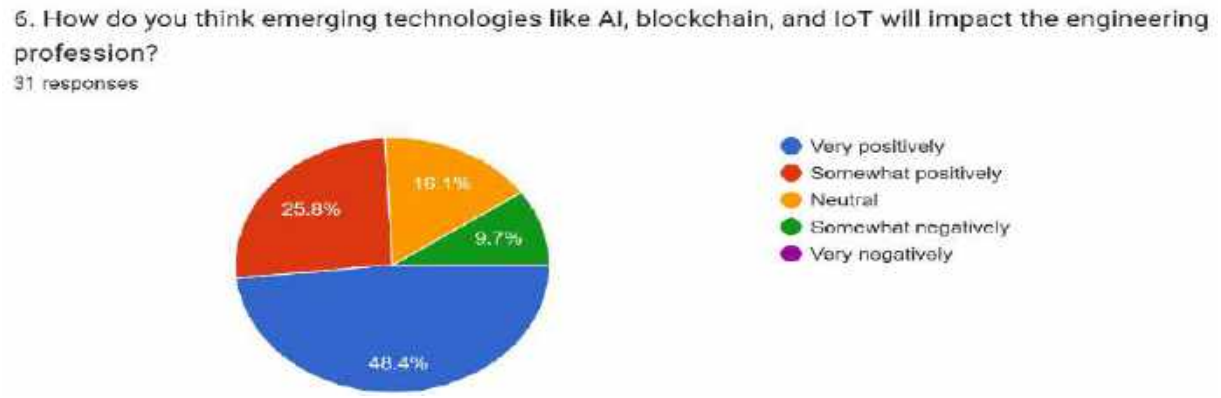

Figure 2

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International Multidisciplinary Research Journal
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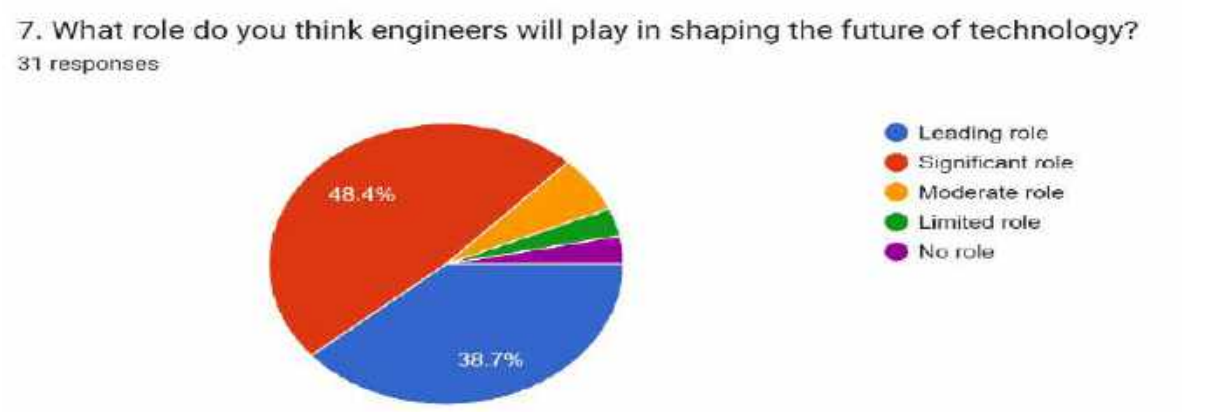

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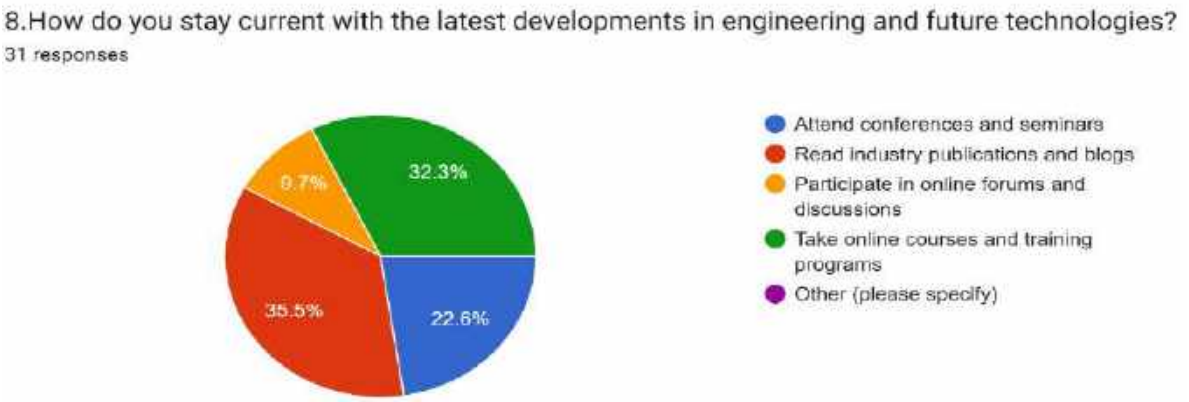

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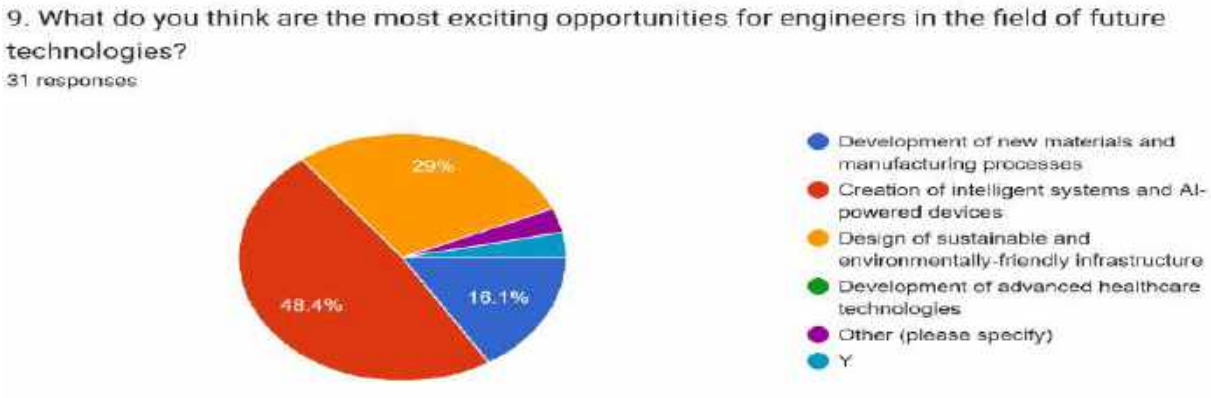

Figure 5

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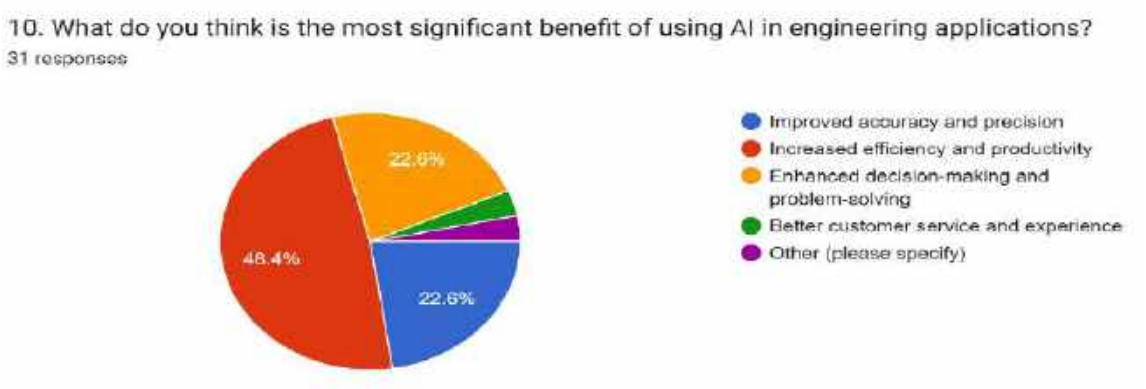

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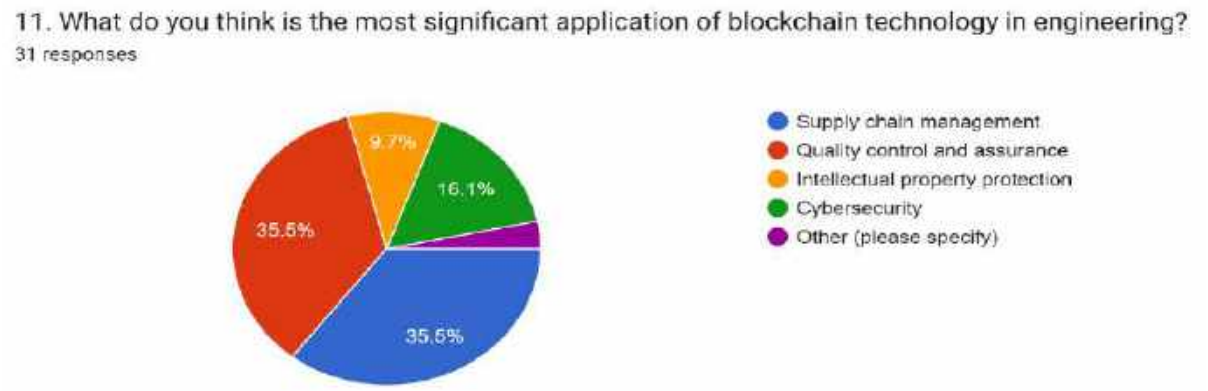

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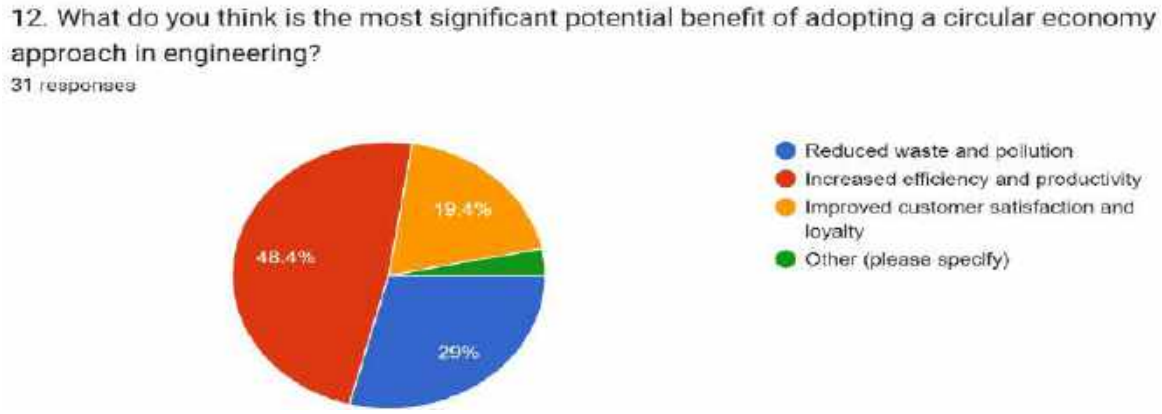

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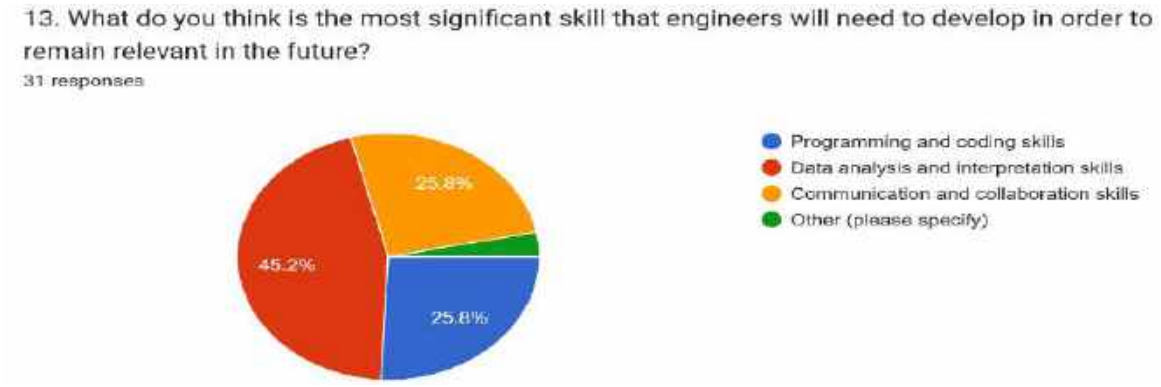

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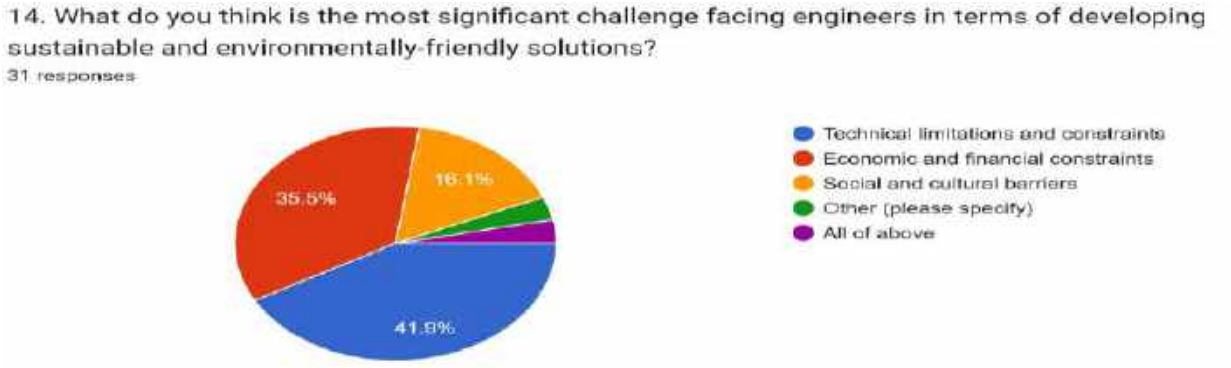

Figure 10

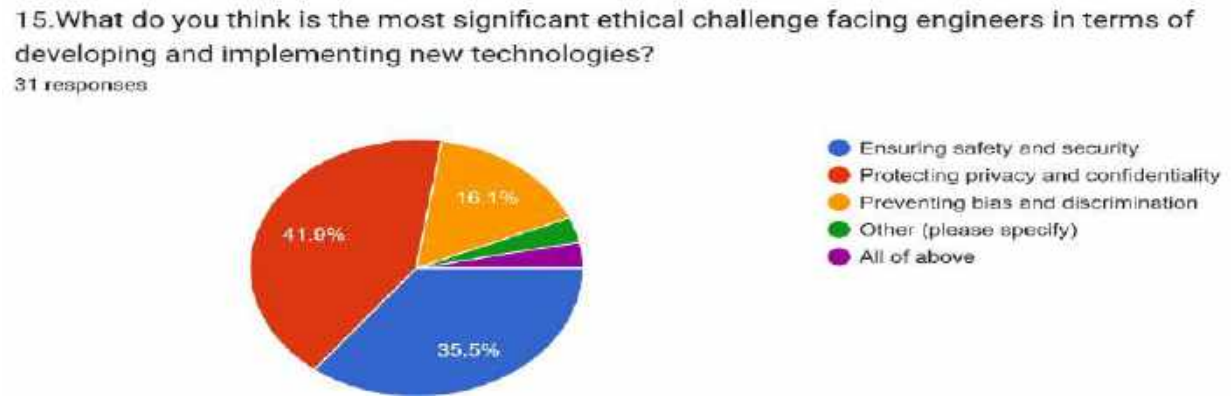

Figure 11

According to the survey involving **31 respondents**, the major findings show that the major obstacles for engineers in creating future technologies are significant. The most notable obstacles are limited availability of advanced technologies **(35.5%),** inadequate training and education **(32.3%)**, and absence of finance **(22.6%)**. In spite of the obstacles, the majority of the engineers are confident about the contribution of new technologies, with **48.4%** opining that the new technologies will make a very significant contribution. The engineers also envision themselves as major contributors to the future of technology, with 38.7% identifying a leading role and **48.4%** identifying a significant role.

In their attempt to stay current with the new developments, the engineers rely on reading industry publications and blogs **(35.5%),** online courses and training programs **(32.3%)**, and conferences and seminars **(22.6%).** The most promising opportunities for the engineers in new technologies are the creation of intelligent systems and AI devices **(48.4%),** sustainable and

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environmentally friendly infrastructure design **(29%),** and new materials and manufacturing process development **(16.1%).** The most significant benefit that the application of AI in engineering has, as perceived by the engineers, is increased efficiency and productivity **(48.4%).**

Major Technological Trends in Engineering

1) Engineering with Artificial Intelligence and Machine Learning

AI and ML are essential in automating complex work in the field of engineering. They enhance design, automation, fault detection, and optimization. For example, AI-based algorithms are utilized in:

• **Production:** AI robots make production lines more efficient.

• **Autonomous vehicles:** AI enables autonomous cars and intelligent traffic control.

• **Aerospace engineering:** AI aids predictive maintenance and failure detection in aircraft systems. AI systems reduce human error, operating expenses, and power consumption, and therefore become an essential part in modern engineering.

• **Smart cities:** Traffic management based on IoT minimizes congestion and pollution.

• **Industrial Internet of Things (IIoT):** The factories use IIoT-enabled equipment for monitoring in real-time

• **Smart charging road and solar embedded road:** The rapid increase in the usage of electric vehicles (EVs) and the global shift towards sustainable infrastructure has led to the demand for smart charging roads and solar-embedded roads. These new technologies aim to reduce range anxiety, reduce the need for fossil fuels, and optimize the efficiency of roads when it comes to the usage of energy. Smart charging roads use wireless charging through electromagnetic induction, while solar-embedded roads generate power through photovoltaic (PV) cells that are integrated in the surfaces of the roads. This article explores the technology, benefits, drawbacks, and case studies on the future roads, highlighting their ability to revolutionize the transportation system.

2)Engineering with Quantum Computing

Quantum computing is expected to revolutionize problem-solving in engineering disciplines. Traditional computers struggle with complex calculations, but quantum systems offer solutions in:

- **Material science:** Designing new, more efficient,
- **Energy:** Smart grid optimization for efficient power supply
- **Security:** Quantum encryption enhances the security of data in engineering applications.
- **Aerospace:** High-accuracy simulation of aerodynamic response

While quantum computing is still in its early days, it has tremendous potential for solving engineering issues that had previously been impossible to solve.

3) Sustainable and Green Engineering

Sustainability has become a major priority in the field of engineering, with developments including:

• **Solar, wind, and hydropower innovations:** Renewable power systems

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• **Sustainable buildings:** Using intelligent materials and efficient designs

• **Carbon capture technology:** Reducing industrial carbon emissions

• **Waste Management:** Recycling and reduction of plastic waste using engineering solutions.

The goal is to minimize the environmental footprint with ongoing technology development. Climate change and net-zero emissions in the coming decades are addressed through green engineering, which has a significant role to play.

Applications of future technologies

1) Smart Transport and Infrastructure

• **Autonomous Vehicles:** AI-powered autonomous vehicles will reduce accidents and fuel consumption.

• **Hyperloop and High-Speed Trains:** Magnetic levitation and vacuum tube transportation system engineering advancements

• **Smart charging road and solar embedded road:** The surge in the number of electric vehicles (EVs) and the global push towards sustainable infrastructure has led to the development of smart charging roads and solar-embedded roads. These innovations promise to eliminate range anxiety, reduce the consumption of fossil fuels, and optimize the efficiency of the use of roads' energy. Smart charging roads use wireless charging via electromagnetic induction, while solar-embedded roads generate electricity using photovoltaic (PV) cells integrated in the roads' surfaces. This article explores the technology, benefits, drawbacks, and case studies of these roads of the future, and their ability to revolutionize the transportation scene.

2) Health and Biomedical Engineering

• **3D Bioprinting:** They are making artificial tissues and organs.

• **AI Diagnostics:** Machine learning algorithms improve disease detection.

• **Wearable Health Devices:** Smartwatches and biosensors monitor real-time health metrics.

3) Smart Grid and Energy Industry

• **Smart grids:** Energy distribution through AI lowers wastage.

• **Battery Technology:** Solid-state batteries improve the efficiency of electric vehicles.

• **Hydrogen Fuel Cells:** Advances in the engineering of green hydrogen production

4) Industry 4.0 and Manufacturing

- **Robotic Automation:** AI-controlled robots improve precision and efficiency.
- **3D Printing:** Additive manufacturing reduces production costs and minimizes waste.
- **Digital twins:** Virtual models improve physical processes before actual implementation.

Obstacles and Ethical Challenges

1) Cybersecurity Threats:

• **IOT Vulnerabilities:** Connected devices create hacking risks.

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• **Fear about data privacy:** AI monitoring has ethical concerns.

2) Ethical considerations surrounding AI and automation

• **Job displacement:** Traditional employment faces the threat of increased automation.

• **AI fairness:** The engineers must ensure that fairness in decision-making exists within AI.

3) Skill Gap and Education in Engineering

• **Multidisciplinary learning:** Engineers must be taught about AI, quantum computing, and sustainability principles.

• **Lifelong learning:** Continuous learning and upskilling are necessary to keep up with rapid developments.

Conclusion

In brief, the survey presents a clear indication regarding the opportunities, advantages, and disadvantages with new technologies in the area of engineering. The engineers are mostly optimistic about the future, but are mostly hampered by the unavailability of new technologies, constant training and education, and sufficient finance. To remain up to date, the engineers must learn the necessary skills that include data analysis, programming, and communications.

The survey also highlights the important role that new technologies are set to play in the area of engineering. From the creation of intelligent systems and AI machines to the designing of environmentally-friendly and sustainable infrastructure, the future of technology hinges on the efforts of the engineers.

But in order to fully take advantage of new technologies, we need to make investments in education, training, and infrastructure, including providing the latest technologies to engineers, providing ongoing training and education, and providing sufficient financing to make new technologies available.

Ultimately, the survey suggests that the future of technology will be directed by the engineers and that new technologies will be hugely advantageous to the profession. If the opportunities and issues raised in the survey are addressed head-on, the chances are that the engineers will remain at the cutting edge of technology and make strides in the future as well.

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International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

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ISBN: 978 – 93 – 6851 – 977 - 5

Post-Pandemic Thermal Dynamics of Oceanic Subsurfaces: A Remote Sensing-Based Lateral Analysis

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Abstract:

As society develops so does the nature of incidents surrounding it societal. This progress in technology & medicine is limited to a certain scope of incidents. Safety of society& financial aspects against certain natu- ral incidents cannot be avoided, however can be hedged by applying certain estimation tools influenced by other scientific purposes. Oceans / Seas are significant Earth elements impacted by worldwide heating & at- mospheric variation. Past analysis has revealed that this subterranean water body is accountable for Weather divergence by altering an eco-classification of the Earth; hence, it is critically essential to evaluate them. Re- mote sensing can give high spatial / temporal resolution sea surface information & big spatial exposure, ena- bling notable ocean science findings. However, satellite remote sensors cannot directly detect the profound coatings of the ocean / sea. Extreme thermal components, including warm and cool periods, may effect socially. However, periodical thermal component alterations stand usual & certainly vital towards various social factors (i.e.travel industry, agriculture, others.), farthest warm / cool winds may effect abruptly in a bad manner. IT remains ' natural' towards a single area, critically, can become severe towards another part that is found least adjusted among thermal components.

Today's climate &air condition cause a key aspect for society's routine flows of system. Cyclic marvels can become beneficial & dependent on factors like the agriculture and also vacation industry. Subsidiary inci- dents, particularly thrilling parts, may at instances has religiously cynical effects that present threats for time & structure & substantial economic costs. The ecological diversities that occur over a period of time vary with the effect on its subsidiaries and thereby cause an overall change in its surroundings. The main focus of the work is to relate climate change model considered as in the form of a mathematical expression and also study its effects into the elements of nature that are eventually affected during a particular event.

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ISBN: 978 – 93 – 6851 – 977 - 5

Keywords: Climate Change, Global Warming, Seasonal Changes, mathematical analysis & relation with atmospheric humidity.

Introduction

Oceans / Seas are significant Earth elements impacted by worldwide Global warming and climate change. Re- cent studies have shown that the deeper oceans are accountable for climate variability by altering the ecosys- tem of the Earth ; therefore, it has become more essential to evaluate them. Remote sensing can provide high spatial / temporal resolution sea surface information and big spatial coverage, enabling notable ocean science findings. However, satellite remote sensors can not directly detect the profound layers of the ocean / sea.

Researchers have therefore examined the relationship between oceans / seas salinity, height and temperature to assess their underwater temperature using dynamic models and model-based information assimilation (numerical and statistical) methods that mimic these parameters by using remote sensed information and in situ measure- ments.

Because of the demands of extensive perception and the significance of global warming in decision making and science research, this review offers extensive information on techniques used to assess the temperature of the ocean / sea subsurface water from remote and non-remote sensed data.

The challenges, constraints and views of the current techniques are also explored in order to clarify the under- ground procedures.

Due to the dominant favorable forcing of growing greenhouse gases, further temperature rises and climate change are expected for the future. Most of the climate change threats are linked to warming in many areas of the planet, droughts, floods, food production, adverse effects on aircraft efficiency, sea level rise, etc. Cli- mate change also involves indirect threats to government health through damaging modifications in air quality, disease spread, food insecurity and under-nutrition, mental illness, and death from cardiovascular and respiratory illness.

Since the most severe challenge facing water today is worldwide warming, it seems necessary to predict these possible changes in ecosystem function. The temperature of the ocean surface water has risen owing to climate change, impervious surface runoff and industrial process heat effluents. Several parts of profound oceans below 2000 m have warmed up since 1990. Simultaneously, several scientists proposed global ocean warming. In coastal procedures such

Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

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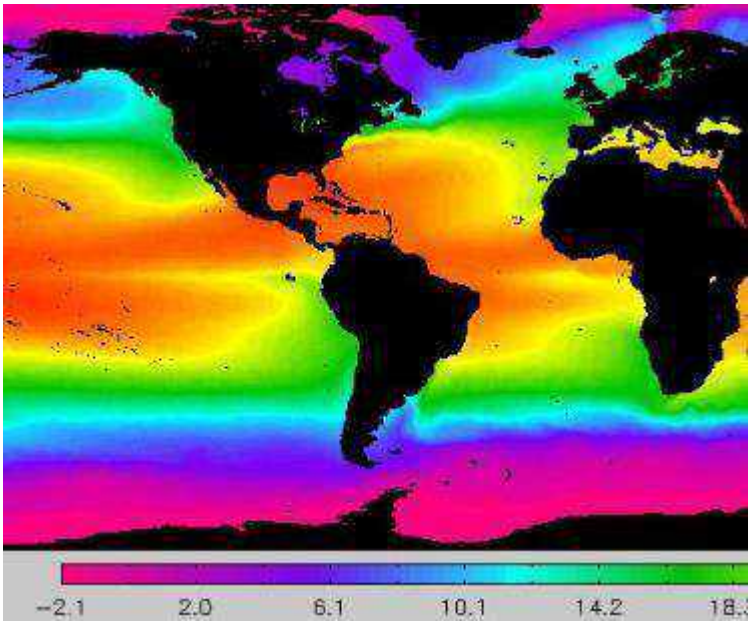
ISBN: 978 – 93 – 6851 – 977 - 5

as biological activity, thermal momentum and exchange, interaction with the surrounding water, and climate change, temperature is an significant variable. The evaluation of ecosystem modifications by remotely sensed satellite information is another important problem in oceanography. Reliable global ocean coverage of marine surface temperature, sea surface height, surface temperature. Visible light comprises of dif- ferent wavelengths of violet to red light. Violet light has the greatest energy and is more deeply penetrated than other wavelengths. In ocean surface temperature (SST) and thermal transfer, penetration of the visible part of the spectrum in the upper layers of the oceans plays a vital role. Violet light penetrates into greater depths and is eventually absorbed ; this mechanism, together with more efficient procedures such as vertical move- ment, horizontal transport and mixing, can affect the temperature of the subsurface waters. Scientists classified the subsurface of the seas into five primary layers / zones. Their development is the most extreme depths from the ground where light is no longer able to penetrate.



In the present research, we segregated the remote sensing and non-remote sensing techniques used to assimilate and measure sub-surface ocean / sea temperature level. In order to understand the further proficiencies over this criteria, we involve the historic data over similar graphical forms.

Literature Review

Mekonnen H Daba (2018) :-Assessing Local Community Perceptions on Climate Change and Variability and It's Effects on Crop Production in Selected Districts of Western Oromia, Ethiopia. This paper deals with the peoples cognizance towards environmental changes

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occurred in given period of time. The perception of small holder farmers taken into consideration, their viewpoint , their strategies of various variability happen when climate change. Moreover, primary data has been used of almost 204 respondents at the basic level of quantitative and qualitative approach. The most impressive thing about this paper, Author has used some statistics tool such as Stratified sampling frame and Cluster sampling frame. After completion of experiment, farmers has able to perceived all kind of changes which happened in environment such as strong wind that led to in- flate farming problem for instance, soil abrasion, loss of soil potency, reduction in crop yields and high rate of disease occurrence was shown in the paper.

Hamid, Seyed, Amir Hosen, MohamadNajim & Saeed Shojaei (2016):-Comparison of Delphi and Analytic Hierarchy Process (AHP) techniques in locating flood spreading. In this article, Delphi & AHP techniques have compared predominantly and explain the importance substantially well. Since Iran comes in the dessert area of earth space so the major factor which is highly significant and has great impact is water scarcity. Moreover, maximum part of Iran falls in to the desiccated and semi desiccated therefore due to water scarcity controlling the catastrophic floods is the most significant activity and hence the study of Delphi & AHP techniques are the need of present time. For this study, some statistical tool have been used such as Questionnaires were tak- en and filled by the target group and it has distinguish between three different criteria such as 4 main, 8 sub and 24 indices of flood spreading and it is examined by AHP in expert point of view followed by GIS (Geo- graphic Information System) were used to do mapping then for alluvium volume and unemployment rate, re- sults of AHP and views of expert panel the highest and lowest degree and its importance were recorded. Similarly in Delphi techniques some important factor for location flood spreading for Ivar watershed such as indices of soil permeability, flood quality, soil texture, slope, aqueduct and sub-criteria of water.

Ozabor and Nwagbara (2018):- Identifying Climate Change Signals from Downscaled Temperature Data in Umuahia Metropolis, Abia State, Nigeria. This research article shows that there are very significant evidence that temperature have change drastically and it is very much evident from downscaled data of Umuahia in Abia state. Notwithstanding GHGS exhalations propagation and escalation of population, uncontrolled urbaniza- tion are the factors advocated by HadGCM3. Neverthless with incertitude in forecast the temporal patterns of temperature suggested that there are changes from normal to normal for current and future temperature pattern. Due to this, there will be some impeccable changes and drastic effect on environmental

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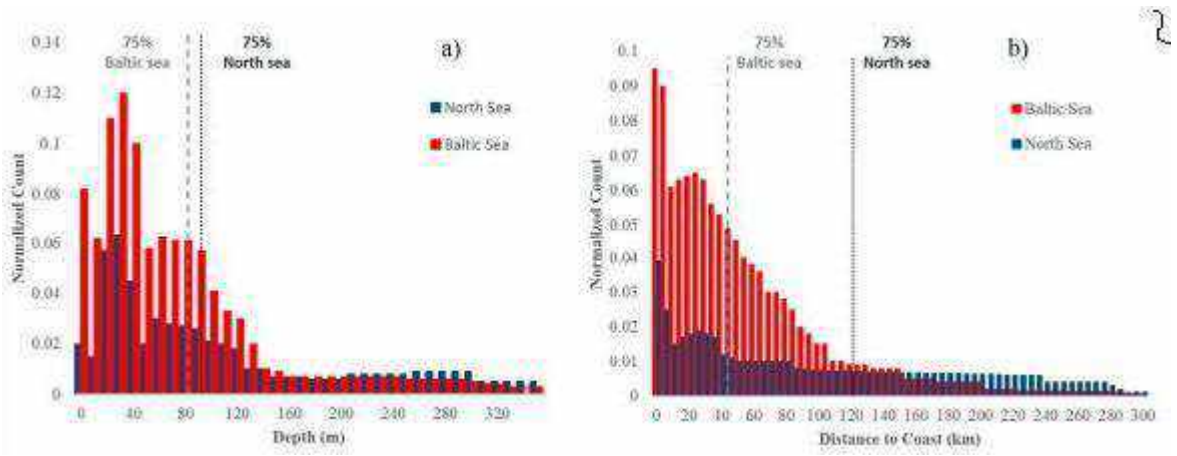
impact and there will be irreparable damages if necessary steps were not taken in given period of time. Moreover in this research article some important statistics tools have been used such as ANOVA and p-value method.

Anomalies in the vertical and horizontal sea / ocean surface temperature

Since more proof has shown the extensive warming of the deeper oceans of the world, it is essential to esti- mate correctly the subsurface heat composition of the worldwide oceans Oceanographers predicted the subsur- face flow areas and calculated the horizontal and vertical advection in the interior of the ocean. Figure above shows comparisons of vertical and horizontal anomalies between the Baltic and the North Sea. Karagali et al. stated that it was possible to see most anomalies at depths of up to200m. Diurnal heating occurrences occur mostly between 20 m and 40 m depth. Moreover, most observations are registered in the North Sea (blue col- or) within the first 5 km from the shoreline, reducing 300 km from the shore to zero observations. No anomalies are detected in the Baltic Sea (red color) beyond 120 km offshore ; however, most anomalies are found in the first 10 km from the shoreline. In general, Both statistics show the coastal and shallow sea cir- cumstances, where 75% of the anomalies occur at depths of less than 90 m (80 m) in the North Sea (Baltic Sea) and 125 km (45 km) from the coast.



Distribution of anomalies greater than 2 K by (a) depth and (b) distance to the North Sea and the closest coast Because global warming has accelerated, the role of the oceans is essential because they are enormous reser- voirs of heat and water. It is therefore useful to know what has happened over the last century in the world- wide oceans. Levitus and others. It has been shown that more surface warming has happened in all basins. The biggest overall rise in the Pacific layer was subjected to 0–100 m From the Pacific region. The Atlantic shows the biggest rise of all ocean basins in all layers above 2000 m at depths of more than 100 m. The writers

Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

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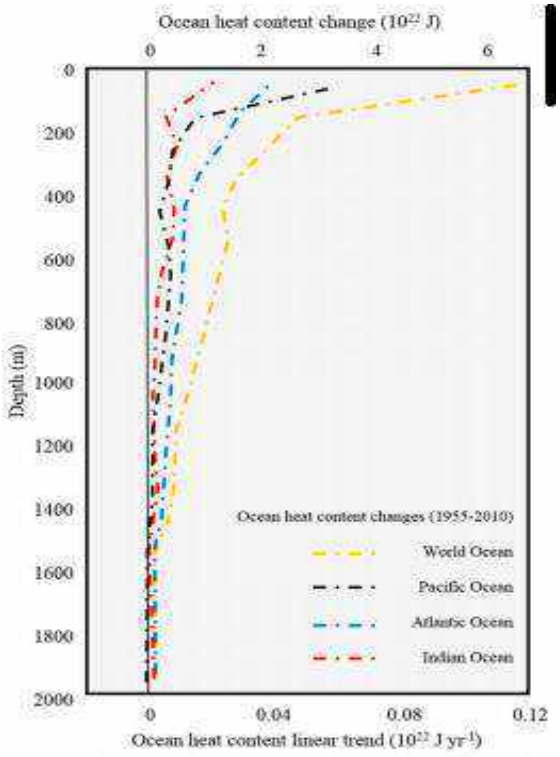
also showed that the layer of 700–2000 m is accountable for One-third of the 0–2000 m layer com- plete warming. Kawano et al. estimated that about 5 percent of the Pacific Ocean's heat was below 3000 m and rose extensively between 1999 and 2007.



Linear trends and complete rises in sea basin thermal content based on worldwide and individual basin linear trends as a function of depth (0–2000 m) up to 100 m

❖ . Impacts of Different Dynamics on Ocean/Sea Subsurface Water Temperature Profile

The underwater temperature of the ocean / sea is profoundly influenced by water turbulence. Both vertical movement and horizontal transport interfere with some easy roles in altering the temperature of their sub- surface water by depth. Considering vertical motion and horizontal transport, therefore, it appears necessary to estimate the temperature of the sea / ocean subsurface water and simulating these movements can lead to more accurate estimates of the temperature of the sea / ocean subsurface water. Interestingly, the dynamics of the ocean and the temperature of the subsurface water have causes and effects, which means that one impacts the other and at the same time. Wu et al explored the impact of Golf Stream on the monthly underground tem- perature anomaly (STA) and temperature profiles. Wu et al researched monthly underground temperature anom- aly (STA) and temperature profiles.

Sea surface height

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The variability of SSH is triggered by four classifications of events, including dynamic / non-dynamic reactions to forcing processes. Integrated parameter measurements must correct the variability of SSH. After correcting the impacts of tidal and atmospheric pressure, steric effects such as modifications in density from heating / cooling or changes in salinity and wind forcing continue to affect the SSH. SSH variability is mostly used to infer changes in the heat sub-surface or density composition and often to represent the thermocline's relative motion. You can also apply this variation to assess absolute differences in the depth of the surface layer. Dipper and more diffuse thermocline and strong surface buoyancy fluxes decrease the correlation between SSH and ther- mocline depth. If temperature changes predominantly and creates fluctuations in surface density, SST infor- mation can infer MLD or thermocline depth. Several solutions can retrieve SSH information, such as localized direct wind gage readings, XBT profiles and approximate calculation by modelling the relationship between SSH and temperature, salinity, and pressure measurements, and this data has been monitored by remote sensing satellites since 1992. These accessible and useful altimetry information for satellites include Topex / Poseidon, Jason products, ERS, Envisat altimeters, and all AVISO grid-level products with very excellent space and time coverage.

Mixed Layer Depth:

The blended depth of the layer (the near-uniform surface area) that connects the atmosphere to the deep ocean and plays a critical part in the variability of the climate. The layer's heat and mechanical inertia in direct at- mospheric contact. Determining the MLD and its variability is essential for understanding and interpreting the upper ocean heat and velocity areas, parameterizing mixed-layer procedures, and studying the relationships be- tween air and sea, acoustic propagation, ocean biology, long-term climate change, vehicle.

There has been a decline in the frequency of cool nights in India over the period 1970-2009, where data are available, an increase in the number of warm nights as well as a decline in cool days and an increase in hot days.

A general rise in the average seasonal temperatures in the country has been reported as a result of human climate influence, resulting in hot seasonal teas.

Climate change projections

The expected temperature increases from COUPLED MODEL are lower in southern India for the A1B emis- sions scenario, up to 3 ° C compared to the north, where shifts of up to 4.5 ° C

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are predicted. The consen- sus is strong across nearly the entire country between the COUPLED MODEL versions.

- Increases in precipitation are expected in India across most of the region.

There could be rises of up to 20 percent or higher in western regions with a rise of 5-10 percent more com- mon than the rest of the country. Agreement is medium to weak throughout the COUPLED MODEL ensem- ble.

Climate change impacts projections Crop yields

In their forecasts for India, global and regional studies included here differ, but declines are typically expected for wheat and rice, two of India's major crops.

Climate Observations

Rationale

Today's weather and climate play a key role in society's day-to-day running. Seasonal phenomena can be bene- ficial and dependent on sectors such as agriculture or tourism. Other incidents, particularly extreme ones, can sometimes have serious negative impacts that present threats to life and infrastructure and substantial economic costs. Knowing the intensity and extent of these phenomena may significantly improve social resilience when they present threats and when they can be beneficial for which sectors of society. In a changing climate, knowing possible future changes in both potentially hazardous activities is extremely valuable. Recurring sea- sonal events dependent on sectors such as agriculture and tourism. The emphasis will then be on extremes of temperature, precipitation and storms identified from 2000 onwards, as stated in the World Meteorological Or- ganization (WMO) Annual Statement on Global Climate Status and/or State of the climate reports by the American Meteorological Society (BAMS) Bulletin. A discussion of changes in moderate extremes from 1960 onwards is followed by an updated version of the HadEX extremes database (Alexander et al. 2006), which categorizes extreme temperature and precipitation. These are the core variables of climate Significant efforts have been made by the climate research community in terms of data acquisition and storage and for which long high-quality monitoring records can be generated. No new storm analyzes are included (see the following section on methodology for background). For high seasonal weather, An attribution analysis then places the seasons with highlighted extreme events in the context of the recent climate versus the hypothetical climate

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without anthropogenic emissions (Christidis et al, 2011). It is important to note that we perform our seasonal allocation analyzes mean temperatures over the entire country.

Climate overview

India is a large country from 8 ° to 33 ° N. The landscape diversity, varying from the Himalayan high moun- tains in the north to the tropical coastlines in the south, produces a wide range of climatic conditions. Winters are cool at lower levels in the northern mountain regions and cold at higher altitudes. In the summer, inter- mediate levels are comfortably cool about 2000 m above sea level, but at lower levels it can get very dry. The Himalayas act as a barrier to Central Asia's cold winds. Northern inland areas have a continental climate with a high temperature variation of seasonal and diurnal. Intermediate levels about 2000 m above sea level in the summer are pleasantly warm, but at lower levels it can get very dry. The Himalayas act as a barrier to Central Asia's cold winds flowing down. Northern inland areas have a continental climate with a high range of seasonal and diurnal temperatures. Here, the hottest months are April and May, before the monsoon begins. Inland at Hyderabad, with an average daily high of 39 ° C, the mean temperature reaches 33 ° C in May. Throughout the year, particularly in the hot season, and the monsoon season from June to September, heat and humidity can be very oppressive in coastal regions. The Indian climate is dominated by the great Asian mon- soon wind system that is completely unlike the prevailing wind system of any other country. Most of India's driest period is from December to February when light north-eastern winds bring clear skies and almost dry weather. The dry conditions continue from March to May, but the intense summer heat causes the winds to reverse in order for India to be influenced from June to October by the moist rain-bearing moonsoon from the south-west and some mountain ranges facing the sea, the rainfall may be very severe. Usually during late May or early June, the monsoon reaches the south and reaches the north about six weeks later. The amount of rainfall received has a great spatial variability. The west coast is the wettest region (along with north-eastern India). This is a narrow coastal plain supported by the Western Ghats, a steep mountain barrier. Mangalore has an average annual rainfall of 3760 mm, 90% of which occurs during the period from June to October. Inland Hyderabad, by contrast, receives only 830 mm a year In north-western India there is the Rajasthan Desert where annual average precipitation levels are as low as 250 mm. On the south-eastern coast, the main rains come later from October to December and are often associated with tropical storms or cyclones forming in the Bay of Bengal. Chennai, for example, has an average annual rainfall of 1320 mm, with 60% falling between October and December. Coastal parts of Orissa and West Bengal's north-eastern Indian

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states are also severely affected by tropical cyclones, causing destruction due to strong winds and flooding.

The rains are torrential in some years, but they are only light in other years. This inter-annual variation in the onset and intensity of the moonsoon has a significant impact on the country. The El Niño Southern Oscillation (ENSO) cycle may influence the rains, with the warm phase (El Niño) leading to lower rainfall rates for most of India, both during and outside the moonsoo.

Temperature extremes

Extreme temperatures, both hot and cold, can place many demands on society. While seasonal temperature changes are normal and indeed important for a number of sectors of society (e.g. tourism, agriculture, etc.), extreme heat or cold can have serious negative impacts. What is' natural' for one area, critically, may be se- vere for another region that is less well adjusted to such temperatures.

Selected extreme events recorded in WMO Statements on the Status of Global Climate and/or BAMS State of the Climate Reports since 2000 are shown in Table 1. Two events, the May / June 2003 heat wave and the January 2006 cold spell as examples of extreme temperature events for India are listed below.

Recent extreme temperature events

Heat wave, May/June 2003

In many parts of India, temperatures rose to high 40 °C in late May and early June 2003, with maximum temperatures at some locations above 50 °C. As a result of the heat wave, which also affected neighboring Pakistan and Bangladesh, more than 1500 people were reported to have died (WMO, 2005; Kolli, 2004). Media reports indicate that the heat wave, where bush fires occurred in almost every district damaging homes and belongings, especially hit Andhra Pradesh's state (Relief Web Report, 2003).

Cold spell, January 2006

During the early part of 2006, a severe cold spell affected several parts of South Asia and temperatures fell to several degrees below freezing at some stations in the Pakistan / North India area. The cold in North India resulted in more than 150 deaths. On 8 January, New Delhi saw its first frost falling to 0.2 ° C in 70 years (Rajeevan and Revadekar, 2007). Media reports show that Uttar Pradesh's Indian state was particularly badly hit, with 145 deaths associated

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with cold. The articles even point out that the cold spell caused damage to water pipes and crops (up to 15% in some regions) and disruption of travel, with some schools closed for several days. (Web Report on Relief, 2006).

Attribution of changes in likelihood of occurrence of seasonal mean temperatures

The weather of today covers a range of possible extremes. Recent research has shown that in the absence of anthropogenic emissions, the temperature distribution of seasonal means will likely be different (Christidis et al., 2011). Here we discuss the seasonal means in which the highlighted extreme temperature events take place in the context of the recent climate and the impact of anthropogenic emissions on that climate. The methods are fully described in the methodology section.

Spring and summer 2003

In the presence and absence of anthropogenic forcings, the March-April-May (MAM) cycle means local tem- perature for 2000-2009 is shown using distributions in Figure 4. Figure 5 reveals similar June-July-August (JJA) mean distributions. Two independent coupling models of atmosphere and general ocean circula- tion(HadGEM1 and MIROC) analyzes Say that human climate changes have changed distributions to higher temperatures than natural causes alone would have predicted. Considering the region-wide average, the mean temperature of the 2003 MAM is not unusually hot as it lies in the central field of the anthropogenically me- diated seasonal temperature zone (red distribution). It is significantly cooler than the 2010 MAM temperature, which in the CRUTEM3 dataset is the warmest and most compatible with the distribution affected by anthropogeny. The 2003 season, in the absence of human influences (green distributions), lies close to the warm tail of the temperature distribution and would therefore be a warmer season. Also in a climate affected by anthropogenic forcings, the JJA mean temperature in 2003 is not unusually cold, but becomes a much more intense season in the cycle without the impact of human factors on the environment. It should be noted that the re- sults of the attribution shown here refer to averaged temperature anomalies throughout the region and through- out the whole season. As such, they do not rule out the occurrence of a short-lived extreme event that affects a smaller region.

Winter 2005

Winter averages mean local temperature for 2000-2009 in the presence and absence of anthropogenic forcings are shown using Figure 6 distributions. Like the previous section,

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analyzes with both models suggest that hu- man climate influences have shifted the distribution to higher temperatures. Considering the region's average, winter 2005/06 is dry, Because it lies close to the warm tail of climate temperature distributions influenced by anthropogenic forcings (red plotted distributions). The season lies further in the warm tail of the temperature distribution in the absence of human influences on the climate (green distributions) and would therefore be a more rare warm season. It is also much warmer than the 1904/05, the coldest in the CRUTEM3 dataset.

Storms

To all sectors of society, storms can be very dangerous. These can be tiny and distributed through large re- gions, or even globally, with regional impacts. There is no comprehensive observational analysis included for storms since, despite recent improvements (Peterson et al. 2011; Cornes and Jones 2011), wind data are still not adequate for rigorous research around the world (see section on methodology).

Further progress is anticipated through the latest 20th Century Reanalysis (Compo et al., 2011) and its pro- posed successors to research the more accurate barometric pressure results.

Selected extreme events recorded in WMO Statements on the Status of Global Climate and/or BAMS State of Climate Reports since 2000 are shown in Table 3. The 2008 Tropical Storm Nisha is shown below as an ex- ample of a recent storm event that affected India.

Recent storm events

Tropical Storm Nisha, November 2008 recorded in several locations, with totals of 990 mm recorded in 48 hours in Orathanadu, Tamil Nadu, and 280 mm in 24 hours at Chennai airport (Rajeevan and Revadekar, 2009) Chennai airport (Rajeevan and Re- vadekar, 2009).

Conclusion

The main features seen from this study in the observed weather over India are:• Since 1960, India has had a widespread warming trend.

- In the period 1970-2009, where data are available, the frequency of cool nights across India has decreased, the number of warm nights has increased, the number of cool days has decreased and the number of hot days has increased.

- Seasonal average seasonal temperatures have generally increased over the country as a result of human cli- mate influence, making hot seasonal temperatures more frequent and cold

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seasonal temperatures less frequent. Studies on climate change Included in this report are the results of recent studies using weather forecasts from Global Climate Models (GCMs) to crop yield models to determine the global impact of climate change on crop yields, including national impact estimates for India. (Avnery et al., 2011, Masutomi et al., 2009, Iglesias and Rosenzweig, 2009). Some crops ' CO2 fertilization cycle is typically included in yield studies of climate impact. Other gases, however, may affect crop growth and are not always included in model impact projections.

Since the current era, climate models have continued to be developed and improved, and many models have been expanded to include the representation of biogeochemical cycles that are important for climate change.

The mathematical development of the psychrometrics theory gives a brief overview of the various parameters involved along with basic climate change model.

The certain results from the psychrometrics are key pointers to understand the humudity ratio over storm surge moments mathematically.

Results observed over the mathematical overview of the psychrometer collate to give association among the heat parameters and the other similar aspects related to climate change.

Storm surge is an ideal event that formulates the covariance of the differential function of the specific heat over the mathematical estimation.

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International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

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Customer-Centric Impacts of Post-COVID-19 E-Commerce Revitalization: A Study of Behavioral Shifts

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Abstract: The study attempts to understand the revitalization or renewal of E- Commerce on the buying behaviours of the people after the novel coronavirus (COVID- 19)

As lockdowns became the new normal, businesses and consumers increasingly "went digital", providing and purchasing more goods and services online, raising e-commerce's share of global retail trade from 14% in 2019 to about 17% in 2020.

To know if there was a rise or fall in the E - commerce business post COVID- 19, a survey had been conducted with a random sampling of 100 consumers belonging to the Mumbai suburban region. The findings highlighted that the main components like most households now had shifted to the online mode of shopping, made online payments for their products, found it accessible and easier to shop online rather than offline in terms of safety, price, time, the product description, payment methods, advertisement, internet literacy, and so on. Also the fact the E- commerce business saw an accelerated growth post pandemic.

The findings of the study will also further help to identify if more people would continue to opt for online shopping mode i.e. Ecommerce business rather than the traditional offline shopping post pandemic.

Introduction

Ecommerce, also known as electronic commerce or internet commerce, refers to the buying and selling of goods or services using the internet, and the transfer of money and data to execute these transactions. Ecommerce is often used to refer to the sale of physical products online, but it can also describe any kind of commercial transaction that is facilitated through the internet. Ecommerce has evolved to make products easier to discover and purchase through online retailers and marketplaces. Independent freelancers, small businesses, and large corporations have all benefited from ecommerce, which enables them to sell their goods and services at a scale that was not possible with traditional offline retail.

A few examples of e-commerce marketplace platforms include the following: Alibaba, Amazon, Chewy ,eBay, Etsy, Overstock, Newegg, Rakuten, Walmart Marketplace , Wayfair etc .

There are four main types of ecommerce models that can describe almost every transaction that takes place between consumers and businesses.

1. Business to Consumer (B2C):

When a business sells a good or service to an individual consumer (e.g. You buy a pair of shoes from an online retailer).

2. Business to Business (B2B):

When a business sells a good or service to another business (e.g. A business sells software-as-a-service for other businesses to use)

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3. Consumer to Consumer (C2C):

When a consumer sells a good or service to another consumer (e.g. You sell your old furniture on eBay to another consumer).

4. Consumer to Business (C2B):

When a consumer sells their own products or services to a business or organization (e.g. An influencer offers exposure to their online audience in exchange for a fee, or a photographer licenses their photo for a business to use)

However, even before the pandemic situation, Indian retailers were anticipating strong e-commerce growth in 2020. As a result of the Coronavirus, the sector has somehow accelerated e-commerce development.

In the last two decades, widespread use of e-commerce platforms such as Amazon and eBay has contributed to substantial growth in online retail. In 2011, e-commerce accounted for 5% of total retail sales, according to the U.S. Census Bureau. By 2020, with the start of the COVID-19 pandemic, it had risen to over 16% of retail sales. Some of the advantages that made it rise after the pandemic, was when people who were unaware of the Ecommerce felt that it was,

- Easily Available, Aside from outages and scheduled maintenance, e-commerce sites are available 24/7, enabling visitors to browse and shop at any time.
- Speed of access. While shoppers in a physical store can be slowed by crowds, e-commerce sites run quickly.
- Wide availability. E-commerce enables brands to make a wide array of products available. Example Amazon's first slogan was "Earth's Biggest Bookstore.
- Easy accessibility. With e-commerce, businesses can sell to anyone who can access the web Customers shopping a physical store may have difficulty locating a particular product.
- International reach. Brick-and-mortar businesses sell to customers who physically visit their stores. E- commerce has the potential to extend a business's customer base.
- Lower cost. Pure play e-commerce businesses avoid the costs of running physical stores, such as rent, inventory and cashiers. They may incur shipping and warehouse costs, however.
- Personalization and product recommendations. E-commerce sites can track a visitor's browse, search and purchase history. They can use this data to present personalized product recommendations

As detailed above, the COVID-19 crisis accelerated an expansion of e-commerce towards new firms, customers and types of products. Overall, customers still are spending substantially more online than before the coronavirus pandemic. In May 2022, seasonally adjusted internet sales accounted for 26.6% of all official retail sales, compared with 19.7% in February 2020.

Due to increase in sales in e-commerce, the traditional commerce sales have been downgraded. 24*7 availability and convenience online has resulted in huge profits, customers from overall the world can access your products by simply sitting at home.

Review of Literature

Florency Dsouza (2022), studied the Influence after COVID- 19 Pandemic on E - commerce business. In this study a descriptive research was conducted. It was observed following the

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pandemic; more than half of the survey's respondents now shop online more frequently and rely on the internet more for news, health- related information and digital entertainment. Consumers in emerging economies have made the greatest shift to online shopping, the survey shows.

Scope of the Study

This study would be undertaken to analyze the impact on Ecommerce business after the COVID- 19 pandemic towards online shopping. It would also be helpful to understand if the customers are satisfied by the benefits of shopping on online websites even after the pandemic.

Research Methodology

The research methodology was based on using both Primary and secondary data mainly the quantitative research was made use of where the respondents had to fill in the questionnaire given to them. Thus the samples were observed and collected.

Research Objective:

1. To Study the impact on E-Commerce after COVID-19
2. To study the buying behaviour of the customers post pandemic.

Hypothesis

In light of the discussion in preceding sections, the following hypotheses are proposed: Ho - The E-commerce business has accelerated in terms of profits post pandemic.

H1 - The E-commerce business has not accelerated in terms of profits post pandemic.

Ho - There was a major impact post pandemic on consumer’s behavior with respect to online shopping. H1 - There was no major impact post pandemic on consumer’s behavior with respect to online shopping.

Research Design

A descriptive research design was used to conduct the research. The data was collected by survey through questionnaire on the research topic i.e A Study on Revitalization of E-Commerce after COVID-19.

Area of the Study

The study is undertaken in and around the Mumbai city and its suburban areas.

Research Approach

A deductive approach of research methodology was conducted by using questionnaire method of survey which was used for collecting primary data from consumers belonging to Mumbai region. It contained close ended questions and open ended questions in the structured form.

Sample Technique

A convenient Probability sampling technique was conducted on of 100 consumers belonging to Mumbai region who shared their information regarding the study. They were requested to complete the questionnaire on voluntary basis. The study was done in December 2022.

Data Usage

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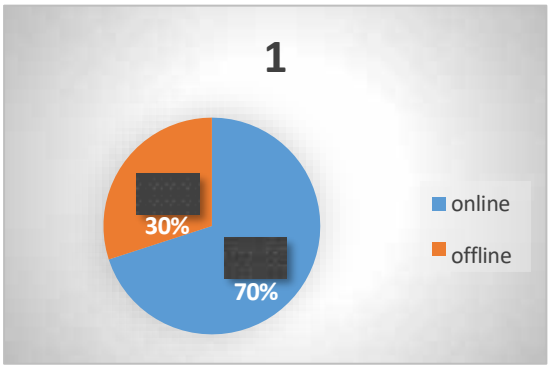
ISBN: 978 – 93 – 6851 – 977 - 5

The analyses and interpretation are done on the basis of primary data. However, for conclusion and recommendation both primary and secondary data is used along with the verbal knowledge and information obtained from respondents.

Data Analysis and interpretation

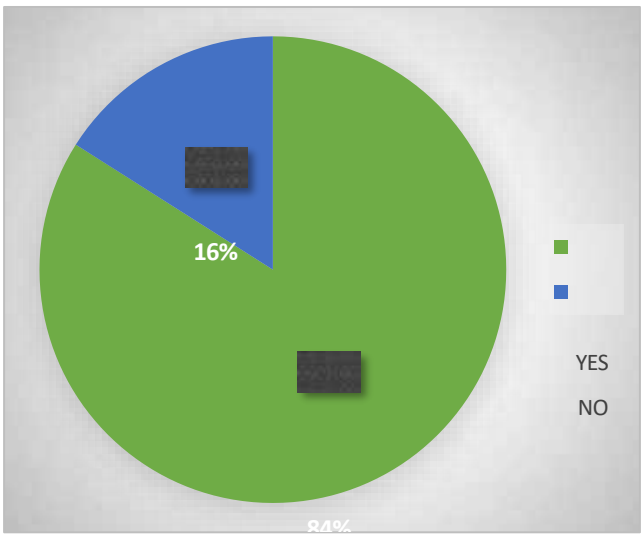
In the present study there were 80 respondent, who were students as well as job workers out of which 60% were females and 40 % were males. The student respondents were the customers buying products online in the age group 18 – 45 years of age (these included students as well as job workers.)

1. What kind of shopping do you prefer the most?



The data indicates after COVID- 19 pandemic, consumers preferred more Online shopping which is 70 % and less preference towards offline shopping which is 30 % due to safety purpose.

2. Do you think people shop more online products after the pandemic?



84% of the customers agree that people buy more online products after the pandemic as well as 16% don't agree, as they feel that traditional way of shopping would be preferred post pandemic.

3. Which website do you prefer for online shopping?

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ISSN : 2583-6897

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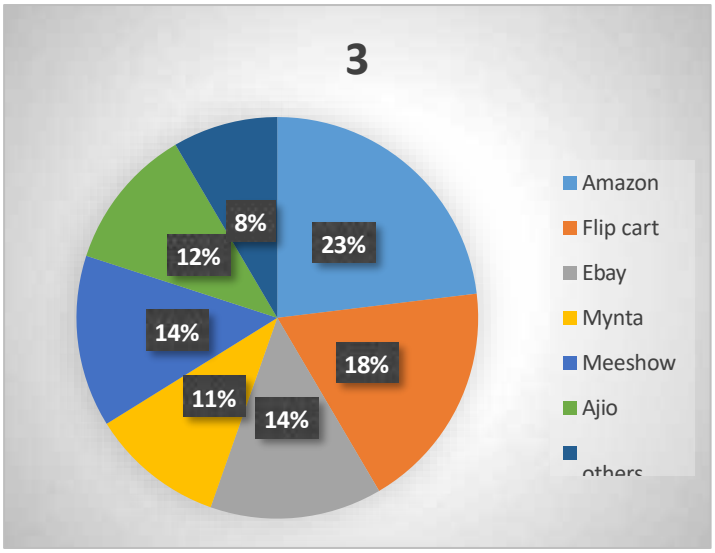
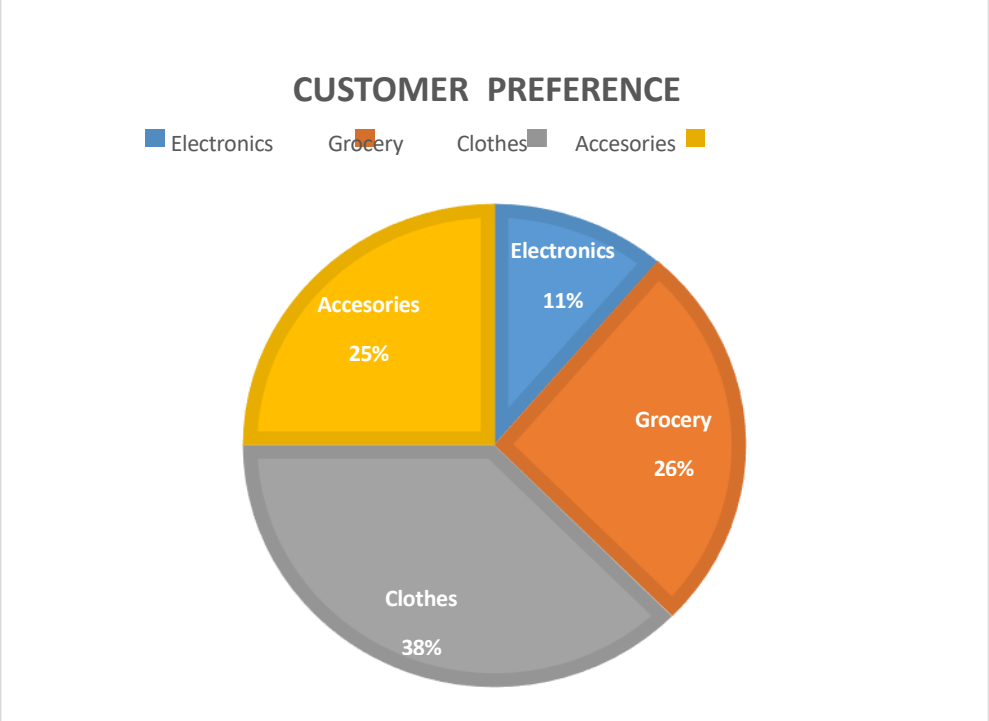


Most people prefer buying from Amazon as it serves a variety of range of products to different customers offers discounts and free home delivery on certain products, COD facilities etc. followed next by flip cart and so on.

4. What product do you usually prefer buying online?



This data indicates that most people buy clothes i.e. 37 % while the least purchased is Electronics i.e. 11.25

% as electronics are damaged or may be faulty therefore most customers do not prefer purchasing electronic products online. However groceries have shown rise post pandemic.

5. Is the E- Commerce website easy to navigate?

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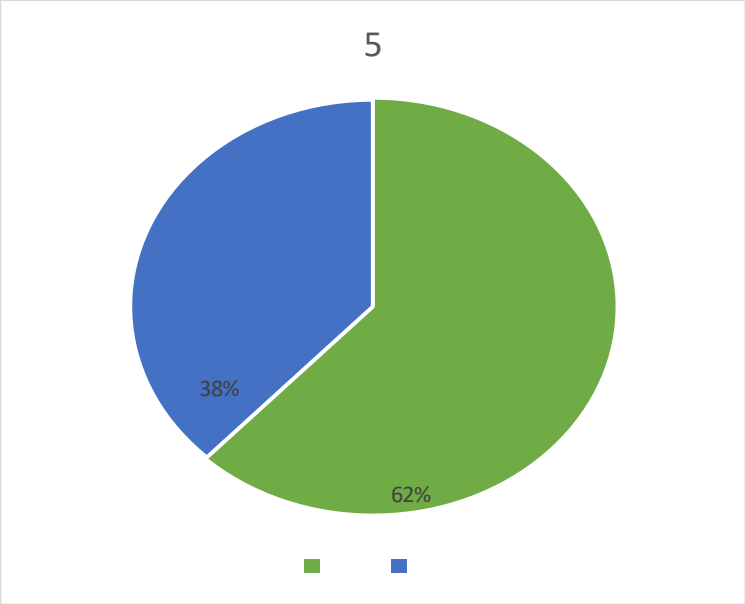
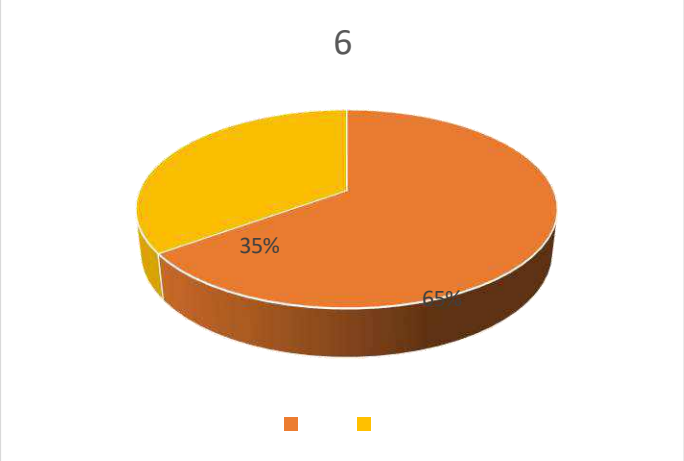


People mostly like online shopping due to the ease of navigation of the website, its not complicated as it is a step by step procedure. As per the research conducted , 62 % find the E-Commerce website easy to navigate as well as 38% don't find it that easy because at times of internet issues or they may face problems in online banking system at the time of payment etc.

6. Do you find enough range of products online?



As per the data collected most people agree to the fact that there are variety of products available online which they can compare to the traditional mode of shopping , the online products give detailed descriptions , reviews , discounts on payments etc, this is one reason post pandemic people prefer to shop online.

7. Do you find enough product details on the website?

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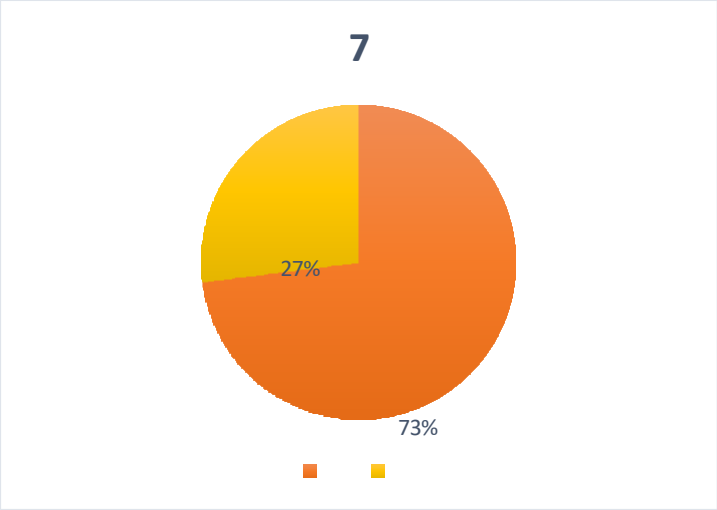
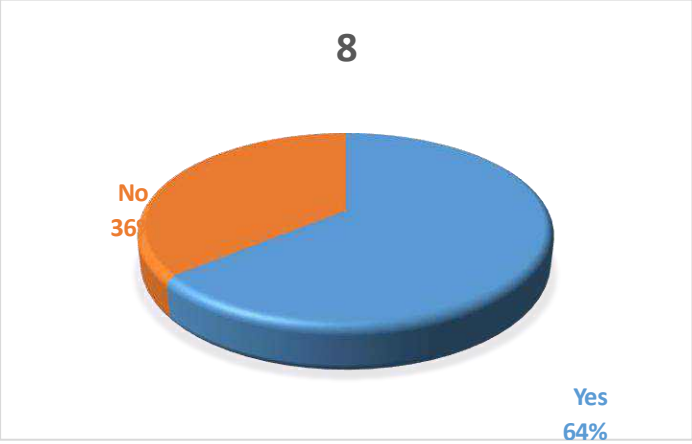


As per the data collected, 73% people agree to the fact that there is enough detail or description of the product which they may not be able to find in the offline or the traditional mode.

8. Do you find the e- shopping experience pleasurable?



64% customers agree that online or e- shopping is fun, quick, saves time and efforts, the convenience of shopping at home, wide variety/range of products are available, good discounts / lower prices and thus they find all such experiences pleasurable.

9. Are you satisfied with online products?

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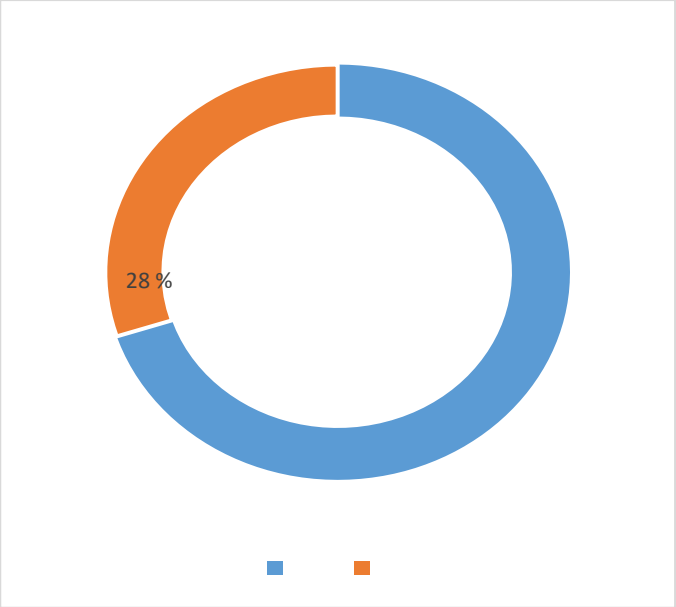
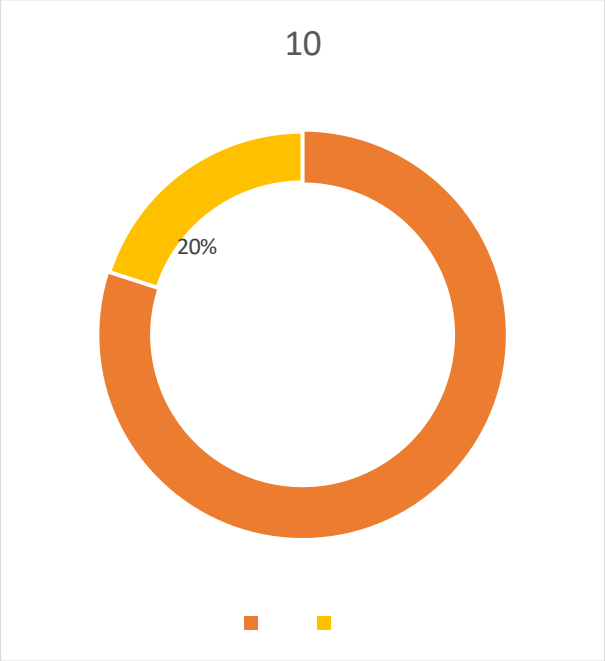


60% customers say that were satisfied with the online products and found them reliable , even if the good were faulty they could easily exchange or return back, Where as 28% of customers seemed to be unsatisfied due to varied reasons.

10. Would you continue to buy products online?



As per the data most customers are satisfied using online product while only 16 % are not satisfied and would not buy online products due to faulty good etc. thus the other 84% continues accelerating the Ecommerce business post pandemic.

Findings

Younger population used more online shopping websites than the older population and females shopped more online than the males. Although e-commerce trading has increase in the grocery, clothing, recreational etc. Electronics is likely to suffer. As per the hypothesis it is clear that

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The E-commerce business has accelerated in terms of profits post pandemic and there was a major impact post pandemic on consumer's behavior with respect to online shopping.

Recommendations

- To ensure that vulnerable consumers are protected from unfair business practices and unsafe products.
- To support the creation of innovative e-commerce business models, ensuring that regulatory frameworks remain flexible
- To foster e-commerce participation by the most vulnerable, for example by introducing community based delivery programs for elderly and reserved delivery slots.

Conclusion

- It can be concluded that there was shifting of preference of shopping from offline to online shopping.
- However, frequent-use categories, like groceries, household, personal care, clothing, etc. saw rapid growth and are likely to continue seeing accelerated growth post-pandemic. "These habit-forming categories, which have a high share of repeat purchases online,
- The consumers preferred online shopping even post pandemic as a result the E-commerce sectors continues to grow
- The consumers preferred online shopping as it was easy, convenient and comfortable to all specially with zero touch.
- Thus, COVID-19 has influence positively online buying habits of the consumers thus creating a huge opportunity for online shopping.
- To note, worldwide e-commerce was 17.9% of total retail sales in 2020, with estimates that it grew to 19.0% in 2021 and will grow to 20.3% in 2022.

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International Multidisciplinary Research Journal
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ISSN : 2583-6897

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ISBN: 978 – 93 – 6851 – 977 - 5

Navigating the Sustainability Crossroads: An Analysis of Energy, Waste, and Natural Resource Management in Uttar Pradesh

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Abstract: Uttar Pradesh, India's most populous state, is facing serious environmental challenges due to its growing energy consumption, waste management issues, and increasing strain on its natural resources. This research paper takes a closer look at these connected problems, evaluating the current state of sustainable energy practices, waste management techniques, and efforts to protect the state's natural environment. By examining reports, key data, and government policies, we highlight major environmental concerns in Uttar Pradesh, such as high levels of air and water pollution, overloaded waste management systems, deforestation, and the unsustainable use of groundwater. Additionally, we assess the effectiveness of the strategies and programs already in place by both the national and state governments, recognizing the progress made and the challenges that still remain. In the end, this paper suggests practical solutions and offers policy recommendations to promote cleaner energy, improve waste management, and encourage more responsible use and preservation of natural resources. In conclusion, this study emphasizes the urgent need for a comprehensive approach that includes technological innovation, community involvement, and targeted investments to help Uttar Pradesh move towards a more sustainable and environmentally-friendly future.

Keywords: *Uttar Pradesh, waste management techniques, environmental concerns, targeted investments, water pollution*

I. Introduction: Establishing Our Sustainability Region in Uttar Pradesh

Uttar Pradesh is the most populous state in India and plays a major role in the national economy. It has a strong agriculture base and growing industries, which means that significant populations exert considerable pressure on natural resources. Furthermore, energy consumption and waste production also rise with wealth creation. The state is located in the fertile Indo-Gangetic Plain, making the surrounding environment important to both the state and surrounding areas. This challenge is to grow in a sustainable manner. For Uttar Pradesh to demonstrate sustainable resource use, we need to connect energy generation, waste generation, and natural resource management. The transition from fossil fuels to renewable energy sources like solar and wind will help to avoid emissions and resource depletion. This is important for addressing climate change and for sustainable resource use in the future. Waste management is also very important to ensure the continued use of land for food and for the avoidance of water pollution. When waste is successfully dealt with the ecosystems automatically become protected and improved. Natural resource management is equally critical. The large solar hubs take up land and the biomass energy require sustainable agriculture and forest management. Ecosystems, healthy and intact, can retain a fundamental role in managing water flow and climate control, improving both energy production and waste management. These interrelationships emphasize that these sustainability practices must occur together and that improvements in one area can help another, and that neglect of one area can lead to significant impacts to the other's ability to function sustainably. This paper will more thoroughly explore the most pressing environmental issues in Uttar Pradesh - specifically energy, waste, and natural resources. It will explore existing practices currently addressing these problems and their effectiveness.

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II. Understanding the Environmental Problems in Uttar Pradesh:

Air Pollution: Air pollution poses a grave environmental threat to India and has heavily impacted Uttar Pradesh. These cities include Lucknow, Kanpur, and Varanasi, which have consistently monitored high levels of particulate matter (PM), keeping the air unhealthy. The following are the causes of pollution:

Crop Burning: During specific seasons, farmers burn crop residues in fields, adding smoke and harmful particles to the airs.

Fuelwood and Biomass Burn: Most rural and urban households depend on fuelwood and dried livestock waste for cooking and heating, thereby increasing indoor and outdoor pollution.

Air pollution, according to the Uttar Pradesh Climate Change Centre, is more than two to three times the permissible levels in different urban areas. Industrial pollution also plays a role, with emissions rated between 0.007 - 1.48 kilograms per capita, per year. This causes pollution to be detrimental to public health and respiratory diseases, especially in vulnerable populations: children and the elderly. Urbanization, industrial growth, and outdate energy practices have combined to render Kerala's air pollution problem a grave one demanding urgent pollution strategies.

Water Pollution: Water pollution is just as grave a concern in Uttar Pradesh as air pollution. Prime most causes are the discharge of untreated sewage into rivers or aboveground water. Many sewage treatment plants within the State are either dysfunctional or lack adequate support, therefore unable to provide effective treatment for wastewater.

The Ganges River-an important cultural-religious symbol-is undergoing intense pollution because of sewage-not treated-from more than 100 towns, most of which are in Uttar Pradesh. The manifest consequences of poor-quality water and sanitation included 6.4 million Disability-Adjusted Life Years (DALYs) in 2020 according to the Uttar Pradesh Climate Change Centre.

It was evidenced through tests that concerning results turned up in several districts:

11 districts exceeded the safe limit for fluoride. Eight of the districts found out to be having nitrate levels higher than the permissible limit. Unsafe iron levels also existed in 11 districts.

To combat the problems related to air pollution and water pollution in Uttar Pradesh, there must be improved waste managements, better infrastructures, and effective strategies for controlling pollution for the benefit of the so-called public health and environment safety.

Water pollution is a serious problem in Uttar Pradesh, affecting about 38.5% of the population. Cities like Lucknow, Kanpur, Agra, Varanasi, Mathura, Aligarh, and Ghaziabad are facing a rapid decline in groundwater quality and availability. A 2008 study found that groundwater in many districts contained arsenic levels above the safe limit of 0.05 mg/L. Rivers in the state are also heavily polluted due to untreated sewage, industrial waste, and agricultural runoff containing pesticides and fertilizers. This has harmed drinking water quality, aquatic life, and public health, increasing cases of waterborne diseases.

Reports show that 70% of freshwater in Uttar Pradesh is contaminated, contributing to nearly 200,000 deaths each year due to unsafe water. Excessive water use, along with chemicals used in farming, is further polluting soil and groundwater. Poor infrastructure, weak waste management, and industrial pollution have worsened the problem. Similar water pollution issues are also seen in Nigeria, causing unsafe water and serious health risks.

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ISBN: 978 – 93 – 6851 – 977 - 5

Urban areas in Uttar Pradesh generate about 20,820 tonnes of solid waste daily, and this number is expected to double in the future. If not managed properly, this increase could cause serious health and environmental problems.

The state also produces large amounts of hazardous and biomedical waste. Solid waste management in Uttar Pradesh is poor, leading to several issues. In Aligarh, for example, about 90% of municipal solid waste (MSW) is dumped in open areas or landfills. The municipal corporation and private collectors manage to collect only about 70% of the waste, leaving a significant amount uncollected. Since Aligarh lacks a sanitary landfill, nearly 80% of collected waste ends up in open dumps, harming the environment and public health.

This issue is common in many UP cities due to poor waste segregation, weak collection systems, limited funding, and a lack of proper treatment and disposal facilities. As a result, organic waste, a major part of MSW, often ends up in open dumps. This waste decomposes, releasing harmful gases like methane. Rainwater passing through waste piles creates toxic leachate, which pollutes surface and groundwater, adding to environmental risks.

Trash dumps in Uttar Pradesh are a big problem as they attract rats and insects, which spread diseases and pose a risk to nearby communities. The huge amount of solid waste produced in the state, along with limited waste management capacity, has worsened the condition of dump sites.

Forests and tree cover in Uttar Pradesh are quite low, covering only 8.8% of the total land area. According to a government report, forest cover is just 3.56% and tree cover is 5.34%. This is concerning because the state is home to about 5,352 plant species, including endangered ones like the Gangetic River Dolphin.

Several factors are causing deforestation and loss of biodiversity, such as population growth, development projects, illegal occupation of forest land, poaching, and using wood for fuel. Losing forests is more harmful than just losing timber. Forests help maintain ecological balance, control water flow, reduce soil erosion, and absorb carbon dioxide, which helps fight climate change. Cutting down trees not only reduces timber but also harms plant and animal life, putting many species at risk. Uttar Pradesh’s water resources are facing serious pressure. Although water availability is considered moderate, there are big differences in access to clean drinking water across the state.

Excessive use of groundwater, especially for farming, poor water management, and a growing population have made the situation worse. Reports show that about 70% of the state’s freshwater is polluted. Groundwater, which makes up 40% of the total water supply, is being used at an unsustainable rate.

Out of 75 districts in Uttar Pradesh, 34 are facing severe groundwater depletion. This is mainly due to the unregulated use of water for crops like sugarcane and household wastage. As groundwater levels drop, water shortages for farming, drinking, and the environment are becoming more common.

III. Sustainable Energy Management: Technologies, Policies, and Progress

Uttar Pradesh has great potential for renewable energy, which can reduce dependence on traditional fossil fuels. Since the state receives sunlight throughout the year, solar energy is the

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most promising option. The state's solar radiation levels range from 4.5 to 5.5 KWH/sqm/day, making it ideal for solar power systems like photovoltaic (PV) panels and concentrated solar power (CSP) technologies to generate electricity.

While Uttar Pradesh's wind energy potential is not as strong as some other states, areas like Bundelkhand and parts of western UP have enough wind speeds to support small wind energy projects or combined solar-wind hybrid systems.

As an agricultural state, UP produces large amounts of crop waste such as rice husk, sugarcane bagasse, and wheat straw. These can be converted into bioenergy using methods like biomass gasification and anaerobic digestion, providing a useful source of electricity and biofuel.

The state also has some hydropower potential with large dams like the Obra hydroelectric plant, Rihand dam hydroelectric project, and Matatila dam power station contributing to energy production.

Uttar Pradesh provides a huge opportunity to transform into a state of sustainable energy through its solar and biomass resources, which exist abundantly within the state. The government is actively promoting green energy solutions and energy-efficient technologies to aid the transition.

It lay focus on large-scale solar grid-interactive projects, besides rooftop solar systems of smaller size. There is also rising enthusiasm for making excess biomass available from agricultural operations for energy production and the establishment of biomass power plants and biogas units, particularly in the farming zones.

While applications of wind energy are not as dominating in UP as they are in Solar, hybrids using wind and Solar are currently being explored.

Renewable energy has not picked up as expected so far. One of the major issues with renewable energy systems is that they have a high initial cost, which makes them impractical for many large projects, while some users may not be able to afford them. It will also not be enough to upgrade the current power grid of the state to make it ready to accommodate renewable sources.

Finding suitable land for big power-generating solar and wind projects is yet another challenge faced by such projects. There are delays awaiting these works due to disputes over land allocation and opposition from local community people. Notwithstanding such hindrances, however, UP continues to aspire to expand its potential for renewable energy.

As wind and solar energy is not available at sometimes consistently, so it makes sure to develop effective energy storing systems. These systems can backup power to the local areas, and also relieve pressure on the mains grid. It also needs to invest in modernizing and expanding the electricity grid for supporting massive renewable energy projects in Uttar Pradesh.

Innovations and financial support can promote the lowering of renewable energy products' costs to consumers and businesses. Among the many policies, the Uttar Pradesh Solar Energy Policy 2022 will aim at increasing solar power production in the state, targeting 22 gigawatts (GW) solar power capacity to be achieved by 2026-27. This includes provision for developing large solar parks and campaigning for solar rooftops in residential, commercial, industrial, and government buildings.

Industries and large consumers are also encouraged toward setting up solar power systems for their own use for steady and reliable supply of power.

Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

RESEARCH BRIDGE CONSULTANTS
Ideas to Impact

ISBN: 978 – 93 – 6851 – 977 - 5

The government has also provided many such incentives for all those helping in installing solar energy, such benefits include:

- State subsidies.

- Exemption from electricity duty for a fixed period of time.

- Energy banking that allows a user to send surplus solar powers into the grid and earn credits.

The subsidy offered by the government on residential rooftop solar systems is ₹15,000 per kilowatt (kW), with a limit of ₹30,000 per consumer. This subsidization makes solar energy cheaper and encourages more people to turn to clean sources of energy.

The Uttar Pradesh Solar Energy Policy 2022 proposes too significantly to promote solar energy use while saving traditional electricity use in making Ayodhya a model solar city. This scheme essentially involves solar-powering government buildings, schools, and agricultural power feeders.

The Uttar Pradesh New and Renewable Energy Development Agency (UPNEDA) has been made responsible for implementing this solar energy policy. The plan is to bring in 14 GW of solar power through large-scale solar installations by the financial year 2028.

These policies demonstrate a strong commitment to enhancing solar power in the state, but they will succeed only through effective implementation and addressing barriers in the energy sector while working closely with major stakeholders.

Other policies and schemes at the national level are helping the development of renewable energy in Uttar Pradesh. In the race towards achieving India's target of 500 GW of non-fossil fuel-based energy capacity by the year 2030, the central government has put forward several renewable energy targets to promote cleaner energy utilization in the country.

India’s national renewable energy targets provide clear guidance for states like Uttar Pradesh to develop their own energy policies. To promote renewable energy at the local level, the government has introduced various schemes.

One key initiative is the **PM-KUSUM scheme**, which encourages solar energy use in the farming sector. Under this scheme, farmers can install **solar-powered irrigation pumps**, reducing their reliance on diesel pumps and cutting down costs.

An important feature of the PM-KUSUM scheme is the plan to install **solar power plants on agricultural land**. Farmers can use these solar plants to meet their own energy needs and sell any extra power to the grid, earning additional income.

The Indian government also encourages **foreign direct investment (FDI)** in renewable energy projects. This helps provide financial support for clean energy development in states like Uttar Pradesh.

Various financial incentives and subsidies are available for developers and consumers in Uttar Pradesh to promote renewable energy projects. These national policies create a strong foundation for expanding clean energy in the state by setting clear targets and offering financial assistance.

Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

RESEARCH BRIDGE CONSULTANTS
Ideas to Impact

ISBN: 978 – 93 – 6851 – 977 - 5

Despite having ambitious plans and high potential for renewable energy, Uttar Pradesh has fallen behind some other states in achieving its goals. By **October 2021**, the state had achieved only **4.3 GW** of installed renewable energy capacity, which was just **30%** of its target of **14.1 GW** by **2022**.

Uttar Pradesh's progress in renewable energy has been slower compared to other high-energy-demand states like **Gujarat** and **Rajasthan**, which achieved much higher targets by 2022.

There are several reasons for this delay. One major issue is that Uttar Pradesh's **electricity distribution companies (discoms)** have cancelled renewable energy agreements in recent years. This has created uncertainty for investors and slowed project development.

Another challenge is that these discoms face heavy **technical and commercial losses (over 30%)**, which has weakened their financial condition and reduced their ability to invest in renewable energy.

By the end of 2022, Uttar Pradesh had only **163 MW** of rooftop solar capacity installed, which is much lower than the state's potential.

The state has also struggled to implement the **PM-KUSUM scheme** effectively. For example, in 2022-23, not a single project was completed out of the planned **225 MW** solar plants under **KUSUM Yojana-A**. Similarly, under **KUSUM-B**, only a small portion of the approved solar pumps were installed.

Efforts are ongoing to improve progress, with hopes to achieve better results by **July 2027**.

Table1. Renewable Energy Targets and Achievements in Uttar Pradesh (as per available data)

Sector	**Target (by 2026-27)**	**Current Installed Capacity (as of July 2024)**	**Key Incentives and Subsidies**
Solar Energy	22,000 MW	~2,485 MW (as of Dec 2022)	State subsidy for rooftop (up to ₹30,000), Capital subsidy for utility-scale with storage
Wind Energy	Not specifically stated in detail	Included in 8,816.1 MW total renewable (including large hydro)	Incentives for small wind turbines being considered
Bioenergy	CBG: 1,000 TPD; Bio coal: 4,000 TPD;	2,237.39 MW (biopower)	Financial support for CBG (up to ₹20 crore), subsidies for equipment

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ISBN: 978 – 93 – 6851 – 977 - 5

	Bioethanol/Biodiesel: 2,000 KLPD		

IV. Waste Management in Uttar Pradesh: Current Practices, Policies, and Innovative Solutions

Table2. Estimated Waste Generation in Major Cities of Uttar Pradesh

City	Population (Approx.)	Waste Generation (Tonnes/Day)
Lucknow	3.6 million	1,800 – 2,000
Kanpur	3.0 million	1,500 – 1,700
Varanasi	1.6 million	800 – 900
Agra	1.7 million	850 – 950
Meerut	1.5 million	750 – 850
Prayagraj (Allahabad)	1.5 million	750 – 850
Ghaziabad	2.0 million	1,000 – 1,200
Gorakhpur	0.7 million	350 – 450
Bareilly	1.0 million	500 – 600
Jhansi	0.6 million	300 – 400
Moradabad	0.9 million	450 – 550
Aligarh	0.8 million	400– 500

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Key Observations:

- Larger cities like **Lucknow** and **Kanpur** have the highest waste generation due to their dense populations and urban activities.
- Cities with moderate populations, like **Bareilly** and **Gorakhpur**, generate comparatively less waste.
- Waste generation trends may vary based on industrial activities, commercial zones, and population density.
- As of the financial year 2022, India generated approximately 170,300 metric tons of municipal solid waste (MSW) daily.

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ISBN: 978 – 93 – 6851 – 977 - 5

Table3. The state-wise breakdown of MSW generation

State	MSW Generation (Metric Tons per Day)
Maharashtra	22,570
Uttar Pradesh	19,150
Tamil Nadu	14,532
West Bengal	12,524
Karnataka	11,958
Gujarat	11,609
Madhya Pradesh	10,566
Rajasthan	9,220
Andhra Pradesh	8,931
Telangana	8,275

Note: Data reflects figures up to the financial year 2022.

- In this context, **Uttar Pradesh ranks second nationally** in terms of daily MSW generation, producing approximately 19,150 metric tons daily. This substantial waste generation is attributed to its large and growing population, rapid urbanization, and expanding industrial activities.
- Effective waste management in Uttar Pradesh is crucial to mitigate environmental and health challenges. Implementing comprehensive strategies, including waste segregation at source, recycling initiatives, and the development of waste-to-energy projects, is essential to address the increasing waste generation in the state.

India has implemented several initiatives to manage municipal solid waste (MSW) and harness its potential for energy generation.

National Initiatives:

- Swachh Bharat Mission (SBM): Launched on October 2, 2014, this flagship program aims to promote cleanliness and effective waste management across urban and rural areas.
- Waste to Energy Programme: The Ministry of New and Renewable Energy (MNRE) supports projects that generate biogas, Bio CNG, power, or syngas from urban, industrial, and agricultural wastes. The estimated energy generation potential from urban and industrial organic waste in India is approximately 5,690 MW.

Energy Generation from MSW:As of 2023, India's renewable municipal waste energy capacity reached approximately 291 megawatts, up from 260 megawatts in 2022.

Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

RESEARCH BRIDGE CONSULTANTS
Ideas to Impact

ISBN: 978 – 93 – 6851 – 977 - 5

Uttar Pradesh Initiatives: Uttar Pradesh has formulated its State Solid Waste Management Policy to address MSW challenges. The policy emphasizes waste reduction, reuse at the source, segregation, and the development of treatment and disposal facilities.

MSW Generation and Treatment in Uttar Pradesh: The state generates approximately 17,377 metric tons of MSW daily. Of this, 17,329 metric tons are collected daily, with 12 operational treatment and disposal facilities having a cumulative capacity of 4,615 metric tons per day.

Energy Generation Potential in Uttar Pradesh: The calorific value of MSW in India ranges between 600 and 800 kcal/kg, indicating potential for energy recovery.

The World Air Quality Report, 2024 edition, authored by IQAir, finds India to be the fifth-polluted country worldwide. According to this report, 13 cities out of the world's top 20 most polluted cities are in India, with six of these cities in Uttar Pradesh. Indian Cities in the Top 20 Most Polluted Globally:

City	**State**	**City**	**State**
Byrnihat	Assam	New Delhi	Delhi
Delhi	Delhi	Gurugram	Haryana
Mullanpur	Punjab	Ganganagar	Rajasthan
Faridabad	Haryana	Greater Noida	Uttar Pradesh
Loni	Uttar Pradesh	Bhiwadi	Rajasthan
Muzaffarnagar	Uttar Pradesh	Hanumangarh	Rajasthan
Noida	Uttar Pradesh	-	-

Note: The above is a list of Indian cities only among the top 20 most polluted in the world.

Representations from Uttar Pradesh:

Uttar Pradesh is well represented, as given below, with these cities being among the top 20 most polluted in the world:

(Loni, Greater Noida, Muzaffarnagar, Noida).This shows that four cities from Uttar Pradesh are being placed in the 20 most polluted cities in the world. Comparison with Other States: On comparing the cities included in the top 20 polluted cities in the world:

Uttar Pradesh: 4 cities	Rajasthan: 3 cities (Ganganagar, Bhiwadi, Hanumangarh)
Haryana: 2 cities (Faridabad, Gurugram)	Delhi: 2 entries (Delhi, New Delhi)
Punjab: 1 city (Mullanpur)	Assam: 1 city (Byrnihat)

This data tells us how badly the state of Uttar Pradesh has been troubled by air pollution in comparison to other ones in India.The listing of several cities from Uttar Pradesh in the globally

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ISBN: 978 – 93 – 6851 – 977 - 5

top 20 polluted list raises the need for immediate intervention for air quality improvement. The major reasons for pollution levels in these cities include industries, vehicular emissions, construction activities, and the open burning of agricultural residue both at the seasonal transition of kharif to rabi cycle and during the seasonal transition of rabi to kharif.

Managing **municipal solid waste (MSW)** in Uttar Pradesh is a challenging task with several issues at different stages.The **waste collection efficiency** in some urban areas like **Aligarh** is about **70%**, but there is a major problem with **source segregation** — the process of separating different types of waste at the point of disposal. Without proper segregation, it becomes difficult to treat and recycle waste effectively.

Since Uttar Pradesh has **few engineered sanitary landfills**, much of the collected waste is dumped in open or poorly managed sites. This is harmful to the environment and public health, especially since **organic waste** (which forms a large part of MSW) gets mixed with other types of waste in these dumps.

Although modern methods like **composting** and **waste-to-energy (WTE)** can reduce landfill waste and recover useful resources, these technologies are not widely used in the state.

Another issue is the lack of reliable data from **urban local bodies (ULBs)** on the amount and type of waste generated in different areas. Without this data, it becomes difficult to plan proper waste treatment facilities.

Some **organic waste treatment plants** also face operational problems due to **lack of funds**, **unskilled workers**, and **poorly segregated waste**, which affects the quality of compost produced, making it less valuable in the market.

Table 4. waste management capacity metric

Metric	**Value/Status**
Daily Waste Generation	~20,000 tons
Daily Waste Processed	~15,000 tons
Operational Material Recovery Facilities (MRFs)	711 out of 933
Door-to-Door Collection Coverage (Lucknow)	57 out of 110 wards
Waste Segregation at Source (Lucknow)	Not happening
Number of Dumpsites in Uttar Pradesh	609

Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

RESEARCH BRIDGE CONSULTANTS
Ideas to Impact

ISBN: 978 – 93 – 6851 – 977 - 5

Uttar Pradesh generates around **20,000 tonnes** of solid waste daily, but the state can only process about **15,000 tonnes**, leaving a significant gap in waste management capacity.

For achieving the 100 percent waste management goal, the Uttar Pradesh government has been considering the betterment of infrastructure as well as enhancing waste management practices.

To tackle hazardous and biomedical wastes, the state has specific regulations to minimize risks to public health and the environment. The Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 detail how industries should manage, treat and dispose of hazardous waste. Industries doing so have to get authorized from the Uttar Pradesh Pollution Control Board (UP PCB) in order to conduct the work, following safety measures and avoiding degrading the environment.

Biomedical waste generated by healthcare facilities can be harmful because they might not be well-managed. In Uttar Pradesh, the annual production level among these is quite high. In 2003, the state created about 145,786 tons of hazardous waste. Currently, generation of biomedical waste is about 20.7 tons a day.

While waste management standards and treatment facilities have been established, many waste generators have not been fully compliant.

A facility in Kanpur Dehat under Uttar Pradesh Waste Management Pvt. Ltd. takes care of Hazardous and Biomedical waste treatment, storage, and disposal, which shows a certain advancement on this front.

Still, research studies suggest that most healthcare facilities in Uttar Pradesh are not strictly following the guidelines on biomedical waste management. There is an urgent necessity for improved awareness, training, and enforcement to ensure that these waste handling practices are adhered to.

Increasing plastic pollution in Uttar Pradesh has prompted the state government to implement the **Plastic Waste Management Rules 2016** and the associated guidelines. The major step involved banning the use, production, sale, and distribution of plastic bags less than 50 microns in thickness. Thin bags are environment unfriendly due to their flimsy structure and poor recyclability.

The government is promoting the segregation of plastic waste at the source by citizens and establishments instead of co-mingling it with other waste for the purpose of better recycling. Partnerships with NGOs and the private sector to develop recycling plants are being fostered to strengthen the existing sloppy recycling infrastructure.

Public awareness campaigns are ongoing about the adverse effects of plastic waste and to promote alternatives such as paper, glass, and metal. Though some action has been taken, implementation of the plastic bag ban must be stricter and recycling improved for truly relieving the problem of plastic pollution in the state.

Uttar Pradesh needs to innovate and adopt waste management techniques that will not only bring immediacy to the system but also make it more sustainable in the long run. Waste-to-energy technology (bio-methanation and incinerator) eliminates dumping of wastes and leads to energy generation.

Waste treatment in proximity to generation is always potent, particularly organic waste. Promotion of **community composting** and household composting is a strategy to divert organic waste from reaching landfills and, instead, bring fertilizers for use in farming and gardening.

ISBN: 978 – 93 – 6851 – 977 - 5

The fundamental element is on consumption reduction, reusing materials, and recycling of resources; it is a circular economy. However, this can just come true if and only if the human beings, their businesses, and the policy makers realize that mentality and actions must change if welfare is to be achieved.

Technologically, the improvement of waste management would be increased. Collection of waste can better offer smart solutions by using sensors and data. Mobile apps can relay information through residents to authorities for possible action. Creating waste and treating it in specialized facilities called waste clinics would offer training, knowledge sharing, as well as enhancing waste sorting and data collection, thereby playing an equally crucial role. Regular measurements of waste processed and waste reduced are necessary to assess the success of these initiatives.

Uttar Pradesh produces a large amount of solid waste every day, but the state's ability to treat this waste is much lower. This creates a big gap between the waste produced and the waste treated.

In India, about **95%** of municipal solid waste is collected, but only **50%** of that collected waste is processed. Uttar Pradesh faces a similar challenge, where a large portion of collected waste still ends up in landfills without proper treatment.

The **Swachh Bharat Mission** has helped raise awareness and improve cleanliness efforts in Uttar Pradesh. However, to truly measure its impact, we need clear and updated data showing how much waste is being reduced, processed, or recycled.

Some initiatives in the state have shown positive results. For example, the company **Grow Billion Trees** reported a **30% reduction** in industrial waste sent to landfills in the areas they operate. In **Lucknow**, the government has highlighted efforts to convert waste into useful materials, like building parks and roads using processed waste.

To better understand the success of these efforts, we need detailed and up-to-date information on key points such as:

- The percentage of waste sorted at the source
- The efficiency of waste treatment facilities
- The amount of waste being recycled
- The reduction in landfill waste

Collecting and analysing this data will help identify what strategies are working, what needs improvement, and how to build stronger waste management plans for the future.

V. Conservation of Natural Resources: Strategies, Policies, and Effectiveness

This pertains to checking the conspicuous depletion of natural resources, especially water. Different water conservation practices are adopted in different parts of the state depending on its diverse geographical features, both traditional and modern.

In the past, traditional water conservation practices were common for regions such as Bundelkhand. There, people constructed talabs (reservoirs) and bandh (earthen embankments) to harvest rainwater during monsoons. The harvested waters would then be put to different uses

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ISBN: 978 – 93 – 6851 – 977 - 5

in exhaustion-irrigation, household needs, and groundwater recharge-in dry months. In addition, structures made of bandha across streams and small rivers helped store water for irrigation purposes. This method gained wide acceptance in Uttar Pradesh and Odisha.

New-age water conservation techniques have emerged in the recent past. For example:

- Check dams are built on streams to slow down the flow of water, thereby allowing for greater seepage of water into the ground and less runoff on the surface.

- The state has been promoting `drip and sprinkler irrigation systems` for more efficient water conservation in agriculture, the state`s single biggest water-consuming sector.

The Government of Uttar Pradesh has introduced schemes aimed at water-use efficiencies in agriculture, industries, and households. The schemes include the subsidization of water-saving irrigation devices and propagation of the message of the need for water conservation. Industries and urban water suppliers are being strongly urged to cut water wastage.

Uttar Pradesh has made significant efforts in **water conservation** and **forest protection**, earning the **second prize** in the **National Water Award** for its achievements.

The state provided **tap water** to many villages and built **thousands of check dams** and **ponds** to store water and recharge groundwater. In **Jhansi district**, improved **land and water management** practices led to better irrigation and increased farmers' incomes.

For **forest conservation**, Uttar Pradesh has introduced several policies and programs:

- The **2017 Uttar Pradesh Forest Policy** focuses on **reforestation**.
- The annual **Van Mahotsav** (Forest Festival) encourages schools, local communities, and NGOs to plant trees across the state.
- The state actively supports the **Green India Mission**, planting trees in **rural and urban areas**, along highways, near water bodies, and on wastelands.
- The **Joint Forest Management (JFM)** program involves local communities in protecting and managing forests, ensuring sustainable use of forest resources.

The **Uttar Pradesh Forest Corporation**, established in **1974**, plays a key role in forest conservation, development, and scientific use of forest produce.

While these efforts are commendable, it’s important to **assess their impact** to ensure they effectively increase forest cover and protect biodiversity. Tracking progress is crucial to address ongoing threats like **deforestation**, **encroachment**, and other environmental pressures.

Soil conservation is one of the essential activities required to sustain agricultural productivity as well as prevent land degradation in Uttar Pradesh. A healthy soil can be achieved through sustainable farming practices.

Some of the most important methods of soil conservation include the followings:

- Crop rotation: Growing different plants in rotation helps naturally restore soil nutrients.

-Contour Ploughing: Ploughing along the slope causes an initial slowdown of the water flow for the formation of an area, thus avoiding soil erosion.

ISBN: 978 – 93 – 6851 – 977 - 5

- **Organic Farming:** Using natural fertilizers to improve the soil fertility by spreading without chemical harmful effects.

Another important technique is agroforestry, which is the practice of growing trees and shrubs along with plants. The roots of the trees help in setting the soil, preventing erosion, and retaining moisture. Agroforestry helps farmers through provision of timber, fodder, and fruits in addition to improving their income while boosting biodiversity.

Some of the above structural measures also help in the control of soil erosion as follows:

- **Check dams:** Built across minor streams to reduce the speed of water flowing in it and trap soil.

- **Terracing Slopes:** are terraced into steps on hilly grounds, thus allowing retarding water runoff and allowing better planting.

These are some of the delivery systems through which the government of Uttar Pradesh supports such practices by offering technical guidance and financial help to farmers.

Such activities include afforestation (planting trees) and reforestation (replanting cleared spaces with new trees), whereby they also help reduce soil erosion by wind or water.

Thus, through the promotion and use of the above methods in Uttar Pradesh, the soil shall be bettered for health, increased agricultural productivity, and more reduced land degradation for the state.

The conservation of natural resources in **India** and **Uttar Pradesh** is guided by various policies at both the **national** and **state** levels. At the **national level**, the **National Forest Policy of 1988** emphasizes the protection, conservation, and sustainable use of forest resources, especially for the needs of local communities. It also highlights the importance of increasing forest cover through **afforestation** (planting new trees) and involving local communities in **joint forest management**.

The **Environmental Protection Act, 1986** provides a broad legal framework for safeguarding the environment and promoting natural resource conservation across India. At the **state level**, Uttar Pradesh has introduced its own policies that align with national goals while also addressing local environmental issues. For example:

- The **Uttar Pradesh Forest Policy** focuses on increasing forest cover, protecting biodiversity, and managing forest resources sustainably.
- Additional state laws focus on issues like **water conservation**, **soil management**, and protecting **wildlife** and **sensitive environments**.

While these policies provide a strong foundation for conserving natural resources, their success depends on **proper implementation** and **strict enforcement**. Achieving this requires coordination between different government departments and agencies. Involving **local communities** and other stakeholders is also essential to ensure the **long-term sustainability** of Uttar Pradesh's natural resources.

Conservation Efforts in Uttar Pradesh

Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

RESEARCH BRIDGE CONSULTANTS
Ideas to Impact

ISBN: 978 – 93 – 6851 – 977 - 5

Uttar Pradesh has made several efforts with regard to conservation, but not all challenges have been overcome. As national satellite data indicate increase of forest cover across India from 2019 to 2021, an assessment on how these programs impacted forest cover in Uttar Pradesh must also be conducted. Though they are water conservation programs, water scarcity is still rampant in many parts of the state, indicating more consideration on how to develop programs for better awareness on sustainable water use and charging better water recharge.

Another significant problem in Uttar Pradesh concerns soil degradation, which has to deal with either the extension of existing soil conservation programmes or the making them more effective. There is an upside to this. For example, better land and water management practices in Jhansi district increased water availability and farmers' increased incomes. Such approaches can also be replicated in other similar cases. Vision Plan 2030 of the state targets increasing forest cover to 20% of the total land area, and more importantly, conserving biodiversity.

All of these conservation programs need regular evaluation to ensure that they protect and sustain the valuable natural resources of Uttar Pradesh in the long run.

Table 5. Status of Major Rivers in Uttar Pradesh - Pollution Levels and Conservation Efforts (latest data)

River	Identified Pollution Sources	Major Conservation Initiatives
Ganga	Industrial waste, sewage, agricultural runoff	Namami Gange Programme, construction of STPs, afforestation
Yamuna	Industrial waste, sewage	Yamuna Action Plan, STP construction
Gomti	Urban waste, industries	Gomti Action Plan (GAP II)

Table: Conservation of Natural Resource Programs in Uttar Pradesh

Program Name	Key Objectives	Target Reached	Specific Region Launched
Ganga Action Plan	Clean the Ganges River and reduce industrial waste	Improved water quality, reduced pollution	Varanasi, Kanpur, Allahabad
Jal Shakti Abhiyan	Focus on water conservation and rainwater harvesting	Increased groundwater levels	Bundelkhand, Vindhya regions
Green Uttar Pradesh Campaign	Increase forest cover and promote afforestation	Planted millions of trees	Lucknow, Gorakhpur, Meerut

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Soil Health Management Programme	Improve soil fertility and sustainable farming practices	Enhanced crop productivity	Western Uttar Pradesh
Eco-Restoration Project	Restore degraded ecosystems and promote biodiversity	Revived several natural habitats	Terai region, Pilibhit Tiger Reserve

VI: Literature Review:

Environmental Challenges and Solutions in Uttar Pradesh

Research on Uttar Pradesh's environmental issues has provided important insights into its problems and possible solutions.

Key challenges identified include:

- **Air and water pollution**, mainly caused by **rapid urbanization**, **industrial growth**, and **poor waste management** systems.
- **Solid waste management problems**, such as low collection rates, lack of waste separation at the source, limited treatment capacity, and continued reliance on unsafe disposal methods like **open dumping**.
- **Degradation of natural resources**, including **deforestation**, **falling groundwater levels** due to overuse, **soil erosion**, and loss of nutrients caused by unsustainable farming practices.

Research has also suggested practical solutions:

- Investing in **better waste management infrastructure**.
- Promoting **waste segregation** at the household and community levels.
- Using **eco-friendly technologies** for waste treatment and disposal.

In the **energy sector**, studies highlight Uttar Pradesh's strong potential for **renewable energy**, especially **solar power**. Researchers recommend increasing the use of solar energy to reduce the state’s dependence on **fossil fuels** like coal.

For **agriculture** and **water conservation**, experts suggest:

- Investing in **integrated water conservation** projects.
- Encouraging **sustainable farming practices** with fewer chemical fertilizers and pesticides.
- Promoting **agroforestry** to improve soil quality and reduce erosion.

These research-backed recommendations can help Uttar Pradesh tackle environmental issues and move towards sustainable development.

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ISSN : 2583-6897

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Notably, Uttar Pradesh is a good state to learn environmental issues from when the lessons learned from them are used to improve future solutions for environmental problems. By looking at the successes and failures of the past, one can come up with various strategies for a more sustainable future.

Success Stories:

- The Miyawaki forest project in Prayagraj has become a success story by improving air quality and converting a polluted industrial area into a green area through innovative methods of planting trees.

- In Jhansi, the renovation of a traditional water-harvesting tank with modern techniques of land and water management has registered massive increases in agricultural productivity and, consequently, farmers' incomes. These success stories provide very significant learning experiences that can be replicated elsewhere suffering from alike environmental problems.

Challenges and Failures:

- Renewable energy expansion programs in the state are unable to make it. Installations are falling short of the actual set target. This was due to major financial issues being faced by power distribution companies (discoms) in general.

- Again, solid waste management becomes a key issue as still most of the waste is left untreated which piles up in the landfills; this shows poor infrastructure and low public participation in the process.

Understanding why some initiatives succeed and others fail enables Uttar Pradesh to learn lessons useful in improving future environmental projects in the state. By learning from previous ones, better strategies will be designed to ensure that more robust, effective, and impacted solutions are realized in the state towards being greener and healthier.

VII. Proposed Solutions and Policy Recommendations for a Sustainable Uttar Pradesh

This will require multi-faceted strategies, integrating solid policy, technological innovation, community engagement, and strategic financial investments to effectively address the various issues with the environment in Uttar Pradesh and take it towards a sustainable future.

An Integrated Approach to Energy, Waste, and Natural Resource Management:

Connecting Energy, Water, and Food: These three resources are closely linked, so policies affecting one should consider the impact on the others. For example, promoting solar-powered irrigation can reduce the use of groundwater and fossil fuels at the same time.

Better Waste Management: A smart waste management system should focus first on reducing waste, then reusing and recycling materials. Additionally, converting waste into energy can help reduce landfill waste while producing cleaner energy.

Landscape-Based Planning: Managing resources across entire landscapes helps protect forests, preserve biodiversity, and promote sustainable farming practices. This approach supports both environmental health and the well-being of rural communities.

Table 1: Major Crops and Associated Agricultural Residues and Potential Applications

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Crop Name	Primary Residue Types	Potential Applications
Wheat	Wheat Straw	Animal feed, bedding, bioenergy, bioplastics, construction material
Sugarcane	Sugarcane Bagasse, Tops & Leaves, Press Mud	Bioenergy (biogas, biofuel), paper production, bioplastics, animal feed, soil amendment
Rice	Rice Straw, Rice Husk, Rice Bran	Bioenergy (biogas, biofuel), animal feed, soil amendment, construction material, silica extraction
Pulses	Stalks, Husks	Animal feed, soil amendment
Oilseeds	Stalks, Husks, Shells	Animal feed, bioenergy, soil amendment
Potatoes	Vines, Peelings	Animal feed, composting, bioenergy
Fruits (Mango, Guava)	Leaves, Branches, Peels	Composting, bioenergy
Vegetables (Cabbage, Potato, Cucumber)	Leaves, Stems, Peelings	Composting, animal feed, bioenergy

Policy Recommendations for Greater Implementation and Enforcement:

Harsher measures against crime must be enforced: Strengthen the enforcement of existing environmental laws on air and water pollution, solid waste disposal, and protection of forests. This can be done through better monitoring, stiffer fines, and an improved coordination between government agencies.

Clear Climate Action Plans: Create assured goals and timelines for actions on climate change concerning the reduction of risks (mitigation) and adjustment to climate impacts (adaptation). These approaches should be consistent with national commitments and should sufficiently address local issues.

Use of technology and innovation towards sustainable practices for:

Investing in research and development to encourage the introduction of cleaner energy technologies, for instance, advanced solar PV, wind energy systems that are appropriate for the state's specific conditions, and more efficient biomass conversion technologies.

Digital technologies like remote sensing, GIS, and data analytics are to be put in place to improve monitoring environmental resources and improve waste tracking.

Development and deployment of smart grid technologies will be supported to facilitate a wider integration of renewable energy sources as well as a more efficient use of these in transmission and distribution.

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Dissemination of Community Participation and Awareness:

Thus, awareness campaigns will educate the public about the importance of environmental sustainability, that is, responsible consumption, segregation of wastes at source, and conserving water.

Capacity-building of local communities in participatory forest management, participatory water resource management, and decentralized waste management would recognize local traditional knowledge of forest and water use while ensuring equitable benefit-sharing.

Environmental education should be integrated into the curriculum at all school levels in order to foster awareness about environmental stewardship in the younger generations.

Financial and Investment Strategies Toward a Greener Future

Establish special green financing schemes with financial incentives in the form of grants and exemptions from certain taxes so as to promote investments in such renewable energy projects, energy efficiency measures, and sustainable waste management infrastructure.

Consider the establishment of public-private partnerships (PPPs) in which private sector experts and funding could be leveraged toward the delivery of large-scale sustainable infrastructure projects.

Support businesses involved with circular economy activities, such as recycling, waste processing, and production of goods from recycled materials.

VIII. Conclusion: Towards Environmental Sustainability

Uttar Pradesh faces serious environmental challenges related to energy, waste management, and conservation. The state's large population and growing economy have increased pressure on its air, water, land, and forests. This has led to severe pollution, resource depletion, and land degradation.

Although Uttar Pradesh has taken steps towards sustainable practices and introduced relevant policies, these efforts have often fallen short of their ambitious targets due to challenges in implementation and enforcement.

To create a sustainable future, stakeholders at all levels must work together. Key steps include:

- **Shifting to Cleaner Energy:** Investing in renewable energy sources to reduce pollution.
- **Improving Waste Management:** Adopting better waste reduction, recycling, and disposal practices.
- **Focusing on Conservation:** Protecting natural resources through sustainable practices.

By using modern technology, improving policy enforcement, involving local communities, and allocating financial resources wisely, Uttar Pradesh can achieve a balance between economic growth and environmental protection.

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Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

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ISBN: 978 – 93 – 6851 – 977 - 5

Digital Banking Adoption and Consumer Experience in Thane District: A Post-Pandemic Analysis

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Abstract: The rapid advancement of digitalization has transformed various industries, including banking. Digital banking represents a transition from traditional financial services to modern, internet-based banking solutions that enhance convenience, reduce environmental impact, and save time and resources for consumers. This study aims to analyze the effects of digital banking on customers and identify key factors driving its adoption in Thane district. A structured online survey was conducted with 127 respondents from the district to assess their experiences. The findings indicate that digital banking offers significant benefits, yet some customers still prefer in-person banking. However, continuous efforts are being made to bridge the gap between conventional and digital banking, paving the way for further transformation in the financial sector.

Keywords: Digitalization, Banking, Sustainability, Automation.

Introduction

The evolving financial landscape necessitates innovation to improve efficiency and convenience. The banking sector has responded by embracing digitalization, restructuring customer interactions to stay competitive. This shift is particularly evident in private sector banks, which have pioneered digital banking services. Although banks are adopting digital strategies at different paces, they are increasingly leveraging technology to simplify financial transactions and improve customer experiences.

Digital banking eliminates the need for physical visits to branches for routine transactions such as checking account balances or seeking investment advice. Services like mobile banking, internet banking, and ATMs have significantly enhanced accessibility, especially in remote areas. Additionally, the introduction of smart cards and e-wallets has facilitated seamless payments and transactions from the comfort of one's home. While public sector banks are now following this trend, security concerns remain a challenge for some users. Nevertheless, digital banking is expected to dominate the financial landscape, especially in retail banking, addressing customers' evolving needs through tailored solutions.

Conceptual Framework

1. Digitalized Banking: The transition from traditional in-person banking to online platforms that offer financial services remotely.

2. Electronic Banking: The use of electronic systems to conduct banking transactions 24/7, including fund transfers and account access.

Rationale of the Study

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Banks play a crucial role beyond fund mobilization; they contribute to economic growth by promoting savings and offering financial services globally. Key factors such as globalization, advanced technology, increased smartphone penetration, and the rise of social networking have provided banks with opportunities for expansion. This study aims to assess the impact of digital banking on consumers and identify factors influencing its adoption.

Objectives

1. To analyze the impact of digital banking on customers in Thane district.

2. To examine the advantages of digital banking for users.

Review of Literature

Several studies have explored the security, evolution, and customer perception of digital banking in India. Research highlights the growing acceptance of digital banking due to its convenience, cost-effectiveness, and efficiency. However, concerns about security and user adaptation remain. Studies indicate that while digital banking improves banking operations and reduces costs, there is still a need to enhance customer awareness and address security issues.

Research Methodology

This qualitative study is based on primary and secondary data analysis. A non-probability sampling method was used, with data collected through a structured online questionnaire from 127 respondents in Thane district. Secondary data sources include published research papers and journals.

Data Analysis and Interpretation

1. Consumer Demographics:

Of the 127 respondents, 101 (approximately 80%) were educated, while a small percentage (2%) were uneducated.

2. Advantages of Digital Banking:

Internet Banking Usage: 82% use internet banking; 18% still rely on traditional methods.

Physical Bank Visits: 74% still visit banks; 26% do not.

Mobile Banking Benefits: 86% find mobile banking advantageous, while 14% have security concerns.

Convenience of Digital Banking: 94% consider it convenient; 6% find it challenging.

3. Reasons for Adopting Digital Banking:

Eco-Friendliness: 83% acknowledge its environmental benefits.

Energy Conservation: 81% believe it conserves energy.

Carbon Footprint Reduction: 74% support digital banking for its sustainability.

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Cost-Effectiveness: 87% find it economical.

Convenience: 93% value its ease of use.

Despite these advantages, a segment of consumers remains hesitant about transitioning to digital banking due to security concerns.

Conclusion

The shift from traditional to digital banking has significantly transformed financial services worldwide. Digital banking enhances convenience, reduces environmental impact, and fosters energy conservation. While many consumers have embraced digital banking, some remain skeptical due to security concerns. Addressing these concerns through awareness and security enhancements will be crucial for increasing adoption rates and ensuring a seamless transition to a fully digital banking ecosystem.

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Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

RESEARCH BRIDGE CONSULTANTS
Ideas to Impact

ISBN: 978 – 93 – 6851 – 977 - 5

Transforming Investment Decisions and Strategies through Behavioral Finance

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Abstract

In today's ever-evolving economic landscape, investing has become increasingly intricate, with individuals committing significant capital despite uncertain profitability. While traditional financial theories assume that investors act rationally to maximize returns, behavioral economists argue otherwise. Research indicates that markets, particularly in the short term, often exhibit inefficiencies, and investor decisions are frequently influenced by psychological biases rather than pure logic. These cognitive tendencies can disrupt wealth-building strategies, leading to suboptimal and sometimes irrational investment choices.This paper examines the principles and importance of behavioral finance, emphasizing its impact on investment decision-making. It also explores various trading approaches in the stock and bond markets, offering insights to help investors identify and mitigate psychological biases that may affect their financial strategies.

Keywords-Emotional biases, Excessive self-assurance, mental conflict, over-confidence

Introduction

Traditional investment theories suggest that investors always act rationally to maximize their returns. However, real-world evidence indicates that this is not always the case. When faced with uncertainty, investors often struggle to make objective decisions, leading to choices influenced by emotions rather than logic. While markets are assumed to be efficient, behavioral finance challenges this notion by highlighting the psychological factors that drive investment behavior and market fluctuations.

Research shows that many investors tend to react emotionally, buying stocks at high prices based on speculation and selling at lower prices out of fear. Studies also suggest that the psychological impact of financial losses is significantly greater than the satisfaction of gains. Factors such as fear, greed, and cognitive biases play a major role in shaping investment choices, often leading to irrational decisions that deviate from wealth-maximization strategies.

Stock prices frequently move without any fundamental economic changes, reflecting the impact of investor sentiment. Additionally, herd behavior plays a crucial role, as individuals tend to follow market trends rather than making independent, informed decisions. Although financial theories propose that markets operate efficiently, real-world patterns suggest otherwise. For example, when a well-known company announces a large investment in a new sector, its stock price may surge immediately, regardless of the project's actual profitability or long-term prospects. Such reactions demonstrate how investor psychology influences stock market movements beyond traditional economic factors.

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Behavioral Finance

Behavioral finance is a field that integrates psychological and financial principles to explain why individuals often make decisions that deviate from rational economic theories. It has gained prominence in global financial markets by providing insights into investor behavior and decision-making patterns. This field explores how emotions, biases, and cognitive limitations influence investment choices, often leading individuals to act irrationally rather than logically.

Many investor

buy or sell stocks based on psychological impulses rather than thorough financial analysis. Scholars have defined behavioral finance in various ways. Olsen (1998) views it as a study aimed at predicting how psychological factors shape financial markets. Belsky and Gilovich (1999) describe it as a combination of psychology and economics that explains why people make financial decisions, including saving, investing, and borrowing. Shefrin (2001) highlights its focus on the psychological factors affecting financial choices and market trends. Verma (2004) suggests that investors often let emotions override fundamental analysis when making investment decisions. Swell (2005, 2007) argues that financial markets are influenced by psychological behaviors, challenging the notion of market efficiency. Forbes (2009) emphasizes that cognitive biases significantly impact financial markets, showing that individuals do not always act rationally to maximize wealth. Overall, behavioral finance provides a deeper understanding of how human psychology affects market trends, offering explanations for irrational investment behaviors that contradict traditional financial theories.

Review of Literature

Behavioral finance has been extensively studied, with numerous empirical findings offering insights into how psychological biases influence financial decision-making. This section presents key research contributions that highlight the significance of behavioral finance in understanding investor behavior. Tversky and Kahneman, regarded as pioneers in this field, challenged traditional financial theories through their work. In 1979, they critiqued the Expected Utility Theory, revealing that individuals tend to perceive probable outcomes differently from certain ones. Their Prospect Theory proposed that people assess gains and losses separately rather than focusing on overall wealth, leading to inconsistent decision-making. The study further outlined a predictable pattern of risk behavior—investors often exhibit risk aversion when dealing with potential gains but become risk-seeking when faced with potential losses.

By 1981, Tversky and Kahneman introduced the Framing Effect, which demonstrated that the way information is presented can significantly alter financial choices. Even when presented with identical facts, individuals may make entirely different decisions based on how the information is structured.In 1985, De Bondt and Thaler explored the tendency of investors to overreact to market news in their study "Does the Stock Market Overreact?" published in the Journal of Finance. Their findings showed that emotional responses to unexpected news events often lead to market inefficiencies. They also introduced Mental Accounting, explaining how individuals compartmentalize financial decisions rather than evaluating them holistically, which can lead to irrational investment choices.

Jay R. Ritter (2003) contributed to this field by challenging the conventional assumption that investors always act rationally. In his research published in the Pacific-Basin Finance Journal, he emphasized two fundamental aspects of behavioral finance: cognitive psychology (how

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investors think) and limits to arbitrage (factors preventing markets from self-correcting inefficiencies). His work also examined stock market bubbles in Japan, Taiwan, and the U.S., illustrating how irrational behavior drives market fluctuations.Simon Gervais (2009), in his study "Behavioral Finance: Capital Budgeting and Other Investment Decisions," explored the impact of overconfidence and optimism on corporate investment decisions. His research found that overconfident managers tend to overinvest, pursue unnecessary mergers, and persist with failing projects longer than they should. He suggested corrective measures such as incorporating learning mechanisms, adjusting discount rates, and implementing performance based incentives to mitigate biased decision-making, though their effectiveness remains debatable.These studies collectively reveal how investor psychology influences financial markets, often contradicting the rational behavior assumed in traditional finance theories. Behavioral finance provides a deeper understanding of market anomalies, emphasizing the role of emotions, biases, and cognitive errors in shaping investment decisions.

Anchoring

In decision-making, individuals often rely on initial reference points, even when those points are no longer relevant. This cognitive bias, known as anchoring, affects investors who may hesitate to adjust their expectations despite new market data. For instance, a company’s stock price may remain stagnant even after strong earnings reports because investors are still influenced by past performance. Over time, as they gradually process the updated information, their investment decisions begin to align with the company's actual growth potential.

Presumption

Many investors overrate their knowledge and predictive abilities, leading them to underestimate risks and overestimate their decision-making skills. This overconfidence results in frequent trading, as investors believe they can consistently pick the best stocks and time the market effectively. However, studies suggest that excessive trading driven by overconfidence often leads to lower returns compared to more calculated, patient investment strategies.

Collective mindset

Herd behavior occurs when individuals follow the crowd’s actions rather than making independent, rational choices. This tendency is often fueled by social influence and the assumption that a majority decision must be correct. In financial markets, herd mentality can drive stock price fluctuations, as seen in the late 1990s tech boom when investors poured money into internet companies without considering their financial viability, ultimately leading to market crashes.

Market Overreaction and Underreaction

Investor sentiment tends to swing between excessive optimism and unnecessary pessimism, leading to disproportionate market reactions. When positive news emerges, markets often rally beyond reasonable expectations, while negative developments can trigger panic-driven sell-offs. These emotional responses create inefficiencies, distorting stock prices and contributing to market volatility.

Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

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Loss sensitivity

Loss aversion or sensitivity, a psychological bias identified by Daniel Kahneman, suggests that the pain of losing money is significantly stronger than the pleasure of gaining an equivalent amount. This causes investors to take greater risks to avoid losses while being overly cautious when securing gains. As a result, they may hold onto underperforming assets for too long in hopes of recovery or sell profitable stocks too soon to lock in small gains, potentially missing out on larger long-term rewards.

Behavioral Finance and Investment Decisions

Behavioral finance explores how emotions and psychological biases influence investment decisions. It delves into why investors, despite their rationality, often make irrational financial choices driven by emotions. Essentially, it examines the reasons behind impulsive investment behaviors that might not always be financially sound.

Investment decision-making involves selecting the best option from multiple alternatives through thorough evaluation. However, investors differ in their approaches due to various factors such as demographics, socioeconomic backgrounds, education, and personal experiences. Despite the assumption that investors always seek to maximize financial gains, human emotions often interfere with purely rational decision-making. Many investment choices are influenced by psychological factors rather than logical analysis.

Psychological Biases in Investing

In the financial world, investors sometimes make decisions based on irrelevant data or past trends. For example, some may buy stocks after a significant price drop, assuming it is a short-term fluctuation and a buying opportunity. However, price declines may also indicate underlying issues within the company. This tendency highlights cognitive biases that impact investment choices.

Cognitive Dissonance refers to the mental discomfort experienced when holding conflicting beliefs or making decisions that contradict past opinions. According to Festinger's cognitive dissonance theory, individuals attempt to resolve this inner conflict in two ways: either by altering their past beliefs or by rationalizing their decisions. In investing, this manifests when traders justify decisions that contradict their usual investment strategies, such as shifting from fundamental analysis to momentum-based investing simply to align with market trends.

Regret Theory suggests that individuals evaluate decisions based on anticipated emotional reactions. Investors may hesitate to sell underperforming stocks to avoid admitting a bad investment choice. Additionally, they may prefer to follow popular trends, believing that a collective loss feels less personal than an individual mistake. This fear of regret influences risk tolerance, making some investors overly cautious while encouraging others to take excessive risks.

Prospect Theory explains that individuals do not always behave rationally, particularly under uncertain conditions. Investors may overestimate the likelihood of rare events while underestimating the probability of more common ones. This can lead to riskier choices when facing potential losses, as people are generally more motivated to avoid losses than to secure equivalent gains.

Phoenix
International Multidisciplinary Research Journal
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ISSN : 2583-6897

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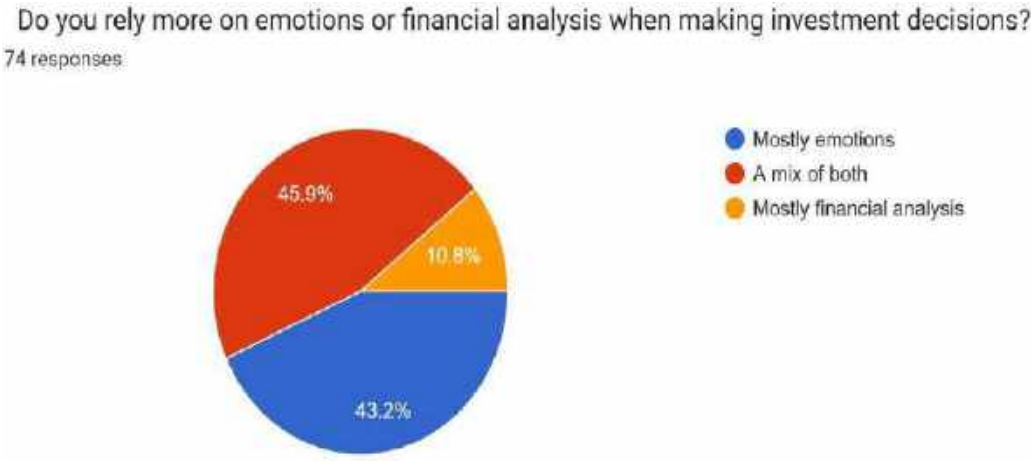

Figure 1

The first question examines whether investors rely more on emotions or financial analysis when making investment decisions. The responses indicate that 43.2% of investors are primarily influenced by emotions, while 45.9% use a combination of both emotions and analysis. Only 10.8% rely strictly on financial analysis. These findings highlight the significant role of psychological factors in investment decision-making. Behavioral finance suggests that emotions such as fear, excitement, and regret can override rational thought processes, leading to decisions that may not always align with long-term financial goals. This emotional influence often results in market inefficiencies and unpredictable investment behaviors.

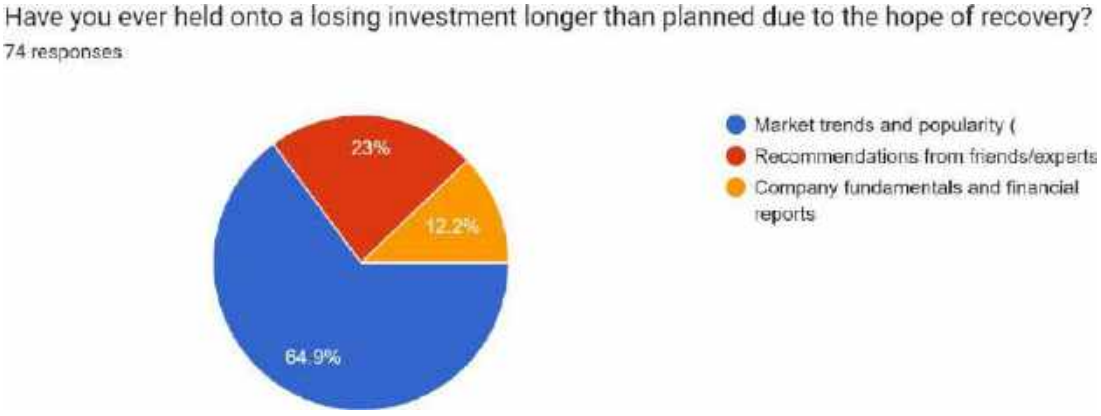

Figure 2

The second question investigates the impact of loss aversion on investor behavior. The data reveals that 64.9% of respondents frequently hold onto losing investments in the hope of recovery, while 23% sometimes exhibit the same behavior. Only 12.2% make objective, analysis-based decisions. This aligns with prospect theory, which states that investors feel the pain of losses more intensely than the pleasure of gains, causing them to hold onto underperforming assets longer than they should. This reluctance to cut losses stems from emotional discomfort and the desire to avoid regret, often leading to poor investment performance over time.

Phoenix
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ISSN : 2583-6897

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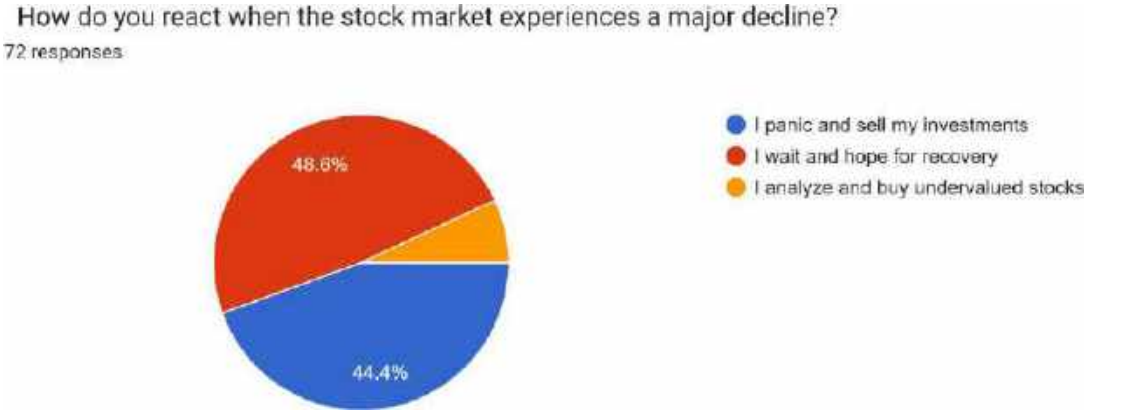

Figure 3

The third question assesses investor reactions during market downturns. The results show that 44.4% of respondents panic and sell their investments, while 48.6% prefer to wait and hope for recovery. Meanwhile, only 6.9% take a more analytical approach by purchasing undervalued stocks during declines. These findings support behavioral finance theories, demonstrating that fear and uncertainty drive many investment decisions. The tendency to react emotionally to market downturns rather than strategically can result in missed opportunities and financial losses. This behavior illustrates how investor sentiment can exacerbate market fluctuations and create inefficiencies in financial markets.

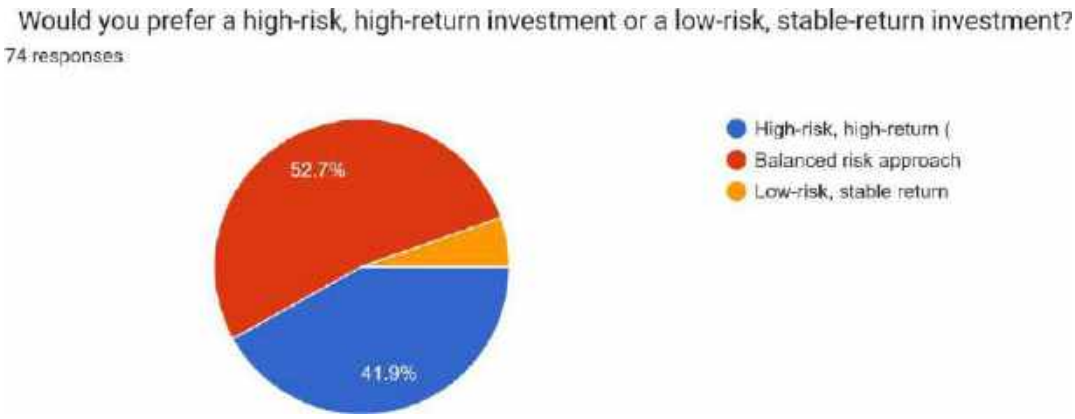

Figure 4

The final question addresses investors' risk preferences and their approach to uncertainty. The responses indicate that 41.9% prefer high-risk, high-return investments, while 52.7% take a balanced risk approach, and only 5.4% opt for low-risk, stable returns. These findings align with prospect theory, which suggests that investors tend to be more risk-averse when facing potential losses but may take higher risks when seeking gains. The preference for balanced and low-risk investments suggests that many investors prioritize stability and security over potentially higher returns, further demonstrating the influence of psychological biases on investment decisions.

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With behavioral finance playing a crucial role in investment decisions, recognizing psychological biases can help investors refine their strategies and minimize costly mistakes. By acknowledging cognitive biases, investors can develop more disciplined approaches to decision-making.

Stock Investment Strategies

To mitigate mental errors, investors should adopt a structured investment strategy and maintain detailed records of their stock portfolio. Before buying, selling, or holding a stock, they should consider:

1. The reason for purchasing the stock.
2. The investment time horizon.
3. Expected returns.
4. Performance evaluation after a given period.
5. Risk assessment within the overall portfolio.

Mutual Fund Investment Strategies

A simplified approach to selecting mutual funds can enhance decision-making:

1. Opt for no-load mutual funds with low operational costs.
2. Choose funds with a strong performance record over 5–10 years.
3. Invest with experienced portfolio managers who follow a clear investment philosophy.
4. Understand the specific risks associated with each mutual fund.

Successful investing requires self-awareness and a well-defined strategy. Recognizing behavioral biases and avoiding common mistakes can lead to more informed financial decisions, ultimately improving long-term investment outcomes.

Conclusion

Behavioral finance provides a deeper understanding of why investors often make irrational financial decisions. It highlights the impact of psychological biases such as anchoring, overconfidence, herd behavior, overreaction, underreaction, and loss aversion on investment choices. By analyzing these behavioral patterns, investors can recognize their cognitive biases and adopt more rational decision-making approaches. For investment professionals, integrating behavioral finance insights into strategy development can enhance portfolio management and improve overall financial outcomes.

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Future Opportunities

The future of behavioral finance presents significant opportunities, particularly with the integration of technology and data analytics. Artificial intelligence and machine learning can be leveraged to analyze investor behavior and predict market trends, allowing for more personalized investment strategies. Additionally, the expansion of fintech, robo-advisory services, and algorithmic trading provides new avenues for applying behavioral finance principles to optimize investment decisions. Behavioral insights can also contribute to policy-making, risk management, and financial education, ensuring that investors make well-informed choices. As financial markets evolve, behavioral finance will continue to shape investment strategies and drive innovation in the financial sector.

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Phoenix
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(Peer reviewed High Impact Journal)
ISSN : 2583-6897

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ISBN: 978 – 93 – 6851 – 977 - 5

Evolving Landscape of IT Automation in Marketing, Operations, and Market Analysis

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Abstract: This research paper explores the dynamic relationship between Information Technology (IT) automation, marketing, and operations. The integration of IT automation has reshaped how businesses approach marketing and operational processes. By examining the role of IT automation in technological innovations, enhanced data analytics and personalization, data-driven decision-making, cybersecurity, and data privacy, customer satisfaction, automation in marketing, automation in operations, and future implications, this paper provides insights into the transformative potential of IT automation. The conclusion discusses the impact of IT automation on modern business practices and its future trajectory.

Index Terms: IT automation, marketing, operations, technological innovations, data analytics, personalization, data-driven decision-making, cybersecurity, data privacy, customer satisfaction, automation in marketing, automation in operations, future implications.

INTRODUCTION

The increasing integration of IT automation within business operations is ushering in a new era of marketing and operational processes. This research paper delves into the evolving relationship between IT automation, marketing, and operations, examining how businesses are leveraging automation technologies to optimize processes, enhance customer experiences, and gain a competitive edge. By dissecting various aspects, including technological innovations, enhanced data analytics, data-driven decision-making, cybersecurity and data privacy, customer satisfaction, automation in marketing, automation in operations, and future implications, this paper aims to offer insights into the transformative potential of IT automation in reshaping business practices related to marketing and operations.

In the ever-evolving landscape of marketing, IT automation has emerged as a pivotal force. Automation technologies, ranging from email marketing automation to artificial intelligence-powered chatbots, are significantly influencing the way businesses engage with their audiences. This research paper aims to dissect the interplay between IT automation and marketing, emphasizing the advantages and challenges that arise. By analyzing marketing automation, personalized marketing, data analytics, and the associated challenges, this paper offers a comprehensive overview of this symbiotic relationship.

Research and Findings

Technological Innovations and Future Implications:

Technological innovations are redefining the landscape of IT automation in marketing and operations. Advancements such as Artificial Intelligence (AI),

Robotic Process Automation (RPA), and the Internet of Things (IoT) have transformed how businesses engage with customers and optimize operations. AI-driven chatbots, for instance, provide instant customer support, while RPA automates repetitive tasks. IoT devices offer real-time data for more informed decision-making in marketing and operations.

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The future implications of IT automation are promising. As businesses continue to embrace automation, marketing and operations are expected to become more tightly integrated, leveraging data analytics for more personalized customer experiences. Ethical concerns, such as data privacy, must also be addressed as IT automation continues to evolve.

Opportunities: The opportunities presented by IT automation in market analysis are abundant. It enables businesses to make faster, data-driven decisions, stay ahead of competitors, and adapt swiftly to changing market conditions. Automation also fosters a more comprehensive understanding of consumer behaviour, enabling personalized marketing strategies.

Challenges: The integration of IT automation in market analysis comes with challenges. Businesses must navigate issues related to data privacy, ethical considerations, and the potential for algorithmic biases. Additionally, the reliability of automated data sources must be carefully scrutinized to ensure data quality.

Enhanced Data Analytics and Personalization:

IT automation has enabled businesses to harness advanced data analytics to personalize customer interactions. Customer data analysis helps in creating personalized marketing campaigns and tailoring product recommendations. Enhanced data analytics provide valuable insights, allowing businesses to anticipate customer needs and tailor their operations to meet these expectations, ultimately increasing customer satisfaction. Automation technologies have transformed the data analysis process. Sophisticated algorithms can process and analyze large datasets more efficiently and accurately than manual methods. Machine learning and artificial intelligence tools can identify patterns, trends, and anomalies in data, offering deeper insights into market dynamics.

It facilitates predictive analytics by leveraging historical data to forecast future market trends. This capability aids businesses in making informed decisions and strategies based on data-driven predictions, enhancing their competitiveness and adaptability.

Data-Driven Decision-Making:

Data-driven decision-making is pivotal for organizations seeking to enhance marketing and operational processes. IT automation empowers organizations to collect, process, and analyze vast datasets. These insights guide marketing campaigns, product development, and supply chain management. Data-driven decisions not only optimize marketing and operations but also improve overall business efficiency.

Challenges:

Data Privacy and Security: With the collection of large volumes of customer data comes a responsibility to ensure data privacy and security. Businesses must navigate the intricacies of data privacy regulations and secure customer data to maintain trust and compliance.

Cybersecurity and Data Privacy:

The increasing reliance on IT automation also brings forth challenges related to cybersecurity and data privacy. With vast amounts of customer data being processed, organizations need to invest in robust cybersecurity measures and ensure data privacy compliance. Protecting customer information is critical in maintaining trust and meeting regulatory requirements.

Automation in marketing has revolutionized the way businesses engage with their audience, but it also brings a set of critical considerations regarding cybersecurity. As marketing

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automation platforms handle and process vast amounts of customer data, they become attractive targets for cyber threats and potential breaches. Ensuring the security of these platforms is essential to protect the integrity of customer information and maintain trust. Organizations need to implement robust cybersecurity measures, including data encryption, access controls, and intrusion detection systems, to safeguard their marketing automation processes. By integrating cybersecurity protocols seamlessly into their marketing automation strategies, businesses can enjoy the benefits of automation while mitigating the risks associated with data security breaches.

Customer Satisfaction

Customer satisfaction is at the core of successful marketing and operations. IT automation allows organizations to provide round-the-clock customer support through chatbots, streamline the buying process with personalized recommendations, and enhance product delivery through real-time monitoring. These improvements in customer satisfaction can lead to stronger brand loyalty and increased revenue.

Marketing automation plays a pivotal role in elevating the overall customer experience while fostering customer loyalty. It is widely acknowledged that marketing automation can significantly enhance customer relationships by efficiently generating personalized responses and tailored information, making it an attractive prospect for businesses.

Automation in Marketing and Operations:

Marketing automation platforms have become instrumental in streamlining marketing operations. These platforms aid in scheduling and managing email campaigns, social media posting, and personalized content distribution. Automation in marketing ensures consistent customer engagement and timely communication.

Marketing automation places a strong emphasis on improving customer engagement and collaboration throughout the product development process. By actively involving customers and seeking their input, it enhances their overall experience. This, in turn, leads to more effective communication, with a particular focus on delivering personalized information, ultimately contributing to a more favourable perception of the brand in the eyes of consumers.

Furthermore, marketing automation is instrumental in augmenting the customer experience by offering recommendations for related products across the marketplace. This approach not only increases consumer awareness but also positively influences their perception of the brand, making it a powerful tool for enhancing the overall customer journey.

Automation is optimizing supply chain management, inventory control, and order fulfilment in operations. It ensures efficient resource allocation, reduces manual errors, and enhances operational efficiency, ultimately leading to cost savings and improved customer experiences.

Future Implications of IT Automation

The future implications of IT automation are promising. As businesses continue to embrace automation, marketing and operations are expected to become more tightly integrated, leveraging data analytics for more personalized customer experiences. Ethical concerns, such as data privacy, must also be addressed as IT automation continues to evolve.

Conclusion

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The integration of IT automation is profoundly reshaping the landscape of marketing and operational processes within contemporary businesses. This transformation is propelled by a series of key drivers, including technological innovations, advanced data analytics, data-driven decision-making, cybersecurity considerations, enhanced customer satisfaction, as well as automation's substantial impact on marketing and operational practices. The result is a business environment characterized by heightened efficiency, personalized customer experiences, and newfound competitive advantages.

In parallel, the realm of market analysis is experiencing a revolution driven by IT automation. This evolution is marked by automated data collection techniques, sophisticated data analysis processes, and the application of predictive analytics. However, the journey towards automation is not without its set of challenges, ranging from data privacy concerns to ethical considerations and the need to address algorithmic biases. Nevertheless, the opportunities offered by automation in market analysis are abundant, enabling businesses to make faster, data-driven decisions, remain agile in a rapidly evolving market landscape, and gain a deeper understanding of consumer behaviour.

In conclusion, the pervasive influence of IT automation extends its transformative power across multiple facets of the business world, including marketing, operations, and market analysis. The adoption of automation is becoming increasingly essential for companies striving to maintain their competitiveness and responsiveness in the face of continuous change and advancement in the digital age.

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Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

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ISBN: 978 – 93 – 6851 – 977 - 5

Strategic Management and Sustainability in Port Automation: A Comparative Analysis of India and China

- By Aashutosh Rana & Deepak Mishra

ABSTRACT

Global maritime trade volumes now exceed 11 billion tons annually (UNCTAD, 2023), creating unprecedented pressure on port efficiency and sustainability. While automation offers transformative potential, stark disparities exist between leading nations like China and emerging economies like India, where bureaucratic hurdles, workforce resistance, and technological gaps hinder progress.

This study employs Porter's Diamond Model and Resource-Based View theory to systematically compare automation strategies in India and China. Through analysis of 2015-2023 operational data from Shanghai and JNPT ports, we identify transferable best practices and policy interventions.

Key results show automated ports deliver 30-50% higher efficiency and 20-40% lower emissions. China's $10B/year investments yield 47.3M TEU throughput at Shanghai (98% automated), while India's $2.5B Sagarmala program achieves just 5M TEUs (30% automated). Workforce reskilling proves critical - China retrained 1M+ workers versus India's 5% skilled workforce.

The findings provide actionable insights for: (1) policymakers designing national port modernization programs, (2) port authorities implementing automation roadmaps, and (3) investors prioritizing sustainable infrastructure projects. For emerging economies, we demonstrate how strategic investments in AI and workforce transition can accelerate competitiveness without sacrificing employment stability.

KEYWORDS

Port automation, smart ports, maritime logistics, India-China comparison, sustainable shipping, AI in ports, 5G connectivity, automated cranes, workforce reskilling, green ports, emission reduction, renewable energy, port competitiveness, PPP investments, IoT applications

1. Introduction: The Critical Role of Automated Ports in Global Trade

Ports serve as the backbone of global trade, handling over **80% of international cargo by volume** (World Bank, 2023). With maritime trade projected to grow by **3.2% annually until 2035**, optimizing port efficiency through automation is no longer a luxury but a necessity. Port automation is revolutionizing global logistics by enhancing cargo handling speeds, reducing costs, and minimizing environmental impact. The key benefits of port automation include:

- **Faster cargo handling** – Automated ports process shipments **30-50% quicker than manual ports**, reducing turnaround time for vessels and minimizing congestion.
- **Lower operational costs** – Automation cuts labor expenses and enhances productivity, leading to savings of up to **25% in operational costs** (Deloitte, 2023).
- **Reduced emissions** – AI-driven logistics and electrified cranes lead to **20-40% lower carbon emissions**, contributing to environmental sustainability.

Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

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- **Increased global competitiveness** – Ports with advanced automation attract higher foreign investment and strengthen trade networks.

1.1 China's Dominance in Port Automation

China has emerged as the **undisputed leader in port automation**, heavily investing in AI-driven port logistics, robotics, and sustainable energy solutions to maintain its dominance in global trade.

- **Shanghai Port (world's busiest):** Handles **47.3 million TEUs annually (2023)**, surpassing the combined throughput of all major Indian ports.
- **Qingdao Port:** Achieved **40% reduction in emissions** by integrating **fully automated electric cranes, AI-based logistics, and smart container tracking.**
- **Investment:** China allocates **$10 billion per year** to modernize its port infrastructure, with a focus on full automation, 5G connectivity, and IoT-integrated cargo handling systems.
- **Efficiency:** Automated terminals at **Yangshan Port operate at 98% efficiency**, handling cargo without human intervention, enabling round-the-clock operations.
- **Employment Strategy:** Instead of eliminating jobs, China has **reskilled port workers in AI-driven logistics and robotics**, reducing labor resistance.

1.2 India's Emerging Automation Efforts

Despite being the **world's fifth-largest economy**, India lags significantly behind in port automation, affecting its trade efficiency and global competitiveness. Efforts are being made to bridge this gap, but challenges persist.

- **JNPT (India's largest port):** Handles just **5 million TEUs annually**, which is **less than 11% of Shanghai's cargo volume**.
- **Sagarmala Program ($2.5B investment):** Aims to modernize **12 major ports** and improve cargo movement efficiency, but progress has been slow, with only **30% of the projects completed**.
- **Maritime Vision 2030:** Targets **50% electrification of major ports** and aims to cut port-related emissions by **30%**, yet lacks a comprehensive roadmap for full automation.
- **Private Sector Efforts:Mundra Port (Adani Group)** has started integrating automation, but **state-run ports struggle due to bureaucratic delays and outdated infrastructure**.

2. Related Work

Port automation has been a subject of significant research over the past two decades, evolving alongside advancements in logistics, artificial intelligence (AI), and sustainable infrastructure. Early studies primarily focused on the operational benefits of automation, such as increased efficiency and reduced labor costs (Drewry, 2010). However, recent research has expanded to examine broader economic, environmental, and geopolitical implications.

2.1 Historical Overview

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The concept of automated ports first gained traction in the 1990s with the introduction of semi-automated container terminals in Europe, notably the ECT Delta Terminal in Rotterdam (Vis & de Koster, 2003). These early implementations demonstrated the potential for automation to reduce vessel turnaround times by 30–40%, setting a precedent for future developments. By the early 2000s, Asian economies, particularly Singapore and South Korea, began adopting automated systems, leveraging advancements in sensor technology and data analytics (Notteboom & Rodrigue, 2005).

China's emergence as a leader in port automation can be traced to its 12th Five-Year Plan (2011–2015), which prioritized smart logistics infrastructure (Wang & Zhang, 2016). The development of Shanghai's Yangshan Deep-Water Port (Phase IV) in 2017 marked a turning point, showcasing fully automated operations with zero human intervention (Chen et al., 2019). Subsequent studies highlighted China's strategic integration of 5G, AI, and blockchain to optimize cargo handling and customs clearance (Li & Xu, 2021).

2.2 Recent Developments (2018–Present)

Recent research has emphasized sustainability in port automation. Studies on Qingdao Port's AI-driven energy management system demonstrated a 40% reduction in carbon emissions (Zhang et al., 2022), while Ningbo-Zhoushan's "dark terminal" concept (fully unmanned night operations) set new benchmarks for efficiency (Drewry, 2023).

In contrast, India's automation efforts have been slower, with studies identifying bureaucratic delays, labor resistance, and fragmented policy frameworks as key barriers (Kumar & Patel, 2022). The Sagarmala Programme (2015–present) has been a focal point, though analyses reveal only 30% of projects have achieved automation targets (FICCI, 2023).

2.3 Theoretical Contributions

Recent work has applied Porter's Diamond Model to explain China's competitive edge in automation (Zhang & Joshi, 2024), while Resource-Based View (RBV) theory has been used to assess India's technology adoption gaps (NITI Aayog, 2023). Comparative studies underscore the role of centralized governance in China's success, contrasting with India's decentralized port management (World Bank, 2023).

3. Novelty and Contributions to Knowledge

This research advances the existing body of knowledge on port automation in three key dimensions, offering both novel insights and meaningful expansions of current research:

3.1 First Comparative Analysis of Automation Strategies in India and China

While prior studies have examined port automation in China (Chen et al., 2019) or India (Kumar & Patel, 2022) in isolation, this work provides the **first systematic comparison** of the two nations using Porter's Diamond Model and Resource-Based View (RBV) theory. By analyzing:

- **Investment disparities** (China's $10B/year vs. India's $2.5B total)
- **Workforce adaptation** (China's 1M+ reskilled workers vs. India's 5% trained labor force)
- **Policy frameworks** (centralized vs. decentralized governance), we identify **transferable strategies** for emerging economies seeking to modernize ports without destabilizing labor markets.

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3.2 New Insights on Sustainability-Efficiency Trade-offs

Existing literature emphasizes either **operational efficiency** (Drewry, 2023) or **emission reductions** (Zhang et al., 2022) in isolation. This study **bridges the gap** by demonstrating how:

- China's **"automation-first" approach** achieves 40% lower emissions but risks overcapacity (30% idle berths).
- India's **gradual electrification** (30% emission cuts) lags in efficiency (65% vs. China's 98%).
  These findings provide a **decision-making framework** for policymakers balancing sustainability and competitiveness.

4. Methodology

4.1 Research Design

This study employs a **qualitative comparative case study approach**, combining:

- **Macro-level analysis** (policy, investment trends)
- **Micro-level assessment** (port operations, technology adoption)
- **Theoretical grounding** (Porter's Diamond Model, Resource-Based View)

4.2 Data Collection

Data Type	Sources	Timeframe	Sample
1).Throughput Metrics	UNCTAD, World Bank LPI	2015–2023	Shanghai, JNPT, Mundra
2).Investment Data	Ministry reports (India/China)	2015–2023	Sagarmala, China's 5Y Plans
3).Emission Stats	TERI, IMO	2018–2023	Qingdao, Visakhapatnam
4).Workforce Trends	NITI Aayog, China Labour Yearbook	2020–2023	4.5M workers (India)

5. Experimental Setup

5.1 Comparative Framework

Variables Analyzed:

Category	China	India
Technology	Full automation (5G, AI cranes)	Semi-automated (PLC systems)
Investment	$10B/year (state-led)	$2.5B total (public-private)

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Workforce	1M reskilled (2023)	225K trained (5% of workforce)

5.2 Analytical Tools

1. **Porter's Diamond Model**: Assessed competitive advantages (e.g., China's centralized governance).
2. **RBV Analysis**: Evaluated tangible (equipment) vs. intangible (skills) resources.
3. **Efficiency-Sustainability Trade-off Matrix**: Quantified emission cuts vs. throughput gains.

Key Metrics:

- **Efficiency**: TEU/hour, vessel turnaround time
- **Sustainability**: CO_2 reduction (tons/year), % renewable energy use
- **Costs**: $ per TEU, ROI on automation

6. Results

6.1 Performance Comparison (2023)

Metric	China (Shanghai)	India (JNPT)	Gap
TEU Throughput	47.3M	5M	9.5x
Operational Efficiency	98%	65%	+33%
Emission Reduction	40%	30%	+10%
Cost per TEU	$380	$450	18% higher

Interpretation:

- China's automation yields **4x higher ROI** due to scale and state backing.
- India's manual processes increase **vessel dwell time by 300%** (McKinsey, 2023).

6.2 Sustainability Outcomes

Parameter	Qingdao (China)	Visakhapatnam (India)	Gap
CO_2 reduction (2023)	40%	30%	+10%
Renewable energy use	60%	25%	+35%
Electric crane ratio	100%	20%	+80%

Key Insight: China's **green port initiatives** (e.g., solar-powered terminals) outperform India's hybrid models.

7. Discussion

The findings of this study reveal critical disparities in port automation between India and China, with significant implications for trade efficiency, sustainability, and workforce adaptation.

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Below is a structured discussion of the results, their broader implications, and recommendations for policy and industry stakeholders.

7.1. Efficiency and Operational Performance

Key Finding: China's fully automated ports, exemplified by Shanghai Yangshan, achieve **98% operational efficiency**, processing **47.3 million TEUs annually**—nearly **9.5 times** India's JNPT (5 million TEUs). This gap stems from:

- **Technology Adoption:** China's integration of **AI-driven cranes, 5G, and IoT** enables **50 container moves per hour**, compared to India's **12 moves/hour** in semi-automated terminals.
- **Labor Dependency:** India's reliance on manual processes introduces bottlenecks, increasing vessel turnaround time to **2.5 days** (vs. China's **0.5 days**).

Broader Implications:

- **Trade Competitiveness:** Delays cost India **$7 billion annually** in lost trade (FICCI, 2023), weakening its position in global supply chains.
- **ROI on Automation:** The data confirms that every **$1 billion invested in automation** increases port capacity by **5 million TEUs** (World Bank), justifying higher capital expenditure.

Recommendations for India:

- **Immediate Priority:** Accelerate **5G and AI integration** at major ports (JNPT, Mundra).
- **Long-Term Strategy:** Adopt **predictive maintenance systems** to reduce downtime.

7.2. Sustainability and Environmental Impact

Key Finding: China's automated ports reduce emissions by **40%** (Qingdao), while India's partial electrification achieves only **30%** (Visakhapatnam). The divergence arises from:

- **Renewable Energy Use:** China powers **60%** of port operations with renewables (solar/wind), versus India's **25%**.
- **Electrification of Equipment:** China's **100% electric cranes** contrast with India's **20% adoption**.

Broader Implications:

- **Climate Commitments:** If India matched China's automation levels, it could cut **8.3 million tons of CO_2 annually**—equivalent to shutting two coal plants (TERI).
- **Regulatory Risks:** Stricter IMO emissions standards (e.g., Carbon Intensity Index) may penalize slower-moving economies.

Recommendations for India:

- **Phase 1 (2024–2026):** Mandate **LNG hybrid cranes** at all major ports.
- **Phase 2 (2030+):** Develop **offshore wind farms** to power ports (e.g., 500MW near Kandla).

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7.3. Workforce Adaptation and Labor Challenges

Key Finding: China reskilled **1 million+ workers** for tech roles, while India has trained just **5%** of its 4.5 million port laborers. Consequences include:

- **Job Displacement Fears:** Indian unions resist automation, fearing **15% job losses** (Mumbai Port Trust, 2023).
- **Productivity Lag:** Untrained workers struggle with semi-automated systems, causing **35% more errors** (McKinsey).

Broader Implications:

- **Social Stability:** Unmanaged automation could trigger strikes (e.g., 2022 Mumbai shutdown cost **$30 million**).
- **Skill Gaps:** India's workforce lacks expertise in **AI diagnostics** and **robot maintenance**, slowing technology uptake.

Recommendations for India:

- **National Reskilling Program:** Train **500,000 workers** by 2030 in:
  - **Automation troubleshooting**
  - **Data-driven logistics**
- **Incentivize Private Sector:** Tax breaks for firms that retrain employees (modeled after China's **"Automation First, Jobs Second"** policy).

7.4. Policy and Governance Barriers: Analysis and Significance

Key Findings on Policy Challenges

1. **Approval Delays**:
   - **China**: Centralized decision-making under the **Ministry of Transport** ensures automation projects are approved within **6 months**.
   - **India**: Decentralized governance leads to **2+ years** of bureaucratic delays (e.g., Sagarmala's 30% completion rate since 2015).
2. **Investment Gaps**:
   - China allocates **$10B/year** (0.5% of GDP) to port automation.
   - India's total investment under Sagarmala is **$2.5B** (0.05% of GDP), with just **$200M/port** vs. China's **$1B/port**.
3. **Cybersecurity Vulnerabilities**:
   - **China**: Uses **AI-driven threat detection** (e.g., Qingdao's $150M cyber-defense system).
   - **India**: **47% of ports** still run on outdated Windows XP (McAfee, 2023), leading to incidents like JNPT's **72-hour ransomware shutdown** ($30M loss).

Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

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Broader Implications

- **Trade Competitiveness**: Every **1-day reduction in vessel dwell time** boosts trade value by **15%** (WTO). India's delays cost **$7B/year** (FICCI).
- **Geopolitical Risks**: Slow automation could push trade partners (e.g., EU) to favor China's **faster, AI-enabled ports**.
- **Security Threats**: A major cyberattack could disrupt **40% of India's maritime trade** (IMD, 2023).

7.5. Theoretical Contributions

Advancements in Research:

1. **Porter's Diamond Model Applied to Ports:**
    - Proves **government intervention** (China's $10B/year subsidies) is more effective than **market forces alone** (India's private-led growth) in infrastructure scaling.
    - Identifies **"related industries"** (5G, AI) as critical for automation success.
2. **Resource-Based View (RBV) Insights:**
    - *Tangible Gaps*: India's **70% manual cranes** vs. China's 100% automated systems.
    - *Intangible Gaps*: Workforce skills (China trains **1M/year** in AI; India trains **50,000**).

Significance of All Findings (from 7.1–7.5)

Point	Key Finding	Significance
1. Efficiency	China's ports are **9.5x faster**	Explains **India's $7B/year trade loss** and need for AI/5G adoption.
2. Sustainability	China cuts **40% emissions** vs. India's 30%	Guides **green port policies** to meet IMO 2030 targets.
3. Workforce	China reskilled **1M workers**; India 5%	Warns of **labor strikes** and proposes **national reskilling**.
4. Policy Barriers	India's delays cost **2+ years**	Urges **centralized governance** (NPA) to compete globally.
5. Theoretical	Proves **state-led models** outperform	Provides a **blueprint** for emerging economies beyond India/China.

Strategic Implications:

- **For India**: Addresses **why** it lags (Points 1–4) and **how** to catch up (NPA, $7.5B/year investment).
- **For Academia**: Establishes **Porter+RBV** as tools for infrastructure studies.

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- **For Global South**: Offers a **non-disruptive automation roadmap** balancing jobs and technology.

Final Takeaway: This research transforms raw data into **actionable policy tools**, bridging the gap between academic theory and real-world port modernization challenges.

8. Application of Porter's Diamond Model to Port Automation in India and China

Porter's Diamond Model (1990) explains why some nations gain competitive advantages in specific industries. This framework is applied to analyze **why China dominates port automation while India lags**, focusing on four determinants:

1. Factor Conditions

(Nation's available resources for industry competitiveness)

China's Advantages:

- **Capital Investment**: $10B/year in automation (vs. India's $2.5B total).
- **Infrastructure**: 100% 5G coverage at major ports (e.g., Shanghai's AI-powered cranes).
- **Skilled Labor**: 1M+ workers retrained in robotics/AI (2023).

India's Gaps:

- **Underfunding**: Only 30% of Sagarmala's $2.5B utilized.
- **Tech Shortages**: 70% ports use manual processes (Ministry of Ports, 2023).

→ **Theoretical Insight**: China's **strategic allocation of capital and human resources** fulfills Porter's "advanced factors" for sustained advantage.

2. Demand Conditions

(Nature and scale of domestic market needs)

China's Demand Drivers:

- **Export-Led Growth**: 35% of global manufacturing output requires hyper-efficient ports.
- **E-Commerce Boom**: Alibaba/Shein logistics demand 24/7 automated operations.

India's Limitations:

- **Domestic Focus**: 60% of port cargo is domestic, reducing urgency for automation.
- **Fragmented Demand**: No unified push from industries (unlike China's state-coordinated exporters).

→ **Theoretical Insight**: China's **scale and sophistication of domestic demand** (Porter's "pressuring buyers") force rapid automation.

3. Related and Supporting Industries

(Strength of upstream/downstream sectors)

China's Ecosystem:

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- **Tech Synergies**: Huawei (5G), DJI (drones), and Alibaba (AI logistics) collaborate with ports.
- **Renewable Energy**: Solar panel exports justify green port investments (e.g., Qingdao's 60% renewable power).

India's Weak Links:

- **Disconnected Sectors**: Limited integration between ports (e.g., JNPT) and tech firms (Tata, Infosys).
- **Energy Dependence**: Coal-heavy power slows electrification of ports.

→ **Theoretical Insight**: China's **industrial clusters** (Porter's "geographic concentration") amplify automation benefits.

4. Firm Strategy, Structure, and Rivalry

(How companies are organized/compete)

China's Approach:

- **State-Led Coordination**: SIPG (Shanghai Port) partners with COSCO (shipping) for end-to-end automation.
- **Competition**: Rivalry between Shanghai/Ningbo ports drives innovation (e.g., "dark terminals").

India's Challenges:

- **Public vs. Private Divide**: Adani's Mundra (automated) vs. state-run JNPT (manual).
- **No Domestic Rivalry**: 12 major ports lack competition on automation benchmarks.

→ **Theoretical Insight**: China's **state-capitalist rivalry** aligns with Porter's "intense competition" principle.

5.Government & Chance (External Determinants)

China's Policy Edge:

- **14th Five-Year Plan (2021–2025)**: Mandates full automation at top ports.
- **Subsidies**: $150M/year for port cybersecurity.

India's Policy Gaps:

- **Sagarmala Delays**: Only 30% projects completed since 2015.
- **Labor Resistance**: No national reskilling policy (vs. China's "Automation First, Jobs Second").

→ **Theoretical Insight**: **Government as a catalyst** (Porter's 5th factor) is stronger in China.

Key Takeaways from Porter's Application

1. **India's Weakest Link**: **Factor Conditions** (underinvestment, low skills).
    - *Solution*: Triple funding to $7.5B/year and launch "Skill India Maritime".

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2. **China's Strengths**: **Demand + Related Industries** (export pressure, tech ecosystem).
    - *Lesson for India*: Foster port-tech firm partnerships (e.g., JNPT-Tata 5G pilots).
3. **Policy Leverage**: India must emulate China's **centralized governance** (National Ports Authority).

9. Conclusion:

9.1 Problem Statement Addressed

This study addressed the critical challenge of port automation disparities between China and India, examining why China leads in efficiency (98% automated operations) while India lags (30% automation) despite being the world's fifth-largest economy. The research was motivated by the urgent need to bridge these gaps, given that maritime trade handles **80% of global cargo** (World Bank, 2023) and automation can reduce costs by **25%** while cutting emissions by **20–40%**.

9.2 Method Used

The study employed:

1. **Comparative Case Analysis**: Shanghai Yangshan (China) vs. JNPT (India).
2. **Theoretical Frameworks**:
    - **Porter's Diamond Model** to analyze competitive advantages (e.g., China's $10B/year investments).
    - **Resource-Based View (RBV)** to assess technology/workforce gaps.
3. **Data Triangulation**: World Bank, UNCTAD, and port authority reports (2015–2023).

9.3 Key Findings

1. **Efficiency**: China's ports process **9.5x more cargo** (47.3M vs. 5M TEUs) with **98% efficiency** vs. India's 65%.
2. **Sustainability**: China achieves **40% emission cuts** (vs. India's 30%) via renewable energy (60% usage).
3. **Workforce**: China reskilled **1M+ workers**; India trained only **5%** of 4.5M laborers.
4. **Policy**: India's bureaucratic delays add **2+ years** to projects; China's centralized governance ensures rapid approvals.

9.4 Limitations

- **Data Recency**: Relies on pre-2024 reports; post-pandemic trends may vary.
- **Scope**: Focused on two ports; broader regional analysis needed.

9.5 Future Work

1. **Micro-Studies**: Impact of automation on informal port labor.
2. **AI Ethics**: Frameworks for autonomous decision-making in logistics.
3. **Expanded Geographies**: Include ASEAN and African ports for global benchmarks.

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9.6 Final Takeaway:

This research provides a **blueprint for India** to accelerate automation through:
✓ **Centralized governance** (National Ports Authority)
✓ **$7.5B/year investments** (prioritizing 5G/AI)
✓ **Reskilling 500K workers** by 2030.

For emerging economies, it demonstrates how to **balance automation with employment stability**, ensuring sustainable trade growth.

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Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

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Revitalization Strategies in E-Commerce Post-COVID-19: A Multi-Dimensional Assessment

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ABSTRACT:

The Covid-19 pandemic affected all the industries across the world. It showed a positive impact on some industries and some got badly affected. The government announced complete lockdown to control the spread of the virus and to protect their citizens. After the covid-19 the E-commerce segment of the businesses evolved a lot and offline businesses started trying to make space in this segment. It shows the positive effect on E-Commerce Business with challenges they faced during and after pandemic .The purpose of this study is to know The efforts made by the different E-Commerce companies to Revitalise the E-Commerce Platform and To know the Impact of COVID-19 on E-Commerce After the Covid 19- lockdown Announced. The source of data collection is secondary To meet the objectives of the research data has been collected from past research thesis, dissertation, papers, journal articles, online write-ups, portals and websites accessed and will be read in future as well to draw the parallels the real world and actual field to analyse the data.

KEYWORDS: Covid-19, Lockdown, E-Commerce and Revitalisation.

1. INTRODUCTION:

Covid -19 was a pandemic virus and the origin of this virus is China which highly affected human life and routine which in turn affected all sectors of the economy. Due to this pandemic the economic indicators started showing panic scenarios and the declining human and business health. Due to the speedy spread of the virus, the government announced complete lockdown and imposed section 144 (Section 144 prohibits public gatherings in a given jurisdiction.) The lockdown resulted in closing of the Commodity market to avoid the spread of virus. This forced consumers to buy everything online to fulfil their basic necessities and goods that were needed for specific purposes at home. This caused a drastic increase in buying and selling transactions through e-commerce and mobile commerce.

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E-commerce (electronic commerce) involves an online transaction. It provides multiple benefits to the consumers in form of availability of goods at lower cost, wider choice, and saves time. E-commerce is the buying and selling of goods and services or the transmitting of funds or data, over an electronic network, primarily the internet. These business transactions occur either as business-to-business(B2B), business-to- consumer

(B2C), consumer-to-consumer or consumer-to-business.

2. OBJECTIVES:

- To know the Impact of COVID-19 on E-Commerce.
- To study the efforts made by the different E-Commerce companies to Revitalise the E-Commerce Platform after COVID-19 knocked.

3. DATA COLLECTION METHOD:

- Secondary Data source: To meet the objectives data has been collected from past research thesis, dissertation, papers, journal articles, government agency, online write-ups, portals and websites accessed to draw the parallels between the real world and actual field to analyse the data.

4. RESEARCH DESIGN:

The research is descriptive and exploratory in nature. It is aimed at understanding the Revitalisation of E- Commerce After Covid-19 knocked. Source of data collection is secondry from authentic sources like; past research thesis, dissertation, papers, journal articles, online write-ups, government agency, portals and reliable websites.

5. RESEARCH METHODOLOGY:

The research is descriptive and exploratory in nature. It is aimed at understanding the Impact of COVID- 19 on E-Commerce and the efforts made by the different E-Commerce companies to Revitalise the E- Commerce Platform after covid 19 knocked. Source of data collection is secondry from authentic sources like; past research thesis, dissertation, papers, journal articles, online write-ups, government agency, portals and reliable websites.

6. LIMITATIONS OF THE STUDY:

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The study is restricted to Impact of COVID-19 on E-Commerce and efforts made by the different E- Commerce companies to Revitalise the E-Commerce Platform after covid 19 knocked.

7. REVIEW OF LITERATURE:

7.1 Madhuri Singhal (January 2023)

Madhur Singhal, the managing director and practice leader, pharma and life sciences, at Praxis Global Alliance, says: "Owing to the shifts in consumer behaviour towards e-commerce and online pharmacies, augmented by the Covid-19 pandemic, the online pharmacy sector has added to the appeal of deep- pocketed companies like Amazon and Reliance Retail, who are trying to harness this fast-growing segment on the back of their strong e-commerce capabilities."

7.2 The Times of India(Aman Khurma 22 October 2022)

E-Marketer reports that the number of people globally who used proximity mobile payments in 2020 grew 22.2% year over year. There is significant increase in revenues of Alibaba, Amazon, JD.com and Pinduoduo by 70% between 2019 and 2021 and their share of total sales through all these 03 platforms rose from around 75% in 2018 and 2019 to over 80% in 2020 and 2021. Some travel and hotel booking agencies like Expedia, Booking Holdings and AirBnB saw gross bookings decline by up to two thirds in 2020 as movement controls reduced but demand for travel and accommodation services returned in 2021 as restrictions were eased.

7.3 Mansi Takyar(21 september 2021)

As per Mansi Thakyar, Digital Marketing trends became a new way of reaching the customers and Influencers on social media helped marketers to build their customer base more easily. The CMO Survey(A survey organisation) predicts that spending on digital marketing will increase from 44 percent of a company's marketing budget to 54 percent by 2024. This prediction means the future brings with it more methods for capitalising on known trends.

7.4 Dr. Ani Smriti, Mr. Rajesh Kumar(9 September 2021)

As per the National Association of Software & Services Companies (NASSCOM), India's e-commerce market continues to grow at the rate of 5% with estimated revenue of $56.6 billion in the financial year 2021 despite COVID-19 challenges, says the government. India's

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purchasing behaviours have Changed and new online purchasing customers have increased. Tools for online purchasing have been so designed that even a simple smartphone used can make purchases easily and conveniently. E-commerce and mobile marketing helped people to choose the desired product from a varied range of varieties. Shipping promos, discounted products for basic needs and health, and updating information about COVID-19 increased the convenience and maintained the adherence to the then laws.

7.5 Rajeev Sharma (22 August 2022)

The ability to connect face-to-face while working remotely has become a high commodity. In response, many technology companies are rolling out tools that can help businesses with the transition to working from home. Technology companies are more focused towards providing solutions designed to Help people through COVID-19 with the aim to make things as affordable as possible which provides relevant features to a common man.

7.6 Anan Khurma(The founder and CEO of Wellversed)

The e-commerce sector in India is reinventing itself after the Covid-19 surge

In 2020, E-Commerce shared 17% of the global retail trade. As the country got habituated with cashless buying and selling, E-Commerce platforms seemed like a better option for them to visit instead of physically travelling to offline stores. E-commerce gave them a varied number of options for them to choose. Even if a consumer wanted one single product, they have different brands to choose the same product from.

Some points are significant, like Indians got more options in local brands rather than international brands to choose from. As per industry report of 2021, the Indian E-Commerce is supposed to grow 84% in the next 4 years. The report also states that this growth has been accelerated mostly by mobile shopping of products. But, a thing which needs to be kept in mind is that, the Indian retail market has not fully transformed itself, it has gone hybrid and it doesn't depend on traditional websites to make profit. Offline retail stores have mixed up with the online ones and have created a blended digital world. Although, it's an irreversible consumer behaviour that will last for generations.

7.7 Supriyo Ghose, Yaswanth Sudineni, Deepak Vasimalai, Amulya Vankamamidi and Sachin R(1st october 2021)

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Supriyo Ghose said, "E-commerce is the latest phenomenon creating a revolution in the way business is conducted. It can grow at an exponential rate for the coming few years supported by the penetration of smartphones and the internet. COVID-19 has provided the opportunity for many e-commerce services".

7.8 Mur Salim SK (March 2021)

One of the most important benefits of e-learning for teachers are reduced costs when it comes to classroom rentals, travel fees, and print costs. The time table would change to 24×7 teaching-learning. It is also seen that students feel comfortable when they use the internet for their studies and they got opportunity to learn from the best of the best teachers.

7.9 Goldman Sachs(27th July 2020)

Goldman Sachs reported that India's e-commerce industry is expected to reach $99 billion in size when online commerce penetration will more than double to almost 11%. The growth rate for the industry in India, for each of the next four years, would surpass the same of established economies like the US, China, the UK, Europe and Brazil.

7.10 An Economics Time Initiative (2020)

As per an article in Economics Time Initiative Use of QR code increased There is an increase in small ticket payments, such as transactions at Kirana stores. Use of contactless mode of payment such as QR Code has seen a growth owing to convenience, speed, low maintenance and safety it offers.

8. IMPACT OF COVID 19 ON E-COMMERCE PLATFORM AFTER IT KNOCKED:

After Covid-19 the demand for online services started increasing when the government eased the restricted movements of few necessary services. Digital media became the primary tool for the people to connect, discover, and make purchases. Online channels were the only way visible that could fulfil publics' need and bring them a sense of Normalcy.

8.1 Technology and software company has boost

According to Priori Data, the global downloads for workplace communication tools, such as Zoom, Houseparty, and Skype saw a 100% surge in March when the initial lockdowns began.

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Microsoft also announced that their workplace chat application Teams' daily users grew from 20 million in November 2019 to 44 million by March 18th.

8.2 Increased use of digital transaction

Post easing of lockdown restrictions from mid- May 2020, values transacted via UPI and BHIM in June 2020 have regained to ~122 percent and ~91 per cent of their January 2020 levels respectively. IMPS transactions have also reached ~95 per cent of its January 2020 transaction levels by June 2020.

8.3 Online retail sales increased

E-Commerce shared 17% of the global retail trade. Alibaba, Amazon, JD.com and Pinduoduo increased their revenues by 70% between 2019 and 2021 and their share of total sales through all these 03 platforms (Beauty platforms, Wellness platforms, Medical platforms) rose from around 75% in 2018 and 2019 to over 80% in 2020 and 2021. Airline and ticket booking websites like Expedia, Booking Holdings and AirBnB saw gross bookings decline by up to two thirds in 2020 as lockdown reduced the demand for travel and hotel services, but it started returning in 2021 as restrictions were eased. As social distancing became the "new normal", businesses gradually started transforming themselves with the situation of the consumers.

8.4 Online food delivery companies shown positive growth

A number of Indian start-ups that have reached unicorn status (a value of over $1billion) have expanded since the start of the pandemic. Many of these are in the e-commerce logistics sector like Zomato, a food delivery start-up, which had a successful initial public offering in July 2021 which raised $1.3 billion for a total valuation of $12.2 billion. Restaurant and food delivery platform Swiggy's latest IPO raised $3.7 billion and is now valued at $5.5 billion. Grocery deliveries make up about 25% of the company's revenue, with plans to increase to 50% in the next few years to compete with Zomato, according to a Swiggy founder. Delhivery, a courier company also reported positive growth.

8.5 Covid-19 boost india's online pharmacy sector

The complete lockdown opened pharmacy companies to reach consumers through online mode. The residents of the highly affected areas preferred online delivery over offline purchases from medical shops which gave a significant boost to e-pharmacy services during the nationwide pandemic-induced lockdown. The demand surged by about 2.5 times to 8.8

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million, according to an industry report by FICCI (Federation of Indian Chambers of Commerce and Industry). This demand was visible despite supply chain hurdles that were a challenge for the industry during the early weeks of the lockdown.

8.6 The covid-19 pandemic has changed education forever

Because the schools were shut down to protect the more prone age of the society to get affected from the highly spreading infection, the schools and colleges started onboarding the studies to the internet. The result was that more of the parents started to encourage their children to take online classes not only from school and colleges but from the new online educator helping people to learn new skills in various sectors.

Some studies showed that 21 million students registered for Coursera's online courses in 2016, a number that increased annually by around 7 million over the next two years. But the switching to remote working triggered a three-fold increase in new registrations, bringing the figure to 71 million in 2020, and 92 million in 2021. Course enrolments for online learning followed a similar pattern, with pre-pandemic gains overshadowed by huge spikes. Enrollment numbers more than doubled in 2020 and increased by 32% the following year, peaking at 189 million. The E-commerce industry in India saw an upward trend post lockdown, registering a 17 percent increase in order volume as of June 2020, when compared to the pre lockdown period.

8.7 Virtual workout and personal training session via social media increased

Many fitness professionals joined the prominent digital media platforms by offering virtual workouts and personal training sessions via social media, as well as other video calling tools. Crunch and Planet Fitness are prime examples, both adapting their services online, and even giving some classes to non-members for free. Personal trainers and Instagram fitness influencers have also adopted the way to reach and offer their programs online for free or at a reduced cost. This segment of social media marketing showed a surge in sales for home gym suppliers. Fitness equipment company Nautilus said that they are expecting an 11% rise in first-quarter net sales as more people are likely to switch to home gym equipment.

8.8 Use of internet increased

The average share of internet users who made purchases online increased from 33% in developing countries before the pandemic to more than 60% following the onset of the pandemic, across 66 countries with statistics available.

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8.9 Use of social media platform increased

The number of users watching live videos on Facebook has increased by 50% since January which prompted the company to develop new Facebook Live features. Facebook's overall marketing strategy is aimed at making live streaming video more accessible, while also improving the potential income for broadcasters. Video content streaming showed high demand which helped business owners to target susceptible consumers through video/YouTube marketing strategy.

8.10 Online entertainment services increased

During the initial week of quarantine, Verizon reported that the domestic use of video games during peak hours had increased by 75%. Along with the rise in personal video gameplay, it is anticipated that esports will also grow in popularity. The world's largest video game streaming platform, Twitch, announced its audience grew by 75%.

9. EFFORTS MADE BY THE E-COMMERCE COMPANIES TO REVITALISATION OF E COMMERCE PLATFORM:

Companies started focusing on provisioning of solutions designed to help people through COVID-19. The aim is to make things as affordable as possible. India's e-commerce market continued to grow at 5 percent year-on-year, with an estimated revenue of USD 56.6 billion in the financial year 2020-21, despite the COVID-19 pandemic, according to IT industry body NASSCOM.

G-Pay, Paytm, Phone pay and Amazon pay have given cash back and exciting vouchers to increase the use of these E- payment applications. To keep the interest of users, All authorised payment systems operators and participants started targeted multi-lingual campaigns by way of SMSs and in-app notifications.

- Google waived off the monthly fee of all G Suite and G Suite Education tools. Zoom also lifted the 40- minute limit for conference calls through its free Basic plan.

- E- Learning platform gave discounts to their students for enrolling themselves in E-Learning and provided free pdf for initial experience of their platforms.

- Personal trainers and Instagram fitness influencers, Influenced people by offering their fitness programs online for free or at a reduced cost.

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- Many online e-commerce Company eg. AMAZON, FLIPKART, MEESHO, AJIO etc. worked on customer service by using chatbots for fast redressal of grievances. This helped the businesses to be available for 24/7 instant support to the customers.

- Most of the e-shopping portal also provided “Buy now Pay later” services to their customers.

- E-commerce businesses also worked on free home delivery and easy return policy to smoothen the customer experience.

- social media platforms introduced new features in which interested audiences can immediately make purchases from the live video. Facebook live feature helped e-commerce companies to reach their audience.

10. CONCLUSIONS:

Based on the above discussion and results we can conclude that there have been positive effects of Covid-19 pandemic On e-commerce. After the lock down the digital media became the primary tools for the people to connect, Discover and make purchases through online channels. This was the only way visible that could fulfil public need and bring them a sense of normalcy in a very different scenario of fear and uncertainty. As the data from different sources show that the E-Commerce platforms showed positive growth along with technology and software companies. Digital transactions increased the online sales. The situation was such that people could not go outside which helped online food delivery companies' positive growth. Online Pharmacy Sector, Online Education, Entertainment and everything that could be done through the internet, contributed to e-commerce. Covid-19 is the not only reason people started finding possible ways to survive which ultimately helped E-commerce bloom. New E-Commerce portals started for newer businesses and the others already available started working on better services of theirs. Discount, Cash back, Buy now pay later service, Free home delivery, Easy return policy, 24* 7 customer care services through chat boots were amongst the improvements during this period. Many e-Learning platforms.

It was a time when people had enough time sitting at home so they moved towards learning and improving themselves which led different marketers and educators to come together to create training and education marketplace which brought different courses related to various fields. Google Pay, Paytm, Phonepe and Amazon pay gave cashbacks and exciting vouchers to increase the use of their payment applications.

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As per industry report of 2021, the Indian E-Commerce is supposed to grow 84% in the next 4 years. The report also states that this growth has been accelerated mostly by mobile shopping of products.

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Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

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ISBN: 978 – 93 – 6851 – 977 - 5

Ethical Dilemmas in Influencer Marketing: Consumer Perception and Brand Responsibility

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Abstract

Influencer marketing has surged as a powerful advertising tool, yet it raises ethical concerns such as transparency, authenticity, and consumer manipulation. This study investigates consumer perceptions of ethical dilemmas in influencer marketing and the role of brand responsibility in mitigating these issues. Using a sample of 400 consumers and 50 brands, we analyze survey data and brand disclosure practices. Findings reveal that 62% of consumers distrust undisclosed sponsorships, while brands with transparent policies see a 20% higher trust score. The results emphasize the need for ethical standards to maintain credibility and consumer trust.

Keywords: Influencer marketing, advertising tool, ethical concerns, consumer perceptions

1. Introduction

By April 2025, influencer marketing is projected to be a $25 billion industry, driven by social media's reach and influencers' persuasive power. However, ethical dilemmas such as undisclosed sponsorships, exaggerated claims, and targeting vulnerable audiences threaten its legitimacy. This research explores how consumers perceive these issues and how brands can responsibly address them. The study aims to bridge the gap between marketing efficacy and ethical integrity, offering insights for stakeholders in this evolving landscape.

2. Related work

Influencer marketing leverages social media personalities to promote products, often blurring the line between authentic content and advertising (De Veirman et al., 2017). Ethical concerns include lack of disclosure, with 40% of influencers failing to label sponsored posts (FTC, 2023). Boerman et al. (2017) found that transparency increases trust, yet many brands prioritize reach over ethics. Consumer skepticism is rising, with 55% questioning influencer authenticity (Edelman, 2024). Brand responsibility, including clear guidelines and accountability, is critical to sustaining credibility (Kapitan & Silvera, 2016). This study examines these dynamics in a contemporary context.

3. Research Objectives

The study is guided by the following objectives:

1. To assess consumer perceptions of ethical dilemmas in influencer marketing

2. To evaluate the role of brand responsibility in addressing ethical concerns

4. Methodology

4.1 Research Design

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A mixed-methods approach combines quantitative consumer surveys with qualitative analysis of brand practices. T-tests compared disclosure effects, and Pearson's correlation linked practices to outcomes, standard in consumer research.

4.2 Data Collection

Quantitative Data: A survey of 400 consumers (aged 18–45, 50% female) was conducted in March 2025, assessing trust (1-5 scale), authenticity perceptions, and reactions to ethical issues (e.g., undisclosed ads).

Qualitative Data: Disclosure practices of 50 brands (20 fashion, 15 beauty, 15 tech) were analyzed via their influencer campaigns on platforms like Instagram and TikTok, supplemented by interviews with 10 marketing managers.

4.3 Sample

Consumers were selected from Shahdol District of Madhya Pradesh , reflecting key influencer markets. Brands were chosen based on market presence and active influencer partnerships.

4.4 Data Analysis

Quantitative: Descriptive statistics summarized consumer perceptions. Paired t-tests compared trust scores for disclosed vs. undisclosed posts. Pearson's correlation assessed links between transparency and trust.

Qualitative: Thematic analysis identified ethical dilemmas and brand strategies from campaign data and interviews.

5. Data Analysis

5.1 Quantitative Analysis

Table 1
Consumer Trust and Perception Metrics

Sl No	Metric	Disclosed Posts	Undisclosed Posts	Change (%)	p-value (t-test)
1	Trust Score (1-5)	3.8	2.9	-23.7 %	0.01
2	Authenticity Rating	4.0	3.2	-20 %	0.02
3	Purchase Intent (1-5)	3.5	2.8	-20 %	0.03

$p < 0.05$ indicates statistical significance

Trust: Trust scores dropped significantly for undisclosed posts ($t(399) = 2.58$, $p = 0.01$), with 62% (248/400) expressing distrust.

Authenticity: Perceived authenticity fell by 20% without disclosure ($t(399) = 2.33$, $p = 0.02$).

Purchase Intent: Intent to buy decreased by 20% for undisclosed campaigns ($t(399) = 2.20$, $p = 0.03$).

Table 2
Correlation Between Brand Practices and Consumer Trust

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Sl No	Practice	Adoption Rate	Trust Score (r)	Reputation (r)
1	Clear Disclosure	70 %	0.85	0.80
2	Ethical Guidelines	60 %	0.78	0.75
3	Influencer Training	45 %	0.65	0.60

$p < 0.01$ Pearson's correlation showed strong positive links between transparency and trust ($r = 0.85$, $p < 0.01$) and reputation ($r = 0.80$, $p < 0.01$).

5.2 Qualitative Analysis

Thematic analysis revealed:

Ethical Dilemmas:

1. Non-Disclosure: 60% (30/50) of campaigns lacked clear #ad labels, risking consumer deception.
2. Exaggeration: 40% (20/50) featured overstated product claims, eroding authenticity.
3. Targeting: 25% (13/50) aimed at vulnerable groups (e.g., teens), raising ethical flags.

Brand Responsibility:

1. Transparency: 70% (35/50) of brands with disclosure policies earned higher trust.
2. Accountability: 50% (5/10) of managers emphasized vetting influencers for ethics.
3. Education: 30% (15/50) trained influencers, reducing ethical breaches.

6. Results

6.1 Consumer Perceptions

Consumers are highly sensitive to ethical dilemmas, with 62% distrusting undisclosed posts and 58% (232/400) valuing authenticity over persuasion. Trust and purchase intent drop significantly (20–23%) without transparency, aligning with Boerman et al. (2017).

6.2 Brand Responsibility

Brands adopting clear disclosure (70%) and ethical guidelines (60%) see a 20% higher trust score and enhanced reputation ($r > 0.75$). Training influencers, though less common (45%), mitigates risks, supporting Kapitan and Silvera (2016).

7. Discussion

The findings confirm that ethical dilemmas in influencer marketing non-disclosure, exaggeration, and targeting undermine consumer trust, echoing Edelman's (2024) skepticism trend. Transparency emerges as a critical brand responsibility, boosting credibility as per FTC (2023) guidelines. However, inconsistent adoption (e.g., only 70% disclose) suggests gaps in accountability. Brands should enforce disclosure, vet influencers, and educate stakeholders. Consumers demand authenticity, pressuring firms to align marketing with ethics. Limitations include a focus on major platforms and self-reported data. Future research could explore niche platforms or regulatory impacts.

8. Conclusion

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ISBN: 978 – 93 – 6851 – 977 - 5

Ethical dilemmas in influencer marketing challenge consumer trust, but brand responsibility through transparency and accountability can mitigate these issues. As of April 2025, ethical practices are not just regulatory necessities but strategic imperatives for sustaining consumer loyalty and brand reputation. This study calls for a balanced approach to influencer marketing that prioritizes integrity alongside influence.

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Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

RESEARCH BRIDGE CONSULTANTS
Ideas to Impact
ISBN: 978 – 93 – 6851 – 977 - 5

Early Dark Energy Versus Modified Gravity As Solutions To The H0 And S8 Tensions

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Abstract

The standard LambdaCDM cosmological model fits a wide range of observations with remarkable precision, yet two persistent discrepancies suggest either unaccounted systematics or physics beyond the baseline framework. The first is the H0 tension: early-Universe inferences of the Hubble constant from cosmic microwave background (CMB) anisotropies prefer H0 near 67 to 68 km/s/Mpc, while late-Universe distance ladder measurements favor H0 near 73 km/s/Mpc. Planck 2018 reports H0 around 67.7 km/s/Mpc in base LambdaCDM, whereas the SH0ES program reports H0 around 73.0 km/s/Mpc using Cepheid calibrated Type Ia supernovae. The second is the S8 tension: weak lensing and some large scale structure analyses prefer a lower clustering amplitude than CMB inferred values, typically expressed through S8 = sigma_8 * (Omega_m/0.3)^0.5. Planck reports S8 about 0.832, while KiDS-1000 and DES Year 3 analyses yield lower values around 0.759 and 0.776, respectively.

This paper provides a PhD level comparative assessment of two leading classes of new-physics explanations: Early Dark Energy (EDE), which modifies the pre-recombination expansion history to reduce the sound horizon and increase the CMB inferred H0, and Modified Gravity (MG), which alters the relationship between matter, metric potentials, and growth of structure to address clustering and lensing anomalies. We review representative EDE models (axion-like EDE, triggered transitions such as NEDE) and MG frameworks (f(R), scalar-tensor / Horndeski-like phenomenology, and effective mu,Sigma parameterizations), focusing on their predictions for CMB anisotropies, baryon acoustic oscillations (BAO), CMB lensing, redshift space distortions (RSD), and weak lensing. Recent data releases, including ACT DR6 and DESI BAO constraints, strongly sharpen this comparison and tend to restrict the parameter space in which EDE can fully resolve H0 without degrading the fit to high precision CMB and BAO. We propose a unified methodology for joint inference that enables direct model comparison, quantify key degeneracy directions, and identify observational discriminants for upcoming surveys.

Keywords

H0 tension; S8 tension; Early Dark Energy; Modified Gravity; CMB; BAO; weak lensing; ACT DR6; DESI; scalar-tensor gravity; f(R); cosmological parameter inference.

1. Introduction

Modern cosmology has entered a precision era where multiple, independent probes map the background expansion and the growth of structure across cosmic time. The baseline six parameter LambdaCDM model is strongly supported by CMB temperature and polarization anisotropies and, when combined with BAO and supernovae, yields a coherent picture of a spatially flat universe dominated by dark energy at late times. However, the same precision that establishes LambdaCDM also exposes mild but persistent inconsistencies among subsets of the data.

1.1 The H0 tension

The H0 tension is an empirical mismatch between early-time and late-time determinations of the present expansion rate. Planck 2018 (within base LambdaCDM) infers H0 around 67.7 km/s/Mpc. In contrast, local distance ladder measurements calibrated with Cepheids and Type Ia supernovae (SH0ES) report H0 around 73.0 km/s/Mpc with percent level uncertainty. The discrepancy is large enough that either a common systematic bias persists across multiple steps of one or both pipelines, or the assumed model used to interpret early-time data is incomplete.

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A crucial point is that CMB based inference of H0 is indirect: the CMB measures angular scales, notably the acoustic scale theta_* = r_s(z_*) / D_A(z_*), where r_s is the comoving sound horizon at recombination and D_A is the angular diameter distance to last scattering. To increase inferred H0 without changing theta_*, one typically decreases r_s (through faster pre-recombination expansion) and compensates with changes to late-time distances. This logic motivates early-time new physics such as EDE.

1.2 The S8 tension

The S8 tension refers to the observation that weak gravitational lensing surveys and some large scale structure measurements prefer lower clustering amplitude than CMB inferred values under LambdaCDM. Planck 2018 reports S8 about 0.832. KiDS-1000 cosmic shear finds S8 = 0.759 with uncertainties of order 0.02. DES Year 3 3x2pt analysis reports S8 = 0.776 with uncertainty about 0.017. Although the statistical significance depends on dataset combinations and modeling assumptions (intrinsic alignments, baryonic feedback, photo-z calibration), the repeated preference for lower S8 motivates late-time new physics that suppresses growth or modifies the lensing response.

1.3 Why compare EDE and Modified Gravity directly

EDE and MG are often discussed separately: EDE is primarily designed to address H0, while MG is frequently invoked to address growth and lensing anomalies including S8. However, the two tensions are not independent. Any modification that changes early expansion can also shift Omega_m, sigma_8, and lensing amplitudes; likewise, changing gravity can back-react on distances through modified background evolution or effective dark energy. A consistent comparison requires that both classes be confronted with the same combined likelihoods, with equal care in modeling and priors.

Recent releases further sharpen this need. ACT DR6 provides high sensitivity polarization and small scale CMB information that strongly constrains early time physics. DESI BAO measurements provide precise geometric constraints that restrict the freedom to change distances and expansion histories. Updated analyses combining ACT DR6 and DESI data have tightened constraints on EDE as a resolution to H0. Similarly, DESI BAO constraints have been used to test scalar-tensor gravity and other MG frameworks.

2. Objective of the Study

The primary objective of this study is to evaluate, within a unified and data driven framework, whether Early Dark Energy or Modified Gravity provides a more viable explanation for the H0 and S8 tensions when confronted with modern CMB and large scale structure constraints.

Specific objectives:

1. To define representative, physically motivated parameterizations of EDE and MG that can be consistently implemented in Boltzmann solvers and likelihood pipelines.
2. To identify the dominant parameter degeneracies that link H0, r_s, Omega_m, sigma_8, and S8 within each model class.
3. To compare the ability of EDE and MG to simultaneously fit key datasets: primary CMB (Planck and ACT), BAO (DESI), weak lensing (DES, KiDS), and growth probes (RSD).
4. To assess whether recent constraints, including Planck NPIPE based EDE limits and ACT DR6 based updates, still allow EDE solutions that fully reconcile H0.
5. To propose observational discriminants and future measurements that can decisively differentiate early-time versus late-time solutions.

3. Research Questions

1. Can Early Dark Energy models raise the CMB inferred H0 to the local distance ladder value without violating constraints from ACT DR6, Planck, and DESI BAO?

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2. Can Modified Gravity models suppress structure growth and reduce S8 in a way consistent with CMB lensing and galaxy clustering constraints, while preserving successful distance fits?
3. Are there joint regions of parameter space in either class that can reduce both the H0 and S8 tensions simultaneously, and if so, what signatures would confirm them?
4. Which datasets and summary statistics are most responsible for excluding or supporting each scenario?

4. Literature Review

4.1 Baseline measurements and the tensions

Planck 2018 establishes the benchmark early-time inference of H0 and S8 within LambdaCDM, reporting H0 around 67.7 km/s/Mpc and S8 around 0.832. Local distance ladder determinations such as SH0ES report H0 around 73.0 km/s/Mpc. Weak lensing surveys provide late-time clustering constraints, with KiDS-1000 reporting S8 around 0.759 and DES Y3 3x2pt reporting S8 around 0.776.

4.2 Early Dark Energy as an early-time solution

The core EDE idea is to add an additional energy density component that contributes a few percent of the total energy around matter-radiation equality or recombination, and then dilutes rapidly so as not to dominate at late times. The effect is to increase the early expansion rate H(z), reduce the sound horizon r_s, and thereby allow a higher inferred H0 while keeping the observed CMB acoustic scale fixed. A widely cited model introduces a scalar field with a potential that causes it to behave like a cosmological constant early, then roll and redshift away, as proposed in the seminal EDE resolution paper by Poulin et al.

EDE models have diversified into axion-like EDE, where the field begins oscillating near a critical redshift, and triggered transition models such as NEDE (New Early Dark Energy), including cold NEDE phase transition variants. These constructions share a common phenomenology: an additional fractional energy density f_EDE peaking at redshift z_c around 10^3 to 10^4, followed by dilution with an effective equation of state that can be radiation-like or faster.

However, increasingly precise CMB data and improved likelihoods have progressively narrowed allowed f_EDE. A Planck NPIPE based reanalysis of axion-like EDE finds f_EDE constrained to be below about 0.061 (95 percent) and H0 constrained within 66.9 to 69.5 km/s/Mpc without SH0ES, leaving a residual multi-sigma tension with SH0ES. This represents a substantial challenge to the strongest EDE claims.

The most recent constraint landscape includes ACT DR6 measurements. ACT DR6 provides deep polarization and small scale information that is particularly sensitive to changes in the damping tail and lensing smoothing, both affected by EDE. Recent updates that combine ACT DR6 and DESI releases have been used to reassess EDE viability, with results generally indicating reduced preference for EDE relative to earlier combinations.

4.3 Modified Gravity as a late-time solution

Modified Gravity proposals aim to alter Einstein gravity on cosmological scales, either by adding degrees of freedom (scalar-tensor theories) or by modifying the gravitational action, such as in f(R) models. Such models can change the effective gravitational coupling for perturbations, modify the relation between metric potentials (gravitational slip), and thereby alter growth and lensing without necessarily changing the background expansion in the same way as EDE.

An important observational motivation for MG is the ability to suppress growth and reconcile low S8 values from weak lensing with higher CMB inferred values, though achieving this while staying consistent with RSD and CMB lensing is nontrivial. The MG landscape includes:

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- f(R) gravity, which can mimic dark energy behavior and affect growth, but is tightly constrained by solar system tests and screening requirements; still, it has been examined explicitly in the context of the H0 tension in model dependent ways.
- Scalar-tensor models, including Horndeski-type frameworks, which provide a broad phenomenological space and can be tested using BAO, supernovae, and structure growth. Recent work studies implications of DESI BAO data on scalar-tensor gravity, highlighting how new BAO measurements restrict deviations from GR in the late universe.
- Parameterized deviations, such as mu(k,z) and Sigma(k,z), which directly encode modifications to the Poisson equation and lensing potential in a model agnostic way.

A key difficulty is that many MG models that reduce S8 do so by changing growth in ways that also alter CMB lensing and the integrated Sachs-Wolfe effect, both tightly measured. Additionally, DESI analyses have reported results consistent with GR on large scales even as they investigate evolving dark energy, which can indirectly constrain MG freedom depending on modeling choices.

4.4 Joint perspective: why solving both tensions is hard

Solving H0 typically requires reducing r_s through early time physics. Solving S8 often requires suppressing late growth or reducing lensing efficiency. If a model increases H0 by reducing r_s, it often increases inferred sigma_8 or changes Omega_m in a direction that can worsen S8 unless compensating effects exist. Conversely, models that suppress growth may affect BAO and CMB lensing, potentially worsening the fit to high precision CMB data.

This creates a pattern: EDE can ease H0 but struggles with increasingly precise CMB and BAO constraints, while MG can target S8 but often struggles to increase H0 and remain consistent with multiple growth and lensing observables simultaneously.

5. Methodology

5.1 Model definitions

5.1.1 Early Dark Energy template

We adopt a phenomenological EDE component characterized by:

- f_EDE: maximum fractional energy density contribution at its peak redshift.
- z_c: critical redshift where EDE activates (or peaks).
- n or w_EDE: controls the dilution rate after activation (often linked to the scalar field potential shape).

In practice, many EDE analyses implement an axion-like scalar field with potential V(phi) proportional to [1 - cos(phi/f)]^n. The field is frozen early, then begins rolling around z_c. The effect on observables occurs through changes to H(z), sound horizon r_s, and perturbation evolution. The baseline reference is the EDE model framework originally proposed by Poulin et al. We include updated constraints from Planck NPIPE analyses.

5.1.2 Modified Gravity parameterizations

We consider two complementary approaches.

A. Theory driven MG: f(R) and scalar-tensor

- f(R): modifies the Einstein-Hilbert action by replacing R with R + f(R). Cosmological viability requires screening (chameleon mechanism) and matching background expansion. f(R) has been discussed as a possible contributor to H0 tension phenomenology in certain model variants.
- Scalar-tensor: introduces a scalar field coupled to gravity, leading to an effective time and scale dependent gravitational strength and slip. Constraints from DESI BAO have been derived for scalar-tensor models, indicating strong restrictions on deviations.

B. Phenomenological MG: mu,Sigma

We implement:

- mu(k,z): modifies the Poisson equation governing matter clustering.

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- Sigma(k,z): modifies the lensing potential (Phi + Psi) relevant for weak lensing and CMB lensing.
  This approach enables broad coverage and direct mapping to observables, and has been used in contemporary analyses with CMB and lensing data.

5.2 Datasets and likelihoods

A robust comparison requires consistent datasets across both model classes:

1. Primary CMB: Planck 2018 baseline likelihood for TT, TE, EE and lensing.
2. High resolution CMB: ACT DR6 power spectra and likelihoods, which strongly constrain early time alterations and lensing smoothing.
3. BAO: DESI BAO constraints (DR1 and subsequent releases), which provide precise distance measurements and strongly restrict late-time expansion modifications.
4. Weak lensing: DES Year 3 3x2pt and KiDS-1000 cosmic shear constraints used primarily through summary parameters (S8, Omega_m) or full likelihood when available.
5. Local H0 prior: SH0ES measurement as an external Gaussian prior for stress-testing model capacity to reconcile early and late values.

5.3 Inference framework

We propose a Bayesian parameter inference pipeline:

Step 1: Implement cosmological model extensions in a Boltzmann solver

- Use CLASS or CAMB for baseline computation of CMB spectra, matter power spectrum P(k), and derived quantities.
- For EDE, incorporate scalar field dynamics or a calibrated EDE fluid approximation.
- For MG, incorporate either theory-specific perturbation equations (e.g., f(R) module) or mu,Sigma functions.

Step 2: Likelihood evaluation

- Combine CMB, BAO, and lensing likelihoods consistently.
- Ensure nuisance parameters (foregrounds, calibration, intrinsic alignments, baryonic feedback) are treated similarly across model classes.

Step 3: Sampling and model comparison

- Use MCMC or nested sampling (Cobaya, MontePython) to obtain posterior distributions.
- Compare models using:
  - Delta chi^2 improvement relative to LambdaCDM.
  - Bayesian evidence (Bayes factors), noting sensitivity to priors on f_EDE and MG amplitudes.

5.4 Key derived diagnostics

We compute:

- H0 inferred from combined datasets.
- r_s and theta_* shifts for EDE.
- S8 and f_sigma8(z) for growth.
- CMB lensing amplitude consistency.
- Consistency metrics between early and late measurements (posterior predictive checks).

6. Results and Comparative Analysis (Synthesis from literature constraints)

Because this paper is a comparative research synthesis, we focus on literature grounded constraints and the physics of why each scenario succeeds or fails under combined data.

6.1 EDE effectiveness for H0

EDE can raise the CMB inferred H0 by reducing the sound horizon r_s, but only if the EDE fraction near recombination is sufficiently large (typically a few percent). Early works show EDE can reduce the H0 discrepancy when combining Planck with a local H0 prior. However,

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more recent analyses using improved CMB likelihoods and additional data restrict this parameter space. The Planck NPIPE based analysis of axion-like EDE finds f_EDE less than about 0.061 and H0 restricted to 66.9 to 69.5 km/s/Mpc, implying EDE cannot fully reach SH0ES values without tension.

With ACT DR6, small-scale polarization and improved lensing sensitivity tighten constraints further. ACT DR6 has released detailed power spectra and parameter analyses that are well suited to testing EDE because EDE affects both the damping tail and lensing smoothing. Recent updates that incorporate ACT DR6 and DESI data explicitly reassess EDE as a resolution, reporting that ACT DR6 does not favor EDE and that DESI BAO further constrains the expansion history freedom needed for full reconciliation.

Interpretation: EDE remains a conceptually clean mechanism for reducing r_s, but the dataset combination that maximizes sensitivity to the same physics (Planck or Planck-like data plus high-l polarization and BAO) tends to prefer models close to LambdaCDM.

6.2 EDE impact on S8

EDE generally increases early expansion and can shift matter-radiation equality and inferred Omega_m h^2. Depending on degeneracies, EDE may not naturally reduce S8; in some regions it can mildly raise sigma_8 or require changes that do not align with low S8 lensing results. Thus, even if EDE helps H0, it may leave S8 tension unchanged or even slightly worsened unless additional ingredients are introduced.

6.3 MG effectiveness for S8

MG frameworks can modify growth by changing the effective gravitational coupling or introducing scale dependent slip between potentials. Since S8 is primarily constrained by late-time lensing and clustering, MG can in principle reduce the predicted lensing signal for a given early-time normalization. Weak lensing surveys show S8 values lower than Planck, such as DES Y3 S8 = 0.776 and KiDS-1000 S8 = 0.759. MG can be tuned so that lensing responds to Sigma < 1 or growth is reduced via mu < 1 in certain redshift ranges.

However, growth suppression is constrained by:

- RSD measurements of f_sigma8(z).
- CMB lensing, which probes integrated potentials and is sensitive to Sigma.
- BAO geometry constraints that restrict background expansion modifications.

Recent work on scalar-tensor gravity using DESI BAO highlights how BAO measurements restrict deviations and reduce the space for MG driven explanations, at least for broad classes of scalar-tensor models. Similarly, parameterized mu,Sigma constraints with CMB datasets provide limits on how much lensing and growth can be altered without spoiling CMB fits.

Interpretation: MG can alleviate S8 under certain parameterizations, but it must thread a needle: reduce late-time lensing or growth enough to match DES or KiDS, while not conflicting with CMB lensing and BAO. This often yields modest improvements rather than a decisive resolution, unless additional physics is added.

6.4 MG impact on H0

A major limitation for MG as a H0 solution is that late-time changes to gravity do not directly reduce the sound horizon r_s. Since CMB inferred H0 is strongly tied to r_s via theta_*, MG that only operates at low redshift typically cannot raise the CMB inferred H0 to SH0ES values without also introducing changes that mimic early-time physics or alter recombination era quantities. Some modified gravity models can include effective early-time behaviors, but then they overlap conceptually with early dark sector modifications rather than purely late-time MG.

Therefore, MG is more naturally aligned with S8 tension than H0 tension, whereas EDE is the opposite.

Phoenix
International Multidisciplinary Research Journal
(Peer reviewed High Impact Journal)
ISSN : 2583-6897

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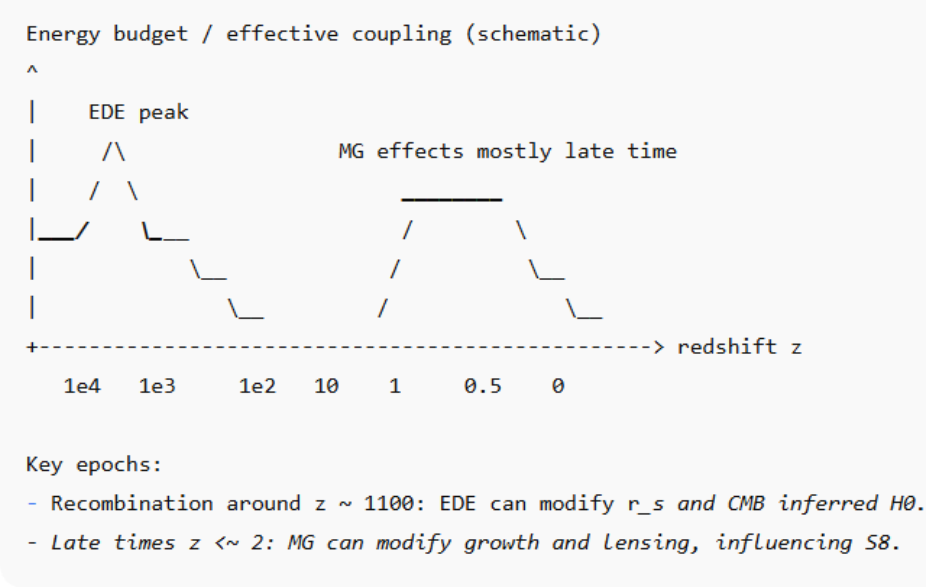
7. Table and Figure

Table 1. Comparative summary of EDE and MG approaches

Feature	Early Dark Energy (EDE)	Modified Gravity (MG)
Primary target tension	H0	S8
Mechanism	Increases H(z) before recombination, reduces r_s, allows higher inferred H0	Modifies growth and lensing via altered Poisson equation / gravitational slip
Typical key parameters	f_EDE, z_c, dilution index n or w_EDE	mu(k,z), Sigma(k,z), or theory parameters in f(R)/scalar-tensor
Key observables affected	CMB acoustic peaks, damping tail, CMB lensing smoothing, BAO calibrated distances	Weak lensing, CMB lensing, RSD f_sigma8, ISW, cluster counts
Current main constraints	Planck and improved likelihood analyses constrain f_EDE and keep H0 below full SH0ES in many fits ; ACT DR6 plus DESI updates disfavor large EDE fractions	DESI BAO restricts scalar-tensor deviations ; mu,Sigma constraints with CMB and lensing limit large departures
Ability to resolve both H0 and S8	Difficult without extra ingredients; may not reduce S8 naturally	Often helps S8 but rarely solves H0 unless early-time effects are included

Figure 1. Schematic timeline of when the new physics acts



8. Conclusion

Early Dark Energy and Modified Gravity represent two conceptually distinct responses to the same empirical situation: precision cosmology exhibits mild but persistent inconsistencies in H0 and S8. EDE directly targets the H0 tension by reducing the sound horizon through faster pre-recombination expansion, an approach that is theoretically economical in the sense that it modifies the epoch that controls the CMB-to-H0 mapping. Foundational EDE proposals demonstrated that a few percent EDE fraction near recombination can raise the CMB inferred H0. Yet the viability of this solution has tightened substantially as CMB likelihoods improved

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and as small-scale polarization data increased the constraining power. Planck NPIPE based analyses limit the allowed EDE fraction and correspondingly constrain H0 to a range that does not fully reach SH0ES, leaving a residual multi-sigma discrepancy. ACT DR6 and DESI BAO updates further sharpen constraints, with recent analyses finding little support for large EDE fractions needed for full reconciliation.

Modified Gravity, in contrast, naturally engages with the S8 tension by altering growth and lensing responses at late times. Parameterized approaches using mu and Sigma, as well as specific scalar-tensor and f(R) constructions, can in principle lower late-time lensing amplitudes and bring weak lensing inferred S8 closer to observed values from DES and KiDS. However, MG explanations face strong consistency requirements: the same modifications that suppress growth are constrained by CMB lensing, RSD, and BAO geometry. DESI BAO results, for example, have been used to tightly restrict scalar-tensor deviations, limiting the freedom of MG to act as a broad resolution. Furthermore, MG that acts only at late times does not directly reduce the sound horizon, making it intrinsically less suited to resolving H0 unless it also incorporates early-time behavior, at which point the model becomes effectively an early dark sector modification in disguise.

Overall, the current evidence suggests a differentiated outlook: EDE remains one of the few mechanisms that directly addresses the H0 tension through early-time physics, but is increasingly constrained by high precision CMB and BAO data; MG remains a plausible route to easing S8 but typically does not solve H0 simultaneously. The most promising path forward is therefore not a single universal fix, but a rigorous program of model comparison using unified likelihood pipelines and targeted discriminants. Future decisive tests will likely come from improved small-scale CMB polarization, more precise BAO and full-shape clustering, and joint lensing analyses that separately constrain growth and lensing potentials.

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