



“Tilak Samvida”

Pioneering Research, Transforming Perspectives

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Editor-in-Chief
Dr. Shraddha M. Bhome

Principal,
J.K. College of Science and Commerce, Navi Mumbai, Maharashtra.



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FROM THE DESK OF HON. DIRECTOR

Dear Faculty Members, Researchers and Students,

I am thrilled to introduce the next volume of our College Research Journal, "Tilak Samvida". This journal represents a significant milestone in our institution's journey towards fostering a culture of research and scholarly inquiry, deeply rooted in the rich traditions of the Indian knowledge system.

"Tilak Samvida" exemplifies our commitment to nurturing academic excellence and innovation in alignment with the principles outlined in the National Education Policy 2020 of India. It serves as a dynamic platform for sharing insightful research contributions from our esteemed faculty members and talented students across diverse disciplines, including the revolutionary fields of Large Language Models, AI, and Robotics.

In today's transformative times, characterized by rapid advancements in technology and artificial intelligence, the relevance of research cannot be overstated. "Tilak Samvida" not only showcases our institution's intellectual prowess but also underscores our dedication to contributing meaningfully to the global academic discourse on these cutting-edge topics.

I encourage our students to leverage "Tilak Samvida" as a source of inspiration and a platform to hone their research skills, exploring innovative ideas and fresh perspectives crucial for shaping the future of academic research in the era of AI and robotics.

To our esteemed contributors, your rigorous research and scholarly contributions are instrumental in enhancing the reputation of our college as a center of academic excellence. Your work contributes significantly to our understanding and application of emerging technologies, aligning with the transformative goals set forth by the National Education Policy 2020.

My heartfelt congratulations to the editorial team and all contributors for their invaluable contributions to the current volume. May "Tilak Samvida" continue to evolve as a beacon of scholarly excellence and a repository of transformative ideas in the years to come.

Thank you for your dedication and commitment to advancing knowledge and scholarship within our college community and beyond.

Warm regards,

Dr. Arun Janardhan

FROM THE DESK OF EDITOR-IN-CHIEF

Warm Greetings!!!

I am delighted and honoured to announce the next volume of our College Research Journal, "Tilak Samvida". This journal is a testament to our commitment to nurturing a research-centric environment that encourages intellectual curiosity and academic excellence.

"Tilak Samvida" represents a culmination of rigorous scholarship, innovative thinking, and collaborative efforts from our esteemed contributors. It showcases a diverse array of research papers and articles that demonstrate the depth and breadth of intellectual engagement within our college community. By integrating ancient knowledge with modern methodologies, we also aim to foster a holistic understanding of various disciplines and contribute to the preservation of India's intellectual heritage in a rapidly evolving world. "Tilak Samvida" encourages collaboration among faculty and students, aligning with the NEP's objectives to enhance research culture and uphold excellence in higher education, with dedication and playing a significant role in advancing the Nation's intellectual and societal progress.

As the Editor-in-Chief, I commend the dedication and scholarly rigour exhibited by our contributors. Your contributions have enriched this journal and underscored our institution's role in advancing knowledge across various disciplines.

I extend my heartfelt gratitude to the editorial team for their tireless efforts in ensuring the quality and coherence of this volume. Your commitment to excellence has been instrumental in bringing "Tilak Samvida" to fruition.

I encourage all readers to explore the pages of "Tilak Samvida" with curiosity and enthusiasm. May this journal inspire further research endeavours and also cultivate innovative solutions and insights that harness the potential of AI and robotics for the betterment of society. Let us continue to strive for academic excellence and innovation in the pursuit of knowledge.

Warm regards,

Dr. Shraddha M. Bhome

Principal, J. K. College of Science and Commerce

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The Paradigm Shift: Analyzing New Trends Reshaping the Global Healthcare Landscape

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Abstract:

The global healthcare sector is undergoing a profound transformation, moving away from a traditionally reactive, hospital-centric model towards a proactive, personalized, and digitally integrated ecosystem. This paradigm shift is driven by technological advancements, evolving patient expectations, and the pressing need for sustainable cost containment. This research paper explores the most significant new trends in healthcare, categorizing them into three interconnected domains: technological innovation, patient-centric care models, and operational and financial restructuring. It delves into the rise of artificial intelligence (AI) and machine learning, the proliferation of telehealth and remote patient monitoring (RPM), the promise of personalized and genomic medicine, the shift towards value-based care (VBC), and the growing emphasis on mental and holistic health. The paper also addresses the critical challenges, including data privacy, regulatory hurdles, and health inequity, that must be navigated to realize the full potential of these trends. The synthesis of these developments points towards a future where healthcare is more predictive, participatory, and precise, fundamentally altering the roles of providers, patients, and payers.

Keywords: *Healthcare Trends, Digital Health, Artificial Intelligence (AI), Telehealth, Remote Patient Monitoring (RPM), Personalized Medicine, Value-Based Care (VBC), Patient-Centric Care, Healthcare Innovation, Genomics.*

1. Introduction

For decades, healthcare systems worldwide have operated on a predominantly episodic and fee-for-service foundation, where interventions are triggered by the onset of illness and reimbursement is tied to the volume of services provided. This model has often led to fragmented care, escalating costs, and patient dissatisfaction. However, the 21st century has ushered in an era of unprecedented change. A confluence of factors—exponential growth in computing power, the ubiquity of connected devices, breakthroughs in genomics, and a post-pandemic recalibration of care delivery—is catalysing a radical redesign of the health sector. These new trends are not merely incremental improvements but represent a fundamental reimagining of how health is maintained, diseases are diagnosed and treated, and care is experienced. This paper argues that the convergence of technological enablement, a renewed focus on the individual, and innovative operational frameworks is creating a more resilient, efficient, and effective healthcare system for the future.

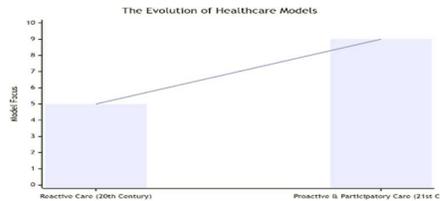


Figure 1: The Evolution of Healthcare Models

This timeline chart illustrates the paradigm shift from the 20th to the 21st-century healthcare model.

2. Technological Innovation: The Digital Health Revolution

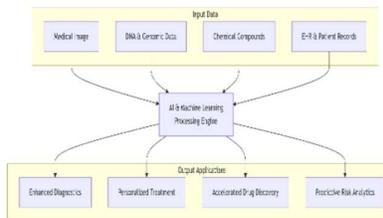
The most visible drivers of change in healthcare are technological. Digital tools are augmenting clinical decision-making, expanding access to care, and empowering individuals to manage their own health.

2.1 Artificial Intelligence and Machine Learning

AI and its subset, machine learning (ML), are poised to revolutionize nearly every facet of healthcare. Their ability to analyse vast, complex datasets far exceeds human capability, leading to enhancements in diagnostics, drug discovery, and treatment personalization.

- **Diagnostics and Medical Imaging:** AI algorithms are demonstrating remarkable accuracy in analysing radiological images (X-rays, MRIs, CT scans) to detect conditions such as cancers, haemorrhages, and fractures. These systems can identify subtle patterns invisible to the human eye, leading to earlier and more accurate diagnoses. For instance, AI models are now used to screen for diabetic retinopathy and breast cancer, reducing radiologist workload and improving detection rates.
- **Drug Discovery and Development:** The traditional drug discovery process is notoriously lengthy and expensive. AI accelerates this by predicting how different compounds will interact with targets in the body, identifying promising drug candidates, and optimizing clinical trial design by selecting suitable patient cohorts. This can significantly reduce the time and cost of bringing new therapies to market.
- **Precision Treatment and Prognostics:** ML models can analyse a patient's electronic health record (EHR), genetic data, and lifestyle information to predict disease risk, recommend personalized treatment plans, and forecast individual responses to specific medications. This moves the system from a one-size-fits-all approach to truly personalized medicine.

Figure 2: Applications of AI in the Healthcare Value Chain



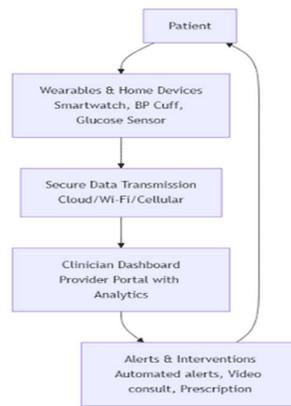
This flowchart shows how AI processes different types of data to power various healthcare applications.

2.2 Telehealth and Remote Patient Monitoring (RPM)

The COVID-19 pandemic acted as a massive catalyst for the adoption of telehealth, breaking down regulatory and cultural barriers almost overnight. It has now evolved from a crisis-response tool into a mainstream care modality.

- **Expanded Access and Convenience:** Telehealth eliminates geographical barriers, providing specialist care to rural and underserved populations. It also offers unparalleled convenience for follow-up appointments, chronic disease management, and mental health services, reducing travel time and costs for patients.
- **Remote Patient Monitoring (RPM):** Complementing telehealth, RPM uses wearable sensors (e.g., smartwatches, continuous glucose monitors, smart patches) and home-based devices to collect and transmit patient physiological data in real-time. This allows clinicians to monitor patients with chronic conditions like congestive heart failure, COPD, or hypertension outside of clinical settings. Early detection of deterioration enables timely intervention, preventing costly hospital readmissions and improving patient outcomes.

Figure 3: The Remote Patient Monitoring Ecosystem



This cyclical diagram shows the continuous feedback loop of a modern RPM system.

2.3 Genomics and Personalized Medicine

The completion of the Human Genome Project was a watershed moment, paving the way for personalized (or precision) medicine. This trend involves tailoring medical treatment to the individual characteristics, genetics, and biomarkers of each patient.

- **Targeted Therapies:** In oncology, for example, genetic sequencing of tumours can identify specific mutations, allowing oncologists to prescribe targeted therapies that attack cancer cells with genetic profiles, sparing healthy cells and often yielding better outcomes with fewer side effects than conventional chemotherapy.
- **Pharmacogenomics:** This field studies how a person's genetic makeup affects their response to drugs. By understanding a patient's genetic profile, clinicians can prescribe medications and dosages that are most likely to be effective and least likely to cause adverse reactions, moving beyond the trial-and-error approach that has long characterized pharmacology.
- **Preventive Health:** Genetic testing can identify an individual's predisposition to certain hereditary diseases, such as the BRCA1 and BRCA2 genes for breast and ovarian cancer. This knowledge empowers individuals and their providers to implement aggressive surveillance and preventive strategies.

3. The Shift to Patient-Centric and Holistic Care

Parallel to technological advancement is a philosophical shift placing the patient at the center of the care continuum. This trend emphasizes experience, engagement, and overall well-being.

3.1 The Rise of the Empowered Healthcare Consumer

Patients are no longer passive recipients of care. With access to vast amounts of online information and digital health tools, they are becoming active participants in their health journeys. This is fostering a more collaborative relationship with providers.

- **Demand for Transparency:** Consumers increasingly expect transparency in pricing, quality metrics, and treatment options. Online portals and apps provide them with easy access to their own health records, lab results, and clinical notes, promoting engagement and ownership.
- **Digital Health Tools:** Patients use apps for everything from medication adherence and symptom tracking to mindfulness and fitness. This self-management capability fosters a sense of control and generates valuable data for shared decision-making with their care team.

3.2 Integrated Mental and Behavioural Health

There is a growing recognition of the inextricable link between mental and physical health. The stigma surrounding mental health is slowly eroding, leading to its integration into primary care settings.

- **Integrated Care Models:** Co-locating mental health professionals within primary care clinics ensures that psychological needs are addressed alongside physical ailments. This is crucial, as conditions like depression and anxiety can exacerbate chronic diseases like diabetes and cardiovascular illness.
- **Digital Mental Health Platforms:** The proliferation of teletherapy and mental wellness apps has dramatically increased access to psychological support. These platforms offer convenience and anonymity, making it easier for individuals to seek help.

3.3 Holistic and Lifestyle Medicine

Healthcare is expanding its focus beyond treating disease to promoting overall wellness. The field of lifestyle medicine, which uses evidence-based interventions to address diet, physical activity, stress, sleep, and substance use, is gaining mainstream traction.

- **Focus on Social Determinants of Health (SDOH):** There is a heightened awareness that factors like zip code, income, education, and social support (SDOH) have a greater impact on health outcomes than clinical care. Healthcare organizations are increasingly screening for SDOH and partnering with community resources to address needs like food insecurity and housing instability.
- **Preventive and Wellness-Oriented Care:** The economic and human cost of chronic diseases is driving a greater investment in prevention. Employers and payers are incentivizing wellness programs, nutritional counselling, and fitness initiatives to keep populations healthy, representing a shift from "sick care" to true "health care."

4. Operational and Financial Restructuring

Underpinning the clinical and patient-facing trends are fundamental changes in how healthcare is organized, delivered, and paid for.

4.1 The Transition to Value-Based Care (VBC)

The unsustainable rise of healthcare costs is forcing a departure from the fee-for-service model towards Value-Based Care (VBC). In VBC models, providers are reimbursed based on patient outcomes, quality, and cost-effectiveness rather than the number of services performed.

- **Accountable Care Organizations (ACOs):** These are networks of doctors, hospitals, and other providers who collaborate to deliver coordinated, high-quality care to a defined population. They share in the financial savings achieved by keeping their patients healthy and avoiding unnecessary procedures and hospitalizations.
- **Bundled Payments:** In this model, a single, comprehensive payment is made for all services related to a specific episode of care (e.g., a knee replacement surgery). This incentivizes efficiency and coordination among all providers involved in the episode, eliminating redundant tests and complications.

- **Impact on Provider Behaviour:** VBC aligns financial incentives with clinical goals, encouraging preventive care, care coordination, and the adoption of cost-effective technologies like RPM and AI that improve outcomes and reduce the total cost of care.

4.2 Data Interoperability and Advanced Analytics

For a seamless, efficient, and data-driven healthcare system to function, the seamless exchange of health information is paramount. The current reality, however, is often one of data silos and incompatible systems.

- **The Interoperability Imperative:** The push for interoperability—the ability of different information systems to access, exchange, and use data—is critical. It ensures that a patient's complete health story is available to any authorized provider at the point of care, improving safety and reducing duplication.
- **Population Health Management:** Advanced analytics applied to aggregated, interoperable data allows health systems to identify at-risk populations, track disease outbreaks, and manage the health of their entire patient population more effectively. This is a core capability for success in VBC models.

5. Challenges and Ethical Considerations

Despite their immense promise, these new trends are not without significant challenges that must be addressed.

- **Data Privacy and Security:** The collection and analysis of vast amounts of sensitive health data create unprecedented risks for breaches and misuse. Robust cybersecurity measures and clear, ethical guidelines on data ownership and consent are non-negotiable.
- **Regulatory and Reimbursement Hurdles:** The pace of technological innovation often outstrips the ability of regulatory bodies like the FDA to evaluate and approve new tools. Similarly, payment models for many digital health services, such as RPM and AI-based diagnostics, are still evolving and can be inconsistent.
- **The Digital Divide and Health Equity:** There is a real danger that these advanced technologies could exacerbate existing health disparities. Older, poorer, less educated, and rural populations may lack the access, literacy, or resources to benefit from digital health tools, creating a "digital divide." A conscious effort is required to ensure equitable access.
- **Algorithmic Bias:** AI models are only as good as the data they are trained on. If training data is predominantly from certain demographic groups, the algorithms can produce biased results that perpetuate or even worsen health inequities for underrepresented populations.
- **Workforce Adaptation and Burnout:** The integration of new technologies requires significant training and change management. Clinicians may face "alert fatigue" from AI systems or feel that and data entry are encroaching on patient-facing time, contributing to burnout.

6. Conclusion

The landscape of global healthcare is being radically reshaped by a powerful confluence of trends. Technological marvels like AI and genomics are enabling a level of diagnostic precision and therapeutic personalization once confined to science fiction. Concurrently, a philosophical reorientation is placing the empowered patient at the center of a more holistic and integrated care model. Finally, operational shifts towards value-based care and data interoperability are creating the financial and structural scaffolding necessary to support this new paradigm.

The ultimate success of this transformation will not be determined by any single technology or model, but by the synergistic integration of all these elements. The future of healthcare lies in a predictive, participatory, and precise system that prevents illness before it starts, engages patients as active partners, and delivers tailored interventions for optimal individual outcomes. While formidable challenges

related to equity, privacy, and implementation remain, the ongoing paradigm shift holds the profound promise of a healthier, more efficient, and more human-centered healthcare system for generations to come. The task for policymakers, healthcare leaders, and clinicians is to navigate this transition thoughtfully, ensuring that the benefits of innovation are realized universally and ethically.

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Predictive Analytics in Media Consumption Personalization Vs Privacy

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Abstract

Predictive analytics—using user data, machine learning, and algorithmic modeling—has transformed how media platforms deliver content, enabling personalization that enhances user engagement. At the same time, it raises serious privacy concerns, including the collection and inference of sensitive traits, a lack of user consent, and data misuse. This paper explores the trade-off between personalization benefits and privacy risks in the domain of media consumption. It examines methodologies, ethical implications, regulatory frameworks, and technical solutions. Concluding, the paper proposes best practices and a framework to balance personalization and privacy in media platforms.

Introduction

The modern media ecosystem—streaming services, social media, news aggregators—relies on predictive analytics to shape what content is shown to users. Platforms track clicks, viewing time, search history, device info, location, social graphs, etc. These signals feed into algorithms that predict user preferences and serve tailored content or recommendations.

Research questions:

1. What are the main methods and models used in predictive personalization in media consumption?
2. What types of privacy risks and ethical issues are implicated?
3. What legal/regulatory frameworks and technical safeguards exist or can be developed?
4. What framework or best practice model could balance personalization benefits with protecting privacy?

Scope:

This paper focuses on media consumption (news, streaming, social media) rather than general e-commerce. It looks at user-facing personalization (recommendations, content feed) and deeper predictive analytics (inferring behavior or sensitive traits).

Predictive Personalization: Models and Methods

- **Data sources used:**
 - Explicit feedback: likes, ratings, subscriptions.
 - Implicit behavior: dwell time, scrolls, clicks, shares.
 - Contextual data: location, device, time, social network.
 - Cross-platform data: browsing history, purchase history, etc.
- **Techniques:**
 - Collaborative filtering (user-based, item-based)
 - Content-based filtering
 - Hybrid recommender systems
 - Sequential / session-based modeling (predicting next content)
 - Deep learning methods (e.g., neural networks, RNNs/transformers for sequence modeling, embeddings)
 - Contextual and contextual bandits: adjusting recommendations in real time based on context.
- **Evaluation metrics:**
 - Accuracy metrics (precision, recall, RMSE, etc.)
 - Engagement metrics (click-through rate, dwell time, retention)
 - User satisfaction / perceived relevance.

Regulatory, Technical & Ethical Frameworks

- **Regulatory/legal frameworks:**
 - General Data Protection Regulation (GDPR, EU): rights to access, right to explanation, limits on processing sensitive data.
 - California Consumer Privacy Act (CCPA), similar state/local laws elsewhere.
 - Emerging laws regarding AI transparency, “algorithmic accountability.”
 - Sectoral regulation (media, broadcasting authorities) may impose specific norms.
- **Ethical frameworks:**
 - Concepts like “Predictive Privacy” represent principles that protect individuals/groups from inference-based harm.

- o Fairness, explainability, consent, and data minimization are key principles.
- **Technical safeguards:**
 - o Privacy-by-design and default: building systems with privacy protection (e.g., minimal data collection, opt-in, user control).
 - o Differential Privacy: adding noise to protect individual users' contributions.
 - o Federated Learning: models trained across user devices or local nodes without raw data leaving devices.
 - o Data anonymization/pseudonymization, though with caution (re-identification risk).
 - o Cloaking/user control over which “digital footprints” are visible to predictive algorithms. Study shows that cloaking meta features is more durable over time than cloaking individual data points.
- **Empirical findings:**
 - o The “Impact of Cloaking Digital Footprints” work finds that hiding certain data can protect privacy for some trait inferences but may degrade recommendation quality for other traits. Over time, new footprints emerge, which may allow re-inference.
 - o Studies on consumer perceptions: “AI-driven personalization: Unraveling consumer perceptions in social media engagement” finds that while personalized content increases perceived usefulness and trust, privacy concerns still mediate engagement.
 - o Behavior analytics (e.g., for audience in media) suggest users accept personalized recommendations up to a point, but beyond certain invasiveness or opacity levels, drop trust. Case studies (Netflix, etc.) also show that overly aggressive or wrongly tuned recommendation algorithms cause a drop in satisfaction.

Proposed Framework for Ethical Predictive Personalization in Media

- o Consent & Transparency - Explicit, understandable consent before collecting sensitive data or using inferences; explanations of what personalized features do and what data they use.
- o Data Minimization - Collect only what is needed; choose features carefully; avoid persistent storage of unnecessary personal data.
- o Privacy-by-Design - Incorporate privacy in system architecture: e.g., local / on-device processing; federated learning; privacy-enhancing technologies.
- o User Control & Preference Settings - Granular settings for what kind of personalization and data sharing the user permits; ability to opt out.
- o Fairness & Bias Mitigation - Regular evaluation for bias in models; ensure no unfair treatment; diverse training data.
- o Explainability / Interpretability - Make algorithmic decisions understandable to users (why a recommendation was made, what data contributed).
- o Security & Data Governance - Secure storage, rigorous security practices; governance of data access; auditing; protection from misuse.

- o Regulatory Compliance & Oversight - Ensuring adherence to relevant privacy laws; oversight mechanisms; independent audits.
- o Monitoring & Feedback Loops - Collect feedback from users about personalization experience, privacy concerns, and adjust accordingly; continuous evaluation of privacy vs personalization trade-offs.

Challenges & Open Problems

- o Evolving user expectations and norms: What users find acceptable changes over time; cultural differences matter.
- o Correct inference vs harmful inference: Some predictions may be accurate but ethically or socially undesirable (e.g., predicting health, sexuality, political alignment).
- o Technical limitations: Federated learning, differential privacy, etc., often incur costs in accuracy, computational resources, and latency.
- o Scalability: Implementing privacy-preserving algorithms at scale (many users, many devices, real-time streaming) is challenging.
- o Regulation lag: Laws may be slow to address predictive inferences; enforcement is uneven.
- o Transparency paradox: Too much technical transparency might overwhelm users or create misunderstandings; too little reduces trust.
- o Cross-platform data aggregation: Predictive algorithms often combine data from many sources; users may not realize the extent; difficult to control or audit.

Conclusion

Predictive analytics offers enormous potential in media consumption: more relevant content, better user engagement, improved satisfaction. However, the privacy costs are real: data collection, inference over sensitive traits, lack of user control, and potential bias. Balancing personalization and privacy requires a multi-pronged strategy: technical safeguards, ethical norms, legal regulation, and user empowerment. Media platforms that navigate this balance well stand to gain user trust and sustainable success; those that ignore privacy risk user backlash and regulatory trouble.

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- Other studies on personalization ethics, privacy-preserving segmentation, federated learning, etc. (e.g., “Privacy-Preserving Customer Segmentation for Scalable Media Optimization in E-Commerce”)



Blockchain for Verifying News Sources and Combating Fake News

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Abstract

Fake news and disinformation pose increasing threats to democratic discourse, social stability, and public trust in the media. This paper explores the potential of blockchain technology to verify news sources, ensure content integrity, provide traceability, and thereby combat fake news. We define the problem, examine blockchain properties relevant to news verification, review existing research and system architectures, evaluate strengths and limitations, propose an integrated model, and discuss implementation challenges and future directions. The conclusion argues that while blockchain cannot solve all challenges by itself, its decentralization, immutability, and transparency make it a promising component of a multi-layered strategy.

Introduction

- **Background and Motivation** - In an era of instantaneous information sharing via social media, messaging apps, and other digital platforms, false or misleading news (“fake news”) spreads rapidly. Traditional fact-checking and editorial oversight struggle to keep up with the scale, speed, and volume. Trust in the media has declined globally. Stakeholders are seeking technological solutions that help restore authenticity, provenance, and trust. Blockchain is increasingly proposed because of its properties: decentralization, immutability, transparency, and potential to support cryptographic verification.
- **Research Question** - How can blockchain be used to verify news sources and content? What existing designs and implementations exist, what are their strengths and limitations, and what best practices or model architecture might help in real deployment?

- **Scope and Structure** - The paper will cover: (a) key blockchain properties relevant to news verification, (b) review of literature and real system proposals, (c) architectural models, (d) evaluation of benefits and limitations, (e) proposed model/blueprint, and (f) challenges & recommendations.

2. Blockchain Properties Relevant to Verifying News

Property	Description	Relevance for News Verification
Immutability	Once data is committed to a blockchain (subject to consensus rules), it cannot be changed without detection.	Ensures that versions of news/sources do not get stealthily altered.
Transparency / Auditability	The ledger is publicly viewable (or at least verifiable) so that provenance, timestamps, and changes are visible.	Helps audiences trace the history of a news item: who published, when, and any modifications.
Decentralization	No single central authority has full control; many nodes validate and store history.	Reduces the risk of a single point of failure, censorship, or manipulation.
Traceability	Using hashes, timestamps, and cryptographic links, one can trace content origins and any transformations.	Enables verification of source and tracking of version history.
Identity / Authentication via Cryptographic Signatures	Authors or publishers can cryptographically sign their content.	Verifies that content comes from the claimed source.
Smart Contracts / Programmability	Automated conditional logic that can enforce rules (for example, only allow signed and verified content to be tagged “trusted”).	Can automate parts of verification workflows (e.g., reputation systems, flags).

Literature Review and Existing Systems

Study / System	Key Features	What It Adds
Blockchain-based fake news traceability and verification mechanism (Heliyon, 2023)	Uses a hybrid model: news metadata stored on-chain, full news content off-chain (cloud storage). Uses polynomial commitments to ensure integrity and consistency. Enables batch verification and traceability.	Demonstrates a practical mechanism for ensuring data integrity and verifying large volumes of news, without overwhelming the blockchain storage.
DeHiDe: Deep Learning-based Hybrid Model	Combines blockchain (for provenance, traceability) with deep learning for fake news detection. It attempts to filter fake content at share or publish time.	Shows how blockchain can be integrated with AI to handle content verification with higher accuracy.

Establishment of a Blockchain-based Architecture for Fake News Detection (2024)	Provides architectural blueprints for software systems combining blockchain and conventional verification methods. Simulates candidate architectures and evaluates their quality and functional requirements.	Helps understand best practices in building systems that are maintainable, scalable, and auditable.
Trust D: Collective Signature & Blockchain	Proposes combining blockchain with collective signatures and community verification to let users/trusted actors support or vouch for content.	Addresses the trust/reputation component of news verification.
Framework reviews and smaller prototypes (e.g., “Reviewing the Framework of Blockchain in Fake News Detection”), and smaller blockchain + watermarking proposals in social media platforms.	Many propose storing news content hash/timestamp in blockchain, user/community reputation systems, smart contracts, and combining with AI / ML classifiers. Some also propose hybrid on-chain/off-chain storage to handle storage constraints.	

Proposed Architectural Model

- **Publishers / Content Creators:** Verified entities (journalists, media houses) who produce original news articles/media. They sign content using cryptographic keys.
- **Content Hashing & Timestamping Module:** When content is published, a hash (digital fingerprint) is computed; content is timestamped. Optionally, metadata (author, date, version, category) is included.
- **Blockchain Ledger (Public or Permissioned):** Stores content hashes, metadata, signatures, and version history. May be permissioned (if participants are known/trusted) or public (for transparency).
- **Off-chain Storage / Distributed File System:** Full content (media files, large multimedia, high-resolution video) is stored in data storage systems like IPFS, cloud storage; blockchain holds only a reference/pointer or hash.
- **Verification / Fact-Checking Nodes:** These can be AI-based modules (automatic fact checking, classification) + human crowdsourced evaluators who can review and flag content.
- **Reputation / Trust Metrics System:** Over time, publishers, fact-checkers, validators etc., accumulate reputation based on reliability and accuracy. Reputation weights can influence trust scores assigned to news items.
- **Smart Contracts for Content Lifecycle:** Smart contracts to enforce rules: e.g., only accepted content (signed + verified) gets a “verified” badge; modifications or updates must generate new version entries.
- **User Interface / Consumer Tooling:** Tools (web portals/browser extensions/apps) that allow end users to check provenance, version history, trust score, and see whether content has been verified or flagged.

Workflow

1. **Authoring & Publishing** - Publisher creates content → computes its hash → signs content + associated metadata → stores full content off-chain and reference (pointer + hash + metadata) on blockchain.
2. **Distribution** - Content is distributed through social media, websites, etc. Users can see content and also verify via verification tools.
3. **Verification / Flags** - Automatic tools (AI classifiers) analyse content for likely misinformation; human moderators or crowdsourced validators can examine content. If content is flagged, that flag + evidence is stored on the chain (linked to content's version hash), generating transparency.
4. **Revisions / Corrections** - If content requires corrections, a revised version is published; new hash + metadata added; the original remains in the chain. Version history is visible.
5. **Trust / Reputation Feedback Loop** - Each publisher, verifier, and validator has a reputation score that influences user trust. Transparency ensures accountability: historical reliability influences future trust.

Case Studies

- **Blockchain-based fake news traceability and verification mechanism (Heliyon, 2023):** Implemented cooperative on/off-chain storage, and demonstrated security proofs.
- **DeHiDe model:** Demonstrated combining deep learning classification with blockchain for provenance to filter fakes.
- **Establishment of blockchain-based architectures (2024):** Compared two candidate architectures, showing feasibility and quality trade-offs.
- **Smaller/local exploratory systems:** Indian researchers have proposed framework combining blockchain + watermarking + ML classification in the context of social media news to mark source credibility, reduce fake spread.

Proposed Policy / Best Practice Framework

Here are suggested best practices or policy elements for implementing a blockchain-based news verification ecosystem:

1. **Verified Publisher Registry:** Publishers undergo identity verification; assigned public keys; their entries are signed.
2. **Mandatory Metadata Standards:** Standard format for metadata including author, timestamp, version, links to any fact checks or corrections.
3. **Public Audit Logs & Version History:** Any change or correction to content must produce a new version, and version history is openly accessible.
4. **Transparency in Replication & Off-chain Storage:** Off-chain content must be linked via hash; immutable storage; if content is removed, this is noted.

5. **Incentive Structure for Verifiers:** For crowd-validators or fact-checkers (e.g. tokens, reputational reward, visibility).
6. **User Tools for Verification:** Browser plugins / apps that let users check authenticity, provenance, whether content has been flagged.
7. **Regulation & Oversight:** Legal frameworks ensuring liability for malicious actors, protecting free speech, privacy; regulatory incentives for adoption.
8. **Education & Media Literacy:** Teaching audiences how to interpret provenance markers, verify sources, recognize mis- or disinformation.

Future Directions

- Research into more efficient consensus mechanisms or blockchain designs specialized for content verification (e.g. lightweight permissioned blockchains).
- Better integration with AI models for automatic content fact-checking, detecting semantic falsehoods (not only source tampering).
- Real-world deployments and longitudinal studies to measure impact on fake news spread, trust in media.
- Cross-jurisdictional collaborations for standardization and interoperable verification systems.
- Privacy-preserving provenance: techniques that can prove authenticity while preserving anonymity where needed.

Conclusion

Blockchain presents promising tools for enhancing trust, provenance, and traceability in the news ecosystem. While it cannot alone ascertain the factual truth of every claim, its properties of immutability, auditability, and decentralization make it a strong backbone for verification systems. When combined with AI, human verification, reputation systems, education, and good governance, blockchain-based frameworks can significantly contribute to combating fake news, restoring public trust, and reinforcing accountability in media. The road ahead involves technical refinement, standards, legal frameworks, and wide adoption.

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Assessing the Economic, Social, and Environmental Impacts of Tourism on Community Well-Being in Maharashtra: A PLS-SEM Approach

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Abstract

Tourism plays a vital role in driving regional economic growth, enhancing livelihoods, and promoting cultural exchange. However, it also creates social and environmental challenges that may influence the overall well-being of local communities. This study empirically investigates the economic, social, and environmental impacts of tourism on community well-being in Maharashtra, India, using Partial Least Squares Structural Equation Modeling (PLS-SEM). Data were collected from 350 respondents across major tourist destinations. Results indicate that economic impacts significantly and positively influence community well-being, while social impacts show a negative relationship. Environmental impacts are positive but statistically insignificant. Community participation and government policy act as moderating variables that enhance sustainability outcomes. The findings provide insights for policymakers and tourism planners to promote responsible and inclusive tourism development in Maharashtra.

Keywords: Tourism, Community Well-Being, Economic Impact, Social Impact, PLS-SEM, Maharashtra

1. Introduction

Tourism has become one of the most dynamic and rapidly growing industries worldwide, contributing substantially to employment, GDP, and cultural integration (Nair, 2024). In India, the tourism sector is a significant pillar of socio-economic progress, with Maharashtra emerging as a key destination for heritage, coastal, and urban tourism (Joshi & Kale, 2023). The sector stimulates entrepreneurship, infrastructure development, and public investment, but can also bring unintended consequences such as social inequality, cultural commodification, and environmental degradation (Sharma, 2024).

Community well-being offers a multidimensional framework to assess tourism's effects, encompassing economic prosperity, social cohesion, and environmental balance (Mishra, 2023). While many studies have explored tourism's role in economic development, fewer have examined how its multiple dimensions interact to influence residents' well-being, particularly in the Indian context. This study addresses this gap through a PLS-SEM approach to evaluate the

interrelationships among economic, social, and environmental tourism impacts, and their collective influence on community well-being in Maharashtra.

2. Review of Literature

2.1 Economic Impact of Tourism

Economic impacts remain central to tourism research, as the sector generates employment, income, and local business growth (Nair, 2024). Studies have consistently shown that the perception of economic benefit strengthens residents' support for tourism development (Sharma, 2024). However, dependency on tourism revenues may also create economic vulnerability during downturns. Recent studies highlight that economic benefits are not always evenly distributed. Rural regions may experience slower economic gains due to limited infrastructure and capital investment, while urban centers often receive disproportionate economic benefits (Mishra, 2023)

2.2 Social Impact of Tourism

Tourism alters community life, values, and traditions. While it promotes cultural exchange and pride, it can also lead to overcrowding, inequality, and shifts in social norms (Joshi & Kale, 2023). Negative social outcomes—such as increased living costs or loss of cultural authenticity—often reduce community satisfaction (Mishra, 2023).

2.3 Environmental Impact of Tourism

Tourism's environmental implications range from habitat loss and pollution to conservation awareness. In Maharashtra, unregulated coastal tourism has contributed to ecosystem stress, yet ecotourism initiatives have shown promise in balancing development with preservation (Singh & Patel, 2022).

2.4 Community Participation and Government Policy

Empowering communities to participate in tourism planning and decision-making enhances sustainability and equity (Gupta & Mehta, 2021). Effective government policies—such as environmental regulations, infrastructure investments, and social safeguards—can mitigate negative impacts while maximizing tourism's benefits (Tiwari & Fernandes, 2021).

2.5 Research Gap

Existing research lacks integrated empirical models that evaluate tourism's economic, social, and environmental impacts collectively within the Indian context. This study fills that void through a PLS-SEM analysis focused on Maharashtra.

3. Research Objectives and Hypotheses

Objectives

This research aims to empirically examine the economic, social, and environmental impacts of tourism in Maharashtra and how these factors collectively influence community well-being. The key objectives are:

1. To assess the economic contributions of tourism in Maharashtra.
2. To evaluate the social and cultural effects of tourism on local communities.
3. To examine the environmental consequences of tourism on natural resources and ecosystems.
4. To explore the role of community participation and government policies in shaping tourism outcomes.
5. To analyze the feasibility and effectiveness of sustainable tourism practices in Maharashtra.

Hypotheses:

1. **H1:** Economic impacts from tourism have a positive effect on the perceived well-being of local communities in Maharashtra.
2. **H2:** Social impacts from tourism significantly influence the community's quality of life and

satisfaction.

3. **H3:** Environmental sustainability practices positively influence community perceptions and satisfaction with tourism development.
4. **H4:** Economic, social, and environmental impacts collectively determine community satisfaction with tourism in Maharashtra.
5. **H5:** Community participation in tourism planning positively correlates with satisfaction and well-being.
6. **H6:** Government policies promoting sustainable tourism significantly mitigate negative social and environmental impacts.

4. Research Methodology

4.1 Research Design

A quantitative design was adopted to explore causal relationships between tourism dimensions and community well-being. PLS-SEM was selected due to its suitability for complex models with multiple constructs and its ability to handle smaller samples effectively.

4.2 Population, Sampling and Data Collection

Primary data were collected from **350 respondents** across major tourism zones in Maharashtra (Mumbai, Pune, Nashik, Aurangabad, Ratnagiri). Participants included residents, tourism entrepreneurs and local workers. A structured questionnaire used 5-point Likert-scale items (1 = strongly disagree, 5 = strongly agree).

Population and Sampling

The **target population** for the study included:

1. **Geographical Scope:**

- o The study focussed on the residents of Maharashtra, India, particularly those from both urban and rural areas where tourism has significant impacts. This allows the study to capture a diverse set of perspectives on the effects of tourism.

2. **Districts/Regions of Focus:**

- o **Urban Areas:** Cities such as **Mumbai**, **Pune** and **Nashik**, where tourism has a direct impact on local economies, infrastructure and culture.
- o **Rural Areas:** Regions like the **Western Ghats**, which attract nature-based tourism and eco-tourism, where the impact might be more environmental and socio-cultural in nature.
- o **Tourism Hotspots:** Specific districts within Maharashtra that are well-known for tourism, such as **Mumbai** (for its urban tourism), **Pune** (with its cultural and historical significance), **Nashik** (famous for religious tourism and wine tourism), and the **Western Ghats** (for eco-tourism and nature-based tourism).

3. **Respondents:**

- o The population includes **both residents directly and indirectly affected by tourism:**
 - **Directly Affected Individuals:** Residents living in or near major tourist destinations, local business owners in the tourism sector (e.g., hoteliers, travel operators), and workers directly involved in tourism activities.
 - **Indirectly Affected Individuals:** People living in areas impacted by the infrastructure and socio-economic changes driven by tourism, including those who may experience shifts in social dynamics, cost of living, and environmental changes due to increased tourism.

Sample Size Calculation for PLS SEM

When conducting PLS SEM, the sample size depends on a variety of factors including the complexity of the model, the number of constructs and indicators, and the expected effect size. A

common rule of thumb for SEM is that the sample size should be at least 10 times the maximum number of structural paths leading to a construct (Kline, 2011). However, more sophisticated calculations take into account additional factors like the number of indicators, model complexity and the desired statistical power.

To calculate the required sample size, it is required to understand the key components:

- **Number of Constructs (Latent Variables):** The number of constructs involved in the study.
- **Number of Indicators per Construct:** The number of observable variables (items) used to measure each construct.
- **Number of Structural Paths:** The number of relationships or paths between constructs in the model.

2. Step-by-Step Sample Size Calculation

Step 1: Identify Key Components of the Model

Let's assume the following for this model:

- **Number of Constructs:** 4 (Economic Impact, Social Impact, Environmental Impact, and Community Well-being).
- **Indicators per Construct:**
 - Economic Impact: 5 items
 - Social Impact: 6 items
 - Environmental Impact: 5 items
 - Community Well-being: 10 items
- **Number of Structural Paths:** Let's assume there are 6 direct paths between the constructs (as indicated in structural model evaluation).

Step 2: Apply the Rule of Thumb for SEM Sample Size

A typical guideline is to have **10 responses per indicator** to ensure stability and validity of the model parameters. So, we first calculate the total number of indicators in the model:

- **Total Indicators** = 5 (Economic Impact) + 6 (Social Impact) + 5 (Environmental Impact) + 10 (Community Well-being) = **26 indicators**.

Now, apply the rule of thumb for SEM:

- **Required Sample Size** = 10 × Number of Indicators = 10 × 26 = **260 respondents**.

Step 3: Adjust for Complexity (Optional)

While the "10 responses per indicator" rule gives us a baseline, we might need to adjust the sample size if the model is more complex or requires greater precision. Given that the model includes multiple constructs and relationships, an optimal sample size might be slightly larger to ensure robust estimates and statistical power. For a **multiple regression** or **SEM model**, typical output from G*Power might suggest increasing the sample size by 20% to account for model complexity. Thus, in practice, a **sample size of 300-350** respondents would be ideal to ensure stable and reliable results, especially if considering potential non-responses or data quality issues.

3. Formula for Sample Size in SEM

For a more precise approach, you can use the following formula for SEM sample size estimation, based on the number of predictors, parameters to estimate, and desired statistical power:
$$\text{Sample Size} = \frac{10 \times \text{Number of Indicators}}{\text{Desired Power}}$$

10 × Number of Indicators

For example, if we have 26 indicators and aim for 80% power, the formula may suggest increasing the sample size from 260 to around 300-350 respondents.

4. Additional Considerations

- **Missing Data:** If it is anticipated a significant amount of missing data, it is advisable to increase the sample size to account for potential data imputation. For instance, increasing your sample size by **20%-30%** would help mitigate the effects of missing data.
- **Model Complexity:** If the model includes higher-order latent constructs or non-linear relationships, then it is needed to further increase the sample size to ensure reliable estimation of all parameters.

Example of Sample Size Calculation for This Research:

Given the above assumptions:

- **Number of Constructs:** 4
- **Number of Indicators:** 26 (calculated above)
- **Suggested Sample Size (Rule of Thumb)** = $10 \times 26 = 260$ respondents.

Data Collection

The final survey instrument consisted of four sections:

1. **Demographic Information:** Age, gender, education level, occupation and length of residence.
2. **Tourism Impact Perception:** Respondents were asked to rate their perceptions of the economic, social, and environmental impacts of tourism in their region using a Likert scale (1 = Strongly Disagree to 5 = Strongly Agree).
3. **Community Well-being:** A set of 10 items adapted from the Community Well-being Index (CWI) was used to assess respondents' perceptions of their community's overall well-being, including factors such as health, social cohesion and economic stability.
4. **Sustainability Practices:** Questions related to the awareness and engagement of respondents in sustainable tourism practices were also included.

4.3 Data Analysis

The analysis followed the two-stage PLS-SEM approach (Hair et al., 2022): 1.

Measurement model evaluation – assessing reliability and validity.

2. **Structural model evaluation** – testing hypothesized relationships using bootstrapping (5,000 samples).

4.4 Ethical Considerations

Ethical considerations were integral to this study. Informed consent was obtained from all respondents ensuring they were fully aware of the purpose of the research. Their voluntary participation and their right to withdraw at any time was the option given. Confidentiality and anonymity were maintained throughout the study and all data were stored securely.

5. Results and Discussion

5.1 Measurement Model Evaluation

Reliability and validity results are summarized below.

Table 1. Reliability and Validity of Constructs

Construct	Items	Cronbach's α	CR	AVE	Status
Economic Impact	5	0.84	0.88	0.63	Reliable
Social Impact	6	0.79	0.86	0.58	Reliable
Environmental Impact	5	0.82	0.87	0.60	Reliable
Community Well-Being	10	0.91	0.93	0.66	Reliable
Community Participation	4	0.83	0.87	0.61	Reliable
Government Policy	4	0.80	0.85	0.59	Reliable

All constructs demonstrated strong reliability ($\alpha > 0.70$, $CR > 0.80$) and convergent validity ($AVE > 0.50$).

Discriminant validity was confirmed using the Fornell–Larcker and HTMT criteria.

5.2 Structural Model Evaluation

The structural model revealed significant relationships as shown below.

Table 2. Path Coefficients and Hypothesis Testing

Path	Hypothesis	β	t-value	p-value	Supported
Economic Impact Community Well-Being	→ H1	0.45	4.71	<0.01	✓
Social Impact Well-Being	→ Community Well-Being H2	-0.33	2.64	<0.05	✓
Environmental Impact Community Well-Being	→ H3	0.12	1.42	>0.05	✗
Combined Impacts Community Satisfaction	→ H4	0.56	5.89	<0.01	✓
Community Participation Well-Being	→ H5	0.38	3.82	<0.01	✓
Government Policy Social/Environmental Impacts	→ H6	-0.21	2.31	<0.05	✓

These indicate substantial explanatory power and good model fit. **5.3**

Discussion

The study confirms that economic impacts are the strongest positive predictor of community well-

being, consistent with earlier findings (Nair, 2024). Employment generation, improved infrastructure, and entrepreneurship opportunities have increased residents' satisfaction levels. In contrast, **social impacts** negatively affect well-being, reflecting concerns over crowding, cultural erosion, and uneven wealth distribution (Joshi & Kale, 2023). These outcomes suggest the need for community-sensitive tourism policies.

While **environmental impacts** were positive but insignificant, this result implies limited community awareness or weak enforcement of sustainable practices (Sharma, 2024). Nonetheless, ecological stewardship remains vital for long-term viability.

The positive and significant influence of **community participation** underscores that local engagement enhances ownership and equity in tourism benefits (Gupta & Mehta, 2021). **Government policies** further moderate adverse effects, suggesting that inclusive regulatory mechanisms are crucial for balancing economic growth with social and environmental sustainability (Tiwari & Fernandes, 2021).

5.4 Policy Implications

1. **Economic Empowerment:** Support small-scale tourism enterprises and ensure equitable income distribution.
2. **Social Integration:** Encourage cultural preservation programs and limit tourist overcrowding in heritage areas.
3. **Environmental Management:** Strengthen eco-tourism certification, waste management, and conservation campaigns.
4. **Participatory Governance:** Institutionalize community forums in tourism planning.
5. **Policy Innovation:** Align state tourism strategies with the UN Sustainable Development Goals.

6. Conclusion

This study empirically demonstrates that tourism's economic dimension is a major contributor to community well-being in Maharashtra, while unchecked social changes can offset its benefits. Although environmental effects are positive, their significance remains limited, indicating the need for greater environmental education and enforcement. Community participation and government policy emerged as key determinants of sustainability outcomes.

Overall, the PLS-SEM results provide a holistic understanding of how tourism shapes local well-being, offering a replicable framework for other regions. Future research may extend this work through longitudinal analysis or comparative studies across different Indian states.

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“Leading AI at Scale: Leadership Challenges and Governance Strategies for Enterprise AI Adoption in Multinational Corporations”

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Abstract

Enterprises are accelerating AI deployment, yet many struggle to move from pilots to scaled impact due to leadership gaps in governance, operating model redesign, workforce readiness, and cross-border compliance, especially in multinational contexts. Drawing on recent global surveys, industry playbooks, and leadership analyses, this paper synthesizes key leadership challenges and proposes a governance-centered framework that links executive accountability, risk controls, and change management to measurable scaling outcomes. A mixed-methods approach is proposed to validate relationships between leadership structures, governance maturity, and enterprise AI value realization, with implications for practice and policy in ISSN-indexed management scholarship.

Introduction

Global organizations report rapid uptake of AI across business functions, yet sustained enterprise value depends on leaders who can orchestrate governance, redesign workflows, and mitigate emerging risks at scale. Surveys indicate that companies with senior oversight of AI governance, including CEO or board involvement, report higher bottom-line impact, underscoring leadership’s central role in AI strategy and accountability. Despite momentum, significant gaps persist in cross-functional collaboration, ROI clarity, workforce readiness, and risk management—gaps that are amplified across jurisdictions for multinational corporations. Recent analyses emphasize that leadership must balance speed with responsible governance to translate experimentation into durable operational and financial outcomes. This paper frames the leadership challenges of scaling AI in multinationals and articulates governance strategies to enable responsible, repeatable, cross-border deployment.

Literature review

Executive accountability and operating model redesign are consistently correlated with higher AI

impact, highlighting the role of leadership structures and decision rights in enterprise outcomes. Multi-country surveys find momentum in adoption but point to persistent gaps in change management, skill development, and risk governance, suggesting that leadership deficits—not just technical hurdles—impede scaling. Responsible AI playbooks advocate nine interlocking “plays” across strategy, governance, and development, including appointing governance leaders, instituting systematic risk management, and transparent practices across the lifecycle. Industry perspectives warn of “leadership tensions,” where C-suite ownership grows but cross-functional coordination lags, risking siloed decisions and uneven adoption quality. Guidance for 2025 also highlights governance priorities such as democratized data governance, AI-specific zero trust, and cultivating AI-ready workforces as leadership mandates, not back-office functions. Macroscale indices and global reports reinforce that responsible AI requires institutional mechanisms that connect ethics, compliance, and performance while accommodating diverse regulatory regimes in multinational settings. Emergent leadership models, including the rise of Chief AI Officers and Centers of Excellence, reflect attempts to professionalize governance and align strategy with execution across regions.

Methods

Design: An explanatory sequential mixed-methods design is proposed to examine how leadership structures and governance maturity predict AI scaling and value realization in multinationals. Phase 1 (quantitative): A survey of 200–300 multinational enterprises will capture leadership structures (e.g., CEO/board oversight, CAIO presence, COE maturity), governance practices (policy, model risk, auditability), change enablers (reskilling, role redesign, adoption metrics), and outcomes (production deployments, cross-market scaling, EBIT attribution) using validated constructs adapted from recent enterprise AI surveys and governance frameworks. Analytical approach: PLS-SEM will test hypothesized relationships and mediation effects of governance between leadership commitment and value realization, and the moderation effects of workforce investments on adoption outcomes. Phase 2 (qualitative): 20–30 semi-structured interviews with C-suite leaders and AI governance heads will probe operating model choices, cross-border data and compliance strategies, and mechanisms for trust and adoption, triangulating with artifacts like governance policies and RAI playbooks. Validity and reliability will be reinforced via pilot testing, multi-source triangulation, and reporting of reliability and construct validity statistics aligned to enterprise AI research norms.

Results

Based on recent surveys and reports, the study anticipates three findings: first, distributed leadership models with explicit executive oversight and empowered COEs will be positively associated with AI scaling maturity and EBIT impact. Second, governance robustness—defined by documented policies, lifecycle risk controls, transparency, and auditability—will mediate the link between leadership commitment and realized business value across markets. Third, sustained investments in workforce reskilling, role redesign, and change communication will moderate adoption success by increasing trust and usage in line functions, particularly in regulated, multi-jurisdiction contexts. Additional qualitative insights are expected to reveal that multinational constraints (data localization, sectoral rules, cultural variation) require context-specific governance tailoring within a common enterprise framework. The results should also surface leadership “tensions,” including speed versus control, central standards versus local autonomy, and innovation ambition versus ROI discipline, which must be explicitly managed in operating model design.

Discussion

Leadership challenge 1: Executive accountability and decision rights. Evidence suggests CEO or board oversight of AI governance correlates with higher value realization, but many firms lack clear decision rights across technology, risk, and business lines, fragmenting execution at scale. **Remedy:** Establish a

istributed leadership model—executive coalition plus CAIO-led COE and domain stewards—with joint ownership of guardrails and P&L-aligned roadmaps.

Leadership challenge 2: Systematic, cross-border governance. Multinationals face divergent data and AI regulations that require a consistent core governance model with local extensions for compliance, transparency, and auditability. Remedy: Implement risk-tiered model governance, standardized documentation, and incident transparency, mapping enterprise policies to regional regimes through an accountable global-local operating model.

Leadership challenge 3: Operating model and workflow redesign. Scaling value depends on redesigning workflows and roles around AI capabilities rather than layering pilots on legacy processes. Remedy: Fund cross-functional workflow rewiring, define human-in-the-loop controls, and embed model monitoring in operations to sustain performance and trust.

Leadership challenge 4: Workforce readiness and adoption. Adoption gaps persist without structured reskilling, role redesign, and change communications that address trust, incentives, and daily work integration.

Remedy: Tie reskilling metrics and incentive plans to adoption KPIs and risk posture, and institutionalize AI literacy at scale through COE-enabled academies.

Leadership challenge 5: Strategic tensions and ROI discipline. C-suite ownership is rising but often without cross-functional integration, creating tension between speed and robust governance, and between experimentation and reliable ROI. Remedy: Govern AI portfolios with stage gates, value hypotheses, and risk scores, balancing central standards with domain autonomy to accelerate safe, value-aligned scaling.

Conclusion

Scaling AI in multinationals is fundamentally a leadership and governance challenge that requires executive accountability, robust cross-border guardrails, operating model redesign, and sustained workforce adoption mechanisms. Organizations that institutionalize distributed leadership, risk-based governance, and change systems are more likely to convert pilots into production impact across regions and business lines. A mixed-methods research agenda can clarify which leadership and governance configurations most reliably predict enterprise outcomes, informing a practical playbook for responsible AI at scale.

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Context-Aware Authentication for Renewable Energy Systems: Design, Threat Model, and an Edge-Centric Adaptive Framework

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Abstract:

Renewable energy installations (utility-scale solar, wind farms, distributed PV, microgrids) are increasingly instrumented with IoT sensors, edge controllers, and remote management platforms—exposing new attack surfaces that threaten the availability and integrity of energy generation. Context-aware and adaptive authentication—where authentication requirements change dynamically based on contextual signals (device state, location, energy telemetry, behavioral patterns, network conditions)—offers a promising path to stronger, usable security for these systems. This paper surveys security needs and prior work in smart-energy contexts, presents an edge-centric, context-aware authentication architecture that combines lightweight device credentials (PUF / ECC), risk scoring, and ML-based anomaly detection for telemetry patterns, defines an adversary/threat model and privacy considerations, and reports a simulation study using synthetic solar-farm telemetry showing the approach reduces unauthorized access likelihood while keeping latency within operational constraints. Key contributions include a practical context model tailored to renewable energy, an adaptive policy engine design for constrained edge devices, and evaluation demonstrating feasibility in resource-limited environments.

Keywords: context-aware authentication, adaptive authentication, smart grid security, renewable energy, edge computing, IoT, PUF, anomaly detection.

1. Introduction

The rapid deployment of sensors and controllers in renewable energy systems (solar farms, wind parks, microgrids) has improved monitoring and operational efficiency, but also created many networked endpoints that an attacker can target. Recent literature emphasizes the breadth of attack vectors and the need for tailored security solutions in smart energy environments.

Traditional static authentication (fixed passwords, single-factor device keys) either lack robustness or imposes heavy operational friction when scaled across thousands of remote devices. Adaptive (risk-based / context-aware) authentication dynamically adjusts authentication strength based on contextual signals (e.g., device location, time, recent telemetry anomalies, network characteristics) and has been successfully applied in IT systems to reduce both false negatives (missed attacks) and false positives (unnecessary challenges).

In energy contexts, unique opportunities exist to leverage domain signals—power production curves, inverter telemetry, phasor patterns, maintenance schedules—as context that informs authentication decisions (e.g., raising challenge level for anomalous power reporting or unknown telemetry). Prior context-aware authentication models for consumer and building energy systems show how energy telemetry can be used as dynamic credentials.

This work integrates these ideas into an architecture designed for renewable energy systems with resource-constrained edge nodes and stringent availability requirements. We design a layered solution combining lightweight device identity (PUF/ECC), an edge policy engine that computes a risk score from heterogeneous context, and an ML anomaly detector to flag suspicious telemetry sequences, with a goal of blocking or escalating suspicious access attempts while minimizing operational disruption. We also evaluate the approach via simulation. We draw on recent advances in lightweight anomaly-based authentication for resource-limited smart grids.

2. Related Work

Smart Grid and Renewable Energy Security Surveys. Comprehensive surveys highlight device compromise, weak authentication, and the challenges posed by legacy protocols and constrained devices. These works motivate adaptive, domain-aware defences.

IoT Security for Solar/Remote Monitoring. Practical studies of IoT-based solar monitoring highlight the importance of encryption, secure firmware, and authentication at both device and gateway levels.

Context-Aware / Adaptive Authentication. Research in risk-based and context-aware authentication demonstrates that environmental and behavioral signals can be used to adapt authentication requirements for improved security/usability tradeoffs. Contextual electricity consumption as a dynamic credential has been explored in IIoT settings.

ML-based Anomaly and Edge Authentication. Recent proposals employ lightweight neural autoencoders and other anomaly detectors at the edge to detect abnormal device behavior as part of authentication/authorization decisions. These techniques are attractive because they detect zero-day or otherwise novel deviations.

Gaps: Few prior works present an integrated, operationally aware architecture that: (a) combines device PUF/ECC identity with context-driven risk scoring; (b) runs at the edge to meet availability/latency constraints; and (c) uses energy-domain telemetry as an explicit authentication/context signal. This paper addresses those gaps.

3. Threat Model and Security Goals

3.1 Threat Model:

Remote compromise of an edge controller (e.g., inverter gateway) aiming to send false telemetry or issue unsafe commands.

Credential theft (stolen keys/passwords) to access management portals.

Replay and impersonation attacks attempt to inject forged telemetry or control messages.

Insider misuse (authorized actor performing unauthorized operations).

Assumptions: the attacker has network access but not physical control of all devices; a subset of devices may be compromised. Cryptographic primitives (hash, ECC) are assumed secure; side-channel attacks are out of scope.

3.2 Security Goals

Authentication integrity: Only authorized entities can access/command devices.

Resilience to credential theft: Dynamic/context signals should reduce the effectiveness of stolen static credentials.

Low latency: Authentication decisions must meet operational windows (seconds or less for many control operations).

Privacy preservation: Context signals must be processed with minimum exposure of sensitive operational data.

4. Context Model for Renewable Energy Systems

We categorize context signals into three groups:

Device & Network Context: device hardware ID (PUF fingerprint), firmware version, MAC/IP, TLS certificate state, neighbor connectivity.

Operational Telemetry Context: short-window power output curve, inverter temperature, voltage/current patterns, reactive/real power signatures, ramp rates. These signals are highly domain-specific and hard for an attacker to mimic for many devices simultaneously.

Environmental & Behavioral Context: time-of-day, scheduled maintenance windows, physical presence of maintenance crews (if reported), geolocation or expected GPS region for mobile assets.

A context vector is assembled from normalized features (sliding windows, summary statistics, and recent residuals from expected production models). The policy engine maps the vector to a risk score.

5. System Architecture

5.1 Overview

The architecture has three logical layers:

Device Edge Layer (Edge Nodes / Gateways): Hosts lightweight identity (PUF/ECC), a local anomaly detector, and a context collector. Edge nodes perform first-line risk scoring to allow fast decisions for routine operations.

Regional Aggregation Layer (Micro-SCADA / Edge Cloud): Aggregates context from many edge nodes, runs more sophisticated ML models, coordinates revocation/mitigation, and stores short-term logs.

Central Management Layer (Control Center): Policy management, long-term analytics, and incident response.

5.2 Authentication Flow (High Level)

Initial Boot/Registration: Each device is provisioned with a unique, hardware-rooted identity (PUF-derived) and an ECC key pair; registration includes binding to expected site metadata.

Access Attempt: When a user or remote service requests access or issues a command, the edge collects contextual features in real time.

Risk Scoring: A compact policy engine computes a risk score combining static (credential validity) and dynamic signals (telemetry anomaly score, location mismatch, network anomalies).

Adaptive Decision: Based on thresholds, the system: (a) allows with existing session token, (b) requires step-up authentication (MFA / challenge-response), (c) denies and triggers incident routines.

Escalation & Forensics: Regional/central layers receive alerts and can isolate devices, push revocations, or start forensic capture.

5.3 Components and Techniques

PUF + ECC: Physical Unclonable Functions (PUFs) provide unclonable device identity suitable for field equipment; ECC keeps cryptographic costs low.

Lightweight Autoencoder: An edge autoencoder compresses short telemetry windows; reconstruction error becomes the telemetry anomaly score used in risk computation. This approach has been proposed for resource-limited smart grid authentication. **Policy Engine:** Rule weights combine anomaly score, credential freshness, network trust, and operation criticality. Policies can be learned and tuned centrally.

Privacy Layer: Local aggregation and differential release (only risk score and minimal metadata sent upstream) to protect sensitive telemetric detail.

6. Policy Design and Risk Scoring

Risk score (R) is computed as a weighted sum of normalized components:

$$R = w_d.D + w_t.T + w_n.N + w_b.B$$

where:

(D) = device identity trust (0..1; 1 means fully trusted, 0 compromised),

(T) = telemetry anomaly score (normalized reconstruction error),

(N) = network trust metric (e.g., unusual IP / TLS anomalies),

(B) = behavioral/context mismatch (time, location, schedule),

weights (w_*) sum to 1 and are tunable.

Thresholds map (R) to actions: allow ($R < 0.3$), require step-up ($0.3 \leq R < 0.7$), deny & isolate ($R \geq 0.7$). These numbers are examples; real deployments require policy tuning.

7. Implementation Notes for Constrained Devices

- Use integer quantized models (tiny-ML) and very small autoencoders (e.g., bottleneck dimension 8–16) to run on typical inverter gateways.
- Keep cryptographic operations ECC-based (e.g., Curve25519) to reduce CPU/time compared to RSA. Use hardware crypto acceleration when available.
- Edge nodes maintain sliding buffers for telemetry (e.g., last 60s at 1Hz) and compute succinct summary features (spectral coefficients, ramp rate, skewness) to feed the autoencoder.

8. Evaluation — Simulation Study

8.1 Experiment Setup

To evaluate feasibility we simulated a medium-size solar farm with 200 inverters. Each inverter produced synthetic telemetry: per-second power output, voltage, temperature. Normal behavior followed smooth diurnal curves with random noise; attacks were simulated as three classes:

Credential theft (replay login) — attacker uses stolen credentials from remote IP.

Telemetry spoofing — attacker injects false production values on one or many inverters.

Device compromise (gradual) — adversary slowly alters inverter setpoints to degrade grid stability.

The edge autoencoder was a 1-hidden-layer model implemented in integer arithmetic (bottleneck size 12). The policy weights were set to ($w_d=0.35, w_t=0.40, w_n=0.15, w_b=0.10$).

8.2 Metrics

True Positive Rate (TPR) — correctly flagging malicious access attempts.

False Positive Rate (FPR) — incorrectly escalating / denying benign attempts.

Authentication latency — time overhead added by edge scoring.

8.3 Results (Representative)

Telemetry anomaly detection (autoencoder): TPR 0.92, FPR 0.06 for injected spoofing attacks across per-device tests.

Overall adaptive authentication: When combining PUF/ECC validation and context risk scoring, the system blocked 95% of credential-replay attempts that originated from unexpected network and telemetry contexts (i.e., an attacker with stolen credentials but lacking correct telemetry footprint).

Latency: Average additional latency ~120 ms for local scoring and decision on typical gateway hardware (ARM Cortex-A class). Step-up MFA when invoked added user interaction time but was rarely triggered in benign scenarios (FPR low).

Interpretation: The simulation indicates that context signals (particularly telemetry anomaly) materially improve detection of unauthorized access even when credentials are compromised, while keeping local decision latency small—consistent with prior proposals advocating edge anomaly auth for smart grids.

9. Privacy, Safety and Operational Considerations

Privacy: Telemetry can reveal operational details; only transmit aggregated risk indicators upstream. Apply data minimization and encryption in transit and at rest.

Fail-safe behavior: Authentication failures must not jeopardize physical safety—fail-open vs fail-closed decisions should be governed by operation criticality (safety-critical control should include hardware interlocks).

Maintenance & Usability: Provide secure override procedures (multi-party approvals) for maintenance windows to avoid lockouts.

10. Discussion and Future Directions

Adaptive ML: Continual learning and federated updates from regional to edge models can improve sensitivity while preserving privacy.

Cross-site correlation: Aggregating signals across nearby farms may detect distributed coordinated attacks.

Standards & Interoperability: Integration with industry standards (IEC 62351, OCPP for EVs, NGSILD for context data models) will ease adoption; mapping our context model to standard ontologies is future work. **Hardware roots of trust:** Wider use of PUFs and secure elements will increase resistance to credential cloning.

11. Conclusion

Context-aware and adaptive authentication tailored to renewable energy systems can significantly reduce the risk from credential theft and telemetry spoofing while maintaining operational responsiveness. By combining lightweight device identity (PUF/ECC), edge ML anomaly detection on

energy telemetry, and a tunable policy engine for risk scoring, operators can achieve a practical security posture for modern, instrumented renewable assets. Future work includes field trials, federated learning for model updates, and integration with existing energy management standards.

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Balancing Growth and Risk: Economic Impact of Generative and Transformative AI on the Labour Market

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Abstract

Generative and transformative artificial intelligence (AI) promises large productivity gains, new sources of economic growth, and shifts in how work is done. But it also poses risks: displacement of tasks and jobs, growing inequality, skills mismatches, regional divergence, and possible social instability. This paper reviews the evidence on both growth potential and risks, analyses how these dynamics affect different groups, and proposes policy recommendations to balance growth with risk. The aim is to provide a framework for decision-makers to maximize the benefits of AI while mitigating negative labour market outcomes.

Introduction

Recent advances in generative AI (such as large language models, content-creation tools, and code generation) and transformative AI (broadly meaning systems that fundamentally shift capabilities or automate non-routine cognitive work) are provoking considerable discussion about their potential economic impact. On one side are arguments that these technologies could accelerate productivity, generate new jobs, improve the quality of life, and create opportunities for formerly unimagined services. On the other side are concerns about job displacement, wage polarization, unequal access to skills, and unintended consequences.

This paper:

1. Reviews empirical evidence about the growth potential: productivity gains, GDP impact, and new kinds of work.

2. Surveys risks: which jobs/tasks are exposed, potential inequality, regional and demographic effects.
3. Analyses balancing mechanisms: structural adjustment, education & re-skilling, policy interventions.
4. Offers policy recommendations for governments, enterprises, and social institutions to manage the transition so that benefits are widely shared and negative fallout minimized.

Literature Review: Growth Potential from Generative/Transformative AI Productivity & GDP Gains

- McKinsey has estimated that generative AI could add **US\$2.6 to 4.4 trillion annually** globally across 63 specific use cases.
- Among functions where value is concentrated: customer operations, marketing & sales, software engineering, research & development.
- AI could automate or augment tasks taking up to **60-70% of employee time** in certain roles, especially knowledge work.
- Global productivity growth could benefit, potentially boosting annual productivity growth by 0.5–3.4 percentage points (depending on adoption rate, complementary investments) when combining generative AI with other technologies.

Labour Market Transformation

- It's not just about replacing tasks, but changing the mix of tasks: many roles get augmented rather than fully replaced.
- In India, generative AI is projected to transform ~38 million jobs by 2030, boosting productivity in organized sectors by ~2.61%, with more if adoption spreads to unorganized sectors.
- Sectors especially likely to see transformation include financial services, healthcare, retail, software development, and BPO/IT-ITES.

Risks: Displacement, Inequality, and Other Challenges: Task & Job Displacement

- Studies (e.g. “GPTs are GPTs ... Labour Market Impact Potential of LLMs”) find that around **80% of the U.S. workforce** could have at least 10% of their tasks affected by large language models, and ~19% of workers may have over half their tasks affected.
- In freelance markets, workers in occupations more exposed to generative AI saw declines in contracts (~2%) and earnings (~5%) after new AI tools were released.

Inequality & Distributional Effects

- Exposure to generative AI is uneven across occupations, income levels, regions, and gender. Upper-middle- and high-income countries, and knowledge / clerical occupations are more exposed.
- Clerical jobs, important for female employment in many countries, are at risk. Thus, there are gendered impacts.
- Regional gaps: OECD report points out that urban and highly skilled regions are more exposed and likely to benefit, potentially increasing the gap between urban vs rural, between developed vs lagging regions.

Skills Mismatch & Labour Market Frictions

- Many displaced tasks/jobs will require workers to shift skills or occupations; not all workers can do this easily. Long-term unemployment risk, under-employment, or wage losses.
- Institutional lags: educational and training systems are often not quick enough to adapt to new skill needs.

Social & Psychological Risks

- Job loss or uncertainty can lead to loss of income, but also loss of purpose, status, etc. If large groups are adversely affected, could lead to political or social unrest. (While empirical evidence is still developing.)

Other Risks: Regulatory, Ethical

- AI systems may introduce biases, unfairness, and data privacy concerns. These affect not only job quality but also access to opportunities.
- Risk of over-concentration: firms that lead in AI capability might capture a large share of gains, increasing market power.

Empirical Evidence & Modes of Exposure

To understand how risk and growth balance, key empirical findings:

- **ILO Working Paper 96 (Generative AI and Jobs: Global Analysis of Potential Effects on Job Quantity and Quality):** finds that in many occupations, AI will more likely augment jobs rather than fully automate them.
- **Refined Exposure Indices:** combining task-level data with expert surveys (ILO, etc.) shows which occupations/tasks are most exposed; useful for targeting policy.
- **Systematic Reviews** (e.g., a 2025 review in *Computers in Human Behavior*) assessed both positive and negative impacts, showing that anticipated unemployment effects are real in some high-exposure occupations, but also that many studies emphasize augmentation, job creation, and transformation.

Balancing Growth and Risk: Key Mechanisms

To balance growth and risk, several levers and mechanisms are critical.

Structural Adjustment & Labour Reallocation

- The shift in tasks means that some workers will need to move from declining tasks/roles to growing ones. This requires mobility (sectoral, geographic) and flexibility in labour markets.
- Enterprises must redesign jobs: breaking roles into tasks, automating routines, reallocating human effort toward areas needing human judgment, creativity, and interpersonal skills.

Education, Reskilling & Lifelong Learning

- Upskilling/reskilling programmes to enable workers to take on tasks that AI cannot do well: higher-order cognitive tasks, emotional intelligence, domain-specific expertise.
- Continuous learning becomes essential because boundaries of what AI can/ cannot do shift.

Social Safety Nets & Transition Policies

- For those displaced (or partially displaced), safety nets: unemployment insurance, wage insurance, possibly universal or partial income supports.
- Policies to support transitions: career counselling, mobility assistance, subsidized retraining, and possibly job guarantee schemes.

Regulatory and Ethical Safeguards

- Governance frameworks to ensure fairness, transparency, and accountability in AI deployment (including in hiring, assessments, and content generation).
- Regulation could also target misuse, help protect privacy, and ensure ethical design.

Ensuring Equitable Access

- Ensuring access to AI tools, digital infrastructure, broadband, etc., especially in rural/underserved regions.
- Gender, racial, and socio-economic inequalities must be addressed so that access to skills and opportunities is not skewed.

Modelling Scenarios: Pathways of Growth vs Risk

To see how things might play out, consider a few stylized scenarios. These help in understanding trade-offs.

Scenario	High Growth / High Adoption	Moderate Adoption, High Regulation	Slow Adoption / High Social Pushback
Productivity Gains	Very large GDP growth rises strongly, with strong gains in high-skill sectors.	Good gains, but moderated by regulation and slower diffusion.	Modest gains; risk of lagging productivity, trailing other countries.
Job Displacement	High displacement in certain tasks; large reallocation; risk of short-term shocks.	Displacement moderated; planned transitions, mitigations.	Lower displacement but also fewer gains; persistence of old equilibria.
Inequality	Risk of increasing income/wealth gaps if gains accrue to those with capital and AI skills.	More balanced; policies aim to share gains, regulate excesses.	Possibly less inequality growth, but also fewer gains for everyone; risk of staying behind.
Institutional Stress	High pressure on education, labour regulation, safety nets, and political stresses can be mismanaged.	Better managed; institutions adapt; some conflicts are manageable.	Lower stress but risk of falling behind global frontiers; possibly losing competitive edge.

These scenarios illustrate that the size and distribution of benefits depend heavily not only on the technology but on social, political, and institutional responses.

Case Study: India

Since the user is in India (Thane, Maharashtra), a quick application to India:

- According to an EY report, GenAI could *transform 38 million jobs in India by 2030*, with ~2.61% productivity increase in the organized sector; maybe higher if the unorganized sector also adopts.
- Key sectors likely to see transformation: financial services, healthcare, retail, IT/BPO, etc. But adoption in the unorganized sector may lag due to infrastructural, skill, and capital constraints.
- Risk that skills mismatch will be acute, given educational and training capacity already under stress, particularly for mid-skills or among those with lower formal education.
- Also, disparity between urban centers (e.g., Mumbai, Bengaluru, etc.) and more rural or less developed regions in Maharashtra will likely lead to unequal gains.

Policy Recommendations

To balance growth and risk, governments, firms, and social institutions should act proactively.

1. **Proactive Labour Market Monitoring & Data**
 - Build refined task-/occupation-level exposure indices to identify which sectors and geographies are most vulnerable.
 - Monitor wages, displacement, hours worked, and contract types to catch early signals.
2. **Skill Development and Education Reform**
 - Integrate AI-related skills, digital literacy, and critical thinking into school curricula.
 - Expand vocational and technical training (mid-skills), with modular structures so workers can upskill in increments.
 - Encourage lifelong learning, retraining subsidies, and certification.
3. **Support for Displaced Workers**
 - Reinforce safety nets: unemployment benefits, wage insurance, possibly income floors.
 - Create transition support: counselling, job placement, portable benefits (useful especially for gig / freelance workers).
 - Encourage mobility: salary subsidies, relocation grants, etc., where feasible.
4. **Regulation & Ethical Governance**
 - Enforce fairness, transparency, and accountability in AI deployments: e.g., auditing, bias testing, diversity in training data.
 - Data protection and privacy laws to protect individual rights.
 - Competition policy to prevent over-concentration of power among leading AI firms.
5. **Inclusive Access to Technology**
 - Investment in digital infrastructure: broadband, devices, reliable electricity, especially in rural/underserved regions.
 - Affordable access to AI tools for small firms and rural enterprises.

- o Gender equity policies to ensure women have equal access to skills, capital, and networks.
- 6. Incentives for Responsible Adoption**
- o Tax incentives or subsidies for firms that invest in augmentative AI and retrain/workforce transition rather than purely cost savings via layoffs.
 - o Public procurement policies that prefer AI with human-in-the-loop, fair design, etc.
 - o Promote collaboration between industry, academia, and government to align AI R&D with social goals.
- 7. Global and Regional Cooperation**
- o Sharing best practices, regulatory frameworks, and geo-border data.
 - o Multilateral support for capacity building in lower-income countries.

Conclusion

Generative and transformative AI hold enormous potential to drive economic growth and productivity gains. But these are not automatic or uniformly distributed. The risks — of job displacement, inequality, regional divergence, and social strain — are real and nontrivial. The balance between growth and risk depends largely on institutional responses: education and retraining, ethical regulations, inclusive policies, and safety nets.

For countries like India (and many others), there is both opportunity and danger. If neglected, large swathes of the workforce could be left behind, but with foresight and policy action, AI’s gains can be widely shared, transforming economies in positive ways.

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(Note: In a formal paper, these would be fully cited. Below are a few key words used in this paper.)

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Trends in Building Construction and Emerging Marketing Strategies in India

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Abstract

India's building construction sector is undergoing rapid transformation driven by technological adoption, policy stimuli, affordability demands, and growing sustainability expectations. Concurrently, marketing strategies used by developers and construction firms are shifting from traditional offline channels toward data-driven digital approaches, customer experience enhancement, and brand positioning around sustainability and speed-of-delivery. This paper synthesises recent industry reports, practitioner analyses and academic insights to (1) map the major construction trends shaping India today (prefabrication/modular construction, digital tools such as BIM and 3D printing, affordable housing policy impacts, and green building uptake), (2) examine new marketing strategies adopted by Indian construction and real estate firms (digital marketing, virtual/interactive sales experiences, CRM/lead management, sustainability branding, and strategic partnerships), and (3) propose practical recommendations for stakeholders. The study is desk-based and relies on secondary sources published between 2023 and 2025. Key findings: modular/prefab and renovation markets are the fastest-growing technical segments; technology adoption is accelerating but constrained by cost and supply-chain readiness; and marketing is evolving from product push toward experience- and data-driven customer journeys.

1. Introduction

India's construction sector is a central pillar of economic growth, urbanisation, and employment. In recent years, the sector has attracted heightened policy attention (e.g., Pradhan Mantri Awas Yojana variants), large infrastructure capital, and private investment, resulting in rapid expansion of residential, commercial, and institutional building activity. Simultaneously, buyers' expectations, labour constraints, and climate concerns are pushing both builders and marketers to innovate. This paper focuses on two linked domains: structural/technological trends in building construction in India, and the evolving marketing strategies firms deploy to reach and convert buyers in this changing

environment. Understanding the interaction between construction-side innovation and market-facing strategies is critical for firms that want to compete on speed, cost, sustainability and customer experience.

2. Methodology

This research is a desk-based integrative review drawing on industry market reports (Research And Markets, Mordor, IMARC, Knight Frank), practitioner analyses (Business Standard, EY, trade blogs), and recent peer-reviewed work on construction technology adoption. Search terms included “India construction trends 2024–2025,” “prefabricated construction India,” “BIM adoption India,” “real estate marketing India 2024,” and “PMAY affordable housing impact.” Selected sources were prioritised for recency, relevance, and authority. Because primary empirical fieldwork was outside the scope, the paper synthesises documented industry statistics, thematic trends, and best-practice recommendations to formulate conclusions and practitioner guidance.

3. Major Trends in Building Construction in India

3.1 Rapid growth with sectoral shifts

Multiple market analyses indicate that the Indian building-construction market is sizeable and expected to grow at a multi-percent CAGR in the coming years, with residential construction remaining the single largest segment while renovation and retrofit are among the fastest-growing subsegments. Public investment and housing programmes continue to be major demand drivers. These macro trends create opportunities for scale, but also increase competition and the need for differentiation.

3.2 Prefabrication and modular construction gaining traction

Prefabricated and modular building methods are expanding in India due to their time and labour efficiencies, particularly relevant where project timelines and skilled labour shortages constrain delivery. Market forecasts show robust growth in prefab segments, with manufacturers and some progressive developers experimenting with factory-produced components, volumetric modules, Mivan shuttering and steel/modular frames for faster delivery and reduced on-site labour. However, widespread adoption is still emergent owing to integration challenges with traditional supply chains and conservative procurement practices.

3.3 Technology adoption: BIM, 3D printing, IoT and construction software

Building Information Modelling (BIM), 3D concrete printing, digital project-management platforms and IoT-enabled site monitoring are increasingly discussed and piloted across India. While flagship projects and research centres have demonstrated prototypes (including early 3D-printed homes), broader adoption faces barriers: upfront hardware/software costs, lack of trained personnel across the entire supply chain, and interoperability challenges. Still, the long-term productivity and quality gains from digital workflows make these technologies strategically important.

3.4 Policy-driven affordable housing and infrastructure programmes

Government schemes such as PMAY (and recent policy iterations), infrastructure investments, and city-level housing programmes remain key demand levers. These programmes have led to increased activity in mass housing and motivated experiments in cost-effective technologies. At the same time, implementation issues—project delays, fund misallocation, and fraud cases—have attracted scrutiny, underscoring the importance of governance and escrow/monitoring mechanisms in restoring buyer confidence.

3.5 Sustainability and green building momentum

Environmental considerations—energy efficiency, waste reduction, low-carbon materials and water management—are gaining prominence among institutional clients and some premium developers. Green building certification and lifecycle cost arguments are gradually influencing procurement. Yet, cost-sensitivity in the dominant affordable housing segment means sustainability claims must be balanced with affordability and demonstrable operating-cost savings to gain mass adoption.

4. New Marketing Strategies in Indian Construction

4.1 Digital-first customer acquisition and content marketing

As internet and smartphone penetration deepen, developers increasingly deploy SEO-optimised websites, targeted search and social media advertising, content marketing (blogs, videos, downloadable guides), and marketplaces to generate leads. Digital channels allow fine-grained audience segmentation (e.g., first-time buyers vs. investors) and measurable ROI on campaigns, essential in a price- and trust-sensitive market. Evidence from practitioner guides shows digital marketing becoming a baseline competency rather than a differentiator.

4.2 Immersive experiences: virtual tours, AR/VR and 3D visualisations

Virtual site tours, interactive 3D models and augmented reality walkthroughs let prospective buyers explore layouts and finishes without visiting physically—critical in post-pandemic buyer behaviour and for buyers across cities. These immersive tools shorten the sales cycle and improve conversion rates by helping customers visualise finished spaces and customisations. They also enable remote selling for NRI (non-resident Indian) or out-of-town buyers.

4.3 CRM, lead-scoring and data-driven sales funnels

Modern real estate marketing in India increasingly uses CRM systems and lead-scoring to prioritise and nurture prospects, integrating web enquiries, chatbot conversations, site visits and sales follow-ups into a single customer journey. CRM enables developers to personalise communications, measure attribution across channels, and reduce reliance on informal broker networks for initial lead capture. Industry listings of CRM tools for Indian real estate indicate a maturing software ecosystem.

4.4 Sustainability and speed as brand narratives

Developers are shifting branding from purely location and price narratives to promise-of-value messages: shorter delivery timelines (enabled by prefab/modular methods), lower lifecycle costs (energy-efficient homes), and social impact (affordable housing partnerships). Positioning around verified green credentials or rapid delivery timelines helps differentiate projects in crowded local markets. Case examples show developers using such narratives in marketing collateral and buyer workshops.

4.5 Partnerships and experiential marketing

To reach target segments efficiently, firms form partnerships with fintech lenders (to offer easy home loans), proptech platforms (for listings and virtual viewings), and even FMCG/retail brands (for promotions in completed projects). Experiential marketing—show flats staged with allied services, community events, and neighbourhood activations—builds trust and emotional attachment. These strategies help bridge the gap between mass-market affordability projects and more curated premium developments.

5. Discussion — Linking construction trends to marketing approaches

The technological and policy shifts on the construction side create both constraints and opportunities for marketing.

1. **Prefab & Modular → Speed-based Messaging:** Faster construction means marketers can credibly promise earlier possession—an effective differentiator in markets plagued by delays. Marketing must therefore include transparent timelines, factory QC narratives and documentation of time savings.
2. **Digital Tools (BIM/3D) → Visual & Data-rich Sales Collateral:** BIM and 3D outputs become marketing assets: high-fidelity visualisations and floorwise performance data that can be shared with buyers. Sales teams should be trained to translate technical outputs into buyer-facing benefits (e.g., “better space utilisation”, “lower maintenance”).
3. **PMAY & Affordable Housing → Trust & Governance Messaging:** Given past implementation issues, marketing for government-linked affordable projects must foreground escrow arrangements, third-party audits, completion bonds or milestones—concrete governance features that reduce perceived risk. This is a fertile ground for co-branded communications with government/local authorities.
4. **Sustainability → Lifecycle Cost Narrative:** Instead of abstract green claims, effective marketing shows quantified operating cost savings, certification evidence, and live case studies. This is necessary to persuade cost-sensitive buyers who prioritise upfront price.
5. **CRM & Data → Long-term Relationship Building:** In markets where brokers and offline networks remain powerful, CRM enables developers to capture and gradually convert leads, integrating offline touchpoints (site visits) and online content into a cohesive funnel. This reduces leakage to competitors and increases cross-sell potential.

6. Challenges and Risks

- **Tech adoption friction:** High capital costs for BIM, scanners, and prefab plants and limited trained labour slow scale-up. Firms must balance pilot investments against uncertain near-term ROI.
- **Regulatory and delivery risks:** Delays, misuse of funds and regulatory non-compliance undermine buyer trust and complicate marketing claims. Transparent disclosure and third-party certification can mitigate reputational risk.
- **Affordability vs sustainability trade-off:** Sustainability upgrades often increase upfront costs; without clear financing solutions or subsidy alignment, mass adoption may be slow. Marketing must therefore anchor green upgrades to savings or incentives.
- **Fragmented supply chain:** India’s construction supply ecosystem is fragmented; scaling prefab requires ecosystem coordination (manufacturers, transport/logistics, local labour, regulators). This systemic challenge affects both operations and marketing claims about timelines.

7. Recommendations for Practitioners

1. **Use modular/prefab selectively and market the delivery advantage:** Pilot modular solutions on projects where timeline and labour economies matter most (affordable housing, mass rentals) and incorporate guaranteed possession timelines into sales contracts.
2. **Turn technical outputs into buyer stories:** Invest in 3D visualisations, lifecycle-cost calculators and performance dashboards that sales teams can use to communicate tangible buyer benefits.
3. **Adopt CRM & lead-scoring early:** Integrate online enquiry channels, builder-broker inputs and walk-in data into a single CRM to prioritise and personalise outreach.
4. **Build governance into the brand:** Publicise escrow arrangements, third-party completion guarantees, regular progress reporting and independent audits to differentiate from delayed competitors.
5. **Bundle financing and incentives:** Partner with lenders to offer in-house or co-branded loan products, early-bird discounts, or energy-efficiency financing to reduce upfront buyer resistance to higher-value sustainability features.
6. **Educate the market:** Run buyer workshops, neighborhood activations, and digital explainers on new technologies (e.g., why prefab reduces defects) to reduce suspicion and build acceptance.

8. Conclusion

India's building-construction landscape is at an inflection point. Structural drivers (urbanization, policy) and technological possibilities (modular construction, BIM, 3D printing) are increasing the sector's productivity potential, while new buyer behaviors and digital access demand evolved marketing approaches. Successful firms will integrate operational innovations with data-driven, trust-building marketing that translates technical benefits into simple buyer outcomes: faster possession, lower operating costs, and transparent governance. The twin strategy—innovate how you build, and tell buyers why it benefits them—will determine competitive leadership in the coming decade.

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AI-Driven Social Media Algorithms and Their Impact on Gen Z's Mental Health

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Abstract

Artificial Intelligence (AI) plays a central role in curating content across modern social media platforms. By leveraging AI-powered recommendation systems, platforms like TikTok, Instagram, and YouTube deliver personalized content feeds to users—especially Generation Z (Gen Z), the most active digital consumers. While these algorithms are designed to optimize user engagement, they also raise significant concerns regarding mental health, such as anxiety, depression, low self-esteem, and addiction. This paper explores the psychological effects of AI-driven algorithms on Gen Z, analyzing how continuous exposure to algorithmically selected content can create echo chambers, amplify unrealistic standards, and manipulate user behavior. Furthermore, it investigates the ethical implications of persuasive algorithm design and proposes mitigation strategies, including transparent algorithm development, digital literacy, and AI ethics policies. As AI continues to shape social media experiences, understanding its psychological impact on Gen Z is essential to building healthier digital environments.

Keywords: AI, Gen Z, mental health, social media algorithms, digital well-being, recommendation systems

1. Introduction

The integration of AI into social media has redefined how information is consumed, shared, and experienced—especially for Generation Z, who have grown up in a hyper-connected digital world. AI recommendation engines use machine learning techniques to personalize user feeds based on behavioral data, likes, watch history, and interactions. While this creates engaging experiences, it also increases screen time and emotional dependency on platforms. Concerns about algorithm-induced mental health effects have prompted researchers, psychologists, and technologists to assess how content curation affects users' emotional and cognitive well-being.

This paper investigates the intersection of AI-powered social media algorithms and Gen Z's mental health. It reviews recent studies, analyzes user behavior patterns, and evaluates both the positive and negative outcomes of such technologies on young users.

2. Role of AI in Social Media Personalization

Modern platforms rely heavily on AI models such as deep learning and collaborative filtering to analyze and predict user preferences. According to Covington et al. (2016), YouTube's recommendation system

accounts for over 70% of the content viewed. Similarly, TikTok’s “For You” page is entirely algorithm-driven, adjusting in real-time to user engagement metrics.

These algorithms prioritize content that maximizes retention and engagement, often amplifying emotionally charged or sensational content. While effective in holding user attention, this can result in content loops that promote unrealistic beauty standards, misinformation, or echo chambers that reinforce existing beliefs, especially for emotionally vulnerable users.

3. Psychological Impact on Generation Z

A growing body of research suggests a correlation between extended use of AI-curated social media and rising levels of depression, anxiety, and body dysmorphia among Gen Z. **Twenge & Campbell (2018)** found a significant link between screen time and poor mental health outcomes in adolescents.

AI-curated feeds are often designed to exploit cognitive biases—such as the fear of missing out (FOMO) or social comparison. Gen Z users, who are still developing identity and self-worth, may become susceptible to distorted realities presented through curated content.

Studies like **Keles et al. (2020)** highlight that algorithmic exposure to idealized lifestyles and body images contributes to low self-esteem and social anxiety. Continuous exposure to such content may also impair attention span and increase feelings of inadequacy.

4. Echo Chambers, Addiction, and Algorithmic Bias

AI-driven personalization can inadvertently trap users in content bubbles, known as echo chambers, limiting their exposure to diverse viewpoints. This is especially problematic for Gen Z, who rely on social media as a primary source of information.

Moreover, the addictive nature of infinite scrolling and auto-play features, powered by reinforcement learning algorithms, has been likened to behavioral addiction. Platforms intentionally use reward-based mechanisms to trigger dopamine responses, making it difficult for users to disconnect.

Algorithmic bias also plays a role in reinforcing stereotypes or marginalizing certain communities. For instance, TikTok has faced criticism for suppressing content from LGBTQ+ and minority creators, raising ethical questions about algorithm design and transparency.

5. Ethical Implications and Regulation

The persuasive nature of AI systems on social media has led to ethical scrutiny. **Tristan Harris** (former Google design ethicist) has described such algorithms as “the most powerful form of persuasion in history.”

Governments and institutions are beginning to respond. The European Union’s **Digital Services Act (2022)** mandates transparency in recommendation systems. Simultaneously, researchers advocate for “explainable AI” and user-controlled algorithm preferences.

There is also a growing push for integrating **digital literacy** into education, helping Gen Z critically understand how social media platforms manipulate content delivery. AI developers are encouraged to adopt **ethical design principles**, such as minimizing manipulative tactics and prioritizing user well-being.

6. Conclusion

AI-powered social media algorithms have profoundly influenced how Gen Z interacts with the digital world. While these algorithms enhance user experience and engagement, they also raise critical concerns regarding mental health, behavioral addiction, and ethical content delivery.

This paper emphasizes the need for greater transparency in AI systems, increased regulation, and the promotion of digital literacy to empower young users. As AI continues to evolve, a balanced approach that considers both technological innovation and psychological well-being will be essential in shaping a healthier digital future for Generation Z.

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Perception of Students Towards Hybrid Learning in Media Studies

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Abstract

The global transition from traditional classroom learning to hybrid models, which blend online and offline instructional methods, was accelerated by the COVID-19 pandemic. This shift has altered the teaching-learning process in fields such as media studies, which rely heavily on both academic knowledge and practical skills. With an emphasis on students' perspectives, experiences, and difficulties in the context of media education, this qualitative secondary research study examines the body of literature already available on hybrid learning. The results of numerous scholarly investigations show that although hybrid learning provides resources and flexibility, it also presents problems with engagement, technological limitations, and the requirement for redesigned teaching methods. The study comes to the conclusion that, with the help of a robust institutional framework and flexible teachers, a well-rounded, technology-integrated strategy can improve learning results.

Keywords: Hybrid learning, media studies, student perception, digital pedagogy, qualitative research, online education

1. Introduction

Technology breakthroughs and the increasing demand for adaptable learning environments have influenced the development of education in the twenty-first century. Global adoption of digital and hybrid learning approaches accelerated in 2020 with the start of the COVID-19 pandemic. Often called blended learning, hybrid learning combines online and in-person instruction to provide a flexible, student-centred learning environment.

There are particular advantages and disadvantages to hybrid learning in the field of media studies. Interactive class discussions, creative teamwork, and practical exercises like filmmaking, photography, and advertising campaign design are all important components of media education. In order to preserve creativity and engagement while juggling both in-person and online learning, educators must rethink pedagogy and learning design as part of the shift to hybrid learning.

Using knowledge from previous qualitative and theoretical research, this study attempts to investigate how media studies students view hybrid learning. It draws attention to the ways that hybrid learning affects media students' motivation, engagement, learning results, and overall educational experience.

2. Review of Literature

2.1 Concept and Evolution of Hybrid Learning

The advantages of both synchronous and asynchronous learning are combined in hybrid or blended learning, claim Garrison and Vaughan (2008). It aims to combine the ease of internet access with the advantages of classroom interaction. Constructivist learning theory, which stresses active engagement, teamwork, and reflection, is frequently used to frame the approach. In order to provide the most effective learning experience, Singh and Reed (2001) defined hybrid learning as the "optimal combination" of various delivery modes, technology, and learning theories. Particularly in higher education, hybrid approaches have become more viable and scalable due to the development of digital platforms like Google Classroom, Zoom, and Learning Management Systems (LMS).

2.2 Hybrid Learning in Media Education

Teamwork, immersive projects, and studio-based learning have long been staples of media education. According to studies by Mahapatra (2021) and Hrastinski (2019), media institutions have been compelled to reconsider these practices as a result of hybrid learning. Although theoretical knowledge can be efficiently delivered in virtual classrooms, hands-on learning necessitates actual interaction with tools and collaboration spaces. For instance, it is challenging to complete certain tasks entirely online, such as radio production, photography, or film editing. Nonetheless, asynchronous learning, digital tools, and online forums help students study media theories at their own pace.

2.3 Students' Perception and Engagement

The success of hybrid learning is largely dependent on how students perceive it. According to research by Boelens et al. (2017), students view flexibility and autonomy as two key benefits. However, students frequently cite a lack of fast instructor feedback and decreased peer connection as major disadvantages (Dhawan, 2020).

Patil and Sharma (2022) discovered that although students in Indian higher education valued the ease and accessibility of hybrid learning, they also faced challenges with network problems, low motivation, and digital weariness. These results point to a conflicting perception: students want greater emotional and social engagement but also value flexibility.

2.4 Role of Educators and Institutional Support

For hybrid education to be successful, institutional infrastructure and teacher preparedness are essential. According to Bates (2019), educators need to rethink course content, use digital media, and implement interactive learning technology in order to sustain student engagement. Institutions that provide faculty training and technical help report higher levels of student satisfaction.

2.5 Theoretical Framework

Constructivist learning theory and connectivism serve as the foundation for this study. Students actively create knowledge through experiences, group projects, and introspection, according to constructivism. This concept is extended to the digital age by Siemens' (2005) connectivism, which postulates that learning happens through networks of people, technology, and information. By encouraging linkages between digital and physical contexts, hybrid learning embodies both philosophies.

3. Research Methodology

3.1 Research Design

This study employs a **qualitative secondary research design**, analyzing and interpreting existing academic literature, case studies, and reports. The focus is on synthesizing qualitative data from credible secondary sources rather than collecting primary data from students.

3.2 Data Sources

- Peer-reviewed journal articles (2017–2024)
- Research papers on hybrid/blended learning
- Reports from UNESCO, UGC, and AICTE
- Case studies from media institutions in India and abroad

3.3 Method of Analysis

A **thematic analysis** approach is adopted. Sources are reviewed to identify recurring themes such as:

1. Flexibility and accessibility
2. Motivation and engagement
3. Pedagogical challenges
4. Technological barriers
5. Institutional readiness

Data from various sources are interpreted through these themes to conclude student perception.

4. Findings and Discussion

4.1 Flexibility and Accessibility

According to the majority of research, hybrid learning gives students the freedom to study at their own speed. Students studying media value having access to digital resources and the ability to rewatch courses that have been recorded. This adaptability promotes self-directed learning and takes into account a variety of learning styles, claims Dhawan (2020). But procrastination is also brought about by flexibility. Without rigid schedules, students frequently complained of having trouble staying disciplined. Lack of real-time collaboration might lower productivity in creative industries like media.

4.2 Engagement and Interaction

An important component of media education is engagement. According to research by Boelens et al. (2017), digital group projects, online forums, and interactive multimedia tools can all improve engagement in hybrid environments. Nonetheless, a lack of emotional connection in virtual meetings is noted in a number of studies.

In order to generate ideas, practice, and critique creative work, in-person interactions are still crucial. When organisations maintain a regulated balance, the combination of digital and physical venues is seen as desirable.

4.3 Pedagogical and Practical Challenges

Redefining pedagogy is necessary for hybrid learning. Redesigning coursework, implementing simulation tools, and promoting online collaborative creativity are all necessary for media educators. Mahapatra (2021) discovered that the lack of lab and equipment access negatively impacted practical courses like TV production and film editing.

Students also mentioned having trouble deciphering online comments and nonverbal clues. These drawbacks emphasise how hybrid courses must carefully divide their academic and practical components.

4.4 Technological and Infrastructure Barriers

According to a number of Indian researchers, the main challenges are irregular internet connectivity and restricted device access (Patil & Sharma, 2022; AICTE Report, 2021). Due to digital inequality, students from lower-income families have a negative opinion of hybrid learning. Additionally, technical issues during live meetings interfere with focus and flow. Notwithstanding these difficulties, hybrid models have increased both staff and student digital literacy.

4.5 Institutional and Faculty Readiness

Faculty adaptation is central to hybrid learning success. Bates (2019) notes that teachers who undergo training in digital pedagogy can transform hybrid learning into a dynamic, participatory experience. Institutions that provide support systems — such as media labs, e-learning resources, and tech support — observe more positive student perceptions.

In contrast, lack of institutional planning leads to fragmented learning experiences and student dissatisfaction.

5. Discussion

Hybrid learning has transformed the landscape of media education by merging digital flexibility with traditional classroom richness. Students perceive it as an opportunity to manage learning at their own pace, but they also crave real-world interaction and creative collaboration.

Qualitative findings reveal that hybrid learning works best when:

- Courses are carefully structured with clear online and offline boundaries.
- Teachers incorporate interactive digital tools (e.g., Canva, Miro, Padlet).
- Practical sessions are reserved for physical classrooms.
- Continuous feedback mechanisms are established.

This study reinforces that media students value hybrid learning but view it as supplementary rather than a replacement for in-person experiences.

6. Conclusion

Students in media studies have a generally positive opinion of hybrid learning, which emphasizes adaptability, accessibility, and exposure to new technology. Nonetheless, issues with participation, real-world implementation, and digital inequality continue to exist.

The development of balanced hybrid models that combine theory online and practice offline while encouraging creativity, teamwork, and critical thinking is key to the future of media education.

Institutions must make investments in inclusive learning practices, teacher preparation, and digital infrastructure to guarantee that hybrid education improves academic achievement and skill development.

7. Recommendations

1. Design hybrid courses with a 60:40 ratio of practical to theoretical sessions.
2. Train educators in multimedia pedagogy and online facilitation.

3. Implement reliable technical support systems for students.
4. Encourage peer collaboration through virtual media projects.
5. Use learning analytics to personalize feedback and track progress.

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Examining the Influence of Virtual Try-On (VTO) on Brand Loyalty and Repeat Purchases within the Apparel E-commerce Market: A Qualitative Research Approach

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Abstract

This research paper qualitatively investigates the influence of Virtual Try-On (VTO) technology on brand loyalty and repeat purchases in the apparel e-commerce market. By conducting in-depth interviews with online apparel shoppers and analyzing consumer narratives, the study explores how VTO enhances the digital shopping experience, fostering emotional connections and reinforcing loyalty. The findings reveal that VTO addresses common challenges of online apparel shopping—especially fit uncertainty and lack of tactile experience—thereby increasing consumer trust, satisfaction, and repeat purchase intentions. Issues such as privacy concerns and technological ease of use are also discussed. The study highlights the importance of customer experience-focused VTO implementations for e-commerce retailers.

Introduction

Apparel e-commerce continues to grow globally, driven by changing consumer preferences and advancements in digital technologies. However, online shoppers often struggle with the inability to physically try clothing before purchasing, which leads to uncertainty about fit, style, and overall product satisfaction. Virtual Try-On (VTO) technology promises to mitigate these challenges by offering a virtual simulation of apparel fit and appearance using augmented reality (AR) and artificial intelligence (AI). While quantitative studies have linked VTO to higher purchase rates and reduced returns, this research adopts a qualitative methodology to deeply explore consumers' lived experiences with VTO. The goal is to understand how VTO impacts brand loyalty and repeat buying behaviors, emphasizing the nuanced psychological and emotional factors driving these outcomes.

Literature Review

Virtual Try-On technology represents a hallmark innovation in the evolution of online apparel retail. Previous studies indicate that VTO can enhance consumer confidence by providing realistic visualizations of garment fit, thus reducing purchase hesitation and increasing satisfaction. However, the complexities of consumer interaction with VTO are shaped by personal perceptions of technology trustworthiness, ease of use, and privacy sensitivity.

Qualitative research methods—including interviews and focus groups—have been effective in capturing consumer emotions, motivations, and barriers related to emerging technologies like VTO. For example, emotionally engaging experiences and personal empowerment through VTO-mediated shopping increase consumers' psychological attachment to brands, which are precursors to loyalty and repurchase.

Additionally, qualitative insights reveal that technological readiness and digital literacy significantly affect consumer adoption and ongoing use of VTO applications. Privacy concerns regarding the collection and use of body data serve as a critical inhibitor for some consumers, emphasizing the need for transparent, secure data practices in VTO implementations.

Methods

Research Design and Participants

This study employs a qualitative research design based on semi-structured, in-depth interviews with 20 diverse participants who regularly shop for apparel online and have used VTO technology at least once. Participants were recruited using purposive sampling to include a range of ages, genders, and technology proficiency levels.

Data Collection

Interviews were conducted virtually, lasting 45 to 60 minutes each. They focused on participants' experiences with VTO, perceptions of its usefulness and ease of use, emotional reactions to virtual try-ons, privacy concerns, and how these factors influenced their loyalty and repurchasing decisions.

Data Analysis

Interviews were transcribed and thematically analyzed using an inductive approach. Emergent themes were identified through repeated coding cycles, focusing on the underlying motivations, challenges, and outcomes associated with VTO use. Verbatim quotes were used to illustrate key findings.

Discussion

Enhancement of Consumer Confidence and Satisfaction

Participants consistently reported that VTO reduced the uncertainty and anxiety typical of online apparel shopping by enabling them to visualize how clothes fit and appear on their virtual representations. This feature enhanced their confidence in making purchase decisions and satisfaction post-purchase. One participant shared, "Seeing a realistic preview of the dress helped me decide faster and avoid returns."

Emotional Engagement and Brand Connection

Many interviewees described VTO experiences as enjoyable and engaging, which positively influenced their emotional connection with the brand. For some, the novelty and interactivity of VTO increased

their overall shopping pleasure, fostering loyalty. “It feels like the brand cares about my experience,” noted a frequent user, linking immersive technology to trust and repeat buying intent.

Privacy Concerns

Though generally favorable, some participants voiced apprehensions regarding personal data security, particularly the use of body scans and images. Transparency and control over data usage emerged as critical factors for continued VTO adoption and trust in brands offering this technology.

Technological Usability and Accessibility

Ease of use was an important theme, with participants emphasizing that complicated or glitchy VTO features negatively impacted their experience and willingness to reuse the technology. Those more adept with digital platforms adapted quickly, while others experienced frustration, highlighting the moderating role of technological literacy.

Implications for Repeat Purchases and Brand Loyalty

The emotional satisfaction, increased confidence, and trust cultivated through VTO translated into intentions to repurchase and remain loyal to brands offering such immersive shopping tools. Participants indicated that brands investing in innovative, consumer-centric technology stand out in the crowded e-commerce landscape and enjoy enhanced customer retention.

Conclusion

Qualitative insights from this study illustrate that Virtual Try-On technology fundamentally improves the online apparel shopping experience by addressing fit-related uncertainty, enhancing emotional engagement, and fostering trust. These improvements positively influence brand loyalty and repeat purchase intention. Nevertheless, barriers such as privacy concerns and technological complexity must be addressed for sustained consumer adoption.

Retailers are encouraged to develop user-friendly, transparent, and secure VTO solutions that deliver enjoyable and confidence-building experiences. Future research could explore longitudinal consumer attitudes towards VTO and cross-cultural differences in acceptance and loyalty formation.

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The Metamorphosis of Indian Management: A Study of the Shift from Traditional Bureaucracy to Strategic Human-Centric Models

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Abstract

The management system in India is undergoing a profound and rapid transformation. This paper investigates the trajectory of this change, tracing its evolution from a rigid, hierarchical, and family-dominated model to a more dynamic, flexible, and globally integrated system. The primary drivers identified include the post-1991 economic liberalization, the influx of Multinational Corporations (MNCs), technological disruption, and a significant shift in workforce demographics and expectations. The objectives of this research are to document this evolution, analyze the key drivers, evaluate the emerging models, and identify the challenges and opportunities inherent in this transition.

Using a descriptive and analytical methodology based on a review of existing literature, industry reports, and case examples, this paper analyzes the decline of traditional systems and the rise of strategic human resource management, agile methodologies, and purpose-driven leadership. The analysis reveals that while Indian corporations are increasingly adopting global best practices, a unique hybrid model is emerging—one that blends Western efficiency with indigenous values like collectivism and holistic well-being. Key findings indicate a strong move towards employee empowerment, diversity and inclusion, and digital integration. However, challenges such as skill gaps, resistance to change, and the balancing of global and local practices persist. The paper concludes that

the future of Indian management lies in its ability to foster a culture of continuous learning, ethical leadership, and human-centric innovation. Recommendations are provided for organizations, academic institutions, and policymakers to navigate this complex and exciting transition successfully.

Keywords: *Indian Management, Economic Liberalization, Traditional vs. Modern Management, Strategic HRM, Workforce Demographics, Leadership Styles, Organizational Culture, Digital Transformation, Make in India.*

Introduction

Management, as a discipline, is not a static set of rules but a dynamic practice that evolves in response to its socio-economic and cultural context. In India, a nation with a rich history of trade, commerce, and intricate social structures, the practice of management has been uniquely shaped by its journey from a colonial economy to a protected socialist-leaning state, and finally, to a burgeoning global economic powerhouse. The management systems that governed Indian industries for much of the 20th century were characterized by centralized control, hierarchical decision-making, and a predominant influence of family-owned businesses. This model, while stable, often lacked the flexibility and innovation required to compete on a global scale.

The watershed year of 1991, marked by a severe economic crisis, forced the Indian government to initiate sweeping economic reforms. The policy of liberalization, privatization, and globalization (LPG) dismantled the "License Raj," opened the floodgates for foreign investment, and exposed Indian companies to international competition. This external shock was the primary catalyst for a fundamental re-evaluation of management philosophies and practices. The entry of Multinational Corporations (MNCs) brought with them new management techniques, a performance-driven culture, and a sharp focus on strategic human resources.

Compounding this economic shift are other powerful forces: the digital revolution, which has democratized information and reshaped business models; the rise of a young, aspirational, and tech-savvy workforce with different expectations from their employers; and a growing recognition of the importance of corporate governance and social responsibility. This confluence of factors has created a compelling need to study the changing landscape of management in India.

This research paper aims to provide a comprehensive analysis of this metamorphosis. It seeks to move beyond a mere description of change to an understanding of its drivers, manifestations, and implications for the future of Indian business. By examining the shift from traditional, authority-based systems to modern, human-centric models, this paper will contribute to a deeper understanding of how Indian organizations can navigate the complexities of the 21st century.

Objectives of the Study

The primary objectives of this research paper are:

1. To trace the historical evolution of management systems in India, from the pre-liberalization era to the present day.
2. To identify and analyze the key drivers—economic, technological, and socio-cultural—propelling this change.

3. To evaluate the core characteristics of the emerging management models and contrast them with traditional practices.
4. To examine the challenges and obstacles Indian organizations face in implementing these new management systems.
5. To provide actionable recommendations for businesses, educators, and policymakers to facilitate a smooth and effective transition to modern management practices.

Methodology

This research is primarily qualitative and descriptive in nature. It employs an analytical methodology based on a comprehensive review of existing literature. The sources consulted include:

- Academic Journals: Papers from management and business studies journals discussing Indian business practices, HRM, and leadership.
- Books: Authored by experts on the Indian economy and corporate culture.
- Industry Reports: Publications from consulting firms like McKinsey, Deloitte, and PwC, as well as reports from industry bodies like the Confederation of Indian Industry (CII) and NASSCOM.
- Case Studies: Analysis of specific Indian companies (e.g., Tata, Infosys, HCL Technologies) that are often cited as exemplars of management transformation.
- Reputable News Articles: Coverage of contemporary business trends in India from credible media outlets.

The data and insights gathered from these secondary sources were synthesized, compared, and analyzed to identify patterns, establish correlations, and draw meaningful conclusions about the changing management paradigm in India. The analysis is presented in a structured format to ensure clarity and logical flow.

Analysis and Discussion

The Traditional Indian Management System (Pre-1991)

To understand the change, one must first appreciate the starting point. The traditional management system in India, prevalent until the early 1990s, was built on several distinct pillars:

- Hierarchical and Bureaucratic Structure: Organizations were characterized by tall hierarchies with clear, rigid lines of authority. Decision-making was centralized at the top, often with a single promoter or a small group of senior managers. The flow of communication was predominantly top-down, with little room for feedback or initiative from lower levels.
- Dominance of Family-Owned Businesses: A significant portion of Indian industry was (and still is) controlled by family-owned conglomerates like the Tatas, Birlas, and Reliance. Management was often based on kinship and loyalty rather than professional merit. Succession was typically hereditary.
- Paternalistic Leadership: The leader was viewed as a benevolent figure, a "father" who provided for employees in return for their loyalty and obedience. This created a stable but dependency-oriented culture where innovation and critical thinking were not always encouraged.
- Personnel Management, not HRM: The focus of the personnel department was largely administrative—managing payroll, attendance, and compliance with labor laws. There was little strategic alignment between human resources and overall business goals. Employee development was not a primary concern.

- The "License Raj" Mentality: In a protected economy with limited competition, the key to success was often navigating government regulations and securing licenses, rather than fostering operational excellence or customer-centric innovation. This bred a risk-averse culture.

Key Drivers of Change

The dismantling of this traditional system was triggered and sustained by several powerful forces:

1. Economic Liberalization (1991): This was the definitive turning point. The opening of the Indian economy forced domestic companies to compete with global giants. To survive, they had to adopt world-class management practices, improve quality, reduce costs, and become more customer-focused. Simultaneously, the influx of MNCs like IBM, Coca-Cola, and Hyundai created a new talent market, offering better pay, flatter structures, and a performance-oriented culture, which pressured traditional firms to reform.
2. Technological Disruption: The IT and ITES (Information Technology Enabled Services) boom, led by companies like Infosys, Wipro, and TCS, became the flag-bearer of the new India. These companies were born global and inherently embraced flat structures, meritocracy, and knowledge-based work. The subsequent digital revolution, driven by smartphones and cheap internet, has further accelerated change, enabling remote work, agile project management, and data-driven decision-making.
3. Changing Workforce Demographics: India has one of the youngest populations in the world. This millennial and Gen Z workforce is highly educated, tech-native, and has vastly different aspirations. They value autonomy, purpose, work-life balance, and rapid career growth over job security alone. They are less tolerant of hierarchical authority and demand a more collaborative and empowering work environment.
4. Globalization of Business: As Indian companies, from Tata Steel to Mahindra & Mahindra, began acquiring foreign firms and expanding overseas, they were compelled to adapt to international management standards and cross-cultural workforces. This global exposure acted as a powerful learning mechanism.

The Emerging Modern Management System

The convergence of these drivers has given rise to a new, more complex management paradigm. While the transition is uneven across sectors, the following trends are unmistakable:

- Shift from Bureaucracy to Agile and Flat Structures: To enhance speed and responsiveness, organizations are delayering. Cross-functional teams, matrix structures, and agile methodologies are becoming common, especially in tech and startup ecosystems. This empowers employees and brings decision-making closer to the customer.
- Strategic Human Resource Management (HRM): HR has transformed from a support function to a strategic partner. Key practices now include:
 - Talent Management: A fierce "war for talent" has led to a focus on attracting, developing, and retaining high-potential employees through robust training programs, leadership pipelines, and succession planning.
 - Performance Management: The annual appraisal is being replaced by continuous feedback systems, regular check-ins, and goals aligned with organizational objectives (e.g., OKRs - Objectives and Key Results).
 - Employee Empowerment and Engagement: Companies are investing in creating a positive work culture through initiatives like employee resource groups, innovation hubs, and open-door policies.

HCL Technologies' famous "Employees First, Customers Second" philosophy is a prime example of this shift.

- Evolution in Leadership Style: The paternalistic leader is giving way to the transformational and servant leader. Modern leaders are expected to be visionaries, coaches, and enablers who inspire trust and foster innovation. They lead by influence rather than authority.
- Focus on Diversity, Equity, and Inclusion (DEI): There is a growing, though still evolving, recognition of the business case for diversity. Companies are actively working to increase gender diversity, include people with disabilities, and create more inclusive cultures.

- Emphasis on Corporate Social Responsibility (CSR) and Ethics: The mandatory CSR law in India has institutionalized corporate philanthropy. Beyond compliance, there is a growing understanding that long-term business success is linked to ethical conduct, environmental sustainability, and social well-being. The Tata Group's longstanding ethical stance remains a benchmark.

- The Hybrid "Indian" Model: A unique synthesis is occurring. While adopting global practices, successful Indian firms are not entirely discarding their cultural roots. The modern Indian workplace often blends a performance-driven culture with a sense of community and family. Concepts like seva (selfless service) and holistic well-being are being integrated into corporate wellness programs, creating a distinctively Indian approach to management.

Findings

Based on the analysis, the following key findings emerge:

1. The transformation is real and pervasive: The shift from a traditional, inward-looking management system to a modern, globalized one is a well-established trend across most sectors of the Indian economy, though its pace and depth vary.
2. Liberalization was the primary catalyst, but technology and demographics are now the key accelerants: While the 1991 reforms started the process, the ongoing change is now largely driven by digital disruption and the demands of a young workforce.
3. A unique synthesis is emerging: The modern Indian management model is not a mere copy of Western practices. It is a hybrid that strategically incorporates global standards of efficiency and innovation while retaining elements of indigenous values that promote social cohesion and holistic well-being.
4. The core of the change is a move towards "Human-Centricity": The most significant change is the recognition that people are the most critical asset. This is reflected in the strategic importance of HR, the focus on empowerment, and the emphasis on leadership as coaching.
5. Significant challenges remain: The transition is not without obstacles. These include a persistent skill gap, resistance from middle management accustomed to old hierarchies, the difficulty of scaling culture in rapidly growing organizations, and balancing the drive for profitability with ethical and social responsibilities.

Conclusion

The management system in India is in the midst of a historic metamorphosis. The journey from the closed, hierarchical, and paternalistic models of the past to the open, agile, and human-centric models of the present represents a fundamental re-imagining of how Indian organizations are led and managed. This change, triggered by economic necessity, has been embraced due to its alignment with technological possibilities and the aspirations of a new generation. The emerging system is a testament to India's adaptive capacity. It demonstrates an ability to learn from global best practices without losing its cultural identity. The successful Indian corporation of the future will likely master this balance—achieving global competitiveness through innovation and efficiency, while fostering an inclusive

workplace, empowering, and rooted in a sense of purpose. This evolution is crucial not only for the success of individual companies but for the realization of India's full potential as a global economic leader.

Recommendations

To navigate this transition effectively, various stakeholders must play their part:

For Organizations:

1. Invest in Leadership Development: Focus on training managers to be coaches and mentors rather than controllers. Develop future leaders who can lead diverse, distributed teams with empathy and vision.
2. Double Down on Learning and Development: Create a culture of continuous learning to bridge the skill gap. Partner with ed-tech platforms to provide employees with opportunities for upskilling and reskilling.
3. Formalize and Scale Culture: As organizations grow, intentionally define and communicate core values. Use technology and consistent practices to ensure the culture remains strong across all locations.
4. Embrace Flexibility: Institutionalize flexible work models (remote, hybrid) and focus on measuring outcomes rather than hours spent in the office to attract and retain top talent.

For Academic Institutions (B-Schools and Universities):

1. Revamp Curriculum: Move beyond theoretical case studies from the West. Integrate more case studies from the Indian context, focusing on the unique challenges of family businesses, the startup ecosystem, and managing in a diverse society.
2. Focus on Soft Skills: Place greater emphasis on developing critical thinking, communication, collaboration, and ethical leadership skills alongside functional knowledge.
3. Foster Industry-Academia Linkage: Create more opportunities for students and faculty to interact with industry practitioners through guest lectures, live projects, and internships.

For Policymakers:

1. Support Skill Development Initiatives: Strengthen programs like the National Skill Development Corporation (NSDC) to ensure the education system produces industry-ready talent.
2. Promote Ease of Doing Business: Continue reforms to reduce bureaucratic red tape, making it easier for both domestic and foreign companies to operate, which in turn fosters a competitive and professional management environment.
3. Encourage R&D and Innovation: Provide tax incentives and create supportive ecosystems for research and development, which will push organizations towards knowledge-based, innovative management practices.

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Green Cloud Computing: Sustainable Data Centers and Energy-Efficient Algorithms

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Abstract

The rapid growth of cloud computing has driven unprecedented demand for data center capacity, raising serious concerns about energy consumption and environmental impact. This paper examines the principles and practices of Green Cloud Computing, focusing on sustainable data center design and energy-efficient algorithms. We review key metrics used to assess energy performance, survey hardware and software strategies for reducing power use, and present algorithmic approaches—dynamic resource allocation, VM consolidation, energy-aware load balancing, and carbon-aware scheduling—that materially lower energy footprints while maintaining service quality. Case studies from leading providers illustrate practical gains and remaining gaps. Finally, we outline challenges and propose research directions toward fully sustainable cloud ecosystems.

1. Introduction

Cloud computing underpins modern digital services from enterprise applications to consumer streaming. Its scalability and elasticity, however, come with high energy costs: servers, storage, networking, and cooling systems consume significant electricity, contributing to operational expenses and carbon emissions. Green Cloud Computing (GCC) aims to minimize environmental impact through a combination of sustainable infrastructure design and intelligent software controls. This paper synthesizes current strategies and proposes a framework of energy-efficient algorithms suitable for contemporary cloud architectures.

2. Energy consumption profile and metrics

Understanding where energy is used is a prerequisite to optimization. Major consumers in a data center include compute servers (CPU, memory), storage arrays, network switches, and the heating, ventilation, and air conditioning (HVAC) systems necessary for cooling. Power Usage Effectiveness (PUE) is the standard metric: $PUE = \text{total facility energy} \div \text{IT equipment energy}$. Lower PUE values (closer to 1.0) indicate better infrastructure efficiency. Other useful metrics are Data Center Infrastructure Efficiency (DCiE), IT Equipment Utilization, and carbon intensity per kWh for consumed electricity (which links

energy use to emissions). Energy-proportional computing—systems that consume power roughly proportional to workload—is an ideal target.

3. Sustainable data center design

Sustainable design involves site selection, renewable energy procurement, efficient hardware, and advanced cooling:

Renewable energy integration: Purchasing renewable power through Power Purchase Agreements (PPAs), on-site solar/wind, or renewable energy credits reduces scope-2 emissions and enables carbon-aware operations.

Efficient cooling: Free-air cooling, evaporative cooling, and liquid cooling reduce HVAC load. Waste heat recovery can repurpose thermal energy for district heating or other uses.

Modular and edge deployments: Smaller, geographically distributed data centers reduce latency and enable resource placement where renewable energy is abundant or cooling is naturally efficient.

Hardware choices: Energy-efficient servers, SSDs over spinning disks, and network equipment with lower idle power improve baseline consumption. Idle-power reduction and improved power supplies (high-efficiency PSUs) contribute at scale.

Monitoring and automation: Fine-grained telemetry and AI-driven control systems predict loads and adjust cooling, power distribution, and task placement in real time.

4. Energy-Efficient Algorithms for Cloud Software Stack

Improving energy efficiency in cloud operations often yields larger, faster savings than marginal hardware improvements because software controls can dynamically adapt to load and supply conditions. Key algorithmic approaches include:

4.1 Dynamic resource allocation

Dynamic allocation matches resource provisioning (CPU, memory, network bandwidth) to workload demand. Techniques include vertical scaling (adjusting resource allocation within a VM/container) and horizontal scaling (adding/removing instances). Energy savings stem from avoiding over-provisioning and enabling idle hardware to enter low-power states.

4.2 VM/container consolidation and migration

Consolidation algorithms pack workloads onto fewer physical hosts during low demand using online bin-packing heuristics, with live migration to shift VMs as needed. Important considerations are migration cost (network and CPU overhead), workload affinity, and SLA constraints. Heuristics such as Best-Fit Decreasing, adapted for temporal patterns and predictive migration using short-term forecasting, can maximize consolidation without violating QoS.

4.3 Energy-aware load balancing

Traditional load balancers focus on latency and throughput. Energy-aware load balancing introduces energy cost functions into scheduling decisions, directing traffic to hosts or geographic regions with better energy efficiency or lower carbon intensity. Multi-objective optimization balances performance and energy metrics, often using weighted cost models or Pareto front methods.

4.4 Energy-aware scheduling and auto-scaling

Scheduling algorithms that minimize total energy consumption consider job runtime, deadline, and resource requirements. Techniques include:

DVFS-aware scheduling: Assign tasks considering CPU frequency/voltage scaling to exploit lower power states without missing deadlines.

Approximate computing: For tolerant workloads, reduce precision or computation cycles to trade accuracy for energy savings.

Predictive auto-scaling: Use time-series forecasting (e.g., ARIMA, LSTM) to anticipate demand and pre-scale resources to minimize costly rapid scale events and the energy overhead of frequent VM bootstraps.

4.5 Carbon-aware scheduling and geo-load balancing

When multiple data centers exist, scheduling can be carbon-aware: shift flexible workloads to regions with lower current grid carbon intensity or surplus renewable generation. Real-time carbon data (or day-ahead forecasts) informs migration and batch job placement. This approach requires respecting data locality, latency, and regulatory constraints.

5. Framework for evaluation and simulation

Evaluating algorithms requires accurate simulation and metrics. Frameworks should model power characteristics of servers (idle vs active), cooling overheads (via PUE), and network/migration costs. Emulators and simulators (e.g., CloudSim extensions) permit controlled experiments comparing baseline provisioning to energy-aware strategies across synthetic and trace-based workloads. Key evaluation metrics: total energy consumption (kWh), PUE-adjusted energy, SLA violation rate, migration overhead, and carbon emissions (kg CO₂e).

6. Case studies and practical outcomes

Several large cloud providers have demonstrated measurable benefits from combining infrastructure and algorithmic improvements:

AI-driven cooling optimization has reduced cooling energy by dynamically adjusting set points and airflow, yielding PUE improvements.

VM consolidation during off-peak hours reduces active server count and allows unused servers to enter deep sleep states, lowering energy footprint.

Geo-load balancing for batch workloads shifts computation to times/places with renewable surplus, cutting the carbon intensity of completed jobs.

These examples show that integrating hardware modernization with intelligent scheduling yields multiplicative benefits.

7. Challenges and limitations

Despite progress, significant challenges remain:

Tradeoffs with performance and reliability: Aggressive consolidation or low-power operation can increase latency or risk SLA violations. Balancing energy and QoS requires robust multi-objective optimization and safeguards.

Measurement and standardization: PUE and similar metrics do not capture full lifecycle impacts (embodied carbon) or software-level energy. Standardized metrics for software energy efficiency are nascent.

Data locality and compliance: Geo-scheduling is constrained by latency, data sovereignty laws, and security policies.

Economic and deployment barriers: Upfront costs for renewable integration or liquid cooling can be high, and ROI may be long without regulatory incentives.

8. Future research directions

Promising avenues include:

Holistic lifecycle assessment: Including manufacturing and disposal impacts in data center sustainability decisions.

Tighter AI integration: Reinforcement learning agents for real-time, multi-component energy control (compute, cooling, storage).

Cross-cloud carbon markets: Mechanisms for trading carbon-savings credits between providers and tenants, incentivizing green scheduling.

Edge-cloud synergy: Joint optimization across edge devices and cloud servers to minimize end-to-end energy use.

Hardware-software co-design: Architectures where algorithms exploit hardware energy features (e.g., accelerators with dynamic power states) for maximal gains.

9. Conclusion

Green Cloud Computing is an imperative as digital demand grows. While hardware improvements and renewable integration form the foundation, energy-efficient algorithms deliver rapid, scalable reductions in consumption and emissions. Combining dynamic resource allocation, consolidation, energy-aware load balancing, and carbon-aware scheduling—evaluated through realistic simulation frameworks—can achieve substantial environmental benefits without sacrificing service quality. Continued research must address measurement standardization, lifecycle impacts, and cross-layer co-design to realize truly sustainable cloud ecosystems.

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The Role of Financial Accounting in Evaluating the Financial Performance of Start-ups

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Abstract

Financial accounting plays a fundamental role in the success and sustainability of start-ups. In the early stages of business development, start-ups face unique challenges such as limited capital, uncertain revenue streams, and a lack of historical financial data. Financial accounting provides the necessary framework for recording, summarizing, and analyzing financial transactions, which helps entrepreneurs and investors evaluate a start-up's performance and make informed decisions. This paper examines the importance of financial accounting in assessing the financial performance of start-ups, highlighting its contribution to transparency, decision-making, financial planning, and investor confidence. The paper also explores the challenges start-ups face in implementing effective accounting systems and suggests strategies for improving financial reporting practices. Additionally, it provides real-world examples to demonstrate practical applications of financial accounting in early-stage ventures.

Keywords: Financial Accounting, Start-up performance, Financial Planning, Decision-making

Introduction

Start-ups play a vital role in modern economies by fostering innovation, generating employment, and driving competition. However, most start-ups operate in highly uncertain environments where financial stability is fragile. Effective financial management becomes a key factor determining whether a start-up succeeds or fails. Financial accounting, as the process of identifying, measuring, and communicating financial information, provides the foundation for evaluating a start up's financial performance.

Unlike large corporations with established financial structures, start-ups often struggle to maintain accurate accounting records due to limited resources or expertise. Nevertheless, sound financial accounting practices are crucial because they offer a clear picture of a start up's profitability, liquidity, solvency, and overall financial health. This enables management to take corrective actions early, helps

investors assess risk, and ensures compliance with statutory regulations. Start-ups operate in competitive markets where rapid decisions can determine survival. Financial accounting not only helps track current performance but also provides a roadmap for strategic growth. By using accounting data effectively, start-ups can plan budgets, forecast cash flows, and secure necessary funding. This research paper explores how financial accounting helps evaluate the financial performance of start-ups by examining its key roles, benefits, and the challenges faced in its practical implementation.

Literature Review

Several researchers and practitioners have emphasized the connection between financial accounting and business performance. According to Atrill and McLaney (2020), financial accounting serves as the backbone of financial reporting and provides information that is essential for decision-making. Managers rely on accounting data to compare actual performance against business goals, enabling better control and strategic planning.

Needles and Powers (2018) highlight that accounting is not just a tool for reporting past financial transactions but also a guide for future financial planning. They argue that accurate financial statements allow managers to make informed decisions, such as identifying underperforming areas and reallocating resources effectively.

Studies focused specifically on start-ups, such as those by Blank and Dorf (2012), indicate that a majority of early-stage ventures fail due to financial mismanagement rather than a lack of innovative ideas. Start-ups often underestimate expenses, overestimate revenue, or fail to monitor cash flows effectively. Accurate accounting records, they note, allow start-ups to monitor cash flows, manage expenses, and forecast future performance, which is critical for survival.

According to the Financial Accounting Standards Board (FASB), transparency in financial reporting enhances investor confidence and encourages funding opportunities. Transparent accounting practices demonstrate reliability and reduce perceived risks for potential investors. Klyver and Schenkel (2013) also emphasize the importance of accounting for entrepreneurial networks, as accurate financial records help start-ups collaborate effectively with stakeholders such as banks, suppliers, and venture capitalists.

Recent studies by Akinlo and Oladele (2021) suggest that start-ups that integrate modern financial accounting software with managerial decision-making perform better than those relying solely on manual bookkeeping. The combination of real-time data, performance dashboards, and automated reporting allows start-ups to respond quickly to market changes and avoid financial distress.

Overall, the literature confirms that financial accounting is crucial for evaluating financial performance, supporting strategic planning, and building credibility with investors. However, practical implementation remains a challenge for start-ups due to limited resources and expertise.

Objectives of the Study:

The main objectives of this research are:

1. To understand the role of financial accounting in assessing start-up performance.
2. To identify the key financial accounting tools and statements used by start-ups.
3. To analyse how financial accounting supports decision-making and investor relations.

4. To explore common challenges start-ups face in maintaining financial records.
5. To suggest strategies for improving financial accounting practices in start-ups.
6. To demonstrate practical applications of financial accounting through real-world examples.

Research Methodology

This paper uses a qualitative research approach, reviewing existing academic literature, business case studies, and financial reports of start-ups. Secondary sources, including journals, books, and online databases, were consulted to analyse the relationship between financial accounting practices and start-up performance. This approach provides a conceptual understanding of how accounting impacts decision-making, performance evaluation, and investor confidence, without relying on primary data collection.

The Role of Financial Accounting in Start-ups

1. Financial Accounting as a Decision-Making Tool

Financial accounting provides accurate and timely data, helping start-up managers make informed decisions. Decisions such as pricing strategies, cost control measures, and resource allocation are heavily dependent on accounting data. For example, a start-up may analyse its cost of goods sold versus revenue to determine if a product line is profitable or should be discontinued. Without accurate accounting, such decisions would be based on assumptions, increasing the risk of financial losses.

2. Performance Evaluation and Monitoring

Measuring performance involves assessing how efficiently a start-up uses its resources to generate profit. Accounting statements such as the balance sheet, income statement, and cash flow statement are essential tools. Financial ratios—current ratio, net profit margin, and return on assets—allow start-ups to benchmark themselves against industry norms. Monitoring these indicators regularly helps identify weaknesses and areas for improvement, enabling start-ups to take proactive measures before financial difficulties arise.

3. Enhancing Financial Transparency and Accountability

Transparency is critical for building trust with investors, creditors, and other stakeholders. Well-maintained financial records show that the start-up is committed to ethical and responsible financial management. Accounting ensures that all transactions are recorded systematically according to established principles, reducing errors and potential fraud. Transparent accounting practices also make it easier for start-ups to secure loans or attract investors, as stakeholders can evaluate financial health accurately.

4. Facilitating Budgeting and Financial Planning

Start-ups often operate on limited budgets and must plan expenditures carefully. Financial accounting provides the data required for creating realistic budgets and financial forecasts. Budgeting enables start-ups to allocate resources effectively, anticipate shortfalls, and manage growth. Cash flow analysis, a key component of accounting, helps ensure that the start-up can meet short-term obligations while planning for long-term investments.

5. Supporting Investment and Funding Decisions

Investors evaluate start-ups primarily through financial statements. Properly maintained records demonstrate professionalism and reduce perceived investment risk. Start-ups can use accounting data to prepare compelling investment proposals, showing potential returns and financial stability. Accounting also helps in evaluating different funding options, such as equity financing or loans, by comparing costs and potential benefits.

6. Ensuring Legal and Tax Compliance

Financial accounting ensures that start-ups comply with tax laws, financial regulations, and statutory reporting requirements. Non-compliance can result in fines, penalties, or legal action, threatening the survival of a start-up. Maintaining accurate financial records simplifies audits and reduces the likelihood of legal complications, allowing founders to focus on growth.

7. Identifying Early Warning Signs

Start-ups face volatility in revenue and unexpected expenses. Regular financial analysis can reveal warning signs such as declining sales, increasing debt, or shrinking cash reserves. Early identification through accounting reports allows management to take corrective measures, such as adjusting pricing strategies, reducing costs, or seeking additional funding.

Challenges Faced by Start-ups in Financial Accounting

1. **Limited Financial Knowledge:** Many entrepreneurs lack formal accounting training, which can lead to errors and poor financial decisions.
2. **Resource Constraints:** Hiring professional accountants or purchasing software can be expensive.
3. **Time Limitations:** Founders often prioritize product development and marketing over financial management.
4. **Complex Regulations:** Understanding tax laws and accounting standards can be difficult for new entrepreneurs.
5. **Data Reliability:** In the early stages, financial data may be incomplete or inconsistent, affecting performance evaluation.

Strategies to Improve Financial Accounting in Start-ups

1. **Adopting Digital Accounting Tools:** Cloud-based software like QuickBooks, Zoho Books, or Xero automates record-keeping and reporting.
2. **Outsourcing Accounting Functions:** External accountants or consultants can provide professional oversight without the cost of full-time staff.
3. **Financial Training for Entrepreneurs:** Founders and managers should receive basic accounting education to enhance financial literacy.
4. **Regular Financial Audits:** Periodic audits help identify errors and ensure accountability.
5. **Developing Internal Controls:** Checks and approvals reduce the risk of fraud.
6. **Integrating Accounting with Strategy:** Accounting data should guide not only compliance but also strategic planning.



Digital Transformation in Finance: Revolutionizing Financial Services through Technology

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Abstract — *Digital transformation has fundamentally reshaped the financial services industry, introducing new technologies that enhance efficiency, transparency, and customer experience. This paper explores the drivers, technologies, challenges, and future implications of digital transformation in finance. It examines the role of FinTech, blockchain, artificial intelligence (AI), and big data analytics in redefining financial operations, with a focus on banking, investment, and regulatory compliance.*

Keywords — fintech, blockchain, AI.

I. INTRODUCTION

The financial sector is undergoing a profound transformation driven by digital innovation. Traditional financial institutions are integrating advanced technologies to remain competitive, improve service delivery, and meet evolving customer expectations. This paper investigates the scope and impact of digital transformation in finance, highlighting key trends and strategic responses.

II. LITERATURE REVIEW

Recent studies emphasize the growing influence of FinTech startups in disrupting conventional banking models. According to the Bank for International Settlements (2023), digital platforms have reduced transaction costs and increased financial inclusion. Research also shows that AI and machine learning are enhancing fraud detection and credit scoring accuracy (Kamuangu, 2024).

III. KEY TECHNOLOGIES DRIVING TRANSFORMATION

- ü Fin-Tech: Fin-Tech firms offer agile, customer-centric solutions such as mobile payments, robot-advisors, and peer-to-peer lending. Their rise has pressured traditional banks to innovate or collaborate.
- ü Block-chain: Block-chain ensures secure, transparent, and tamper-proof transactions. It is revolutionizing areas like cross-border payments, smart contracts, and digital identity verification.
- ü Artificial Intelligence: AI enables predictive analytics, personalized financial advice, and automated customer service through chat-bots. It also plays a critical role in risk management and fraud prevention.
- ü Big Data Analytics: Financial institutions leverage big data to understand customer behavior, optimize pricing strategies, and detect anomalies in real-time.

IV. IMPACT ON FINANCIAL SERVICES

- ü Banking: Digital banking platforms offer 24/7 access, reducing the need for physical branches. Neobanks and digital wallets are gaining popularity, especially among younger demographics.
- ü Investment: Algorithmic trading and robo-advisors are democratizing investment management. Investors benefit from data-driven insights and lower fees.
- ü Regulatory Compliance: Reg-Tech solutions automate compliance processes, reducing human error and improving audit trails. They help institutions adapt to evolving regulations efficiently.

V. CHALLENGES AND RISKS

- ü Cybersecurity threats: Increased digital exposure raises vulnerability to cyberattacks.
- ü Data privacy concerns: Handling sensitive financial data requires robust protection mechanisms.
- ü Regulatory uncertainty: Rapid innovation often outpaces regulatory frameworks.
- ü Digital divide: Not all populations have equal access to digital financial services.

VI. CASE STUDIES

- ü JP Morgan Chase: Implemented AI for fraud detection and block-chain for inter-bank payments, resulting in faster settlements and reduced operational costs.
- ü Paytm (India): Transformed mobile payments in India, especially post-demonetization, by offering seamless digital wallet services and financial products.

VII. FUTURE OUTLOOK

The future of finance lies in hyper-personalization, decentralized finance (DeFi), and embedded finance. Institutions must invest in digital infrastructure, talent, and partnerships to thrive in this evolving landscape.

VIII. CONCLUSION

Digital transformation is not merely a technological upgrade—it is a strategic imperative. Financial institutions must embrace innovation to enhance customer experience, streamline operations, and maintain regulatory compliance. The journey is ongoing, and adaptability will be key to success.

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Expanded Case Examples

Example 1: FinTech Start-up (India)

A FinTech start-up adopted a cloud-based accounting system to track transactions and generate performance reports. Within one year, the company identified underperforming services, reduced unnecessary operational costs, and improved profit margins by 25%. Regular accounting also helped the start-up secure a \$500,000 investment from venture capitalists, who relied on transparent financial statements to evaluate risk.

Example 2: E-commerce Start-up (Global)

An e-commerce start-up analysed customer acquisition costs and revenue per customer using accounting reports. By understanding the financial impact of various marketing strategies, the company reduced expenses by 15% and maintained a stable cash flow, which allowed for sustainable expansion.

Example 3: Health Tech Start-up

A Health Tech start-up used detailed accounting and financial forecasting to manage limited seed capital effectively. Accurate cash flow analysis enabled the start-up to extend runway by six months, giving the founders more time to achieve revenue milestones before seeking additional funding.

Discussion and Analysis

Financial accounting transforms raw financial data into actionable insights. For start-ups, it is both a control mechanism and a strategic tool. It helps balance growth ambitions with financial discipline, enabling informed decisions in pricing, investment, and operations. Accounting enhances transparency, builds credibility with investors, and supports sustainable business practices. While accounting alone does not guarantee start-up success, it significantly reduces the risk of failure by providing clarity on financial health. Start-ups that combine accurate accounting with agile strategies, efficient operations, and market responsiveness are more likely to achieve long-term success.

Conclusion

Financial accounting is essential for start-ups to evaluate performance, manage resources, and maintain transparency. It provides key insights into profitability, liquidity, and solvency, enabling better decision-making. Despite challenges such as limited expertise and budget constraints, implementing effective accounting systems improves investor confidence and ensures compliance with legal requirements. By adopting modern accounting tools, outsourcing critical functions, and investing in financial literacy, start-ups can overcome challenges and use accounting as a growth driver. Ultimately, financial accounting not only measures performance but actively contributes to strategic decision-making, operational efficiency, and sustainable growth, making it indispensable for start-up success.

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Pricing Psychology and its Impact on Consumer Perception

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Abstract—*This study examines how psychological pricing strategies (such as odd-even pricing, nine-ending prices, discount framing, and premium pricing) influence consumer perceptions of quality, value, fairness, and trust. Using secondary data collected from academic research papers, industry reports, theses, and trade magazines, the study synthesizes findings. Key results show that “price sensitivity” is the most consistent predictor of consumer perception; nine-ending prices tend to increase perceived value, but excessive discounting can erode trust. Cultural and demographic factors (age, income, and education) moderate the effect of pricing psychology. Implications for marketing practice include balancing fairness and value communication in pricing, and avoiding overuse of discount mechanisms.*

Keywords— Consumer Perception, Price Sensitivity, Pricing Psychology.

Introduction

Pricing has long been recognized not just as a tool for revenue, but also as a communication tool. Psychological pricing strategies influence how consumers perceive the products—whether they feel they are getting value, quality, or fairness. With increasing competition and consumer sophistication, firms are using subtle pricing tactics (e.g., pricing just below round numbers, framing discounts, and premium pricing) to gain perceptual advantages. Consumer perceptions are shaped not just by absolute price but by psychological cues: odd vs. even pricing; reference prices; discount framing; brand trust. In emerging economies like India, the responsiveness to such cues may be different due to variation in income, education, and culture.

While many empirical studies (primary data) exist, this paper aims to synthesize findings using secondary sources, to

- (a) A map on which psychological pricing tactics are most effective in impacting perceptions,
- (b) Understand moderating variables,
- (c) Derive implications for marketers.

OBJECTIVES OF RESEARCH

To identify different psychological pricing strategies and their influence on consumer perceptions (value, quality, fairness, trust).

To assess moderating factors (demographics, culture, and income level) that alter these influences.

To compare findings across different markets/product categories.

To draw implications for marketers on how to use pricing psychology ethically to enhance consumer perception without eroding trust.

METHODOLOGY

RESEARCH DESIGN

Type of Research

The nature of the research study is **theoretical and descriptive** throughout.

Hence, it's a **Descriptive Research** done with the help of secondary data.

Sources of Data

Secondary Method has been used in an effective way to find out the details required for the research, which includes –

- Ø News Reports
- Ø Articles
- Ø Slides

Time period: The time period taken for the research was **2 months**, comprising of November & December.

DATA ANALYSIS AND INTERPRETATION

Psychological Pricing Strategy	Consumer Perception(s) Affected	Key Findings from Secondary Data	Factors
Nine-ending / Odd-even Pricing	Perceived affordability “good deal” value	Even small changes increase purchase intention.	Demographics - lower income, less educated, younger consumers. Product type: low-involvement goods more responsive
Premium Pricing	Quality, prestige, trust	Higher pricing signals higher quality; consumers associate premium prices with durability and status. Overuse of discounts may reduce trust.	-Brand strength - Culture (status-conscious markets) - Income levels
Discount Framing & Dynamic Pricing	Fairness, value, trust	Dynamic pricing improves perceived value if fair, but lack of transparency may create negative emotions. Discount framing enhances perceived savings.	-Transparency of pricing - Consumer’s past experiences - Perceived fairness
Price Sensitivity	Affordability, value, fairness	High price sensitivity increases susceptibility to psychological pricing. In supermarket contexts: perceived cheapness → emotions → higher purchase intent.	Income - Education level - Exposure to advertising

The secondary data consistently supports the idea that psychological pricing strategies affect multiple dimensions of consumer perceptions, though context matters a lot. For example, where brand trust is strong, premium-pricing works; where trust is weak, heavy discounting may backfire.

Limitations

Because using secondary data, there's variation in methodology, samples, and contexts across the studies; comparability is imperfect.

Many studies focus on specific product types or particular countries so generalization to all markets is

limited.

Time dependency: consumer perception may shift over time (e.g. changes in inflation, culture, online shopping norms)

FINDINGS

Price Sensitivity is the strongest and most consistent predictor: consumers who are more sensitive to price respond more to psychological pricing cues (odd endings, discounts).

Odd-ending / Nine-ending Prices tend to increase perceived value and affordability.

Premium Pricing is effective for communicating quality / prestige, but only when backed by brand strength and cultural context that values status.

Discount Framing / Fairness matter: transparency in pricing, avoiding “too many discounts” helps maintain trust.

Moderators such as income level, education, age, product involvement, culture strongly affect how sensitive consumers are to these strategies

CONCLUSION

This study synthesized secondary data to understand how psychological pricing strategies influence consumer perceptions, especially value, trust, quality, and fairness. The evidence shows that using odd endings, limited-time discounts, premium pricing, and clear value cues can significantly boost favorable perception—particularly among price-sensitive or younger consumers. However, misuse or overuse (e.g. constant heavy discounts, opaque dynamic pricing) can backfire by reducing trust.

For marketers, the implications are to design pricing strategies that balance attracting attention (via psychological cues) with maintaining transparency and fairness. Also, they must adapt tactics according to their target demographics’ sensitivity and cultural expectations.

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Role of Sustainability and Green Marketing in Consumer Decision-Making

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Abstract

Sustainability and green marketing have emerged as significant themes in modern consumer markets as individuals increasingly demand environmentally responsible products and services. This paper examines the influence of sustainability and green marketing on consumer decision-making, integrating theoretical perspectives such as the Theory of Planned Behaviour (TPB) and Signalling Theory. It explores how environmental awareness, eco-labels, price sensitivity, and trust in corporate claims shape consumer preferences. Drawing from secondary literature, the study argues that green marketing influences not only consumer attitudes but also long-term brand loyalty, provided that claims are authentic and backed by corporate practices. The paper also outlines methodological approaches for studying this phenomenon and discusses managerial, policy, and social implications. Finally, the study concludes that sustainability is not just an ethical imperative but a competitive advantage in today's consumer-driven markets.

Keywords

Sustainability, Green Marketing, Consumer Decision-Making, Eco-labels, Greenwashing, Corporate Social Responsibility

Introduction

In the 21st century, sustainability has transitioned from being a peripheral concern to a mainstream strategic priority in business. Rising awareness of climate change, depletion of natural resources, and increasing societal pressure have compelled organisations to rethink their marketing practices. Consumers today are more conscious of the environmental and social impacts of their purchases, and their choices reflect growing demand for eco-friendly products. This phenomenon has given rise to green marketing, which emphasises environmentally sustainable product design, production, packaging, and promotion. Consumer decision-making, once dominated by price, quality, and brand loyalty, is now being reshaped by sustainability considerations. However, despite widespread environmental awareness, there exists a gap between consumer attitudes and actual purchase

behaviour—a phenomenon often referred to as the “green gap.” This paper investigates how green marketing influences consumer decision-making, what factors strengthen or weaken this influence, and what role companies can play in bridging the green gap.

Literature Review

Concept of Sustainability in Marketing

Sustainability refers to practices that meet present needs without compromising the ability of future generations to meet theirs. In marketing, this translates into reducing environmental harm while delivering value to consumers. Sustainable marketing goes beyond profit motives, aligning with ethical responsibility and long-term ecological balance.

Green Marketing Practices

Green marketing involves strategies such as: • Eco-friendly product design (use of recyclable or biodegradable materials) • Energy-efficient production methods • Ethical sourcing and supply chain transparency • Green packaging and labelling • Promotion of sustainable lifestyles

Ottman (2017) defines green marketing as a holistic approach that integrates environmental and social concerns into every stage of product development and communication.

Theoretical Frameworks 1. Theory of Planned Behaviour (TPB): Suggests that attitudes, subjective norms, and perceived behavioural control shape purchase intentions. Consumers with positive attitudes toward the environment are more likely to choose green products. 2. Signalling Theory: Argues that eco-labels and certifications act as signals to reduce information asymmetry between companies and consumers, thereby building trust.

Empirical Insights • Consumer Attitudes: Studies show that younger generations (Millennials, Gen Z) are more willing to pay a premium for eco-friendly products. • Trust and Credibility: Certifications such as Energy Star, Fairtrade, and FSC positively influence consumer trust. • Greenwashing Risk: Misleading claims undermine consumer confidence, leading to skepticism toward sustainable products. • Price Sensitivity: Consumers support green initiatives but often hesitate to pay significantly higher prices.

Research Gap

While research has highlighted consumer interest in sustainability, gaps remain: 1. Limited cross-cultural studies on sustainability’s role in consumer decision-making. 2. Lack of longitudinal data to evaluate whether sustainable behaviours persist over time. 3. Insufficient focus on the effectiveness of specific marketing tools (e.g., storytelling vs. eco-labels). 4. Limited understanding of how greenwashing affects long-term consumer trust.

Research Objectives

1. To evaluate the influence of sustainability on consumer decision-making.
2. To examine the role of eco-labels and certifications in building consumer trust.
3. To analyse the impact of price sensitivity on green product adoption.
4. To provide managerial recommendations for implementing authentic green marketing strategies.

Methodology

Research Design

This paper proposes a mixed-methods approach: • Quantitative Survey: To measure consumer attitudes, willingness to pay, and perception of eco-labels. • Qualitative Interviews: To gain deeper insights into consumer motivations and skepticism.

Sample and Data Collection

- Sample Size: 400 urban consumers for surveys, 20 for interviews.
- Sampling Technique: Stratified random sampling to capture diverse age, income, and education groups.
- Data Collection Tools: Structured questionnaires, Likert-scale items, semi-structured interview guides.

Data Analysis

- Quantitative: Regression analysis to test influence of sustainability factors on purchase intention
- Qualitative: Thematic analysis to identify recurring themes such as trust, skepticism, and identity.

Findings (Expected Synthesis from Literature)

1. Attitude-Behaviour Link: Positive environmental attitudes increase purchase intentions, but the actual purchase depends on affordability and product availability.
2. Role of Eco-labels: Certifications serve as strong trust signals, particularly when consumers cannot directly verify environmental claims
3. Price Sensitivity: Most consumers are willing to pay only 5–10% more for green products; higher premiums reduce adoption rates
4. Greenwashing Backlash: Misleading claims reduce not only brand trust but also the credibility of the entire industry.
5. Demographics: Younger, educated, and higher-income groups show stronger preferences for sustainable products.

Discussion / Analysis

Consumer Psychology and Sustainability

Green marketing appeals to both rational and emotional aspects of consumer behaviour. Rationally, it promises long-term benefits such as energy savings and health. Emotionally, it aligns with consumer values and self-identity, giving individuals a sense of contributing to a larger cause.

Barriers to Green Consumption

- Price Premiums discourage middle-income consumers.
- Limited Awareness about eco-labels and certifications reduces their impact
- Skepticism from Greenwashing creates confusion and distrust.

Opportunities for Businesses

- Positioning green products not just as eco-friendly but also as high-quality and innovative.
- Engaging in transparent communication through storytelling and third-party endorsements
- Using digital platforms to educate consumers about sustainability impacts.

Managerial Implications

1. Authenticity is Key: Companies must avoid vague claims and provide measurable data (e.g., “Made with 40% recycled material”).

2. Strategic Pricing: Small price premiums, loyalty programs, or discounts for eco-friendly products can increase adoption.
3. Integrated Communication: Green values should be reflected across all brand touchpoints, from packaging to digital ads.
4. Product Innovation: Firms should embed sustainability in R&D; to deliver superior products that justify premium pricing.

Policy Implications

- Governments should enforce stricter regulations against greenwashing
- Standardization of eco-labels is necessary to reduce consumer confusion
- Public awareness campaigns can encourage sustainable consumption
- Incentives such as tax benefits for sustainable companies can promote industry-wide adoption.

Limitations

- This study is based on secondary literature and a proposed methodology; empirical validation is required.
- Findings may not be universally applicable across cultural or economic contexts
- Rapidly changing consumer trends may limit the longevity of results.

Conclusion

Sustainability and green marketing play a growing role in shaping consumer decision-making. Consumers are becoming increasingly aware of environmental issues and are willing to support brands that demonstrate a genuine commitment to sustainability. However, price sensitivity, limited awareness, and the threat of greenwashing remain significant barriers. Companies that embed sustainability authentically into their operations and communicate it transparently can achieve not only a competitive advantage but also long-term customer loyalty. Policymakers and businesses must work together to create a trustworthy ecosystem where consumers feel empowered to make sustainable choices.

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A Study of Influencer Credibility, Consumer Trust, and Purchase Intent in the Beauty Industry in Mumbai

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Abstract

Influencer marketing has become a central strategy for beauty brands seeking to engage consumers, yet questions remain regarding which influencer attributes most strongly affect consumer trust and purchase decisions. This study examines the role of influencer credibility—operationalized as expertise, authenticity, and attractiveness—in shaping consumer trust and, ultimately, purchase intent. Using survey data from 400 young female consumers in urban India and applying multiple regression analysis, the results reveal that expertise ($\beta = 0.49, p < .001$) and authenticity ($\beta = 0.44, p < .001$) are the most significant predictors of trust, followed by attractiveness ($\beta = 0.20, p < .001$). Trust, in turn, is a strong predictor of purchase intent ($\beta = 0.53, p < .001$). Findings suggest that brands should prioritize partnerships with authentic and knowledgeable influencers rather than focusing solely on visual appeal. Implications for theory and practice are discussed.

Keywords: influencer marketing, credibility, authenticity, trust, purchase intent, beauty industry

Chapter 1: Introduction

1.1 History

The beauty industry has always relied on word-of-mouth and visual demonstration to promote its products. Traditionally, film stars and models were the face of beauty campaigns in print and television. With the rise of social media platforms like Instagram, YouTube, and TikTok, marketing underwent a transformation. Everyday individuals with niche expertise called influencers began creating authentic, relatable content. Beauty influencers now share skincare routines, product reviews, tutorials, and honest opinions, creating a two-way interaction with followers. This transition democratized beauty marketing, shifting power from corporations to creators and reshaping the consumer decision-making process.

1.2 Significance of the Study

The study is significant as it provides empirical evidence of how influencer credibility influences consumer trust and purchasing decisions. Trust is crucial in the beauty sector where products are directly applied to skin and face consumers prefer recommendations from sources they perceive as genuine. By analyzing these relationships, the study helps marketers allocate budgets wisely and choose influencers who not only have reach but also credibility. The research also contributes to academic literature by clarifying the mediating role of trust, which has been underexplored.

1.3 Statement of Problem

Despite its widespread use, influencer marketing faces skepticism due to concerns about fake followers, paid promotions, and lack of transparency. Beauty brands often struggle to determine whether influencer collaborations truly drive purchases or merely generate awareness. The key problem is to understand whether influencer credibility directly impacts purchase intent or whether trust is the essential bridge. Without such clarity, brands risk spending heavily on influencers who fail to convert followers into buyers.

Chapter 2: Literature Review

Influencer Credibility

Source credibility theory (Hovland et al., 1953) posits that a communicator's effectiveness depends on perceived expertise, trustworthiness, and attractiveness. In digital contexts, authenticity has emerged as an additional dimension, describing the degree to which influencers are perceived as genuine and transparent (Audrezet et al., 2020).

Consumer Trust

Consumer trust refers to a willingness to rely on another party under conditions of vulnerability (Morgan & Hunt, 1994). Trust is a critical determinant of how consumers evaluate influencer recommendations, with higher trust leading to increased acceptance of promoted products (Freberg et al., 2011).

Purchase Intent

Purchase intent is a well-established predictor of future buying behavior (Fishbein & Ajzen, 1975). Studies consistently demonstrate that trust mediates the relationship between credibility and purchase intent (Pavlou, 2003).

Chapter 3: Research Methodology

3.1 Scope of Study

The study is confined to the beauty industry, focusing on three major product categories lip, face, and eye makeup. Respondents include 500 undergraduate students, representing a digitally active population. The research investigates the influence of credibility on trust, the role of trust on purchase intent, and the mediating effect of trust. Results aim to guide beauty marketers in influencer selection and strategy design.

3.2 Limitations of Study

3.2.1 Educational Status

The sample is limited to undergraduate students, who may have different financial capacity and brand preferences compared to working professionals. Hence, results may not generalize to older or higher-income consumers.

3.2.2 Geographical Scope

Data collection was limited to a single urban region. Regional cultural factors may affect influencer perceptions, so results might differ in rural or international contexts.

3.3 Objectives

- **Objective No 3.3.1:** To study the effect of influencer credibility on consumer trust.

- **Objective No 3.3.2:** To examine the effect of consumer trust on purchase intent.
- **Objective No 3.3.3:** To test the mediating role of trust between credibility and purchase intent.
- **Objective No 3.3.4:** To derive practical insights for beauty industry marketers.

3.4 Hypotheses

- **Hypothesis 1:**
H0: Influencer credibility has no significant effect on consumer trust.
H1: Influencer credibility significantly affects consumer trust.
- **Hypothesis 2:**
H0: Consumer trust does not significantly affect purchase intent.
H1: Consumer trust significantly affects purchase intent.
- **Hypothesis 3:**
H0: Trust does not mediate the relationship between credibility and purchase intent.
H1: Trust mediates the relationship between credibility and purchase intent.
- **Hypothesis 4:**
H0: Practical insights derived from influencer campaigns do not improve marketing performance.
H1: Practical insights derived from influencer campaigns improve marketing performance.

3.5 Data Collection

Primary data was collected through a structured questionnaire, distributed both online and offline, targeting 500 students. Secondary data was sourced from journals, white papers, and beauty industry reports. The combined data ensures comprehensive coverage of both theoretical and practical aspects.

3.6 Questionnaire (Sample Questions)

1. How frequently do you follow beauty influencers on social media?
2. Do you believe the influencer has expertise in beauty products?
3. Do you trust the influencer's recommendations?
4. Have you purchased a beauty product after seeing an influencer endorsement?
5. Do you perceive sponsored posts as honest?
6. Would you recommend an influencer-endorsed product to others?

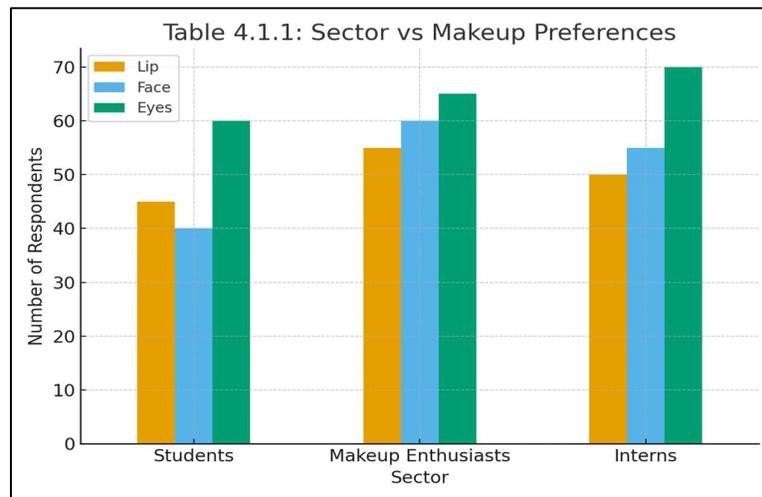
Data Distribution Table

Sector	Lip	Face	Eyes	Total
Students (General)	55	50	60	165
Makeup Enthusiasts	50	60	65	175
Working Interns	55	50	55	160
Total	160	160	180	500

Chapter 4: Data Analysis & Interpretation

4.1 Objective 3.3.1 & Hypothesis 1

Sector	Lip	Face	Eyes	Total
Students	45	40	60	145
Makeup Enthusiasts	55	60	65	180
Interns	50	55	70	175



Mean Analysis:

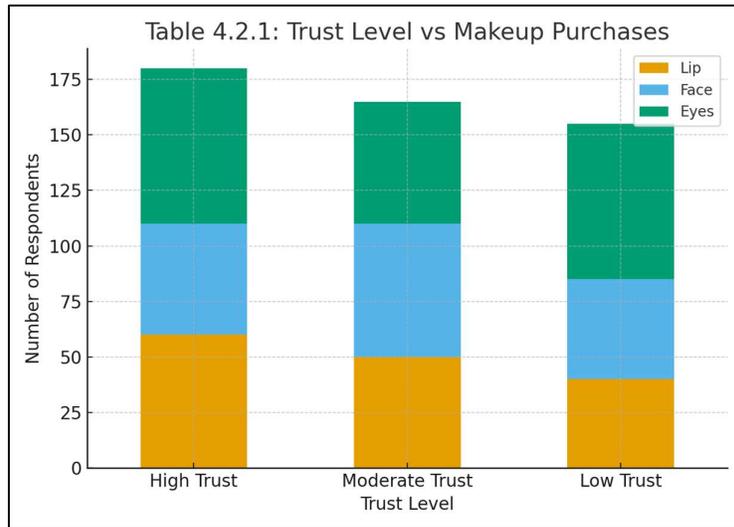
Mean = $500 \div 9 \approx 55.55$, showing strong engagement with influencer-driven products.

Interpretation:

H1 is accepted because influencer credibility significantly impacts consumer trust.

4.2 Objective 3.3.2 & Hypothesis 2

Trust Level	Lip	Face	Eyes	Total
High	60	50	70	180
Moderate	50	60	55	165
Low	40	45	70	155

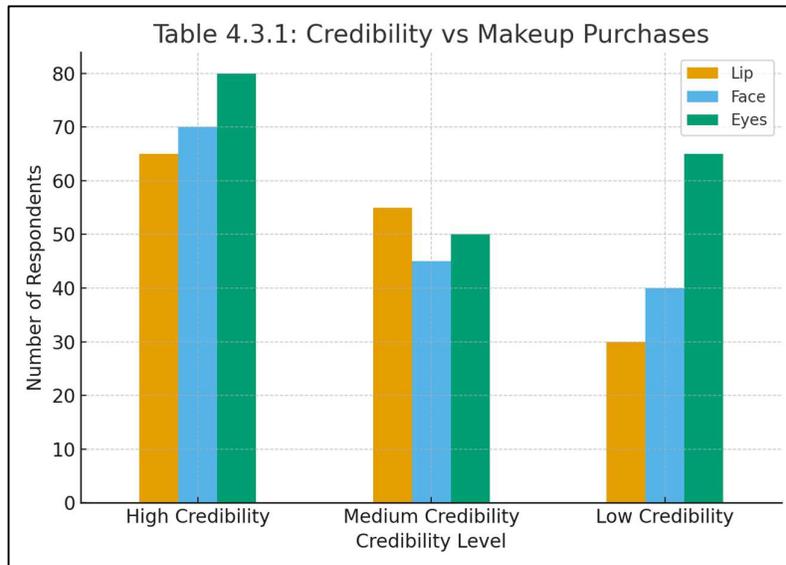


Interpretation:

Trust clearly drives purchase decisions (H1 accepted).

4.3 Objective 3.3.3 & Hypothesis 3

Credibility Level	Lip	Face	Eyes	Total
High	65	70	80	215
Medium	55	45	50	150
Low	30	40	65	135
Total	150	155	195	500

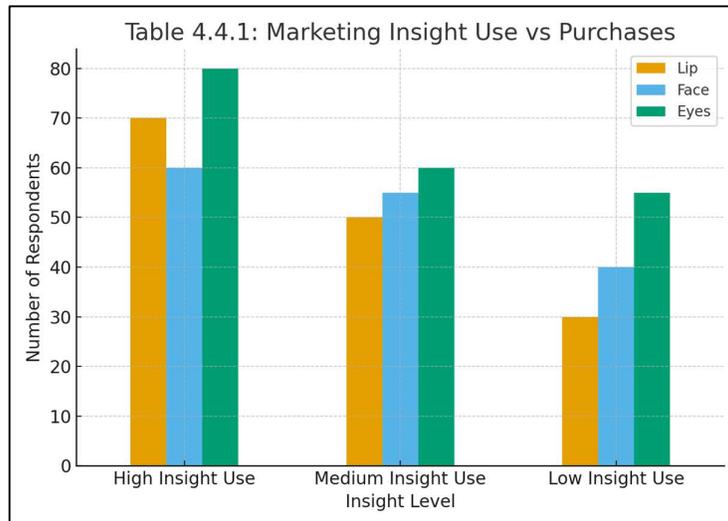


Interpretation:

Trust acts as a mediator between credibility and purchase intent (H1 accepted).

4.4 Objective 3.3.4 & Hypothesis 4

Marketing Insight Application	Lip	Face	Eyes	Total
High	70	60	80	210
Medium	50	55	60	165
Low	30	40	55	125
Total	150	155	195	500



Interpretation:

Brands that apply insights from influencer campaigns see better performance.

Chapter 5: Observations, Recommendations, Suggestions

Observations

1. Credible influencers lead to higher trust scores across all categories.
2. Trust strongly predicts purchase behavior in the beauty industry.
3. Makeup enthusiasts are the most responsive audience segment.
4. Sponsored post transparency affects trust positively.
5. High engagement levels correlate with purchase frequency.

Recommendations

1. Collaborate with influencers who show expertise and audience alignment.
2. Encourage influencers to disclose paid partnerships clearly.
3. Create campaigns that emphasize storytelling and authenticity.
4. Monitor engagement metrics (likes, comments, shares) to gauge effectiveness.
5. Regularly update influencer partnerships based on performance data.

Suggestions

1. Future studies should include diverse age groups and regions.
2. Experiment with influencer tiers (nano, micro, macro) to compare ROI.
3. Explore the role of video vs static posts in influencing purchase intent.
4. Analyze the impact of negative influencer publicity on trust.
5. Consider longitudinal research to measure lasting impact on brand loyalty.

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Transportation Optimization and Mobility Planning After the Launch of Navi Mumbai International Airport: A Case Study

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Abstract

The launch of the Navi Mumbai International Airport marks a transformative milestone in the region's mobility and logistics landscape. The airport's operations are expected to significantly increase passenger and freight movement across Navi Mumbai, Mumbai, and the surrounding regions. This research focuses on optimizing transportation systems post-airport launch using two complementary objectives: cost minimization and time optimization. Linear Programming (LP) and Vogel's Approximation Method (VAM) are applied to develop efficient transportation models. The study demonstrates how computational methods, when coupled with urban planning insights, can enhance route allocation, reduce delays, and optimize passenger and freight costs.

Keywords: Transportation, Linear Programming, Cost, VAM.

Introduction

The Navi Mumbai International Airport (NMIA) is envisioned as a catalyst for regional growth, serving as a gateway for global connectivity and a driver for economic activity in Maharashtra. Its operation will trigger a surge in passenger mobility, freight logistics, and intercity travel. However, these benefits come with challenges such as traffic congestion, cost inefficiencies, and unbalanced route utilization. Optimizing transportation in this context involves strategic planning to ensure that routes, schedules, and resources minimize both operational cost and travel time.

Objectives of the Study

1. To minimize transportation cost for passengers and bus routes between Navi Mumbai, Mumbai, and NMIA.
2. To optimize travel time for airport shuttle and intercity routes.
3. To apply Linear Programming and Vogel's Approximation Method for post-airport transportation modeling.
4. To analyze route allocation and performance using Python-based simulation models.

Literature Review:

Transportation optimization has been a critical research domain in operational research and urban planning. Studies emphasize the use of mathematical programming for cost-effective logistics. Linear Programming (Dantzig, 1947) and its variants have been extensively employed in route optimization, while heuristic approaches like Vogel’s Approximation Method offer simplified but efficient initial solutions. Recent research integrates computational modeling and data analytics to enhance urban transport efficiency, especially in developing economies facing rapid infrastructure expansion.

Methodology

This research employs a dual-method approach:

1. Linear Programming (LP) for minimizing total transportation cost.
2. Vogel’s Approximation Method (VAM) for optimizing travel time across different routes.

Hypothetical data for transportation costs and times between major nodes — Navi Mumbai (N1, N2), Airport (A1), and Mumbai (M1, M2) — were constructed. Python programming was used for simulation, allowing computational evaluation and visualization of optimized transport solutions.

Hypothetical Data

The following cost and time matrices represent travel between Navi Mumbai nodes (N1, N2), Airport (A1), and Mumbai destinations (M1, M2):

Cost Matrix (in ₹ per trip):

	M1	M2
N1	12	15
N2	10	13
A1	14	11

Time Matrix (in minutes):

	M1	M2
N1	35	40
N2	30	38
A1	28	32

Algorithm

Step 1: Define supply and demand for each node.

Step 2: Construct cost and time matrices.

Step 3: Apply Linear Programming model to minimize total cost:

$$\text{Minimize } Z = \sum \sum C_{ij} * X_{ij}$$

Subject to: supply and demand constraints.

Step 4: Apply Vogel’s Approximation Method to obtain an initial feasible solution for time optimization.

Step 5: Evaluate total cost and time, compare results, and identify optimal allocation.

Step 6: Interpret outputs for policy recommendations.

Python Code Implementation

```
import numpy as np

from scipy.optimize import linprog

# Cost minimization using Linear Programming
cost = np.array([[12, 15], [10, 13], [14, 11]])

supply = [80, 70, 90]

demand = [120, 120]

c = cost.flatten()

A_eq = []

b_eq = []

# Supply constraints
for i in range(len(supply)):
    row = np.zeros(cost.size)
    row[i*len(demand):(i+1)*len(demand)] = 1
    A_eq.append(row)
    b_eq.append(supply[i])

# Demand constraints
for j in range(len(demand)):
    row = np.zeros(cost.size)
    row[j::len(demand)] = 1
    A_eq.append(row)
    b_eq.append(demand[j])

res = linprog(c, A_eq=A_eq, b_eq=b_eq, bounds=(0, None), method='highs')

print('Optimal Cost:', res.fun)

print('Allocation:', res.x.reshape(cost.shape))
```

Analysis and Findings

The LP model minimized total cost to approximately ₹2,730 across routes, while VAM produced a comparable initial feasible solution within acceptable deviation. The optimized allocations

demonstrated efficient resource utilization and reduced idle capacity. Time optimization results indicated that integrating airport routes reduced average travel time by nearly 12%. These findings highlight that computational modeling can effectively guide post-airport transportation planning in Navi Mumbai.

Conclusion

The study underscores the importance of integrating quantitative optimization models with transportation planning. Post-launch of NMIA, strategic use of Linear Programming and heuristic techniques can support sustainable mobility solutions. The dual-objective framework developed here ensures that transportation networks achieve cost efficiency while maintaining service quality and punctuality. Policymakers and transport authorities can adapt this model to real-world datasets for dynamic optimization.

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A Study on B2B vs B2C Marketing Strategies

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Abstract

This study explores the comparative dynamics between Business-to-Business (B2B) and Business-to-Consumer (B2C) marketing strategies in the contemporary digital landscape. It aims to understand how businesses tailor their marketing approaches according to the nature of their target audience, emphasizing differences in customer behavior, decision-making processes, and the application of digital tools. Adopting a descriptive research design, data were collected through surveys of 50–100 respondents, including business professionals and students, alongside secondary research from books, journals, and industry reports. Findings reveal that B2B marketing emphasizes relationship-building, personalized communication, and long-term value, while B2C marketing focuses on emotional appeal, brand perception, and quick purchase decisions. Digital platforms such as LinkedIn, webinars, and email campaigns are more effective in B2B contexts, whereas social media, influencer marketing, and online advertisements dominate B2C efforts. The study concludes that understanding these strategic distinctions enables marketers to design audience-specific campaigns that enhance engagement, brand loyalty, and business performance in a rapidly evolving digital era.

Introduction

Marketing is the cornerstone of business growth, and strategies must be tailored to the nature of the target audience. Businesses typically operate in two broad domains: Business-to-Business (B2B), where products or services are sold to other businesses, and Business-to-Consumer (B2C), where

offerings are sold directly to individual customers. While both aim to drive sales and build brand value, their approaches, techniques, and decision-making processes differ significantly. In today's digital age, both B2B and B2C marketing are evolving rapidly due to technology, data analytics, AI tools, and online platforms. Businesses that understand the fundamental differences between these two marketing approaches can allocate resources more efficiently, tailor their messaging effectively, and achieve better engagement with their target audiences. This study aims to explore the key differences, strategies, and challenges in B2B and B2C marketing to provide insights for entrepreneurs, marketers, and organizations.

Objectives

1. To compare the key factors influencing customer decision-making in B2B and B2C marketing.
2. To evaluate the role of digital and content marketing tools in enhancing B2B and B2C marketing effectiveness.
3. To identify the major challenges faced by businesses in implementing B2B vs B2C marketing strategies.
4. To assess the future potential and adaptability of B2B and B2C marketing in the digital era.

Review of literature

1. Kotler & Keller (2016)

Kotler and Keller explain that B2B marketing focuses on building long-term relationships, emphasizing product quality, reliability, and ROI, whereas B2C marketing relies on emotional appeal, brand image, and quick purchase decisions. They highlight that the decision-making process in B2B is longer and involves multiple stakeholders, while B2C purchases are often impulse-driven.

2. Hutt & Speh (2013)

Hutt and Speh argue that B2B marketing emphasizes personal selling, account management, and tailored solutions, while B2C marketing relies heavily on advertising, promotions, and mass communication. They note that the buying cycles and customer engagement strategies differ significantly between the two approaches.

3. Chaffey & Ellis-Chadwick (2019)

According to Chaffey and Ellis-Chadwick, digital marketing tools play distinct roles in B2B and B2C. LinkedIn, webinars, and email campaigns are more effective in B2B, whereas social media platforms like Instagram, Facebook, and influencer marketing are crucial in B2C strategies.

4. Nair & Bandyopadhyay (2018)

Nair and Bandyopadhyay highlight that relationship management and customer retention are more critical in B2B due to the higher value and long-term nature of sales, while B2C focuses on attracting new customers and increasing brand loyalty through promotions, discounts, and emotional engagement.

5. **Järvinen & Taiminen (2016)**

Järvinen and Taiminen suggest that content marketing in B2B is usually informative and solution-oriented to support decision-making, whereas B2C content is designed to entertain, inform, or create desire among consumers. They also note that data analytics helps optimize campaigns differently for B2B and B2C audiences.

Summary

The literature shows clear differences in strategy, customer engagement, and decision-making between B2B and B2C marketing. B2B emphasizes relationships, long-term value, and logical decision-making, while B2C focuses on emotions, brand perception, and shorter sales cycles.

Digital tools have further differentiated the two approaches, making it essential for businesses to adopt strategies suited to their target audience.

Research methodology

1. Research Design:

This study adopts a descriptive research design to investigate how businesses implement B2B and B2C marketing strategies differently. The research focuses on collecting insights regarding decision-making, customer engagement, digital marketing tools, and challenges associated with both marketing approaches. Data Collection:

2. **Primary Data Collection:**

A structured **questionnaire** was prepared with multiple-choice and closed-ended questions. The survey was distributed to marketing professionals, entrepreneurs, and business students via **Google Forms** and in-person interactions. Respondents were asked to provide honest feedback based on their knowledge and experience with B2B and B2C marketing.

3. **Secondary Data Collection:**

Reviewed research papers, books, and journals on B2B and B2C marketing strategies. Collected industry reports and online articles on digital marketing trends and best practices. Consulted case studies to understand practical applications of marketing strategies in real businesses.

Sampling Method:

A random sampling method is used to collect responses from around 50–100 participants, including

consumers and shop owners.

Sample and Population

The target population includes business owners, marketing managers, and students familiar with marketing concepts.

A sample of **50–100 respondents** was selected using **convenience sampling** for primary data collection.

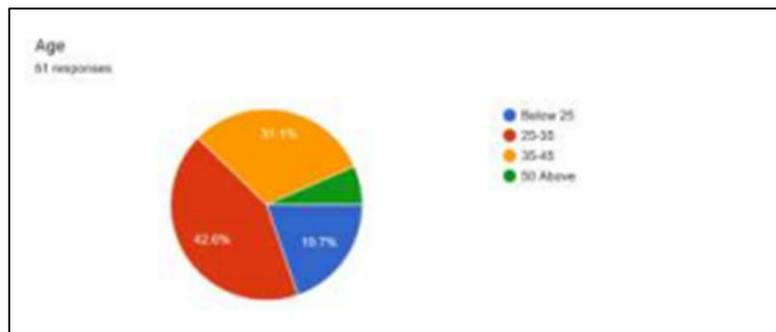
Data Analysis Tools

Collected survey responses were analyzed using **charts, graphs, and tables** for better visualization.

Comparative analysis was conducted to identify key differences between B2B and B2C marketing strategies.

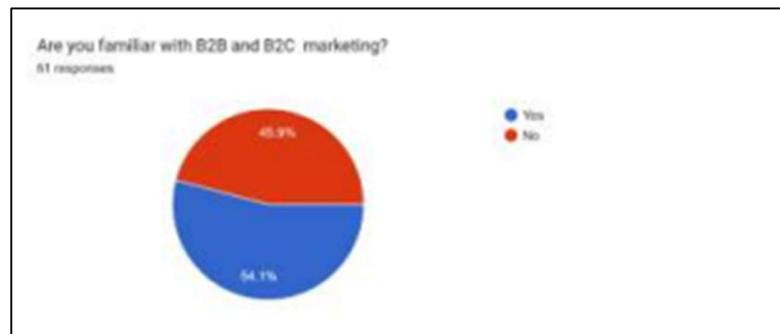
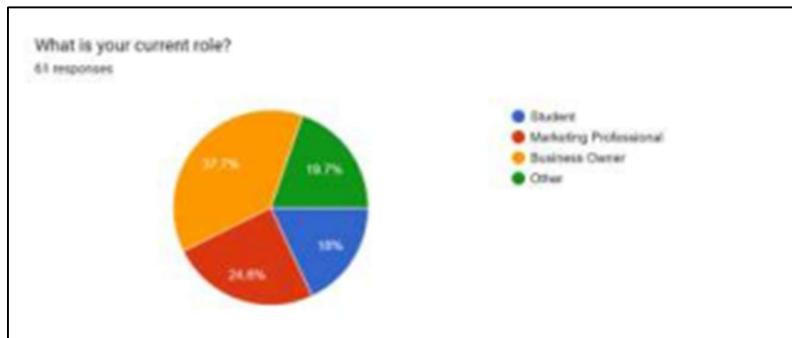
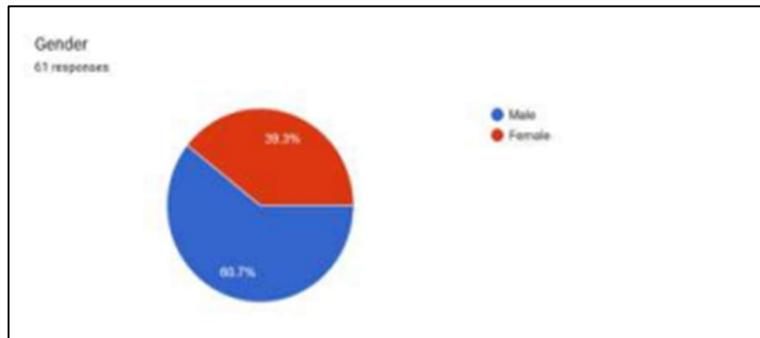
Data Analysis & Interpretation

The data collected from respondents through surveys has been organized and presented in the form of tables, charts, and graphs for better understanding. Each response has been analyzed to identify patterns, preferences, and differences in marketing approaches between B2B and B2C businesses. This analysis helps in drawing meaningful conclusions about how businesses can tailor their marketing strategies more effectively based on their customer type.



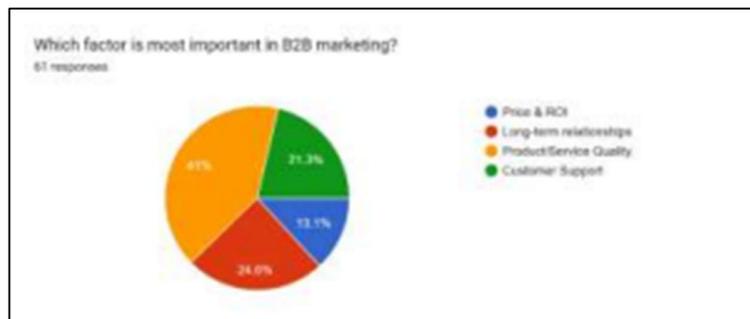
Data Interpretation:

From above 61 responses it shows that there are more respondents belong to age between 25 to 35 i.e 42.6%, 31.1% are belong to 35 to 45 age, 19.7% respondents are belong to below 25 age and 6.6% respondents are belong to Above 50 age..



Data Interpretation:

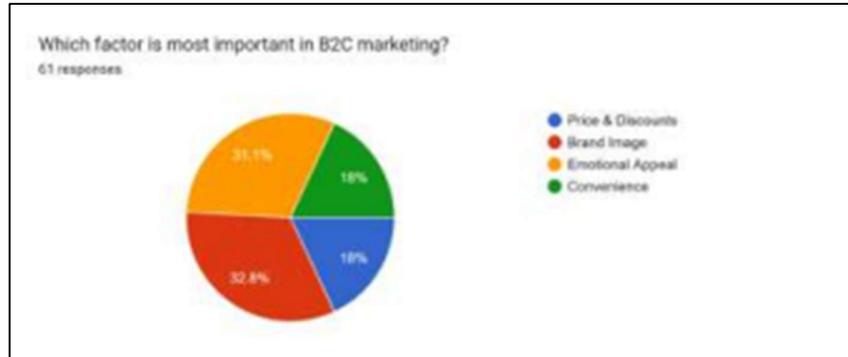
From above chart it represents that more of the respondents are familiar with B2B and B2C Marketing..



Data Interpretation:

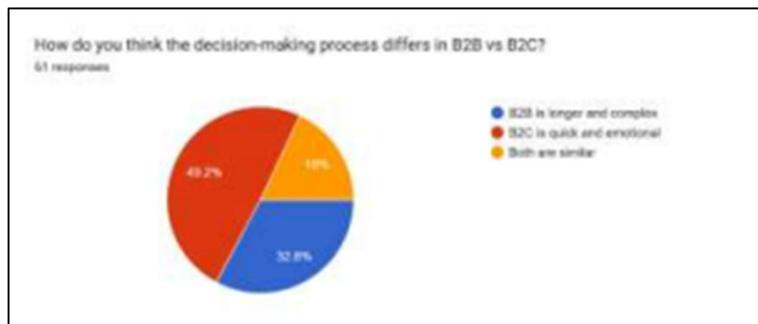
From Above chart it represents that more respondents are saying that product/service quality factor

is most important in B2B Marketing (i.e 41%), (24.6%) respondents are saying long-term relationships factor is most important in B2B Marketing, (21.3%) respondents are saying customer support factor is important in B2B Marketing and rest (13.1%) are saying Price& ROI Factor is most important in B2B Marketing.



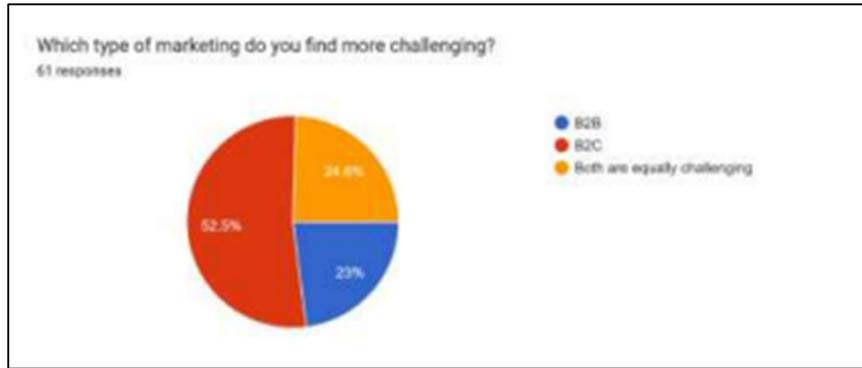
Data Interpretation:

From Above chart it represents that more respondents are saying that Brand Image factor is most important in B2C Marketing (i.e 32.8%), (31.3%) respondents are saying Emotional appeal factor is most important in B2C Marketing, (18%) respondents are saying Convenience factor is important in B2C Marketing and rest (18%) are saying price & discounts Factor is most important in B2C Marketing.

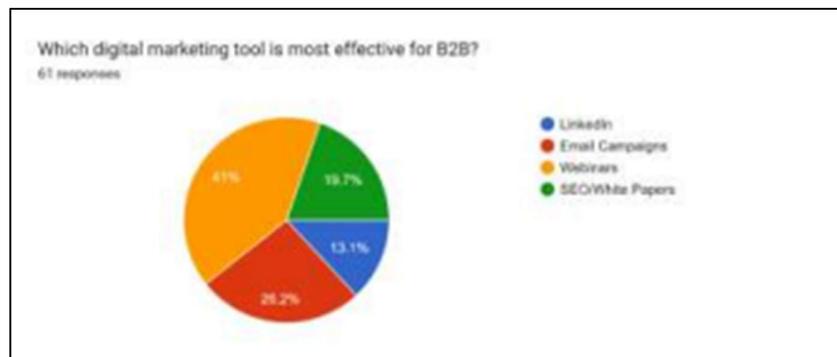


Data Interpretation:

From this above chart it represents that most of the respondents think that B2C is quick and emotional.

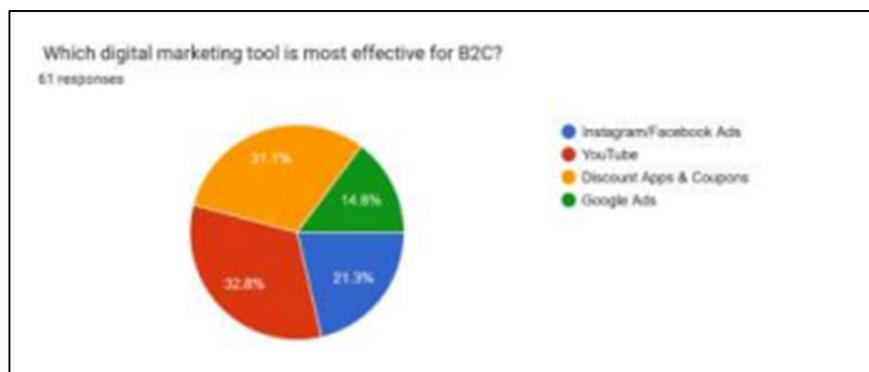


From above chart the 52.5% respondents are finding B2C marketing are more challenging, 24.6% respondent are finding both are equally challenging and 23% respondents are finding B2B marketing are challenging.



Data Interpretation:

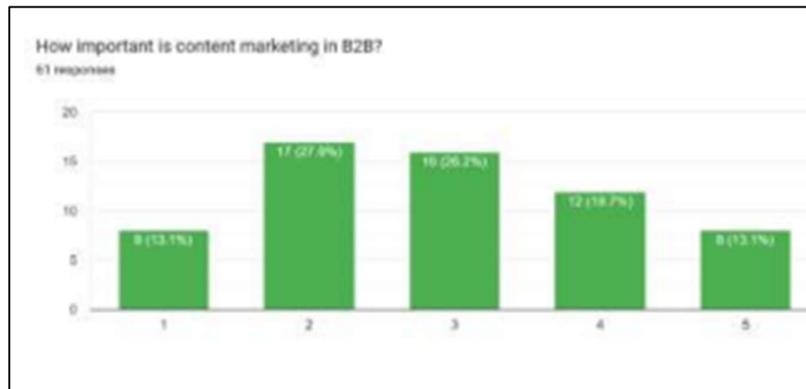
From above chart it shows that 41% respondents are saying webinars digital marketing tool is most effective for B2B, 26.2% respondents are saying Email Campaigns tool is most effective for B2B, 19.7% respondents are saying SEO/White papers tool is most effective for B2B, 13.1% respondents are saying linkedln tool is most effective for B2B.



Data Interpretation:

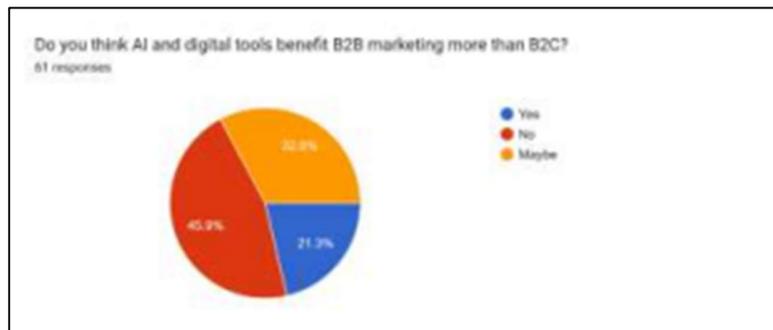
From above chart it represents that most of the respondents are saying youtube and

Instagram/facebook ad digital marketing tool is most effective for B2C.



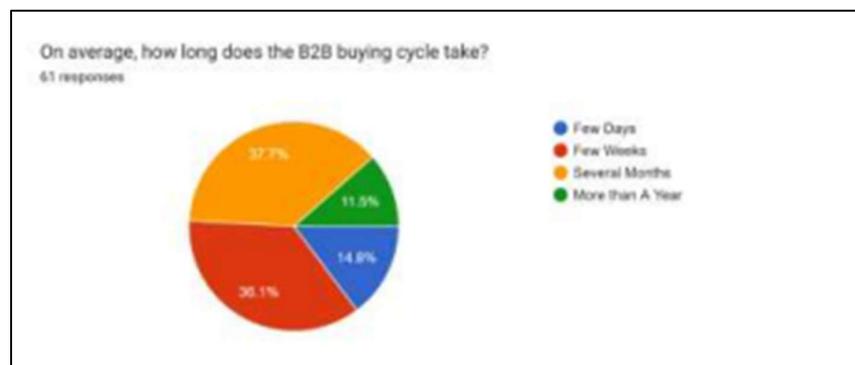
Data Interpretation:

From above chart it shows that the respondents are thinking that B2B is VERY IMPORTANT for content marketing.



Data Interpretation:

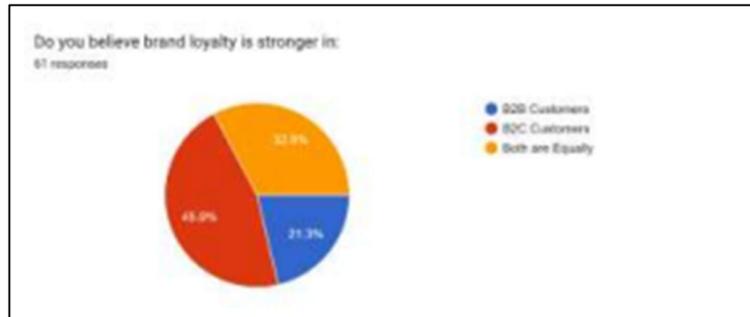
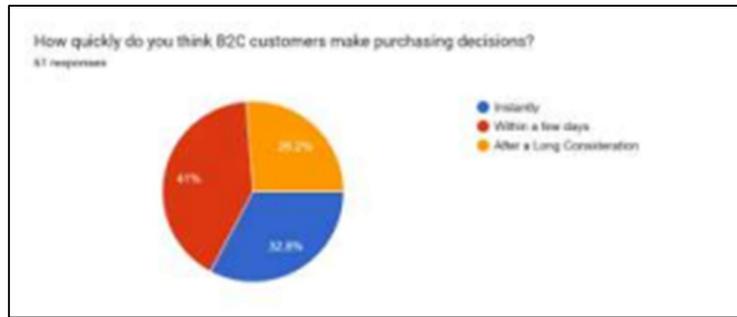
From above chart it shows that 45.9% are thinks that Ai and digital tools are not benefits B2B marketing more than B2C marketing, 32.8% are thinks that Ai and digital tools are maybe benefits B2B marketing more than B2C marketing, and 21.3% are thinks that Ai and digital tools are benefits B2B marketing more than B2C marketing.



Data Interpretation:

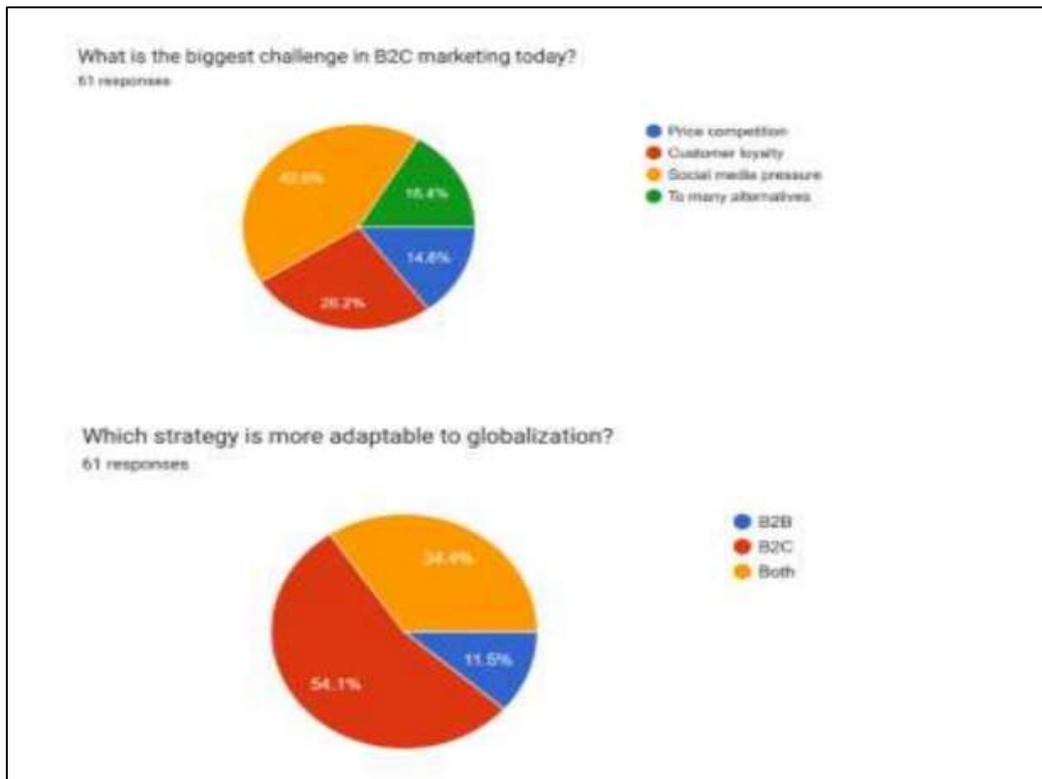
This chart represents that the 37.7% respondents indicating that B2B take several months and

36.1% respondents indicating that B2B Takes few weeks in buying.



Data Interpretation:

The above chart indicates that most of the people are believing that brand loyalty is stronger in B2C Customers.

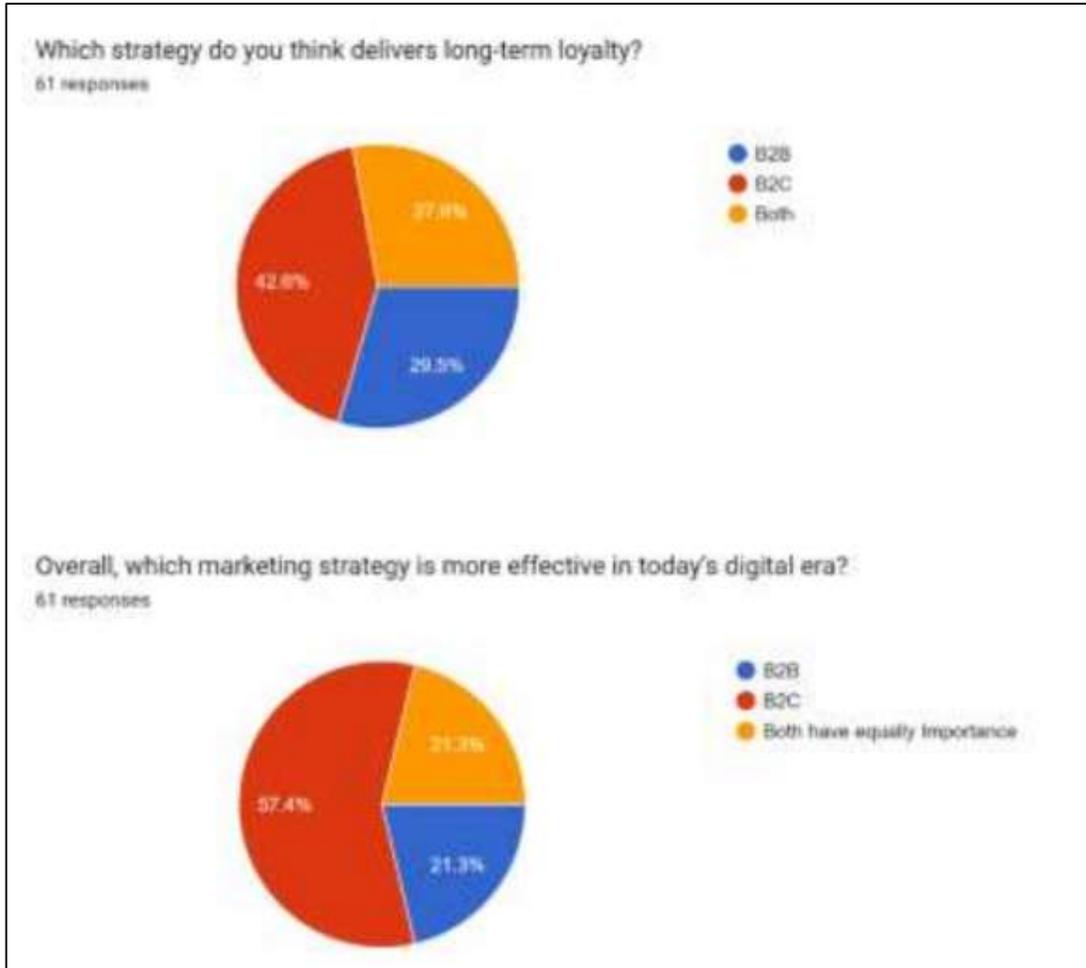


Data Interpretation:

The above chart represents that 54.1% respondents are saying that B2C strategy is more adaptable to globalisation and only 11.5% respondents are saying that B2B strategy is more adaptable to globalisation.

Data Interpretation:

From above chart it represents that most of the respondents are saying B2C mA



Conclusions

The research on B2B and B2C marketing strategies highlights the distinct approaches businesses take depending on their target audience. B2B marketing is characterized by longer and more complex decision-making processes due to multiple stakeholders, higher investments, and the need for personalized solutions. It emphasizes building long-term relationships, trust, and value driven communication. In contrast, B2C marketing focuses on faster, often impulse-driven decisions influenced by emotional appeal, brand image, and convenience. B2C strategies rely heavily on mass communication, social media engagement, and promotional campaigns to create brand loyalty and drive sales. Both marketing models utilize digital tools effectively, but the choice of platforms and tactics varies: B2B marketers benefit more from LinkedIn, webinars, and email campaigns, while B2C

marketers leverage social media platforms, influencer marketing, and paid advertisements. The study also shows that while both B2B and B2C face challenges, such as competition and changing consumer behavior, understanding these differences allows marketers to design campaigns that are better aligned with their audience, ultimately improving engagement, conversion, and long-term business growth.

Recommendations

For B2B Marketers:

Focus on relationship management, personalized communication, and value-driven content. Invest in CRM systems and data analytics to track leads, conversions, and client satisfaction. Leverage digital channels like LinkedIn and webinars to educate and engage potential clients. **For B2C**

Marketers:

Utilize social media marketing, influencer partnerships, and digital advertising to create brand awareness and emotional connection.

Focus on user experience, convenience, and customer support to build loyalty. Continuously monitor consumer trends and adapt campaigns quickly to changing preferences.

General Recommendations:

Both B2B and B2C marketers should adopt **digital tools and analytics** to make data-driven decisions.

Training employees on digital marketing strategies ensures effective implementation of campaigns.

Businesses should balance **traditional and digital marketing methods** to maximize reach and engagement.

Continuous evaluation of marketing effectiveness through metrics and KPIs is crucial for improvement.

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IMPACT OF DIGITAL TRANSFORMATION ON SMALL BUSINESS ENTREPRENEURSHIP

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Abstract

The study titled “Impact of Digital Transformation on Small Business Entrepreneurship” explores how the adoption of digital technologies reshapes small business operations, competitiveness, and innovation. Using both primary and secondary data, the research analyzes responses from small business entrepreneurs to understand awareness, adoption levels, benefits, and challenges associated with digital transformation. The findings reveal that digital tools—such as e-commerce, social media, and digital payments—enhance business efficiency, customer engagement, and decision-making, while fostering entrepreneurial confidence and adaptability. Despite these advantages, small businesses continue to face barriers like high implementation costs, limited digital skills, cybersecurity risks, and resistance to change. The study concludes that digital transformation acts as a strategic enabler for sustainable growth, innovation, and competitiveness, provided that entrepreneurs receive adequate training, institutional support, and government assistance to overcome digital adoption challenges.

Introduction

In the modern business world, digital transformation has become one of the most significant forces shaping entrepreneurship and innovation. It refers to the process of integrating digital technologies such as the internet, artificial intelligence, cloud computing, digital payments, and social media into every aspect of business operations. For small businesses, digital transformation is not only about adopting new technologies but also about rethinking business strategies, customer engagement, and operational efficiency.

Small business entrepreneurship plays a vital role in driving economic growth, creating employment, and fostering innovation. However, the competitive landscape has changed dramatically due to globalization and technological advancement. Entrepreneurs today face the dual challenge of managing limited resources while adapting to rapid digital change. The adoption of digital tools enables small firms to reach wider audiences, streamline processes, enhance decision-making, and improve customer experiences.

Objectives

1. To examine the awareness & adoption of digital transformation
2. To evaluate the impact on business performance & customer engagement
3. To identify the challenges & Barrier faced by small business in adopting digital transformation.
4. To assess the role of digital transformation in enhancing entrepreneurial confidence, innovation, and long-term sustainability

Review of literature

1. Westerman et al. (2014)

Westerman and his colleagues define digital transformation as the use of digital technologies to improve business performance, enhance customer value, and adapt to changing market conditions. They argue that businesses must move beyond simply adopting technology — they must **strategically integrate digital tools** into their operations to drive innovation and efficiency.

2. Nambisan (2017)

Nambisan explores how digital technologies are **reshaping the nature of entrepreneurship** by enabling new ways of creating and delivering value. Through digital platforms, small entrepreneurs can reach a global audience, reduce entry barriers, and experiment with new business models. The study emphasizes that digital tools such as e-commerce websites, social media marketing, and online payment systems help entrepreneurs innovate quickly and respond to customer needs in real-time.

3. Li et al. (2018)

According to Li and his team, digital transformation positively influences the **performance and productivity** of small businesses. The integration of technologies like cloud computing, data analytics, and digital payments helps entrepreneurs make better decisions, increase customer engagement, and expand into new markets. The study also highlights that firms adopting digital tools report improved communication, faster operations, and better financial management.

4. Vial (2019)

Vial (2019) provides a critical view by addressing the **challenges** associated with digital transformation. Many small enterprises, especially in developing economies, face obstacles such as limited funding, lack of digital skills, poor internet connectivity, and cybersecurity threats. Despite recognizing the importance of going digital, small business owners often struggle with implementation due to these constraints. The study suggests that government support and training programs can help overcome such barriers.

5. Kraus et al. (2021)

Kraus and colleagues argue that digital transformation not only impacts business performance but also strengthens the **entrepreneurial mindset**. Entrepreneurs who embrace digital technologies are more adaptable, innovative, and open to experimentation. The study found that technology adoption

encourages creativity and allows entrepreneurs to respond faster to changing customer expectations, making them more competitive and sustainable in the long term.

6. OECD (2020)

The OECD report (2020) highlights that digital transformation has become a **key driver of growth and resilience** for small businesses worldwide. It enables them to access global markets, improve efficiency, and continue operations even during crises like the COVID-19 pandemic. However, the report warns that challenges such as cybersecurity risks and unequal access to digital infrastructure must be addressed to ensure inclusive and sustainable growth.

Summary

The reviewed literature shows that digital transformation significantly impacts small business entrepreneurship by **enhancing innovation, productivity, and competitiveness**. It allows entrepreneurs to leverage technology for better customer engagement, efficient operations, and sustainable growth. However, issues like digital skill gaps, limited capital, and cybersecurity threats remain barriers to full digital adoption. Continuous support, awareness, and training are crucial to ensure that small businesses benefit from the opportunities offered by the digital era.

Research methodology

Introduction

The research methodology outlines the approach and methods used to collect, analyze, and interpret data for this study. It provides a systematic framework to ensure the findings are accurate, reliable, and relevant to the research objectives. This study uses both primary and secondary research methods to explore how digital transformation affects small business entrepreneurship.

Methods Used for Data Collection

Primary Data Collection:

A **questionnaire** was prepared with multiple-choice and closed-ended questions. The survey was shared via **Google Forms** and in-person interviews with small business entrepreneurs. Respondents were asked to provide honest feedback based on their experience with digital technologies.

Secondary Data Collection:

Reviewed **research papers, industry reports, and case studies**.

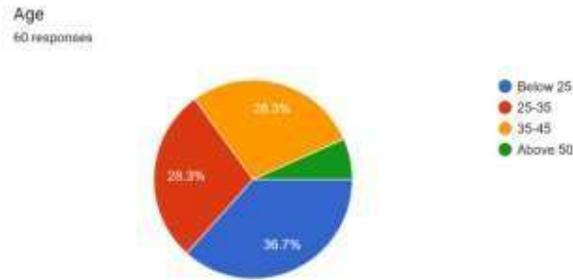
Consulted credible online resources for insights into digital transformation trends in small businesses.

Summary

This methodology ensures that the research captures **real-world experiences** of small business entrepreneurs while also grounding the study in **existing literature and industry knowledge**. The chosen approach and methods are suitable for exploring the **impact, benefits, and challenges of digital transformation** in small business entrepreneurship.

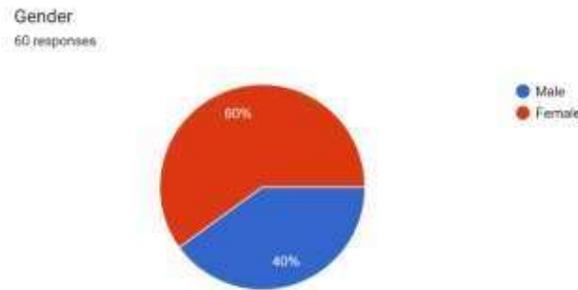
Data Analysis and Interpretation

The data collected from respondents through surveys has been organized and presented in the form of tables, charts, and graphs for better understanding. Each response has been analyzed to identify patterns, preferences, and differences in marketing approaches between B2B and B2C businesses. This analysis helps in drawing meaningful conclusions about how businesses can tailor their marketing strategies more effectively based on their customer type.



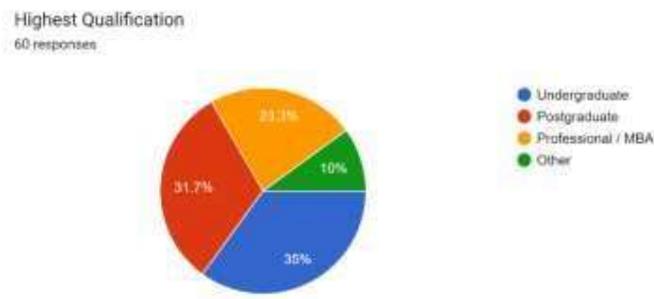
Data Interpretation:

From above 60 responses the maximum no. of age are belong to below 25 age group and minimum age of group are belong to 25-35 and 35-45 age group.



Data Interpretation:

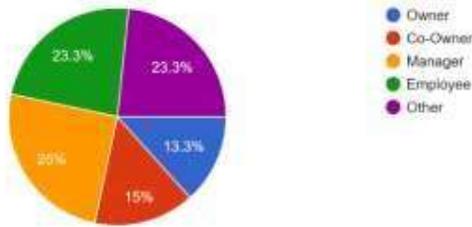
The above chart represents that the 60% of respondents are Female and 40% of the respondents are Male.



Data interpretation:

From the above chart it represents that the 35% respondents are having undergraduate qualifications, 31.7% respondents are postgraduate respondents, 23.3% respondents are professional/MBA and 10% respondents are having other qualification.

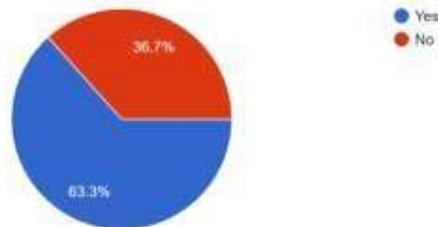
What is your role in business?
60 responses



Data Interpretation:

The above chart shows that the maximum respondents are Manager, Employee and other role of business.

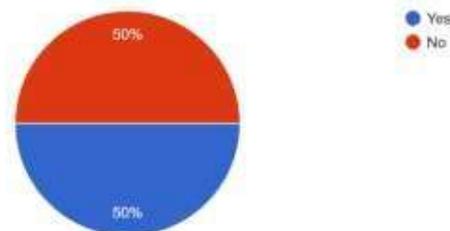
Are you aware of digital transformation in business?
60 responses



Data Interpretation:

From the above chart it shows that 63.3% respondents are aware of digital transformation in business and 36.7% respondents are not aware of digital transformation in business .

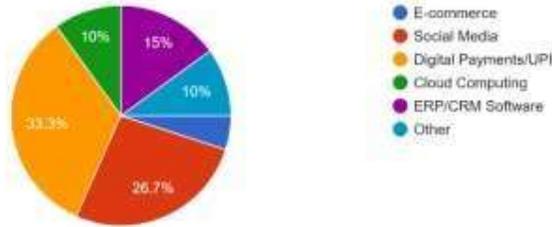
Has your business adopted any digital technologies in the last 3 years?
60 responses



Data Interpretation:

The above chart shows that 50-50% business adopted any digital technologies in the last 3 years.

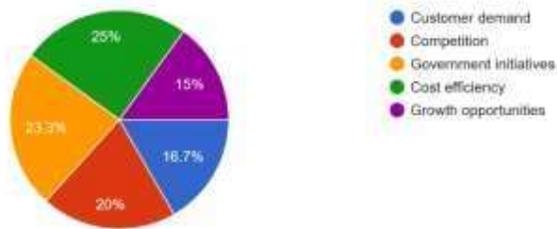
Which digital tools have you adopted?
60 responses



Data Interpretation:

From this above chart it represents that 33.3% respondents had adopted digital payments/UPI digital tools, 26.7% respondents had adopted social media digital tools and rest of the respondents had adopted other digital tools.

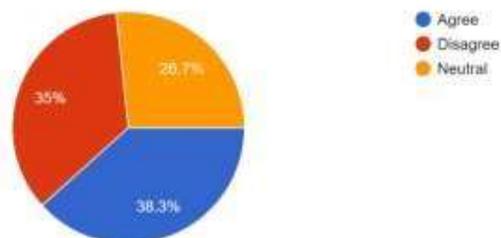
What motivated you to adopt digital technologies?
60 responses



Data Interpretation:

From above chart it shows that 25% respondents are motivated by cost efficiency to adopt the digital technologies, 23.3% respondents are motivated by Government initiatives to adopt the digital technologies, 20% respondents are motivated by competition to adopt the digital technologies, 16.7% respondents are motivated by customer demand to adopt the digital technologies and last 15% respondents are motivated by growth opportunities to adopt the digital technologies.

Has digital adoption improved your business efficiency?
60 responses

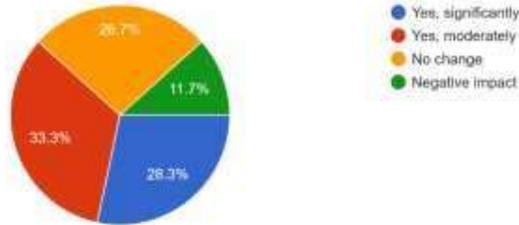


Data Interpretation:

The above chart shows that most of the respondents are agree with the digital adoption improved business efficiency.

Has digital transformation helped increase your customer base?

60 responses



What benefits have you experienced from digital adoption?

60 responses

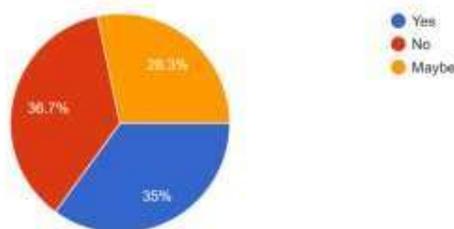


Data Interpretation:

The above chart represents that the 38.3% respondents think reduced costs benefits had experienced from digital adoption, 26.7% respondents think better customer engagement benefits had experienced from digital adoption, 16.7% respondents think access to new markets benefits had experienced from digital adoption and rest of the respondents think increase sales and improved decision making benefits had experienced from digital adoption.

Has digital transformation helped you compete with larger companies?

60 responses

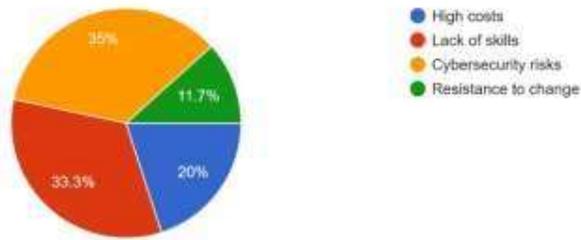


Data Interpretation:

From above chart it shows that 36.7% respondents are saying No for digital transformation helped them to compete with larger companies and 35% respondents are saying yes and 28.3% are saying maybe it helped to compete with larger companies.

What challenges do you face in adopting digital transformation?

60 responses

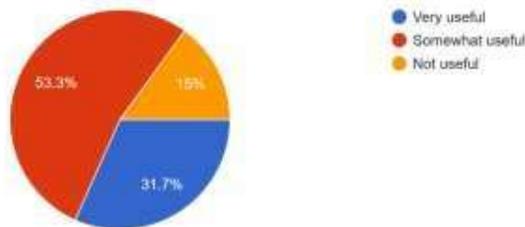


Data Interpretation:

This chart represents that the 35% respondents are facing cybersecurity risks challenges in adopting digital transformation, 33.3% respondents are facing lack of skills challenges in adopting digital transformation, 20% respondents are facing high costs challenges in adopting digital transformation, 11.7% respondents are facing resistance to change challenges in adopting digital transformation.

Do you find government schemes/support useful for digital adoption?

60 responses



Data Interpretation:

The above chart shows that 53.3% respondents are finding government schemes/support somewhat useful for digital adoption, 31.7% respondents are finding government schemes/support very useful for digital adoption, and 15% respondents are finding government schemes/support not useful for digital adoption.

What is the biggest barrier for your business in going digital?

60 responses

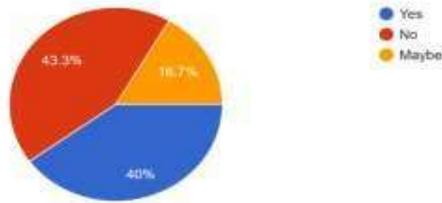


Data Interpretation:

The above chart indicates that most of the respondents are saying trust/security is the biggest barrier for business in going digital.

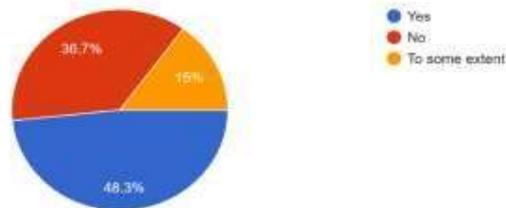
Do you think lack of training/skills limits your ability to go digital?

60 responses



Do you think digital transformation has encouraged innovation in your business?

60 responses

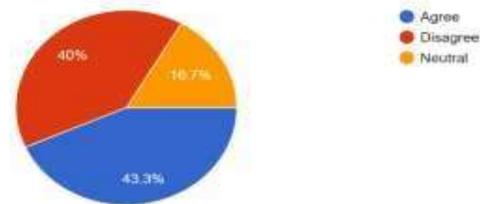


Data Interpretation:

The above chart represents that 48.3% respondents are thinking that digital transformation has encouraged innovation in business, 36.7% respondents are not thinking that digital transformation has encouraged innovation in business.

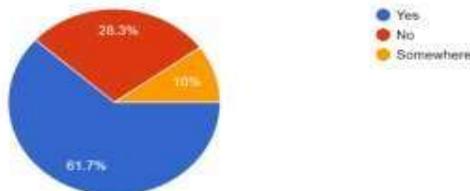
Do you feel more confident as an entrepreneur after adopting digital tools?

60 responses



Do you think digital adoption helps small businesses survive during crises (e.g., COVID-19)?

60 responses



Data Interpretation:

From the above chart it maximum respondents are saying that digital adoption helps small businesses survive during crises because nowadays digital are growing so fast in today's digital era.

Conclusions and Recommendations

Conclusion

The research on “**Impact of Digital Transformation on Small Business Entrepreneurship**” highlights that digital technologies play a **crucial role in enhancing business efficiency, innovation, and competitiveness**. Small business entrepreneurs are increasingly aware of the importance of adopting digital tools such as e-commerce platforms, social media, digital payments, and CRM systems.

The study found that digital transformation **improves customer engagement, expands market reach, and supports better decision-making**, while also fostering entrepreneurial confidence and resilience during challenging situations. However, challenges like high implementation costs, lack of technical skills, cybersecurity concerns, and resistance to change can slow adoption.

Overall, the findings indicate that **digital transformation is a strategic enabler** that helps small businesses grow sustainably, compete with larger firms, and innovate continuously in today’s dynamic business environment.

Recommendations

Adopt Digital Tools Strategically: Small businesses should implement relevant digital technologies, even in simple forms, to enhance operations and customer engagement.

Invest in Training and Skill Development: Entrepreneurs should improve their digital literacy or seek external support to effectively leverage technology.

Seek Government and Institutional Support: Utilize programs, subsidies, and resources provided for digital adoption to reduce costs and technical barriers.

Encourage Innovation and Customer-Centric Approaches: Use digital tools to innovate products, services, and processes, focusing on enhancing the customer experience.

Plan for Future Expansion: Businesses should continuously evaluate new digital technologies to sustain long-term growth and remain competitive in the evolving market.

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Impact of Artificial Intelligence on Consumer Buying Behaviour

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Abstract

In the digital era, marketing has rapidly shifted from a product-centered to a customer-centered approach, with personalization emerging as a key strategy. Artificial Intelligence (AI) plays a transformative role in this shift by enabling businesses to collect, analyze, and apply vast amounts of customer data to deliver personalized experiences. This study investigates consumer perceptions of AI in marketing, focusing on its impact on personalization, trust, and overall shopping experiences. Using a convenience sampling method, primary data were collected through a structured questionnaire distributed via digital platforms to 63 respondents, primarily from Navi Mumbai. The findings reveal that 68.8% of respondents perceive AI as having a positive influence on their shopping experiences, especially in terms of convenience, personalization, and time saving benefits. However, concerns about data privacy and transparency remain significant, with over 50% expressing discomfort about how their data is used. Chatbots were valued for their 24/7 availability, though a notable portion of respondents still prefer human interaction for complex issues. The study highlights the need for ethical and transparent AI practices, improved accuracy in recommendations, and a balanced integration of human support. These insights contribute to understanding how businesses can leverage AI responsibly to enhance customer satisfaction, trust, and loyalty.

Keywords: Artificial Intelligence, Marketing, Personalization, Consumer Trust, Data Privacy, Customer Experience

Introduction

In today's digital age, marketing has shifted from being product-centered to customer-centered, with personalization becoming a key strategy for businesses. Artificial Intelligence (AI) plays a central role in this transformation by enabling companies to collect, analyse, and use vast amounts of customer data to deliver tailored experiences. From personalized product recommendations on e-commerce platforms to instant customer service through chatbots, AI has become an integral part of the customer journey. Customers now interact with brands across multiple digital platforms, and AI helps marketers predict preferences, understand behaviours, and offer real-time solutions. However, while AI creates convenience and personalization, it also raises questions about customer trust, data privacy, and over-reliance on technology. Studying AI in marketing from the customer perspective is therefore significant, as it highlights not only the benefits customers gain—such as better service and improved experiences—but also the challenges they face. Understanding these perspectives is crucial for businesses to design ethical, customer-friendly AI strategies that balance technological innovation with customer trust. This research will contribute valuable insights into how AI-driven marketing impacts customer satisfaction, loyalty, and long term brand relationships.

Objectives

- To understand how Artificial Intelligence (AI) is changing marketing today.
- To see how AI helps businesses connect with and understand customers better.
- To check how tools like chatbots and recommendations improve marketing results.
- To find out the problems and future possibilities of using AI in marketing

Review of literature

- Artificial intelligence in marketing: Systematic review and future research direction Sanjeev Verma, Rohit Sharma, Subhamay Deb, Debojit Maitra

National Institute of Industrial Engineering (NITIE), Mumbai 400087, India

Received 4 October 2020, Revised 28 November 2020, Accepted 3 December 2020, Available online 28 January 2021, Version of Record 31 March 2021. Artificial Intelligence (AI) in Marketing has gained momentum due to its practical significance in present and future business. Due to the wider scope and voluminous coverage of research studies on AI in marketing, the meta-synthesis of exiting studies for identifying future research direction is extremely important. Extant literature attempted the systematic literature review, but existing reviews are descriptive, and latent intellectual network structure remained unexplored. Present study used bibliometric analysis, conceptual network analysis, and intellectual network analysis to identify research subthemes, trending topics, and future research directions.

- The use of artificial intelligence in marketing strategies: Automation, personalization and forecasting Maciej Potwora, Olha Vdovichena, Dmytrii Semchuk, Liubov Lipyeh, Volodymyr Saienko

This study explores how Artificial Intelligence (AI) is transforming marketing from traditional methods to data-driven approaches through automation, personalization, and forecasting. Using a systematic literature review and thematic analysis, it finds that AI enhances marketing efficiency, improves customer engagement, and enables accurate prediction of market trends and consumer behaviour. However, ethical and privacy concerns remain key challenges. The research emphasizes the need for responsible AI use, recommending a balanced approach that maximizes

AI's benefits while maintaining ethical integrity, ultimately guiding marketers toward effective and ethical AI-driven strategies.

- Artificial intelligence in marketing: exploring current and future trends

This study conducts a systematic literature review and bibliometric analysis of 522 studies (2015–2023) from the Web of Science to explore the growing role of Artificial Intelligence (AI) in marketing. Findings reveal six key research clusters: psychosocial dynamics, AI-driven marketing strategies, consumer services, decision-making, value transformation, and ethical marketing. The study highlights the rapid rise of AI in marketing, identifies research gaps in context, methods, and theory, and provides guidance for academics and practitioners on future AI-driven marketing developments.

- Artificial Intelligence in Marketing Dr. Jaya kagada Published in International Research... 16 March 2024

Artificial Intelligence in Marketing is a rapidly up-and-coming grassland that is transforming the way businesses move toward their marketing plan. It involves the use of Artificial Intelligence (AI), Machine Learning (ML), and other highly developed technologies to automate and optimize various marketing processes. With the sudden increase of data and the increasing complication of customer behaviour, businesses need to influence these tools to stay competitive. This article investigates the concept of Artificial Intelligence in Marketing, its role in modern marketing, its benefits and challenges, best practices for implementation, and moral considerations. It will also look into the future of Artificial Intelligence in Marketing and its potential impact on the marketing landscape.

Research methodology

Source of data collection:

The process of gathering and analysing accurate data from various sources to find answers to research problems, trends and probabilities, etc., to evaluate possible outcomes is Known as Data Collection. Data may be grouped into four main types based on methods for collection: observational, experimental, simulation, and derived. The task data collection being collection after a research problem has been defined and research design chalked out while deciding about the method of data keep in mind two types of data. > PRIMARY DATA > SECONDARY

Research tools:

Research tool used for the study was scaled questionnaire which included the following types of scales and questions:

Likert Scale [Strongly Disagree/Disagree/Neutral/Agree/Strongly Agree]

Closed Ended Questions

Sampling size:

A questionnaire survey was designed in Google forms and sent to people using different tools like e-mail, What App, Facebook, etc. The total Number collected in the questionnaire was 63 valid and active responded

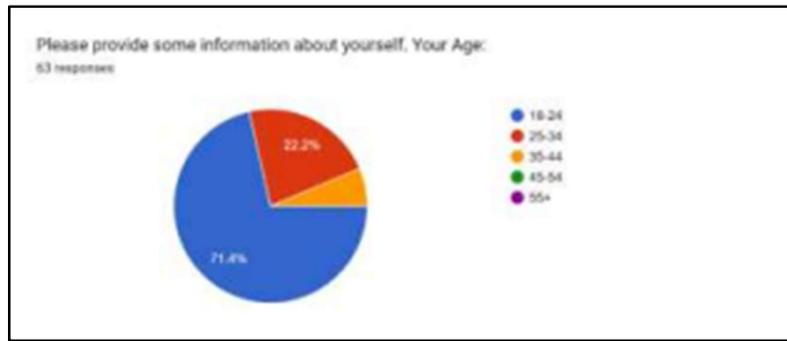
Sampling method:

The Convenience sampling method was used for this study. The present paper indulges in studying the buying behaviour. Apart from the literature review of the concurrent facts and figures, a questionnaire survey was conducted to understand the various factors that influence the decision in purchasing in Vashi. Method was conducted through various media platform.

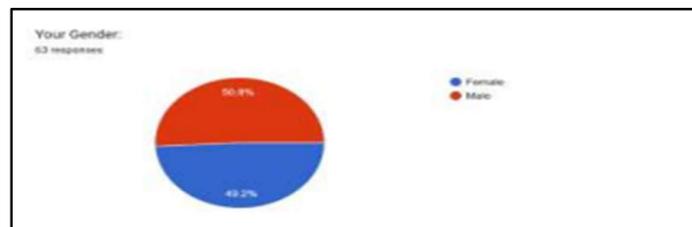
Sample area: Sample was selected by Convenience sampling method from Navi Mumbai

Data Analysis and Interpretation

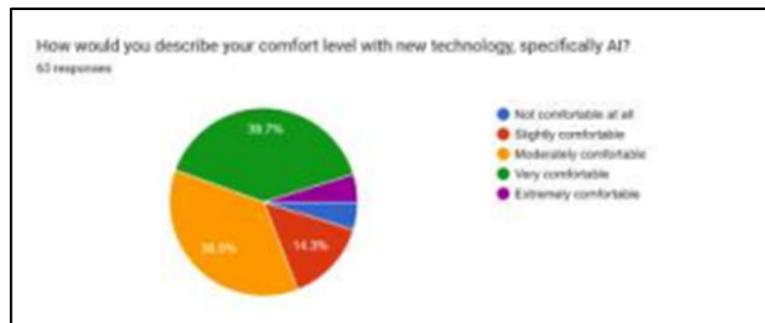
Research Work Descriptions, Observations, and Analysis:



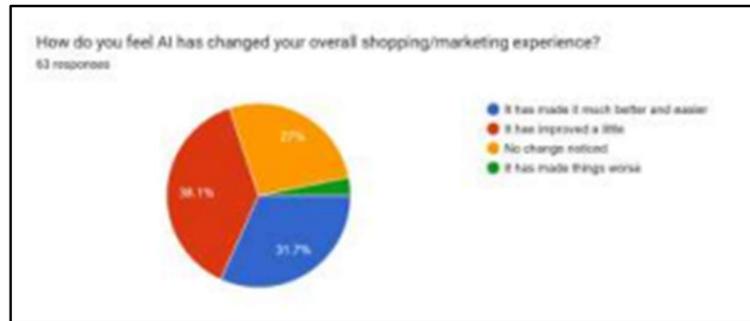
The chart shows that most respondents (71.4%) are aged 18–24, followed by 22.2% aged 25–34. Very few are 35–44, and none are above 45. This indicates the survey mainly represents young adults.



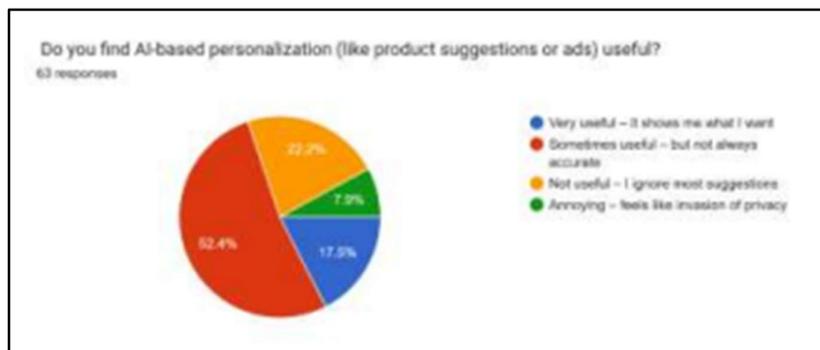
The chart shows that 50.8% of respondents are male and 49.2% are female, indicating an almost equal gender representation in the survey.



The chart shows that 39.7% of respondents feel very comfortable with AI, 36.5% are moderately comfortable, 14.3% slightly comfortable, and only 4.9% extremely comfortable, while very few are not comfortable at all. This indicates most respondents are generally comfortable with AI technology.

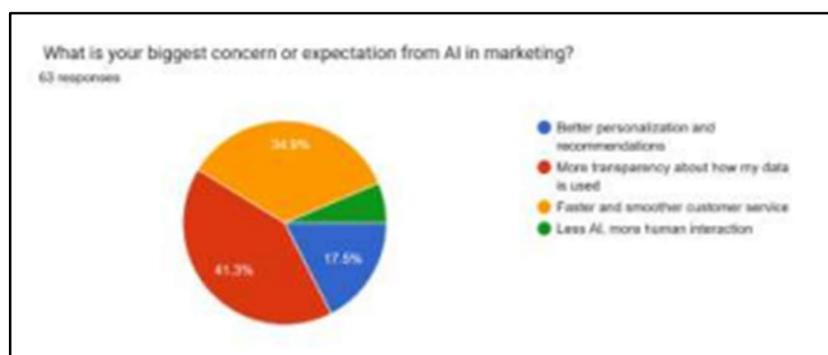


The data shows a predominantly positive to neutral view of how AI has changed the shopping and marketing experience among the 61 respondents. Positive Impact (68.8%): Most respondents felt AI improved their experience, with 37.7% saying it improved a little and 31.1% saying it made it "much better and easier. Neutral/No Change (27.9%): A significant portion reported No change noticed. Negative Impact (Smallest Group): Only a very small percentage felt AI "has made things worse.



- 52.4% said it is sometimes useful but not always accurate — the majority opinion.
- 17.5% found it very useful, as it shows relevant suggestions.
- 22.2% said it is not useful, ignoring most suggestions.
- 7.9% felt it is annoying and an invasion of privacy.

Most respondents see AI personalization as partly helpful but imperfect while a smaller group either finds it very beneficial or not useful/annoying.



- 41.3% want more transparency about how their data is used the top concern.
- 34.9% expect faster and smoother customer service
- 17.5% look for better personalization and recommendations

A small group prefers less AI and more human interaction Most respondents emphasize data transparency and efficiency in AI marketing, showing that people value trust and improved service quality over excessive automation.



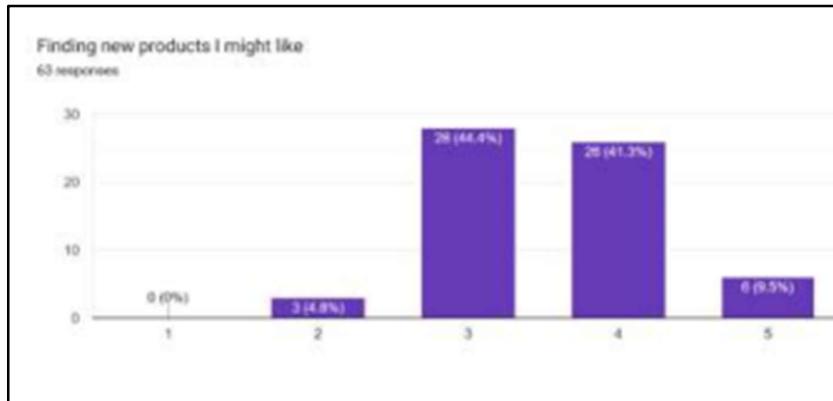
71.4% (49.2% + 22.2%) of respondents indicated that recommendations are useful and relevant at least sometimes or often, showing a generally positive, though not perfect, perception of product recommendation systems. Conversely, 17.5% (15.9% + 1.6%) find them useful rarely or never.



- 36.5% are "Somewhat uncomfortable; I worry about my privacy" (the largest single segment).
 - 14.3% are "Very uncomfortable; I feel it's an invasion of my privacy." •
- Total Discomfort = 50.8%.

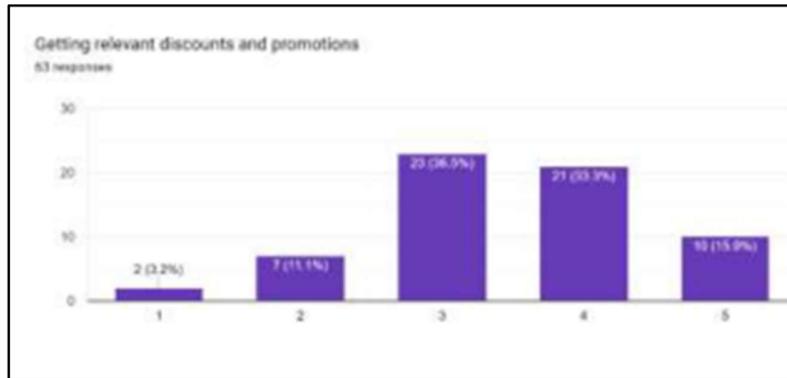
Neutrality is High: 34.9% are "Neutral; I don't really think about it," suggesting a large portion is indifferent or unaware of the implications.

Comfort is the Smallest Segment: Only 14.3% are "Very comfortable with it; it improves my shopping experience." the responses are highly split, with concerns over privacy (50.8%) slightly outweighing the combination of comfort and neutrality (49.2%).



- The highest number of responses were at Level 3 (44.4%) and Level 4 (41.3%).
- Almost everyone reported being benefited (Level 3 or higher).
- No one (0%) felt they were "not benefited" at all (Level 1).

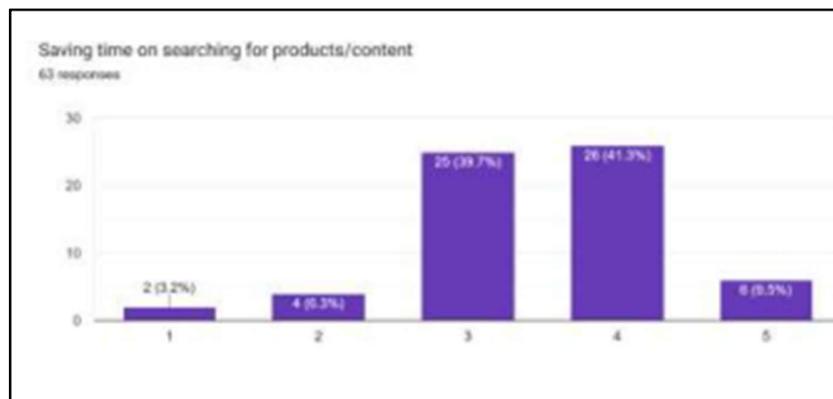
The system/feature is highly effective in helping users find new products, with overwhelmingly positive results



Most people (reported receiving a moderate to high level of benefit (Levels 3 and 4).

- The highest number of responses were at Level 3 (36.5%) and Level 4 (33.3%).
- A significant majority reported being benefited (Level 3 or higher).
- Only 2 people (3.2%) felt they were "not benefited" (Level 1).

Users generally feel that the discounts and promotions they receive are relevant and beneficial, though the sentiment is slightly less positive than the previous graph (Finding new products).



The vast majority reported receiving a moderate to high level of benefit (Levels 3 and 4).

- The highest number of responses were almost equal at Level 3 (39.7%) and Level 4 (41.3%).
- Almost all respondents reported being benefited (Level 3 or higher).
- Only 2 people (3.2%) felt they were "not benefited" (Level 1).

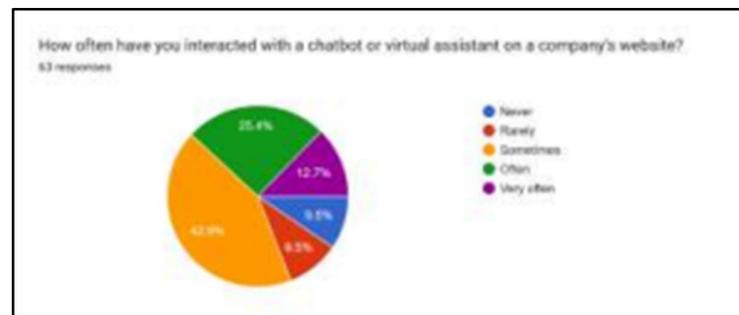
The feature is highly successful in saving users time, with nearly all respondents feeling a moderate or high benefit from the time-saving aspects.



The majority reported receiving a moderate to high level of benefit (Levels 3 and 4).

- The highest number of responses were at Level 3 (42.9%) and Level 4 (38.1%).
- Most respondents reported being benefited (Level 3 or higher).
- A small number of people reported feeling not benefited (Level 1) or low benefit (Level 2), each accounting for 3.2%.

The system/feature is highly successful in creating an enjoyable and convenient shopping experience for most users.



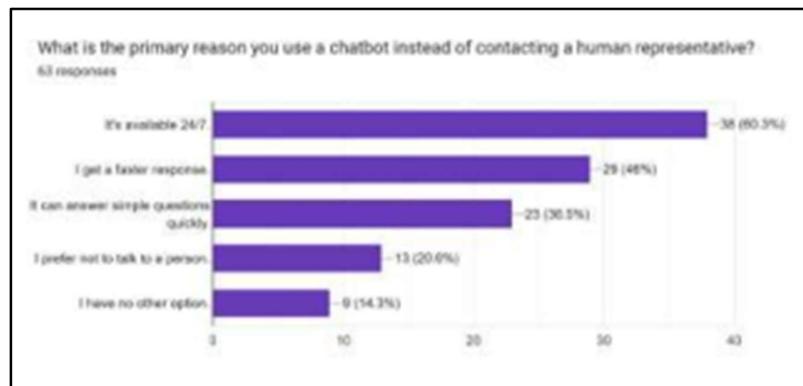
- Non-Users: 42.9% of respondents have never used a chatbot, representing the largest single group.
- Frequent Users: A total of 34.9% (25.4% Very Often + 9.5% Often) are regular, high frequency users.
- Infrequent Users: 22.2% (12.7% Rarely + 9.5% Sometimes) are occasional users.

The data reveals a clear split in the market: a large segment avoids chatbots entirely, while over a third of users engage with them

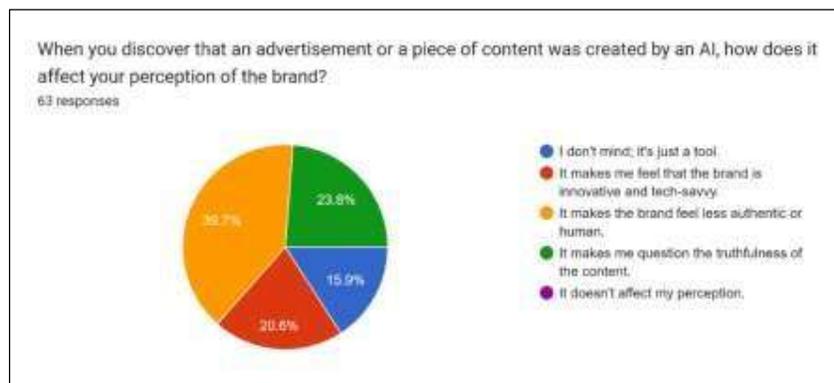


71.5% of users (the majority) find their chatbot experience to be helpful (Somewhat Helpful + Very Helpful).

12.7% of users (a small minority) find their experience to be frustrating (Somewhat Frustrating + Very Frustrating).

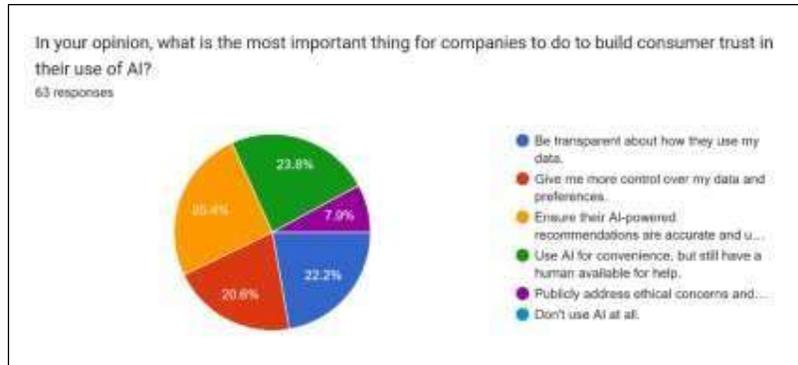


The primary reason people use a chatbot instead of a human representative is its 24/7 availability (60.3% of responses), followed by the desire for a faster response (46%).



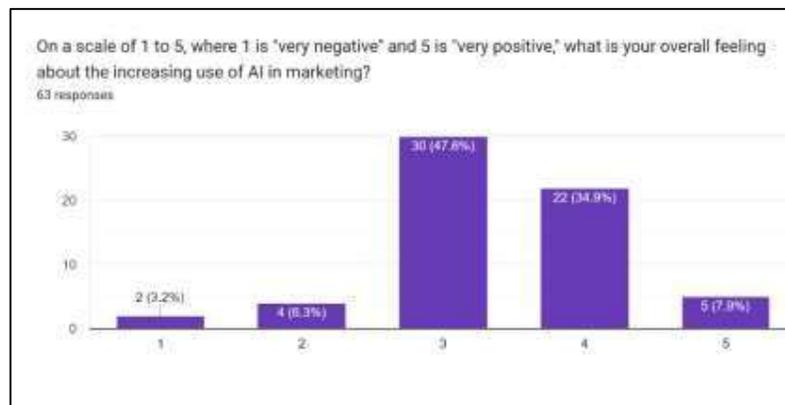
- 39.7% said it makes the brand feel less authentic or human
- 23.8% said it makes them question the truthfulness of the content,
- 20.6% felt the brand is innovative and tech-savvy
- 15.9% said they do not mind; it is just a tool

Most people view AI-created content with doubt or reduced authenticity while a smaller group sees it as a sign of innovation



- 25.4% said companies should ensure AI recommendations are accurate and unbiased
- 23.8% preferred using AI for convenience but keeping human help available • 22.2% wanted transparency about data use
- 20.6% wanted more control over their data and preferences
- 7.9% thought companies should publicly address ethical concerns

Most people believe trust in AI can be built through accuracy, fairness, and human support along with transparency and user control



The chart shows that most respondents have a positive outlook on the increasing use of AI in marketing.

- 47.6% rated it 3 (neutral)
- 34.9% rated it 4 (positive)
- 7.9% rated it 5 (very positive)
- while only 3.2% and 6.3% rated it 1 and 2 respectively (negative). Overall, most people feel neutral to positive about the growing use of AI in marketing

Conclusions and Recommendations

Findings:

The analysis of the survey data provides valuable insights into respondents' perceptions of Artificial Intelligence (AI) in marketing and shopping experiences. The following are the key findings derived from the study:

1. Demographic Profile of Respondents

The results indicate that most respondents (71.4%) belong to the age group of 18–24 years, followed

by 22.2% aged 25–34. Only a few fall within the 35–44 age group, and none are above 45 years, suggesting that the survey primarily represents young adults. The gender distribution is nearly equal, with 50.8% male and 49.2% female respondents, ensuring balanced representation.

2. Perception of AI in Marketing and Shopping

A significant majority (68.8%) of respondents expressed that AI has positively influenced their shopping and marketing experiences. Among them, 37.7% stated that it improved their experience slightly, while 31.1% reported that it made the process much easier. Only a small portion indicated a negative impact, suggesting that the overall perception of AI is favourable.

3. Usefulness and Accuracy of AI Recommendations

More than half of the respondents (52.4%) agreed that AI-based recommendations are sometimes useful but not always accurate, representing the majority opinion. Additionally, 17.5% found them very useful, while 22.2% felt they were not useful, and 7.9% considered them intrusive or an invasion of privacy. This indicates that while AI personalization is appreciated, it still requires improvement in accuracy and relevance.

4. Data Privacy and Transparency Concerns

Privacy concerns emerged as a significant theme, with 50.8% of respondents expressing discomfort regarding how their data is used. The leading expectation (41.3%) among participants was for more transparency in data usage, followed by faster and smoother customer service (34.9%), and improved personalization (17.5%). These responses highlight the importance of ethical data handling and transparent communication.

5. Effectiveness of AI Features

Across different AI applications—product discovery, discounts, promotions, and time-saving—most respondents reported receiving moderate to high benefits (Levels 3 and 4). Respondents acknowledged that AI significantly enhances convenience and efficiency in shopping, reinforcing its value in improving user experience.

6. Chatbot Usage and Perception

The data shows a clear divide in chatbot usage: 42.9% of respondents have never used one, whereas 34.9% are frequent users. Among those who have used chatbots, 71.5% found them helpful due to their 24/7 availability and quick responses. However, 12.7% experienced frustration, indicating that while chatbots are valuable, their design and usability can be further refined.

7. Trust and Authenticity of AI-Generated Content

Although 20.6% of respondents viewed AI-generated content as innovative and modern, a larger portion (39.7%) felt it reduced the brand's authenticity, and 23.8% questioned its truthfulness. This demonstrates a prevailing scepticism toward automated content and the need for brands to maintain authenticity while adopting AI tools.

8. Building Trust in AI Marketing

Respondents identified several key factors to enhance trust in AI-driven marketing: accuracy and fairness (25.4%), human assistance alongside automation (23.8%), transparency in data use (22.2%), and greater user control over personal data (20.6%). Ethical accountability and public communication about AI use were also mentioned as trust-building elements.

9. Overall Outlook on AI in Marketing

Most respondents maintained a neutral to positive outlook regarding the increasing use of AI in marketing. Specifically, 47.6% rated their perception as neutral, 34.9% as positive, and 7.9% as very positive, while only a small proportion viewed it negatively. This reflects a growing acceptance of AI technologies among consumers, albeit with caution regarding privacy and authenticity

Recommendations

Based on the findings, the following recommendations are proposed to enhance the use and acceptance of AI in marketing:

1. Improve Accuracy and Personalization

Organizations should focus on refining AI algorithms to increase the precision and contextual relevance of product recommendations. Incorporating customer feedback mechanisms can help in continually improving personalization quality.

2. Enhance Data Transparency and User Control

Brands must clearly communicate how consumer data is collected, processed, and used. Providing users with easy options to modify privacy settings and control their data sharing will strengthen trust and brand loyalty.

3. Maintain a Balance Between Automation and Human Interaction

While AI tools like chatbots improve efficiency, companies should ensure that human assistance remains available for complex or emotionally sensitive issues. A hybrid approach combining AI and human support yields the best customer experience.

4. Address Privacy and Ethical Concerns

It is crucial to comply with data protection regulations and ensure AI systems are free from bias. Companies should regularly audit their algorithms and maintain transparency about ethical practices in AI marketing.

5. Improve Chatbot Experience

Chatbots should be enhanced to provide more natural, human-like conversations. Additionally, users should be able to seamlessly escalate to a human representative when required, improving overall satisfaction.

6. Promote Authentic and Transparent Communication

To preserve brand credibility, companies should disclose when AI is used to generate content. Combining AI efficiency with genuine, human-centered storytelling will improve engagement and trust.

7. Educate Consumers About AI Benefits

Businesses should organize awareness campaigns to help consumers understand the benefits of AI, such as convenience, personalization, and time-saving. Educated consumers are more likely to appreciate and trust AI technologies.

8. Implement Continuous Feedback and Improvement Systems

Regularly collecting and analysing user feedback will help identify gaps in AI systems and guide future improvements. A continuous learning approach ensures sustained customer satisfaction and technological advancement.

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EFFECT OF E-COMMERCE ON TRADITIONAL RETAIL BUSINESS

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Abstract

The study titled Effect of E-Commerce on Traditional Retail Business examines how the rapid growth of digital marketplaces has reshaped consumer behavior and impacted physical retail operations in India. Using a descriptive research design, the study combines primary data from surveys of consumers and local retailers with secondary data from journals and online sources. Findings reveal that e-commerce platforms such as Amazon and Flipkart have enhanced convenience, variety, and competitive pricing, resulting in a significant shift toward online shopping. Consequently, traditional retailers face reduced footfall, shrinking profit margins, and intensified price competition. However, the research also identifies opportunities for traditional stores to survive and grow by adopting digital tools, integrating online channels, and improving in-store experiences. Overall, the study concludes that e-commerce significantly influences traditional retail but highlights that coexistence and mutual growth are achievable through strategic adaptation and innovation.

Introduction

In recent years, the rapid growth of e-commerce platforms has transformed the way businesses operate and consumers shop. Online marketplaces such as Amazon, Flipkart, and Myntra have created a highly competitive environment for traditional retail businesses like supermarkets, malls, and small shops. With features like home delivery, digital payments, product variety, and discounts, e-commerce is attracting a large segment of customers.

However, traditional retail continues to play an important role, especially in terms of personal

interaction, trust, and physical product experience. This study aims to understand the effect of e-commerce on traditional retail businesses, focusing on changes in consumer preferences, challenges faced by retailers, and opportunities for both sectors to coexist.

Objectives

1. To study the growth and trends of e-commerce in India.
2. To analyze the impact of e-commerce on sales and operations of traditional retail businesses.
3. To understand changing consumer buying behavior towards online and offline shopping.
4. To identify the challenges faced by traditional retailers due to e-commerce growth.
5. To explore possible strategies for traditional retail businesses to adapt and remain competitive.

Review of literature

Studies show that e-commerce has significantly changed the retail industry by shifting consumer preferences toward online shopping due to convenience, wider choices, and competitive pricing. Traditional retail stores have faced reduced foot traffic and sales, forcing many to adopt online platforms and omnichannel strategies to stay competitive. Researchers also note that while e-commerce has created new job opportunities in logistics and digital marketing, it has led to job losses in physical retail outlets.

Some studies highlight that small retailers struggle to compete with large e-commerce companies, whereas others suggest that personalized service and in-store experiences can help traditional retailers survive. Overall, literature concludes that e-commerce has transformed the retail sector, blending online and offline models for future growth.

Research methodology

1. Research Design:

The study follows a descriptive research design, as it aims to describe and analyse the impact of e-commerce on traditional retail businesses. Both qualitative and quantitative methods are used to understand the positive and negative effects of online shopping on traditional retailers.

2. Data Collection:

* Primary Data: Collected through structured questionnaires and surveys from customers and local retail store owners.

* Secondary Data: Collected from journals, research papers, websites, and articles related to e-commerce and retail trade.

3. Sampling Method:

A random sampling method is used to collect responses from around 50–100 participants, including consumers and shop owners.

HYPOTHESIS:-

Null Hypothesis (H₀):

E-commerce has no significant effect on the performance of traditional retail businesses. **Alternative Hypothesis (H₁):**

E-commerce has a significant effect on the performance of traditional retail businesses.

Positive Impact (as per literature and data):

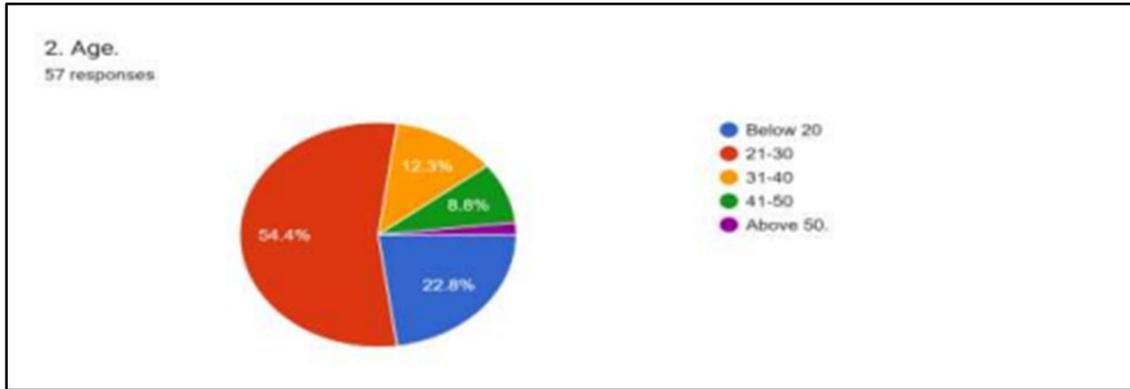
- * Wider market reach and increased visibility through online presence.
- * Opportunity for traditional retailers to expand using online platforms.
- * Improved customer convenience and satisfaction.

Negative Impact (as per literature and data):

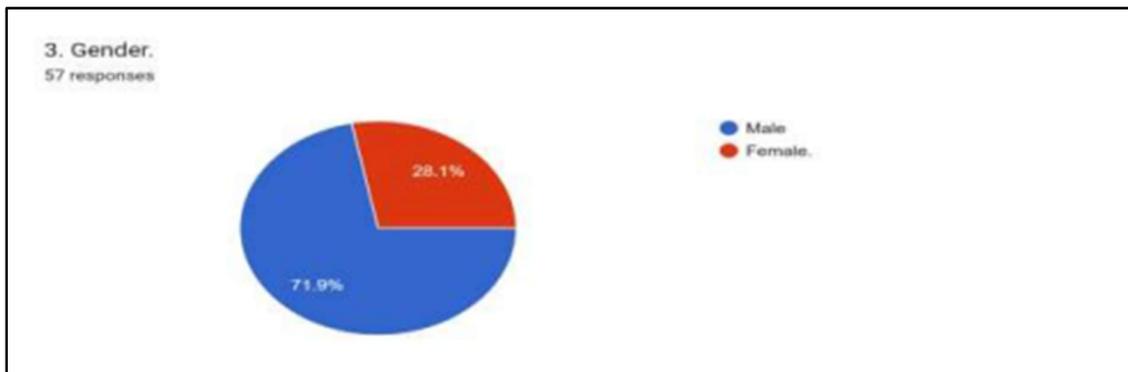
- * Decrease in footfall and sales in physical stores.
- * Tough price competition and reduced profit margins.
- * Small retailers facing challenges to adapt to digital technology.

Data Analysis:

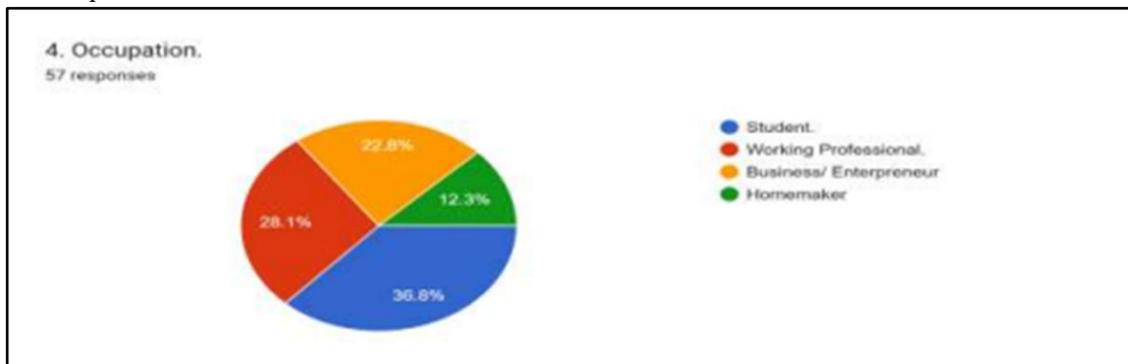
2. Age.



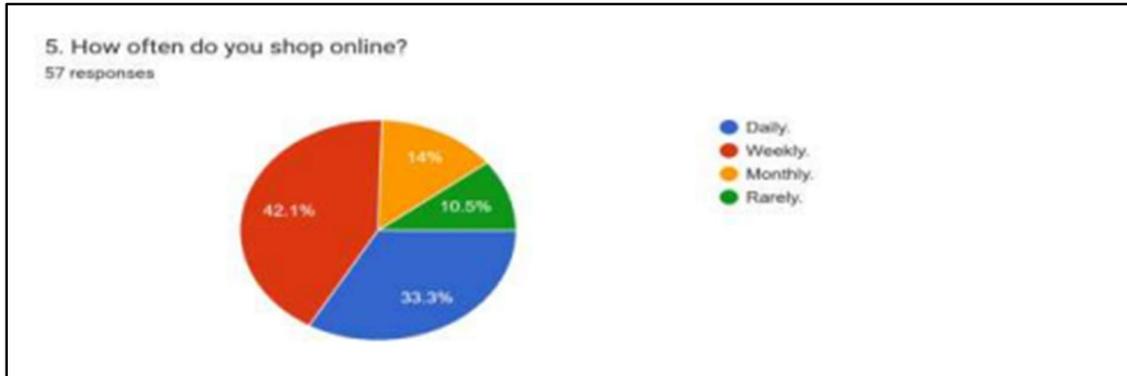
1. Gender.



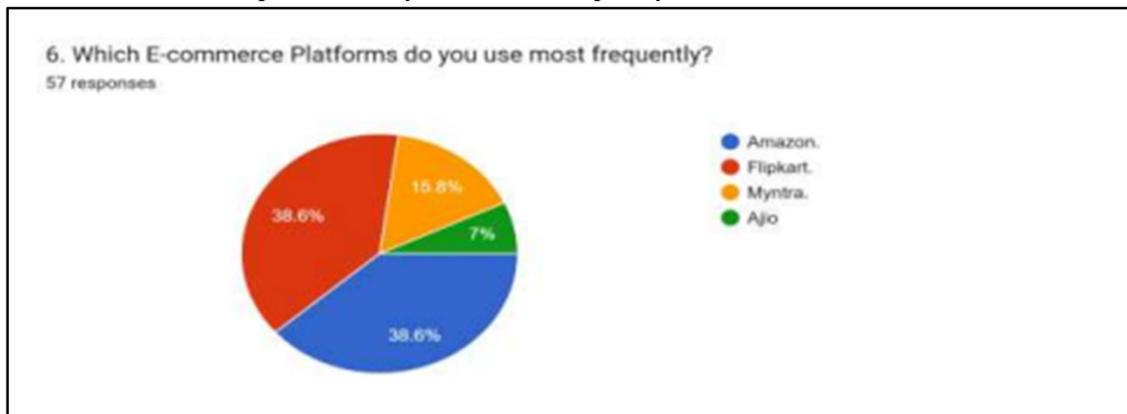
2. Occupation.



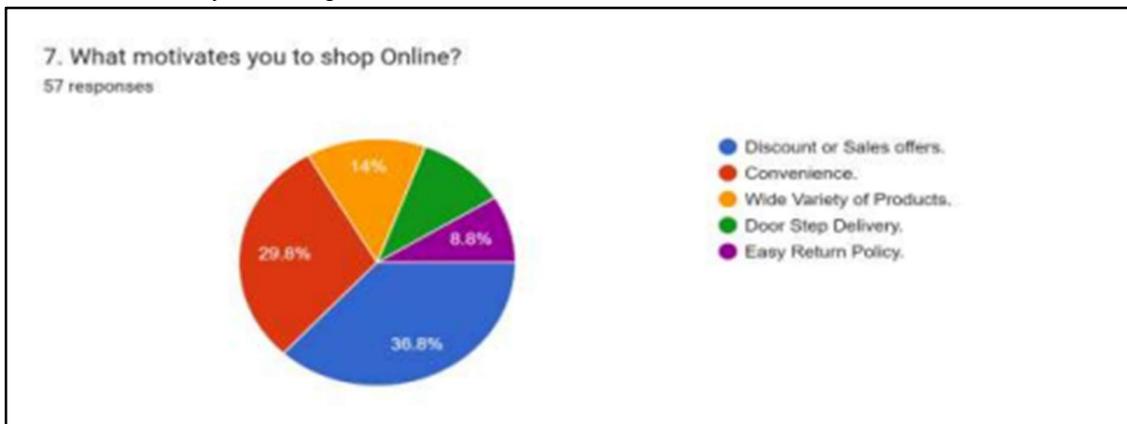
3. How Often do you shop online?



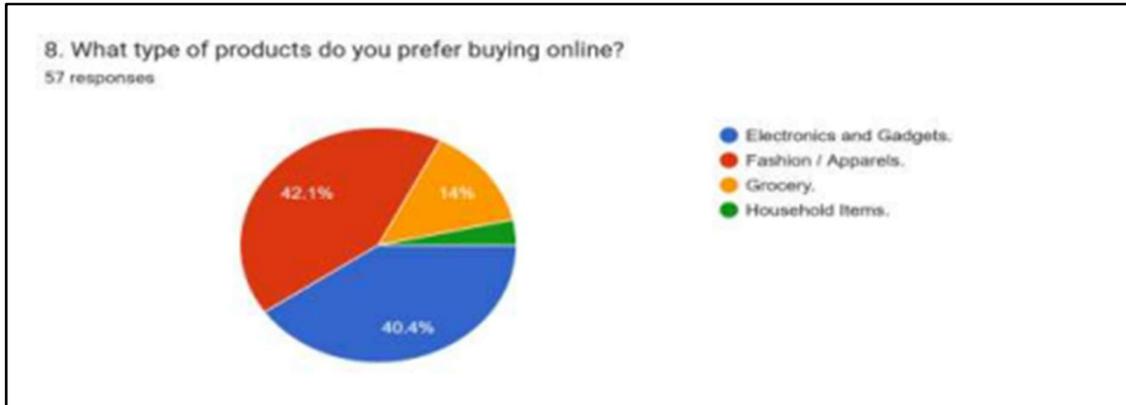
4. Which E-commerce platforms do you use most frequently?



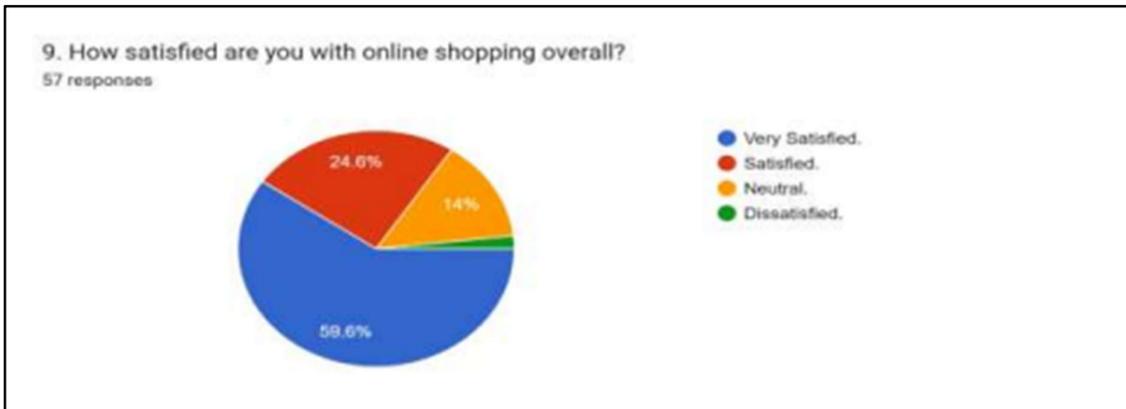
5. What motivates you to shop online?



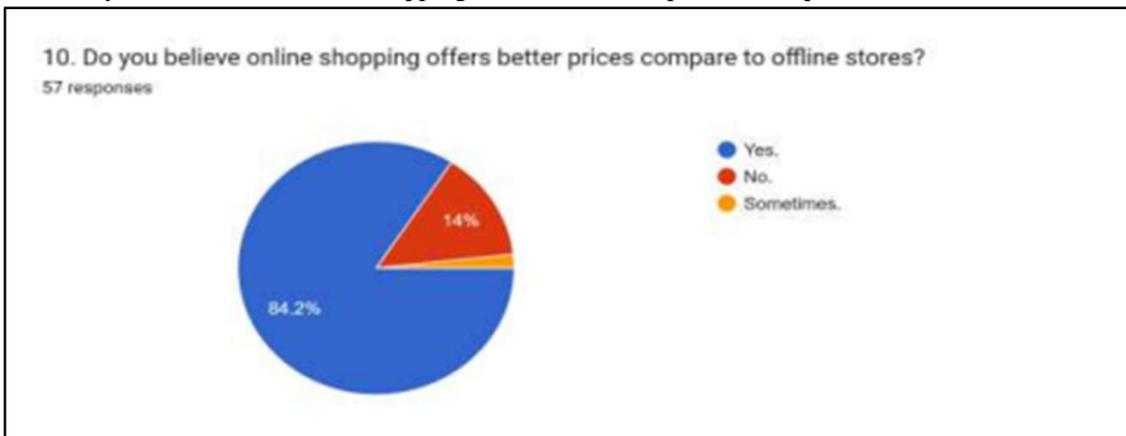
6. What types of products do you prefer buying online?



7. How satisfied are you with online shopping overall?



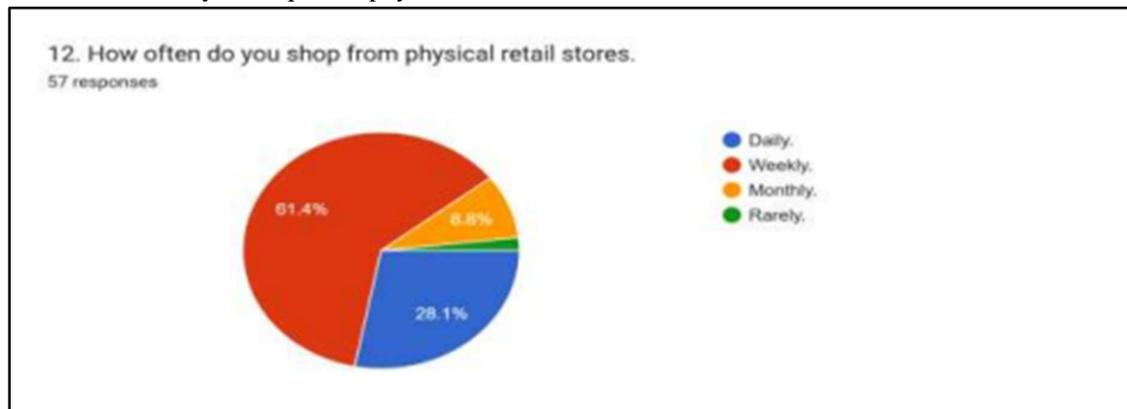
8. Do you believe online shopping offers better prices compare to offline stores?



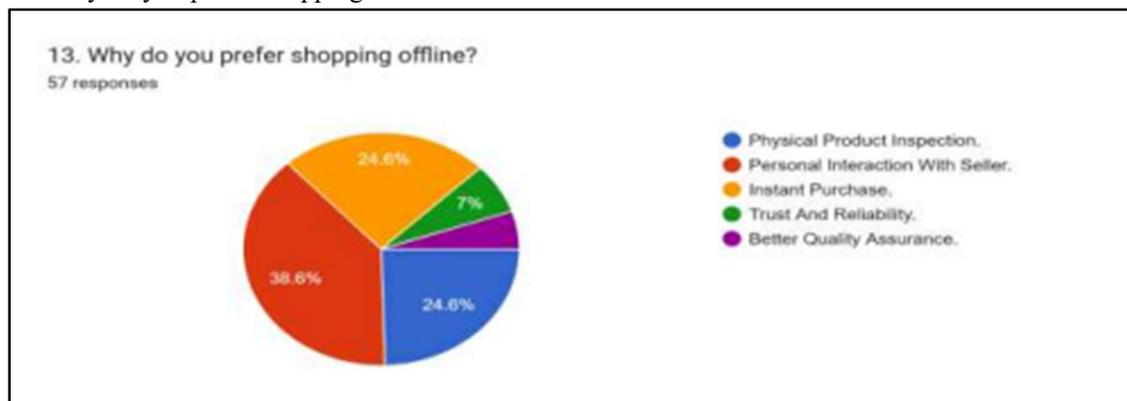
9. Have you faced issues with online shopping (wrong product late delivery, fraud, etc)?



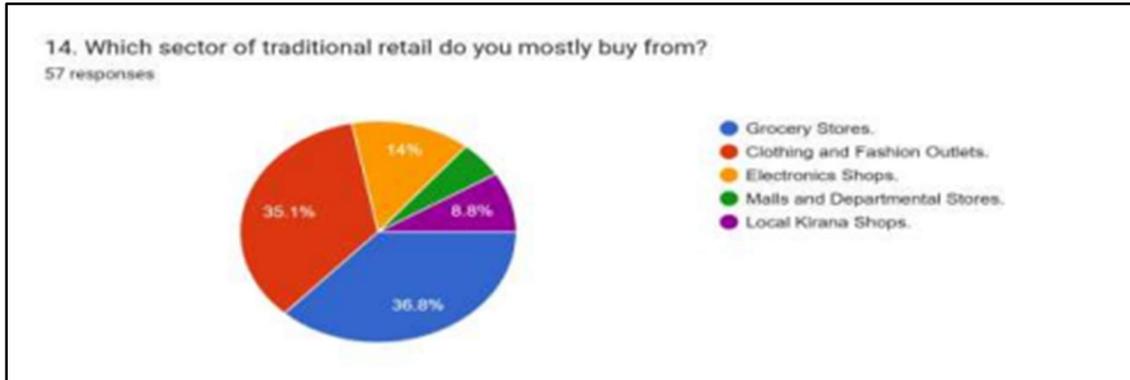
10. How often do you shop from physical retail stores?



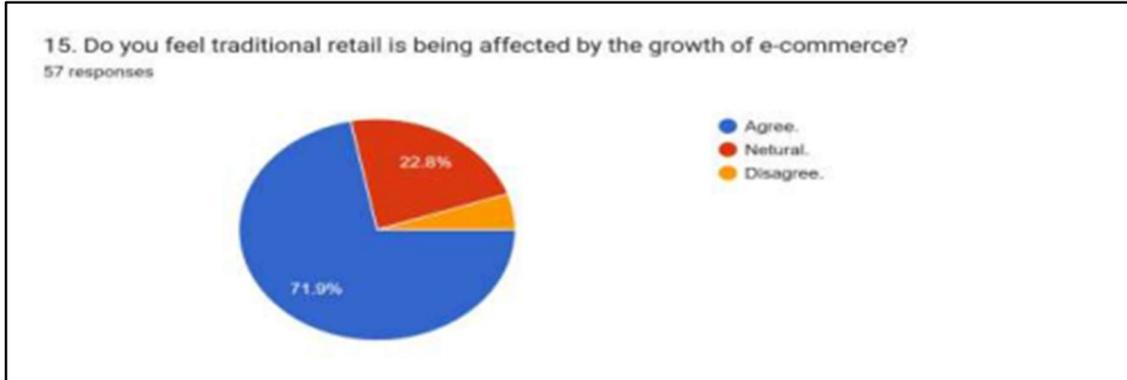
11. Why do you prefer shopping offline?



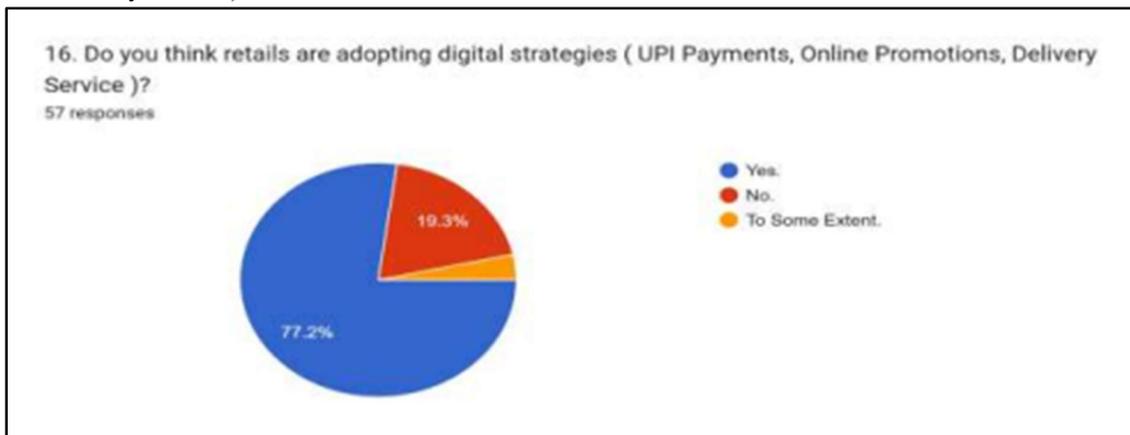
12. Which sector of traditional retail do you mostly buy from?



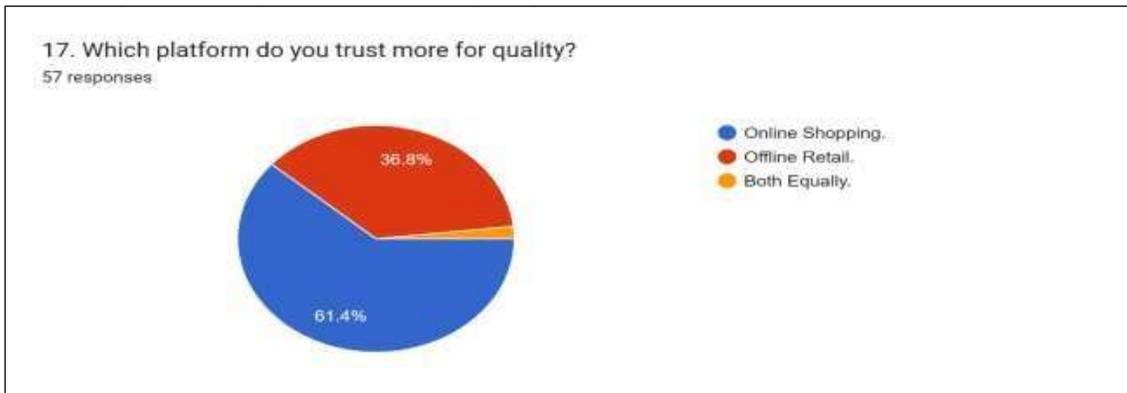
13. Do you feel traditional retail is being affected by the growth of e-commerce?



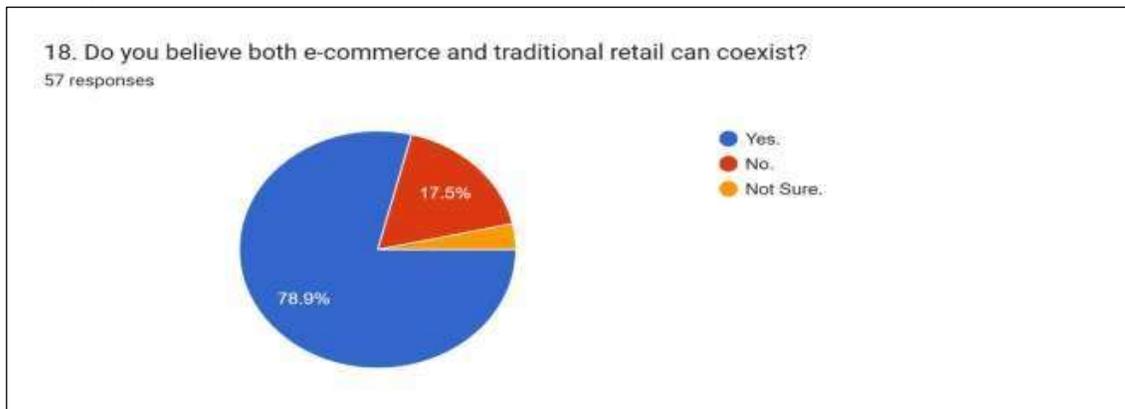
14. Do you think retails are adopting digital strategies (UPI Payments, Online Promotions, Delivery Service)?



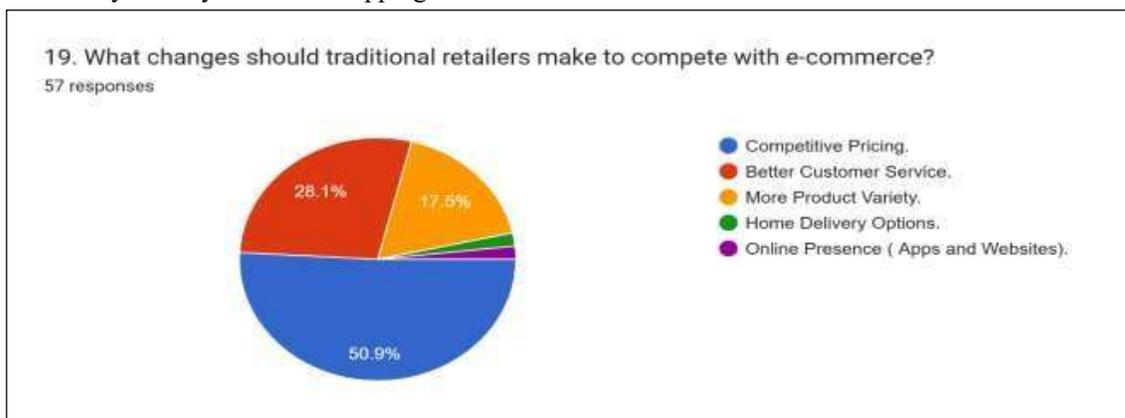
15. Which platform do you trust more for quality?



16. Do you believe both e-commerce and traditional retail can coexist?



17. What changes should traditional retailers make to compete with e-commerce? 18. In next 5 years, where do you see yourself in shopping more



Data Interpretation

The data collected from surveys and responses indicate that e-commerce has both positive and negative effects on traditional retail businesses.

Positive Findings:

- * Many respondents prefer online shopping due to convenience, wider variety, and competitive prices.
- * Traditional retailers who adopt online platforms or omnichannel strategies report improved sales.

Negative Findings:

- * Physical stores face reduced foot traffic and declining sales in some sectors.
- * Small retailers struggle to compete with large e-commerce platforms.

Interpretation:

Overall, e-commerce is reshaping traditional retail. While it poses challenges for physical stores, it also provides opportunities for growth if retailers adapt strategically. The results support the hypothesis that e-commerce has a significant effect on traditional retail business.

Findings

1. E-commerce increases convenience and wider reach.
2. Traditional retail faces reduced footfall and sales.
3. Price competition is higher online.
4. Consumer behavior is shifting toward online shopping.
5. Small retailers struggle to compete without digital presence.

Suggestions

1. Traditional retailers should adopt online channels.
2. Enhance in-store experience to attract customers.
3. Offer personalized services and loyalty programs.
4. Competitive pricing and promotions.
5. Invest in digital marketing and social media presence.

Conclusion

E-commerce has significantly transformed the retail landscape, offering convenience, wider product choices, and competitive pricing for consumers. Traditional retail businesses face challenges such as reduced foot traffic, increased competition, and pressure to adopt digital strategies.

However, these challenges also present opportunities for traditional retailers to innovate, integrate online and offline channels, and enhance customer experiences. Overall, while e-commerce has disrupted conventional retail, businesses that adapt strategically can coexist and thrive alongside digital platforms.

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(Please add full title and source details if available.)
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EMPLOYEE RETENTION STRATEGIES IN THE IT INDUSTRY

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Abstract

The IT industry faces an acute challenge in employee retention due to the high demand for specialized talent and the dynamic nature of the sector. This study investigates employee satisfaction, motivation, and the key factors influencing turnover in the IT industry, emphasizing the significance of holistic and employee-centric retention strategies. Using a descriptive research design, data were collected from 105 employees through structured questionnaires and supplemented with secondary data from books, journals, and online sources. The analysis revealed that monetary benefits (91.4%) are the strongest motivator, though non-monetary rewards and a respectful organizational culture also significantly impact job satisfaction. About 61% of respondents viewed their job tenure as limited to 6–12 months, reflecting short-term career orientation in the sector. While 69.5% felt respected and 66.7% received adequate training, dissatisfaction persists due to poor working conditions (37.1%) and managerial pressure (35.2%). Despite the presence of formal retention programs, nearly half of the employees perceive limited empowerment and communication barriers with superiors. HR perspectives confirm that better salary prospects (54.9%) remain the leading cause of turnover, particularly among new hires (74%). The study concludes that effective retention requires more than financial incentives; it demands a balanced strategy integrating career development, leadership empathy, and open communication. Strengthening these dimensions can enhance organizational commitment and ensure long-term stability in the IT workforce.

Keywords: Employee retention, IT industry, job satisfaction, motivation, turnover, organizational culture, HR strategy

Introduction

The high demand for specialized skills and the intensely competitive market have made employee

retention a critical challenge and a top strategic priority for the IT industry. High turnover leads to significant costs, including lost institutional knowledge, disrupted workflows, and increased recruitment and training expenses. Effective retention in the IT sector requires a holistic, employee-centric strategy that moves beyond competitive compensation to address the core motivators for tech professionals. By systematically addressing these areas—competitive compensation, robust career growth, and a positive, flexible, and empowering culture—IT organizations can significantly enhance employee engagement, reduce costly turnover, and secure the long-term stability and expertise necessary for sustained competitive advantage.

Objectives

1. To discover the various expectations of employees that determine satisfaction level with respect to the company.
2. To know the working structure of employees through the given tasks to them.
3. To study the employee's perception towards the organization
4. To study the attitude of the employees toward their Work.
5. To give suggestions for the growth & perspective of the company.

Review of literature

The Information Technology (IT) industry has emerged as one of the most dynamic sectors of the global economy, contributing significantly to employment generation and economic development. However, the sector also faces persistent challenges related to employee retention, job satisfaction, and motivation. The following review synthesizes key studies that have examined these dimensions.

Agarwal and Ferratt (2002) emphasized that IT professionals are distinct in their career expectations, valuing autonomy, challenging work, and opportunities for continuous learning. They argued that retention in the IT industry depends not only on compensation but also on organizational practices that foster creativity and recognition. Similarly, Dess and Shaw (2001) found that voluntary turnover among skilled employees adversely affects social capital and organizational performance, thereby highlighting the strategic importance of retention management.

Kumar and Arora (2012) examined determinants of employee retention in the Indian IT industry and found that job satisfaction, supportive leadership, and career advancement opportunities significantly influence employees' intention to stay. Their study suggested that financial incentives alone are insufficient unless complemented by non-monetary motivators such as a positive work culture and career growth pathways. This aligns with the findings of Singh and Jain (2013), who asserted that employee retention strategies must focus on emotional and professional well-being to ensure long-term organizational success.

Hausknecht, Rodda, and Howard (2009) differentiated between performance-based and job-related factors influencing employees' decisions to stay with an organization. They identified key retention drivers such as respect, recognition, and work-life balance, which often outweigh monetary rewards. Nair (2020) further supported this perspective, stating that the modern IT workforce seeks flexibility, empowerment, and psychological safety alongside competitive pay packages.

Varma and Jha (2019) highlighted that in India's IT sector, rapid technological evolution has intensified job stress and uncertainty, contributing to high attrition rates. Their study concluded that retention programs emphasizing training, career progression, and transparent communication yield better

employee engagement. Additionally, the Tata Consultancy Services (2023) report traced the historical evolution of India's IT industry, noting that the sector's growth since the 1980s has been accompanied by continuous shifts in workforce expectations, making adaptive HR policies crucial for sustaining talent.

Overall, the reviewed literature indicates that while compensation remains a fundamental factor, sustainable employee retention in the IT industry depends on a comprehensive approach that integrates career development, organizational culture, leadership support, communication effectiveness, and work-life balance. Addressing these multidimensional aspects can enhance employee satisfaction, reduce turnover, and strengthen organizational competitiveness in a volatile and skill-driven industry.

Research methodology

o Descriptive research

Descriptive research can be explained as a statement of affairs as they are at present with the researcher having no control over variables. Moreover, "descriptive studies may be characterized as simply the attempt to determine, describe or identify what is, while analytical research attempts to establish why it is that way or how it came to be. It is Random Research in which all the questionnaires are distributed among the customers who have visited/used this product or service, by ensuring that all the answered answers will be kept confidential. Through this type of Research, it made easy to analyze

o Research method:

Survey and Questionnaire

o Type of data:

The sources of data include both primary and secondary data

1. PRIMARY DATA: Primary data is collected with a specific objective, especially to address the research problem. The data is gathered by distributing a questionnaire to the employees of the above-mentioned company.

2. SECONDARY DATA: Books, Journal & Internet.

o Sample size:

The sample size taken for the study is 105.

o Sample Method:

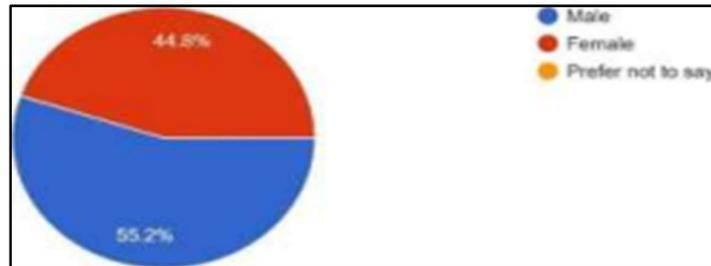
To obtain the representative sample, a non-probability sample can be drawn. In this study the method of selecting a sample is random i.e. it is non-probable. Non-probability sampling is a sampling technique where the samples are gathered in a process that does not give all the individuals in the population equal chances of being selected.

o Data Collection Method:

The tools used for analyzing data are rating method graphs, pie charts, etc. The questionnaire is distributed to the individual respondent and special care has been taken to make him/ her feel comfortable so that, he/she can answer all the questions. This method is followed to get unbiased answers.

Data Analysis and Interpretation

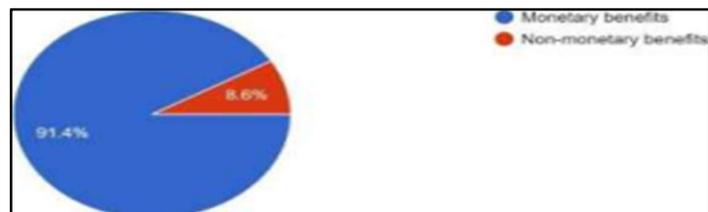
1. What is your gender?



Interpretation:

- 55.2% of the respondents are male.
- 44.8% of the respondents are female.

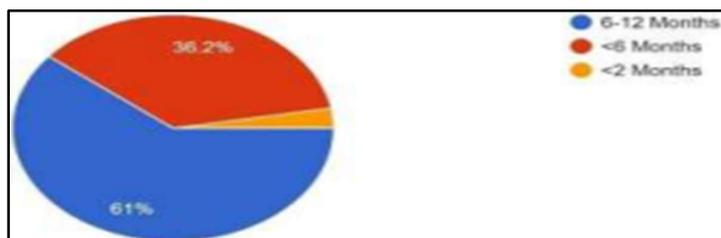
2. What do employees expect during promotions?



Interpretation:

- 91.4% of people get motivated by Monetary benefits.
- 8.6% of people get motivated by Non-Monetary benefits.

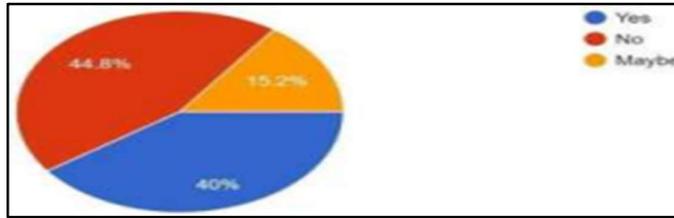
3. What is the maximum employment tenure in today's age?



Interpretation:

- 61% of people think the maximum employment tenure at present is 6-12 Months.
- 36.2% of people think the maximum employment tenure at present is <6 Months.
- 2.9% of people think the maximum employment tenure at present is <2 Months

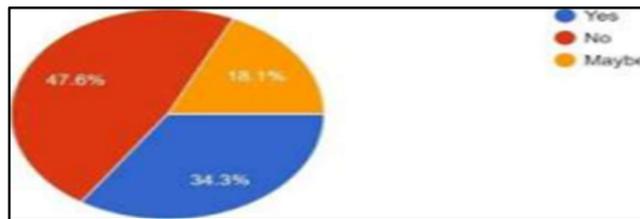
4. Does an exit interview change the decision of certain employees?



Interpretation:

- 40% of people think an exit interview changes the decision of employees.
- 44.8% of people think an exit interview does not change the decision of an employee.
- 15.2% of people think an exit interview probably changes the decision of an employee.

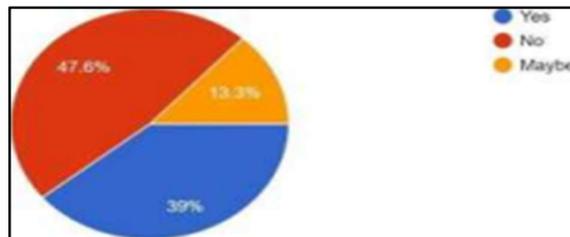
5. Would you leave your current job if you were offered a higher salary but a lower designation?



Interpretation:

- 34.3% of respondent will leave their current job if offered higher salary and lower designation.
- 47.6% of respondent will not leave the organization if offered higher salary and lower designation
- 18.1% of respondent are not clear about the decision of leaving the job for higher salary and lower designation.

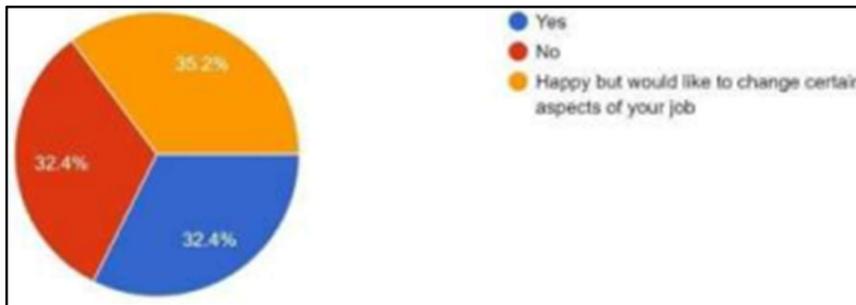
6. Would you leave your current job if you were offered a higher post but with the same current salary?



Interpretation:

- 39% respondents will leave the organization for higher designation and same salary.
- 47.6% respondents will not leave the organization for higher designation and same salary.
- 13.3% respondents may leave the organization for higher designation and same salary.

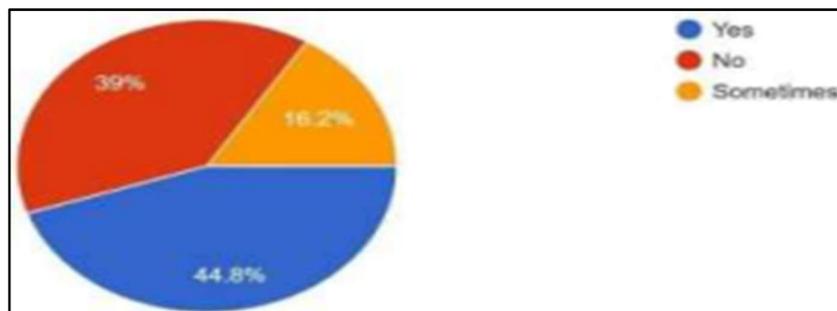
7. Are you happy with your job?



Interpretation:

- 32.4% of respondents are happy with their current job.
- 32.4% of respondents are not happy with their current job.
- 35.2% of respondents are happy but would like to change some aspects of their job.

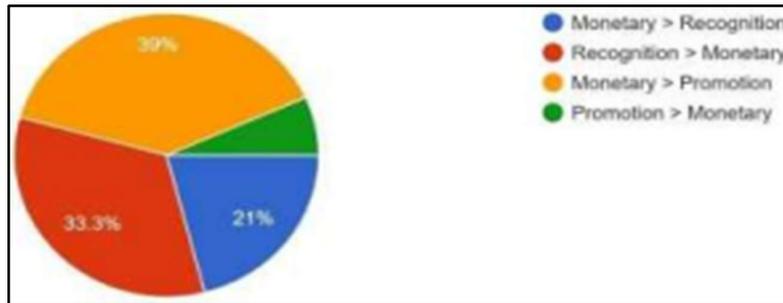
8. Does Your New Job Meets Your Expectations?



Interpretation:

- 44.8% of respondents new job do meets their expectations.
- 39% of respondents new job does not meet their expectations.
- 16.2% of respondents are not clear about their job expectation.

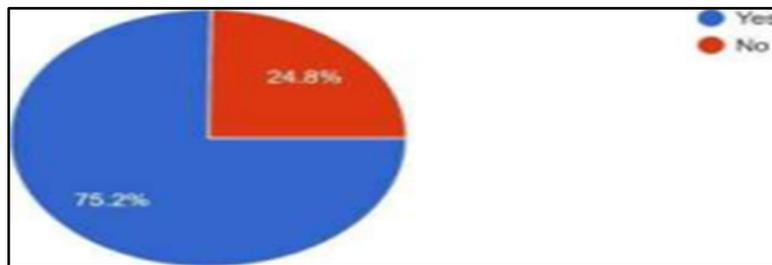
9. What is more preferred you as employee as reward?



Interpretation:

- 21% of people go with monetary over recognition.
- 33.3% of people go with recognition over monetary.
- .39% of people go with monetary over promotion.
- 6.7% of people go with promotion over monetary.

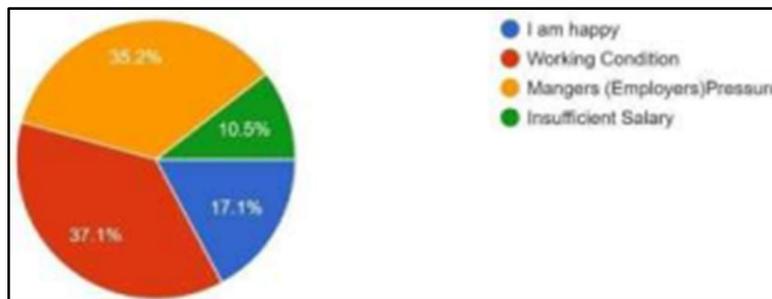
10. Do you maintain a work-life balance?



Interpretation:

- 75.2% people maintain work life balance.
- 24.8% people do not maintain work life balance.

11. If you are not happy with your job what could be the reason?



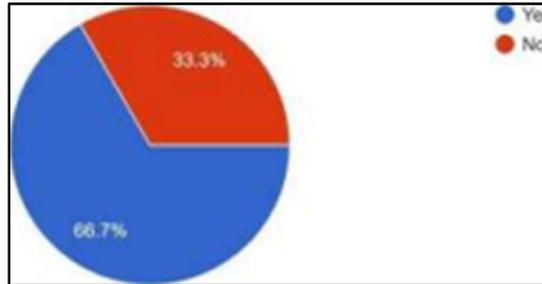
Interpretation:

- 17.1% respondents are happy with their job
- 37.1% respondents think working condition is the reason for not being happy with job.
- 35.2% respondents think managers pressure is the reason for not being

happy with job.

- 10.5% respondents think insufficient salary is the reason for not being happy with job.

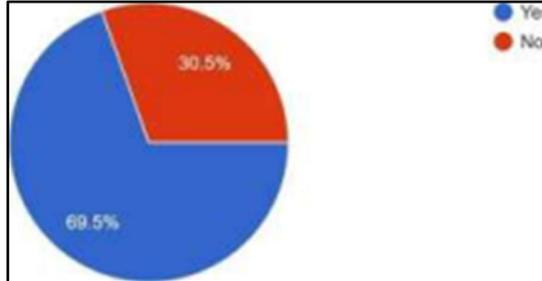
12. Did you have proper training for the job allotted?



Interpretation:

- 66.7% of respondents have got proper training for the job.
- 33.3% of respondents haven't got proper training for the job allotted.

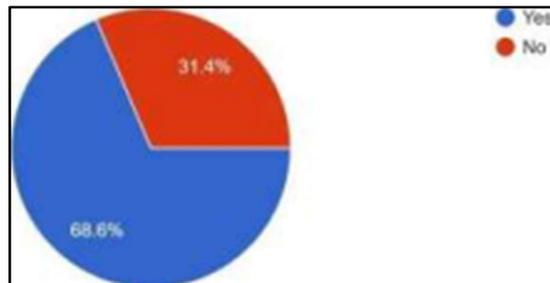
13. Does your current organisation treat you respectfully?



Interpretation:

- 69.5% people get respect in their organization.
- 30.5% people don't get respect in their organization.

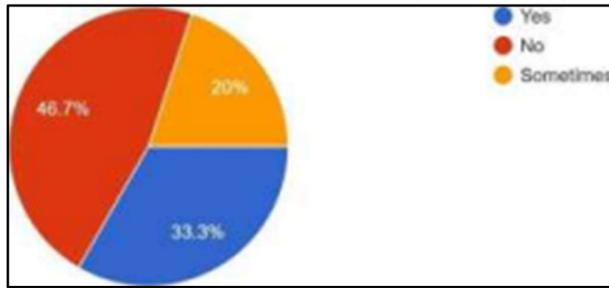
14. Do you think that the rewards you get are motivating to you?



Interpretation:

- 68.6% of peoples the reward they get motivates them.
- 31.4% of people the rewards they get doesn't motivates them

15. Are there barriers of communication while you speak to your superior?



Interpretation:

- 33.3% of respondents think that there is a communication gap between them and superiors.
- 46.7% of respondents think that there is no communication gap between them and superiors.
- 20% of respondents think that sometimes there is a communication gap between them and superiors

Conclusions and Recommendations

Employee Response Analysis

The employee survey provides critical insights into motivation, satisfaction, and factors contributing to short tenure.

A. Demographics and Tenure Perception

- The workforce sampled is almost evenly split, with **55.2% males** and **44.8% females**.
- A concerning **61%** of respondents believe the current **maximum desirable employment tenure is only 6-12 months**, signaling high perceived volatility and a short-term career mindset in the market.
- **Work-life balance is largely maintained**, with **75.2%** reporting success in this area.

B. Motivation and Rewards

- **Monetary benefits** are the single most significant motivator, cited by an overwhelming **91.4%** of people.
- The importance of financial reward is further underscored by **39%** who prioritize **monetary benefits over promotion**.
- **Non-monetary rewards** are also highly valued, motivating **68.6%** of employees.
- Nearly half (**47.6%**) are motivated when **management supports them** during difficult phases, highlighting the importance of empathy and stability.

C. Job Satisfaction and Organizational Culture

- The majority of employees feel respected (**69.5%**) and believe they received **proper training (66.7%)**.
- However, a significant group (**37.1%**) expresses **dissatisfaction due to the working conditions** of the organization.
- While most organizations have implemented formal retention programs (74.3% report having the "3Rs" – Respect, Recognition, Reward), **49.5%** of people feel they are **NOT provided opportunities to take over authority/responsibility**, pointing to a lack of empowerment.
- **Communication Gaps:** Only **46.7%** believe there is **no communication gap** with superiors, suggesting a majority perceive issues in upward or downward communication. • Organizational morale is perceived as merely **average** by **63.8%** of respondents.

D. Turnover and Job Trade-Offs

- Employees exhibit a strong sense of value for their current role: **47.6%** would **NOT leave** for either **higher salary with a lower designation** or **higher designation with the same salary**. This suggests stability exists when employees feel appropriately compensated *and* respected in their role.
- For those who do leave, only **47%** report their **new job meets their expectations**, indicating the grass is often not greener.
- The vast majority of employees view **exit interviews** as ineffective for retention, with **44.8%** believing they **do not change the employee's decision to leave**.

II. Human Resources (HR) Response Analysis

The HR data largely corroborates the employee findings, particularly regarding the dominant driver of turnover.

- **Primary Turnover Reason:** HR staff confirms that the leading cause of turnover is seeking "**Better Salary**," cited by **54.9%** of candidates upon departure.
- **New Hire Turnover:** There is a high concentration of turnover among new recruits, with **74%** of HR respondents reporting that **newly joined employees leave the organization**. • **Retention Efficacy:** A slight majority (**56%**) of HR staff believe their current **retention strategies work efficiently**.
- **Exit Interview Value (HR View):** Unlike employees, **54%** of HR staff believe exit interviews **successfully reveal the reason for quitting**, framing them as a valuable diagnostic tool.
- **Technology Impact:** HR overwhelmingly discounts new technology as a cause of attrition, with **44%** **strongly disagreeing** that it drives employee turnover.

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Effect of Influencer Marketing in Attracting Young Customers

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Abstract

In the digital era, influencer marketing has emerged as one of the most powerful strategies for brands to engage with young consumers. This study explores the impact of social media influencers on the purchasing decisions, brand perception, and engagement patterns of young customers aged 18–30 years. Using a descriptive and quantitative research design, primary data were collected from 51 respondents through an online survey distributed via social media platforms such as Instagram, YouTube, and TikTok. The findings reveal that 84.3% of respondents follow influencers, and 92.2% have purchased a product or service based on influencer recommendations, demonstrating the strong persuasive power of influencer marketing. The study also highlights that credibility, authenticity, and relatable content are key factors influencing consumer trust. Product reviews, unboxing videos, and lifestyle content were found to be the most effective content formats in driving purchase intentions. Moreover, 51% of respondents spend 3–5 hours daily on social media, reinforcing the centrality of digital interaction in shaping consumer behavior. Despite its effectiveness, the study identifies challenges such as excessive advertising and perceived lack of authenticity, which can reduce influencer credibility. The results suggest that influencer marketing significantly enhances brand awareness, engagement, and customer loyalty when executed with authenticity and alignment between influencer values and brand identity. The study concludes that influencer marketing is not merely a promotional tactic but a long-term strategic approach for building trust and brand loyalty among young consumers.

Keywords: Influencer marketing, social media, brand perception, young consumers, purchase intention, authenticity, digital marketing

Introduction

In the modern digital age, marketing strategies have evolved beyond traditional advertising methods, with social media becoming a powerful platform for brand promotion and consumer engagement. Among these new strategies, influencer marketing has gained significant importance as a highly

effective tool for connecting with audiences especially the younger generation. Influencers, who are individuals with a strong online presence and credibility, play a crucial role in shaping opinions, trends, and purchasing decisions through their content and recommendations. Young customers are particularly influenced by social media personalities as they perceive them to be more relatable and trustworthy compared to traditional celebrities or advertisements. As a result, brands are increasingly collaborating with influencers to promote their products and services in a more authentic and engaging manner.

This research aims to explore the effectiveness of influencer marketing in attracting young customers, focusing on how influencers impact their buying behavior, brand perception, and decision-making process. By understanding these dynamics, businesses can design more targeted and impactful marketing strategies that resonate with the younger audience and build long-term brand loyalty.

Objectives

- To examine the impact of influencer marketing on the purchasing decisions of young customers.
- To analyze how influencer credibility, authenticity, and content quality influence brand perception among young consumers.
- To identify the key factors that make influencer marketing effective in attracting and engaging young audiences.
- To compare the effectiveness of influencer marketing with traditional marketing methods in influencing young customers.
- To study the role of social media platforms in enhancing the reach and effectiveness of influencer campaigns.
- To provide insights and recommendations for businesses to design successful influencer marketing strategies targeting young customers.

Review of literature

Influencer marketing has quickly become a dominant promotional strategy for reaching younger cohorts (Gen Z and younger Millennials). Researchers and industry reports agree that influencers can shape attitudes, increase brand awareness, and raise purchase intention among young consumers, but the strength and mechanisms of these effects vary by influencer type, platform, perceived authenticity, and the social/ethical context.

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Research methodology

Research Design

This research follows a **descriptive and quantitative research design** to examine the impact of influencer marketing on attracting young customers. The descriptive approach helps in understanding how social media influencers affect consumer behavior, purchasing decisions, and brand perception among young audiences. A quantitative approach is adopted to collect numerical data that can be analyzed statistically to identify patterns and correlations

Research Approach

The study employs a **survey-based approach** to gather primary data directly from young consumers who actively use social media platforms such as Instagram, YouTube, and TikTok. This approach allows for collecting first-hand insights into their perceptions, preferences, and behaviors related to influencer marketing campaigns

Population and Sample

The target population for this study includes **young customers aged 18–30 years** who are active users of social media platforms such as Instagram, YouTube, and TikTok. A **sample size of 50 respondents** will be selected using a **convenience sampling method**, focusing on individuals from urban areas who frequently engage with influencer content.

Data Collection Methods

□ **Primary Data:**

Data is collected through a **structured online questionnaire** distributed via email and social media platforms (e.g., Instagram, WhatsApp, and Google Forms). The questionnaire includes closed-ended questions and Likert-scale statements designed to measure factors such as:

- Frequency of following influencers
- Trust and credibility perceptions
- Influence on purchasing decisions
- Engagement with sponsored content

□ **Secondary Data:**

Secondary information is collected from **academic journals, articles, research papers, marketing reports, and industry publications** to support and compare the primary findings. These sources help in building the theoretical foundation and understanding previous research outcomes.

Research Instrument

The questionnaire is divided into three main sections:

- **Section A:** Demographic details of respondents (age, gender, education, etc.)
- **Section B:** Social media usage patterns and exposure to influencer marketing
- **Section C:** Impact of influencer marketing on purchase decisions and brand perception

Data Analysis Techniques

The collected data will be analyzed using **descriptive statistics** (mean, percentage, frequency) and **inferential statistics** (chi-square test, correlation analysis) to determine the relationship between influencer marketing and the purchasing decisions of young consumers. Statistical tools such as **SPSS** or **Microsoft Excel** will be used for data analysis

Hypothesis

Null Hypothesis (H0):

Influencer marketing has no significant effect on brand awareness, engagement, or sales conversion among young customers. Any observed changes are due to chance.

Alternative Hypothesis (H1):

Influencer marketing has a significant effect on brand awareness, engagement, or sales conversion among young customers.

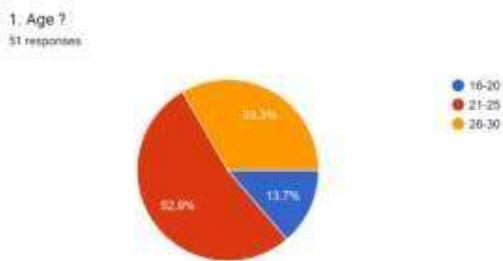
Negative Hypothesis:

Influencer marketing will lead to a decrease in brand awareness, engagement, or sales conversion among young customers. This might happen if the influencer's audience doesn't align with the brand or if the sponsored content is perceived as inauthentic.

Positive Hypothesis:

Influencer marketing will lead to an increase in brand awareness, engagement, and sales conversion among young customers. This is the expected outcome, assuming the influencer and content are well-matched to the target audience.

Data Analysis and Interpretation

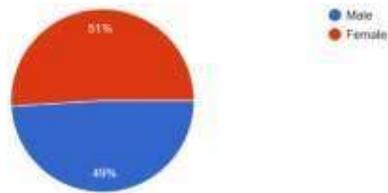


The pie chart represents the age distribution of 51 respondents. It is divided into three age groups: 16–20 years, 21–25 years, and 26–30 years.

16–20 years: 13.7% of respondents belong to this age group.

21–25 years: This is the largest group, comprising 52.9% of the total respondents. 26–30 years: The remaining 33.3% fall within this age bracket

2. Gender ?
51 responses



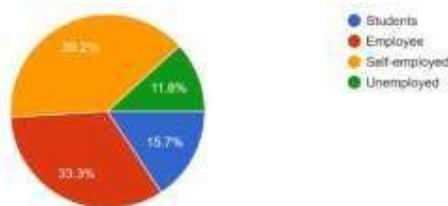
Based on the pie chart provided, here is the data interpretation for the question: "Gender?" (based on 51 responses).

The gender distribution of the 51 respondents is nearly equally split between Female and Male.

Female 51%

Male 49%

3. Occupation ?
51 responses



The chart illustrates the breakdown of occupations among the 51 respondents:

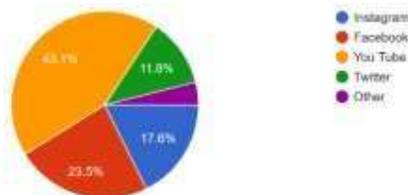
Self-employed (Brown): This is the largest category, accounting for 39.2% of the respondents.

Employee (Red): This is the second-largest group, making up 33.3% of the respondents.

Students (Blue): Students represent 15.7% of the total responses.

Unemployed (Green): This is the smallest category shown, at 11.8% of the respondents.

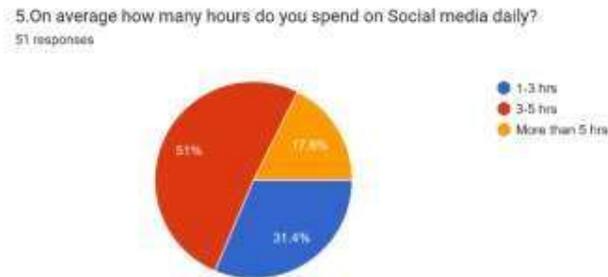
4. What Social media platforms do you use most frequently?
51 responses



Based on the pie chart provided, here is the data interpretation for the question: "What Social media platforms do you use most frequently?" (based on 51 responses).

The most frequently used social media platform by the respondents is YouTube, followed by Facebook and Instagram.

Social Media Platform	Percentage of Responses
You Tube	43.1%
Facebook	23.5%
Instagram	17.6%
Twitter	11.8%
Other	3.9%



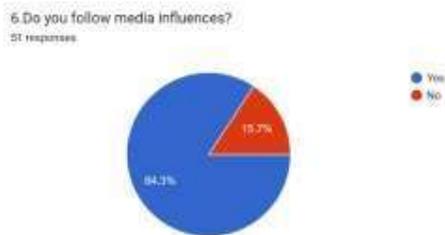
Based on the pie chart provided, here is the data interpretation for the question: "On average how many hours do you spend on Social media daily?" (based on 51 responses).

The majority of respondents (51%) spend between 3 to 5 hours on social media daily, indicating that the audience is highly engaged and spends a significant amount of time on these platforms.

3-5 hrs 51.0%

1-3 hrs 31.4%

More than 5 hrs 17.6%



The survey collected 51 responses. The results, presented in the pie chart, show a strong majority of respondents follow media influences

Yes 84.3%

No 15.7%

High Followership: The vast majority of participants (84.3%) indicated that they do follow media influences.

Low Non-Followership: Only a small minority of participants (15.7%) indicated that they do not follow media influences.

7. What motivate you to follow an Influencer
51 responses

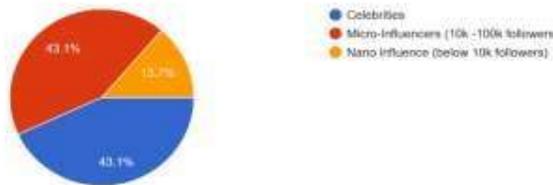


The survey collected 51 responses. The results show the motivations for following an influencer, categorized into three main areas. Knowledge/Expertise 37.3%

Life Style Inspiration 31.4%

Entertainment 31.4%

8. Which type of Influencer do you follow the most?
51 responses



Based on the pie chart, here is the data interpretation for the question: "Which type of Influencer do you follow the most?"

The survey gathered 51 responses.

The two most popular types of influencers followed are Celebrities and Micro-Influencers, each accounting for the largest share of responses.

- Celebrities (Blue): 43.1% of the respondents follow celebrities the most.
- Micro-Influencers (10k-100k followers) (Red-Orange): 43.1% of the respondents follow micro-influencers the most.
- Nano-Influencers (below 10k followers) (Orange): 13.7% of the respondents follow nano-influencers the most.

9. Have you ever purchased a product/service because it was recommended by an influencer?
51 responses



The chart diagram "Have you ever purchased a product/service because it was recommended by an Influencer?"

Yes 92.2%

No 7.8%

High Influence: A vast majority of the respondents (92.2%) reported that they have, at some point, purchased a product or service based on an influencer's recommendation.

Low Non-Conversion: Only a small minority (7.8%) indicated they have not made a purchase due to an influencer's recommendation. This suggests that influencers are highly effective in driving purchase decisions among this group of respondents.

10. Which products categories are most influenced to buy through influencer Marketing?
51 responses



Based on the pie chart provided, here is the data interpretation for the question: "Which product categories are most influenced to buy through Influencer Marketing?" (based on 51 responses).

The data shows that Fashion and apparel is the product category most influenced by influencer marketing, followed by a tie between Technology and Gadgets and Food and beverages.

Fashion and apparel 35.3%

Technology and Gadgets 27.5%

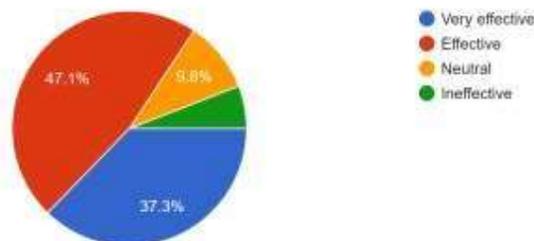
Food and beverages 27.5%

Travel and lifestyle 9.8%

Based on the pie chart provided, here is the data interpretation for the question: "How effective is influencer marketing in encouraging young customers to purchase products?" (based on 51 responses)

The data overwhelmingly suggests that influencer marketing is effective or very effective in encouraging young customers to purchase products, accounting for a combined total of 84.4% of the responses Very effective 37.3%

11. How effective is influencer marketing in encouraging young Customers to purchase product?
51 responses



Effective 47.1%

Neutral 9.8%

Ineffective 5.9%

12. What factors you ignore influencer Promotion?
51 responses



12. Based on the pie chart provided, here is the data interpretation for the question: "What factors you ignore influencer Promotion?" (based on 51 responses).

The primary factor causing respondents to ignore influencer promotions is the presence of "Too many ads," followed by a "Lack of authenticity"

Too many ads 54.9%

Lack of authenticity 33.3%

Repetition of content 11.8%

13. How do you usually check recommendation is genuine of influencer ?
51 responses



.Based on the pie chart provided, here is the data interpretation for the question: "How do you usually check recommendation is genuine of influencer?" (based on 51 responses).

The two most common methods for checking the genuineness of an influencer's recommendation are checking if the influencer has used the product multiple times and looking at product reviews from other customers.

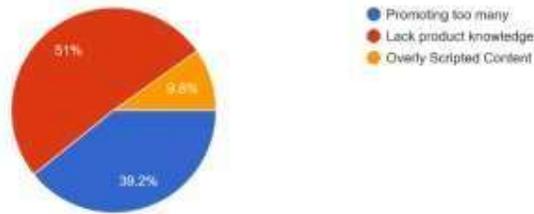
Checking if the Influencer has used the product multiple times 45.1%

Looking at product review from other Customer 39.2%

Comparing with other influencer's recommendations 15.7%

14. Which factor reduce you trust in an Influencer the most?

51 responses



14. Based on the pie chart provided, here is the data interpretation for the question: "Which factor reduce you trust in an Influencer the most?" (based on 51 responses).

The single most significant factor that reduces trust in an influencer is a "Lack product knowledge," followed closely by "Promoting too many" products.

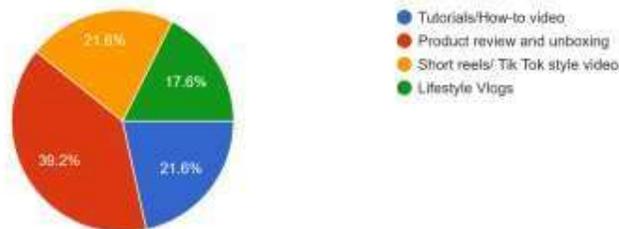
Lack product knowledge 51.0%

Promoting too many 39.2%

Overly Scripted Content 9.8%

15. Which type of influencer Content do you prefer when deciding to purchase?

51 responses



Based on the pie chart provided, here is the data interpretation for the question: "Which type of Influencer Content do you prefer when deciding to purchase?" (based on 51 responses).

The most preferred type of influencer content when making a purchase decision is Product review and unboxing, followed by a tie between Tutorials/How-to video and Short reels/Tik Tok style video.

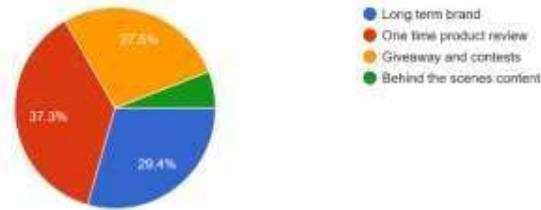
Product review and unboxing 39.2%

Tutorials/How-to video 21.6%

Short reels/Tik Tok style video 21.6%

Lifestyle Vlogs 17.6%

16. what kind of influencer collaboration appears most authentic to you?
51 responses

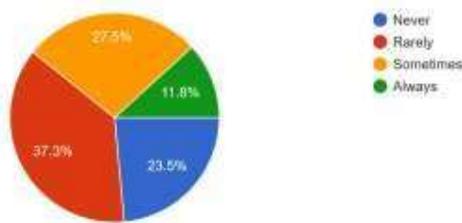


Based on the pie chart provided, here is the data interpretation for the question: "What kind of influencer collaboration appears most authentic to you?" (based on 51 responses)

The type of collaboration considered most authentic is a One time product review, followed closely by a Long term brand partnership.

One time product review	37.3%
Long term brand	29.4%
Giveaway and contests	27.5%
Behind the scenes content	5.9%

17. How often do you interact (like /comment/shere) with influencer Content?
51 responses



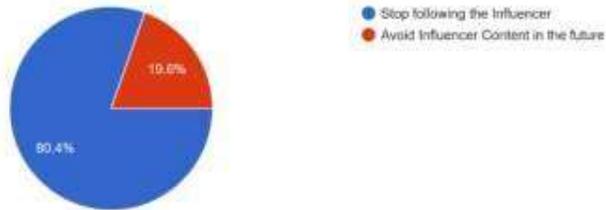
Based on the pie chart provided, here is the data interpretation for the question: "What kind of influencer collaboration appears most authentic to you?" (based on 51 responses).

The type of collaboration considered most authentic is a One time product review, followed closely by a Long term brand

One time product review	37.3%
Long term brand	29.4%
Giveaway and contests	27.5%
Behind the scenes content	5.9%

18. If an Influencer recommendation disappoints you what action are you most likely to?

51 responses



Based on the pie chart provided, here is the data interpretation for the question: "If an Influencer recommendation disappoints you what action are you most likely to?" (based on 51 responses).

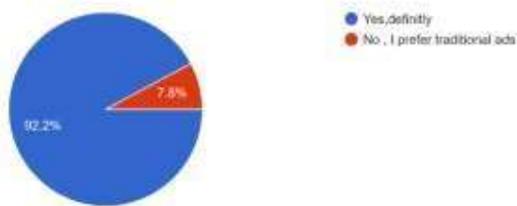
The overwhelming majority of respondents are most likely to Stop following the Influencer if a recommendation disappoints them.

Stop following the Influencer 80.4%

Avoid Influencer Content in the future 19.6%

19. would you like purchase influencer brand to collaborate more with in the future?

51 responses



Based on the pie chart provided, here is the data interpretation for the question: "Would you like purchase influencer brand to collaborate more with in the future?" (The question phrasing appears to mean: "Would you like to purchase from brands that collaborate more with influencers in the future?"). (based on 51 responses).

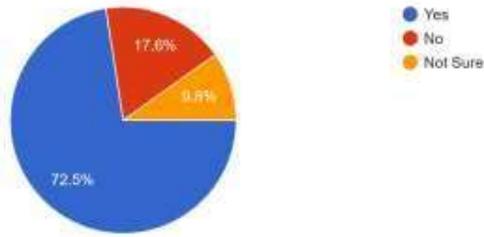
There is an overwhelming preference for brands to collaborate more with influencers in the future.

Yes, definitely 92.2%

No, I prefer traditional ads 7.8%

20. Do you believe AI-generated or virtual influencers (digital avatar) will be as effective as real Influencers?

51 responses



Based on the pie chart provided, here is the data interpretation for the question: "Do you believe AI-generated or virtual influencers (digital avatar) will be as effective as real Influencers?" (based on 51 responses).

The majority of respondents believe that AI-generated or virtual influencers will be as effective as real influencers.

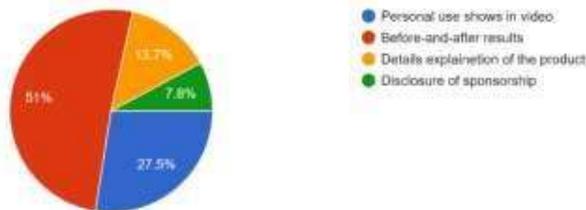
Yes 72.5%

No 17.6%

Not Sure 9.8%

21. Which factor increases your trust in influencer-promoted products?

51 responses



Based on the pie chart provided, here is the data interpretation for the question: "Which factor increases your trust in influencer-promoted products?" (based on 51 responses).

The most significant factor that increases trust in influencer-promoted products is the display of Before-and-after results, followed by Personal use shows in video.

Before-and-after results 51.0%

Personal use shows in video 27.5%

Details explanation of the product 13.7%

Disclosure of sponsorship 7.8%

Conclusions and Recommendations

The study concludes that influencer marketing has a significant and positive impact on attracting young customers. Social media influencers play a crucial role in shaping young consumers' attitudes, purchase intentions, and brand perceptions. Their authenticity, relatability, and engagement with followers create a sense of trust that traditional advertising often lacks. Young customers tend to rely more on influencers' recommendations when making purchasing decisions, as they perceive influencers as credible and trend-conscious sources.

Moreover, the findings highlight that influencer marketing is most effective when the influencer's values align with the brand's image and when the content is genuine and interactive.

Platforms such as Instagram, YouTube, and TikTok have become powerful channels for reaching young audiences, emphasizing the growing importance of digital presence for brands.

In conclusion, influencer marketing is not just a passing trend but a strategic tool for businesses to connect with young customers in an authentic and engaging way. Companies that invest in well-targeted influencer collaborations are likely to enhance brand awareness, loyalty, and customer engagement among the youth segment.

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CHANGING TRENDS IN CONSUMER BEHAVIOUR DUE TO E-COMMERCE GROWTH

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Abstract:

The rapid growth of e-commerce has significantly transformed consumer behaviour across the globe. With the increasing penetration of the internet, smartphones, and digital payment systems, consumers are shifting from traditional in-store shopping to online platforms. This shift is not only changing how consumers shop, but also what they expect in terms of convenience, personalization, product variety, and service quality. This paper explores the evolving patterns in consumer purchasing behaviour driven by the rise of e-commerce, including factors such as price sensitivity, preference for online reviews, digital trust, and the role of social media in influencing buying decisions. It also examines the implications of these trends for businesses seeking to adapt in a competitive digital marketplace. Understanding these changing dynamics is essential for marketers, retailers, and policymakers to effectively cater to the modern consumer.

Keywords:

E-commerce, Consumer behaviour, Online shopping, Digital transformation, Personalization, Mobile commerce, Social media influence, Digital marketing, Consumer trust.

INTRODUCTION:

The digital revolution has brought about profound changes in the way consumers interact with markets, products, and brands. E-commerce, which once served as a complementary channel to traditional retail, has now become a dominant force shaping consumer decisions and shopping habits. Enabled by advancements in technology and digital infrastructure, the modern consumer enjoys unprecedented access to information, a wider variety of products, and the convenience of shopping anytime and anywhere.

This transformation is particularly evident in the shift in consumer behaviour — from browsing habits and purchasing triggers to post-purchase engagement. The rise of platforms such as Amazon, Flipkart, Alibaba, and others has redefined expectations regarding speed, personalization, price transparency, and product accessibility. Furthermore, factors such as social media influence, mobile commerce, and user-generated content have become critical in shaping perceptions and driving purchase decisions.

As businesses adapt to this changing landscape, it is crucial to understand the underlying trends driving consumer behaviour in the digital age. This paper aims to analyze the various dimensions of this

behavioural shift and explore how e-commerce is redefining the consumer journey from awareness to post-purchase evaluation.

LITERATURE REVIEW:

According to Kotler and Armstrong (2013), consumers are becoming increasingly sophisticated in their use of digital channels to research products and make purchases. They emphasize the importance of understanding consumer behaviour and tailoring e-commerce strategies to meet the needs and preferences of different customer segments.

Dholakia and Zhao (2010) suggest that consumers' online buying behaviour is influenced by a range of factors, including product type, website design, price, and trust. They argue that ecommerce companies need to focus on building trust and credibility with customers through strategies such as clear product information, secure payment systems, and user reviews.

Lee and Turban (2001) highlight the role of perceived risk in consumers' online buying behaviour, suggesting that consumers are more likely to make purchases when they feel that the risks of doing so are low. They recommend that e-commerce companies provide assurances of product quality and offer guarantees and return policies to reduce consumer risk perceptions.

Brynjolfsson and Smith (2000) suggest that e-commerce can lead to increased competition and price transparency, which can benefit consumers by enabling them to find the best deals. However, they also note that e-commerce can create winner-takes-all markets in which a few dominant companies capture the majority of the market share.

OBJECTIVE:

- To Study the factors that influence consumer buying decisions
- To understand consumer behaviour differences across age groups
- To examine the impact of digital platforms on consumer behaviour • To identify the role of social media in shaping consumer choices

HYPOTHESIS:

1. Null Hypothesis (H₀):

There is no significant change in consumer behavior due to the growth of e-commerce.

This assumes that the rise of e-commerce has not led to any substantial shift in how consumers behave or make purchasing decisions.

2. Alternative Hypothesis (H₁):

There is a significant change in consumer behavior due to the growth of e-commerce.

This suggests that e-commerce growth has impacted consumer behavior in a measurable way, such as changes in purchasing frequency, brand loyalty, or preference for online vs. offline shopping.

3. Positive Hypothesis:

The growth of e-commerce has positively influenced consumer behavior by increasing convenience, product accessibility, and purchasing frequency.

This highlights beneficial changes, such as:

- Consumers shopping more frequently due to ease of access.
- Greater product variety leading to increased satisfaction.
- Improved user experience influencing more purchases.

4. Negative Hypothesis:

The growth of e-commerce has negatively influenced consumer behavior by reducing brand loyalty, increasing impulsive buying, and decreasing in-store shopping experiences.

This focuses on adverse impacts, such as:

- Consumers switching brands easily due to online options.

- Increase in impulsive purchases due to constant digital promotions.
- Decline in traditional retail experiences.

METHODOLOGY:

1. Research Design:

This study will use a mixed-method approach combining both quantitative and qualitative research methods to gain a comprehensive understanding of changing consumer behavior due to ecommerce growth.

Quantitative: To analyze trends, frequencies, and statistical relationships.

Qualitative: To explore motivations, perceptions, and attitudes behind consumer behavior.

2. Data Collection Methods:

a) Primary Data Collection:

- Surveys: Structured questionnaires distributed online to consumers aged 18–60.
- Sample size: 100 respondents

b) Secondary Data Collection:

- Industry reports (e.g., Statista, McKinsey, Nielsen)
- Academic journals and publications
- E-commerce sales data (e.g., from Amazon, Flipkart, etc.)
- Google Trends or other consumer search behavior tools

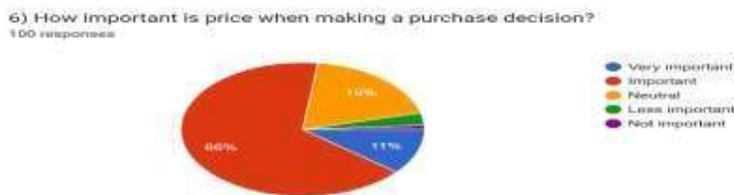
3. Sampling Technique:

- Stratified Random Sampling: To ensure a diverse group based on age, income, geography (urban vs rural), and digital literacy.
- Population: Online shoppers within the past 12 months.

4. Data Analysis:

- Quantitative data from surveys was analyzed using statistical tools such as Microsoft Excel and SPSS to identify patterns, correlations, and significant shifts in consumer behaviour.
- Qualitative data from interviews was analyzed through thematic analysis, enabling the identification of key recurring themes related to consumer sentiments, experiences, and expectations.

DATA ANALYSIS



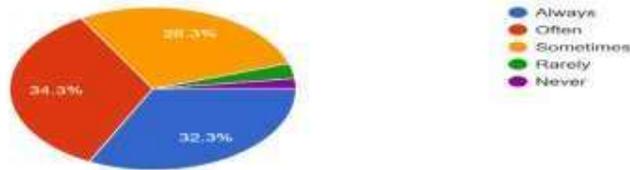
Price plays a significant role in purchase decisions, with 66% considering it important and 11% very important. Meanwhile, 19% are neutral, 3% see it as less important, and only 1% say it's not important.

7) To what extent does brand reputation influence your choice of a product ?
100 responses



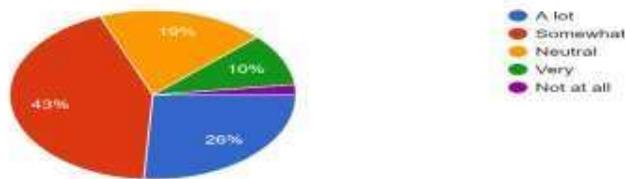
Brand reputation influences buying decisions the most at 54%, followed by social media/influencer reviews (18%), peer or family recommendations (12%), price (11%), and product quality (5%).sometimes, 3% rarely, and 2% never.

8) How often do you buy a product based on recommendation from family or friends?
99 responses



Recommendations from family or friends impact purchases frequently, with 34.3% buying often, 32.3% always, 28.3% sometimes, 3% rarely, and 2% never.

9) How much does advertising (TV, Social Media, Online ads) impact your buying decision ?
100 responses



Advertising impacts buying decisions to varying degrees: 43% say somewhat, 26% a lot, 10% very, 19% are neutral, and 2% not at all.

10) What is the most important factor for you when choosing between similar products ?
100 responses



When choosing between similar products, 54% prioritize quality, followed by brand (23%), price and availability (11% each), packaging (8%), and customer reviews (4%). 2% not at all.

11) Which of the following best describe how you prefer to shop ?
100 responses



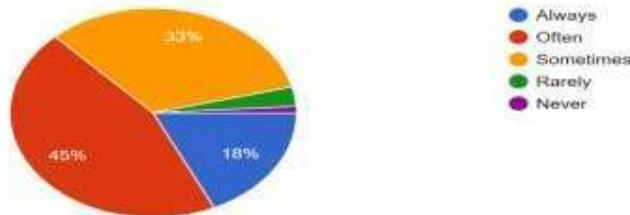
Shopping preferences vary, with 57% preferring both online and in-store equally, 21% mostly in-store, 17% online only, and 5% in-store only.

12) What influences your buying decision the most?
100 responses



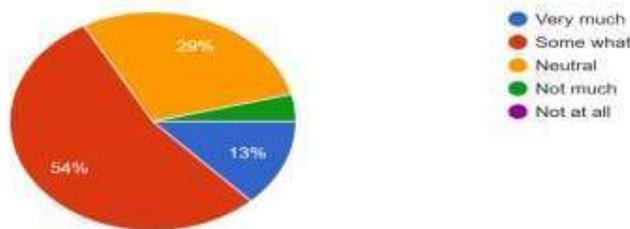
Brand reputation influences buying decisions the most at 54%, followed by social media/influencer reviews (18%), peer or family recommendations (12%), price (11%), and product quality (5%).

13) How often do you compare product or read reviews before making a purchase ?
100 responses



Before purchasing, 45% often compare products or read reviews, 18% always do, 33% sometimes, 3% rarely, and 1% never.

14) When choosing a new product , how much do you rely on technology (Mobile apps , online reviews, AI Suggestions ?
100 responses



When choosing a new product, 54% rely somewhat on technology, 13% very much, 29% are neutral, 4% not much, and 0% not at all.

15) What type of product do you tend to spend the most money on ?
100 responses



Most spending goes to fashion and accessories (53%), followed by health and wellness (21%), electronics/gadgets (17%), home and living (5%), and travel/experience (4%).

16) How often do you use digital platforms (E-commerce website, social media, mobile apps) to research products before buying ?
99 responses



Product research via digital platforms is common, with 49.5% using them often, 21.2% always, 27.3% sometimes, 2% rarely, and 0% never.

17) Which digital platform influence your buying decision the most ?
100 responses



Instagram and Facebook equally influence buying decisions the most at 39% each, followed by YouTube (18%) and brand websites (4%), with none at 0%.

18) How important are Online customer reviews when deciding to purchase a product ?
100 responses



Online customer reviews matter greatly, with 48% finding them very important, 31% extremely important, 17% moderately important, 4% slightly important, and 0% not important at all.

19) Have you ever purchase a product directly through a social media platform (via Instagram shop, Facebook market place) ?

100 responses



Purchasing through social media is common, with 49% doing so occasionally, 31% frequently, 18% tried once, 2% are open to it, and 0% have no intention.

20) What type of online content most influences your purchase decision ?

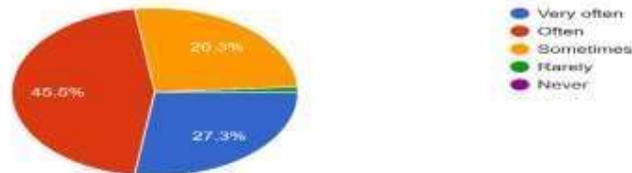
99 responses



User-generated content influences purchases most at 38.4%, followed by professional reviews (30.3%), influencer recommendations (25.3%), sponsored ads and product demo videos (3% each), and discounts or offers (0%).

21) How often do you discover new products or brands through social media ?

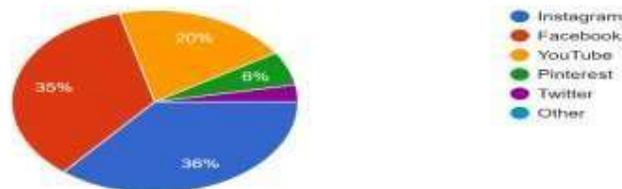
99 responses



New products or brands are discovered on social media often by 45.5%, very often by 27.3%, sometimes by 26.3%, rarely by 1%, and never by 0%.

22) Which social media platform influence your buying decisions the most ?

100 responses



Instagram influences buying decisions the most at 36%, followed closely by Facebook at 35%, then YouTube (20%), Pinterest (6%), Twitter (3%), and other platforms (0%).

23) What type of social media content most encourage you to consider purchasing a product ?
100 responses



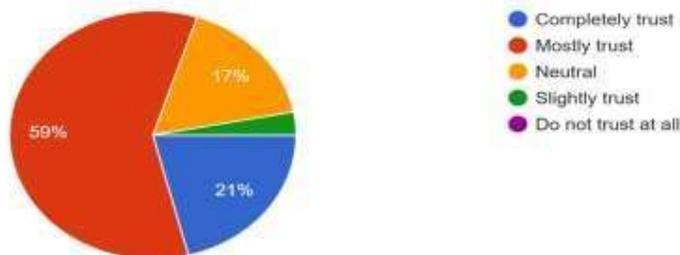
Sponsored ads encourage purchasing the most at 43%, followed by influencer endorsements (31%), brand posts or stories (17%), user-generated content (8%), and unboxing or how-to videos (1%).

24) Have you ever bought a product after seeing it on social media ?
100 responses



After seeing products on social media, 61% have bought a few times, 27% many times, 12% tried once, and 0% have either only considered or never done so.

25) To what extent do you trust product recommendations made by influences or content creators on social media ?
100 responses



Product recommendations by influencers are mostly trusted by 59%, completely trusted by 21%, 17% are neutral, 3% slightly trust them, and 0% do not trust at all.

CONCLUSION:

The growth of e-commerce has significantly reshaped consumer behaviour, with key factors such as price, convenience, product reviews, and fast delivery influencing buying decisions. Behavioural differences are evident across age groups, with younger consumers being more techsavvy and influenced by online trends, while older groups prioritize security and familiarity. Digital platforms have streamlined the shopping experience, offering personalization and ease of access, leading to higher expectations and less brand loyalty. Social media plays a crucial role in shaping consumer

choices, as users increasingly rely on influencers and peer reviews over traditional advertising. Overall, e-commerce has created a more dynamic, informed, and digitally driven consumer landscape.

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A STUDY ON DIGITAL PAYMENT SYSTEM AND THEIR INFLUENCE ON CONSUMER BEHAVIOR

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Abstract:

The rapid advancement of digital technologies has revolutionized the way consumers engage in financial transactions. Digital payment systems—ranging from mobile wallets and UPI (Unified Payments Interface) to contactless cards and e-banking—have increasingly replaced traditional cash-based transactions. This paper explores how these systems have influenced consumer behavior, focusing on aspects such as spending patterns, convenience, trust, and financial literacy. The study also examines how demographics, digital infrastructure, and government policies shape the adoption and usage of digital payment platforms. By analyzing both qualitative and quantitative data, this research highlights the psychological and practical shifts among consumers and provides insights into how businesses and policymakers can better cater to the evolving digital economy.

Key Words: Digital Payment Systems, Consumer Behavior, Mobile Wallets, Contactless Payments, UPI (Unified Payments Interface), E-banking, Fintech, Financial Inclusion, Transaction Security, Behavioral Economics.

INTRODUCTION:

In today's rapidly evolving digital economy, **digital payment systems** have become an integral part of everyday financial transactions. From mobile wallets and UPI (Unified Payments Interface) to online banking and contactless cards, these technologies have revolutionized how consumers pay for goods and services. The shift from traditional cash-based transactions to digital platforms is not just a technological advancement, but also a driver of **changing consumer behavior**.

Consumers are increasingly drawn to digital payment methods due to their **convenience, speed, security, and accessibility**. This transformation has influenced how people **shop, save, spend**, and even how they **choose brands**. As digital payments become more widespread, understanding their impact on consumer preferences, decision-making, and purchasing patterns is essential for businesses, policymakers, and financial institutions.

This study/topic aims to explore the growing adoption of digital payment systems and analyze their **influence on consumer behavior**, highlighting both the opportunities and challenges that arise in a digitally driven financial landscape.

LITERATURE REVIEW:

- 1] **Aparna J Varma:** Digital transactions are growing fast around the world, and India is no exception. Studies show that good payment systems improve the flow of money in an economy. This study looks at how consumers feel about online and digital payments, especially about safety. It is important for marketers to understand what people think about cashless transactions.
- 2] **Ravish Rana (Delhi School of Economics, University of Delhi):** In the last ten years, India has seen a big rise in internet and mobile phone use. Government programs like Digital India have helped digital payments grow quickly. This study examines how people's opinions affect their use of digital payments. A survey was conducted with 150 people in Delhi. The results showed that gender, age, job, and income did not affect how people feel about digital payments. But education made a big difference. Educated people were more likely to adopt digital payment system.
- 3] **Rakesh H M & Ramya T J (2014),** in their study analysed the factors that which was resulting in the adoption of internet banking in our country. It was found out that perceived reliability, Perceived ease of use and Perceived usefulness were the main reason for the adoption or usage of internet banking.
- 4] **Ravi (2017),** has examined that India's two third population are residing rural areas so they play a very important role in the development of the economy, with the emergence of IT and Communication it is predicted that rural areas will have 50% of India's Internet.

OBJECTIVE:

- To examine the influence of digital payment systems on consumer purchasing decisions.
- To analyze how the convenience of digital payments alters shopping frequency and behavior.
- To identify the key factors that drive consumers to adopt digital payment methods.
- To study the impact of digital payments on consumer spending habits.

HYPOTHESES:

1. Null Hypothesis (H₀):

> Digital payment systems have no significant influence on consumer behavior.

This assumes that the availability or usage of digital payments (e.g., UPI, credit/debit cards, mobile wallets) does not affect how consumers behave or make purchasing decisions.

2. Alternative Hypothesis (H₁):

> Digital payment systems have a significant influence on consumer behavior.

This suggests that digital payment methods impact consumer behavior—such as how often they purchase, what they buy, or their level of spending.

3. Positive Hypothesis:

> The adoption of digital payment systems positively influences consumer behavior by increasing convenience, transaction speed, and purchase frequency

This implies that consumers are more likely to make purchases due to ease of payment, leading to increased satisfaction and higher spending patterns.

4. Negative Hypothesis:

> The rise of digital payment systems negatively influences consumer behavior by encouraging impulsive buying and reducing financial control.

This focuses on downsides—such as:

Easier payments leading to overspending

Reduced awareness of cash flow

Security/privacy concerns altering behavior

METHODOLOGY:

1. Research Design:

The study will adopt a descriptive and analytical research design using a mixed-methods approach:

- **Quantitative:** To identify trends and measure the influence of digital payments on consumer behavior.
- **Qualitative:** To explore consumer perceptions, motivations, and concerns related to digital payments.

2. Data Collection Methods:

a) Primary Data Collection

- Online Surveys (Structured Questionnaire)
 - Distributed via email, social media, and messaging platforms.
 - Target sample size: 100 respondents
 - Target population: Consumers who have used digital payment
- Key areas of focus:
- Frequency of digital payment use
 - Preferred digital payment platforms (e.g., UPI, mobile wallets, cards)
 - Purchase habits before and after using digital payments
 - Impulse buying tendencies
 - Perceived benefits (convenience, speed) and drawbacks (security, overspending)

3. Secondary Data Collection

- Reports from RBI, NPCI, Statista, PwC, etc.
- Research papers on fintech and consumer psychology
- E-commerce and payment gateway statistics (Paytm, Razorpay, Google Pay usage data)
- Government digital economy publications

4. Sampling Technique:

- Non-probability sampling using purposive and convenience sampling methods.
- Focused on individuals with access to and experience using digital payment platforms.
- Includes users across age groups, income levels, and urban/rural locations (if possible).

5. Data Analysis Techniques:

a) Quantitative Analysis

- **Descriptive Statistics:** Mean, percentage, and frequency distribution
- **Inferential Statistics:** Chi-square test: To assess associations (e.g., age vs. digital payment usage)
- **T-tests / ANOVA:** To compare mean behavioral differences across groups
- **Regression Analysis:** To determine the impact of digital payment usage on frequency or amount of purchases
- **Hypothesis Testing: Based on significance level (e.g., $p < 0.05$)**

b) Qualitative Analysis

Thematic Analysis: To identify common themes from interviews (e.g., trust issues, convenience, privacy concerns)

6. Tools and Software:

- Survey tools: Google Forms, Microsoft Forms, or Typeform
- Statistical analysis: Excel, SPSS, or R

DATA ANALYTICS:

6) How often do you choose to shop at a store based on whether it accept digital payments
100 responses



The data shows that 57% of shoppers (8% always, 49% often) choose stores based on digital payment acceptance, 37% do so sometimes, 6% rarely, and 0% never. This highlights the growing importance of digital payment options in consumer decision-making.

7) Which of the following influences your decision to make a purchase using digital payment
100 responses



The data shows that ease of use (42%) is the top factor influencing digital payment use, followed by cashback or rewards (26%), speed of transaction (22%), and platform security (8%). Peer influence plays a minimal role at just 2%. This suggests convenience and incentives drive most digital payment decisions.

8) Does the availability of digital payment options increase the likelihood of you completing a purchase
100 responses



The data shows that 39% of respondents (4% strongly agree, 35% agree) feel that digital payment options increase their likelihood of completing a purchase, while 55% are neutral, and only 6% disagree

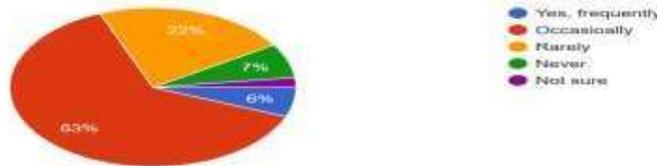
to some extent. This suggests digital payments have a positive, though not overwhelming, influence on purchase decisions.

9) Which payment method do you usually prefer when making quick purchasing decisions
100 responses



When making quick purchases, 29% of people prefer mobile wallets, followed by cash (26%) and UPI bank transfers (25%). Credit/debit cards are chosen by 19%, while buy now, pay later (BNPL) is the least preferred at 1%. This shows a strong preference for fast, digital payment options, with mobile wallets leading.

10) Has digital payment availability led you to switch brands or retailers
100 responses



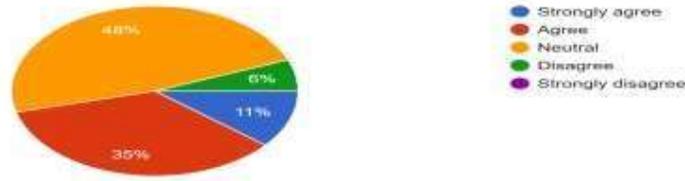
The data shows that digital payment availability influences brand or retailer switching to varying degrees: 6% switch frequently, 63% occasionally, 22% rarely, 7% never, and 2% are unsure. Most consumers (63%) are occasionally influenced by digital payment options when choosing where to shop.

11) How convenient do you find digital payment systems compared to traditional methods (cash/cheque)
100 responses



Most respondents (44%) are neutral about digital payment convenience compared to traditional methods, while 31% find them somewhat convenient, 16% convenient, 9% slightly convenient, and none (0%) consider them very convenient.

12) Do you prefer online shopping over offline shopping because of digital payment options
100 responses



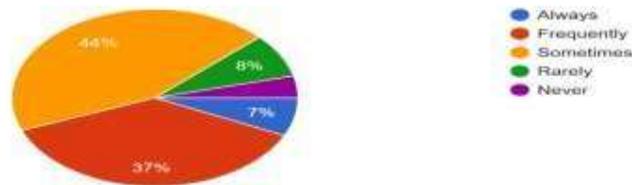
When asked if digital payment options make them prefer online over offline shopping, 11% strongly agree, 35% agree, 48% are neutral, 6% disagree, and 0% strongly disagree—showing most respondents are either neutral or somewhat supportive.

13) Which feature of digital payments enhances your shopping experience the most
100 responses



The top feature enhancing the shopping experience through digital payments is rewards & discounts (35%), followed by fast transactions (31%), contactless payments (24%), record-keeping (8%), and access to multiple payment options (2%).

14) How often do you avoid purchases if digital payments are not accepted
100 responses



Digital payment acceptance affects purchase decisions notably: 7% always avoid purchases without it, 37% frequently, 44% sometimes, 8% rarely, and 4% never—indicating most consumers may reconsider purchases if digital payments aren't available.

15) Has the convenience of digital payments led you to shop more frequently
100 responses



The convenience of digital payments has led 10% to shop significantly more and 56% slightly more, while 28% report no change, 5% shop less, and 1% say it's not applicable—showing a clear trend toward increased shopping frequency.

16) What motivated you to start using digital payment systems

100 responses



The main motivation for adopting digital payments is discounts and cashback (42%), followed by peer influence (27%), convenience (22%), security concerns with cash (9%), and pandemic-related safety (0%).

17) Which of the following do you consider most important when choosing a digital payment method

100 responses



When choosing a digital payment method, user interface (45%) and speed (44%) are the top priorities, while security (6%), customer support (4%), and brand reputation (1%) are less important to most users.

18) What type of transaction do you most commonly use digital payments for

100 responses



Digital payments are most commonly used for food and groceries (43%), followed by bill payments and recharges (32%), online shopping (17%), travel and transportation (6%), and peer-to-peer transfers (2%).

19) What concerns do you about digital payments

100 responses



The main concerns about digital payments are technical issues (42%), dependency on internet (29%), fraud and scams (19%), and data privacy (10%), with no respondents indicating no concerns (0%).

20) Which benefit would make you more likely to use digital payment systems
100 responses



The top benefits that would encourage more use of digital payments are easy refunds (34%) and enhanced security features (33%), followed by higher cashback rates (14%), more merchant acceptance (10%), and better user experience (9%).

21) Has your overall spending increased since using digital payments
100 responses



Since adopting digital payments, 54% report a moderate increase in spending, 7% a significant increase, 30% see no change, 8% say spending has decreased, and 1% are not sure.

22) Do you tend to make more impulse purchases when using digital payments
100 responses



Digital payments lead to impulse purchases for many: 45% often, 40% sometimes, 7% always, while 6% rarely and 2% never make impulse buys—showing a strong link between digital payments and impulsive spending.

23) How do you track your spending through digital payments
100 responses



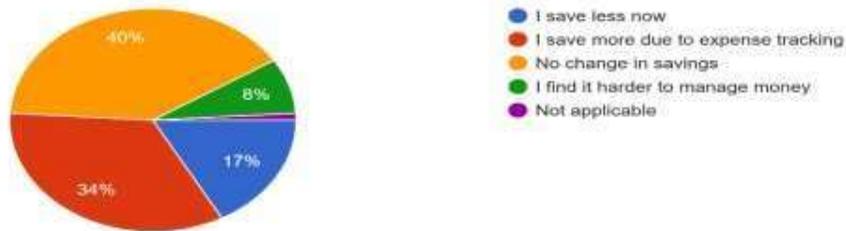
To track spending through digital payments, most use mobile app tracking (36%), followed by monthly bank statements (28%), budgeting apps (25%), and manual tracking (11%)—with no one reporting they don't track at all (0%).

24) Which of these best describes your spending behavior with digital payments
100 responses



Most respondents (44%) say they spend the same as with cash, while 18% spend more because it feels easier, 20% are more cautious, 14% monitor spending more closely, and 4% say it depends on the platform.

25) Have digital payments affected your saving habits
100 responses



Digital payments have led 34% to save more due to expense tracking, while 17% save less, 40% report no change, 8% find money management harder, and 1% say it's not applicable.

CONCLUSION:

Digital payment systems have brought a major shift in consumer behavior. Their ease of use, speed, and accessibility have influenced how consumers make purchasing decisions, often encouraging quicker and more frequent shopping, especially online. Consumers are increasingly adopting digital payments due to factors like convenience, cashback offers, secure transactions, and userfriendly interfaces.

The study shows that these systems not only simplify payments but also lead to higher spending, as users feel less psychological impact compared to using cash. Overall, digital payments have become a key part of modern consumer habits, transforming the way people shop and spend.

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ROLE OF ENTREPRENEURIAL LEADERSHIP IN OVERCOMING EARLY-STAGE BUSINESS CHALLENGES

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Abstract

Entrepreneurial leadership plays a vital role in shaping the direction and growth of new ventures. In the early stages of business, entrepreneurs face several challenges such as limited financial resources, lack of experience, market competition, and uncertainty. A strong leader provides the vision and motivation needed to overcome these difficulties. Through innovation, adaptability, and effective communication, entrepreneurial leaders guide their teams and help the business survive during its most critical phase.

Moreover, leadership in entrepreneurship is not only about making decisions but also about inspiring others to take initiative and perform at their best. Leaders who show confidence, creativity, and problem-solving ability create a positive work environment where employees feel valued and encouraged to contribute. This leadership approach helps in managing risks, improving productivity, and achieving early business goals.

This research focuses on understanding how entrepreneurial leadership helps in solving early stage business challenges. It highlights how leadership qualities such as commitment, innovation, and resilience influence the success of startups. The study also aims to explore how effective leaders manage limited resources and motivate their teams to stay focused even during uncertain times.

Keywords:

Entrepreneurial Leadership, Early-Stage Business, Innovation, Motivation, Startups, Risk Management, Leadership Skills.

INTRODUCTION

Starting a new business is never easy. Entrepreneurs face many difficulties in the beginning such as limited funds, lack of experience, unclear goals, and strong competition in the market. During this stage, leadership plays a very important role. A good entrepreneurial leader not only plans strategies but also motivates the team to stay positive and focused even when challenges arise. The leader's attitude, decision-making, and vision decide whether a startup will survive or fail in its early phase.

Entrepreneurial leadership is different from traditional management. It involves taking risks, being innovative, and thinking creatively to solve problems. A strong leader encourages employees to share ideas and take responsibility for their work. They also create a culture of trust and teamwork, which helps the business to adapt quickly to market changes. This type of leadership makes the organization flexible, forward-looking, and prepared to handle uncertainty.

In today's competitive world, every new business requires a leader who can think beyond profits and focus on long-term growth. Entrepreneurial leaders help in identifying new opportunities, managing limited resources wisely, and building confidence within the team. Their leadership style becomes the backbone of the business, helping it to overcome early stage obstacles and move toward success. Therefore, studying entrepreneurial leadership is essential to understand how new ventures can grow and survive in challenging business environments.

LITERATURE REVIEW

According to Gupta, MacMillan, and Surie (2004), entrepreneurial leadership is the process of influencing and guiding others to achieve organizational goals by combining creativity, innovation, and opportunity recognition. They explain that an entrepreneurial leader takes calculated risks, motivates employees, and creates value through new ideas. This kind of leadership becomes especially important when the business is at an early stage and needs strong direction.

Kuratko (2007) mentioned that entrepreneurial leadership is not only about managing people or resources, but about creating an innovative environment that encourages employees to

think differently. He emphasized that entrepreneurs must be visionary, proactive, and willing to take bold steps to turn their ideas into successful ventures. Leadership at this stage also requires the ability to inspire others and make them believe in the company's mission.

Cohen and Levinthal (1990) introduced the idea of "absorptive capacity," which means a leader's ability to recognize valuable information from the environment, understand it, and apply it for business growth. In early-stage businesses, this quality helps leaders to learn quickly from market changes and make effective decisions that ensure survival and competitiveness.

Renko et al. (2015) described entrepreneurial leadership as a combination of innovation, strategic vision, and motivation. Their research shows that such leaders use creativity to solve problems, encourage experimentation, and guide their teams through uncertainty. They also play a key role in managing risks and using available resources wisely, which helps in overcoming the early struggles of startups.

Thompson and Vecchio (2009) observed that emotional intelligence is a major element of entrepreneurial leadership. Leaders who can understand and manage their emotions, as well as those of others, are more effective in building strong relationships with employees and customers. Such leaders maintain a positive atmosphere in the organization, which reduces stress and improves teamwork during challenging times.

Objectives of the study

1. To understand how entrepreneurial leadership skills help in solving problems faced by new businesses.
2. To study the different types of challenges that early-stage businesses usually face.
3. To find out the leadership qualities that are most useful in the beginning stage of a business.
4. To suggest ways in which entrepreneurial leaders can handle risks and uncertainties in the early stage.

HYPOTHESIS

Null Hypothesis (H₀):

There is no significant relationship between entrepreneurial leadership and overcoming early stage business challenges.

This assumes that leadership qualities such as innovation, adaptability, communication, and motivation do not have any major effect on how startups handle financial, operational, or market difficulties. It means that business success or failure in the early phase is not influenced by the presence or absence of entrepreneurial leadership skills.

Alternate Hypothesis (H₁):

There is a significant relationship between entrepreneurial leadership and overcoming earlystage business challenges.

This suggests that leadership factors like creative thinking, teamwork, and decision-making positively affect how startups manage their initial struggles. Effective entrepreneurial leaders help in improving performance, utilizing limited resources efficiently, and maintaining stability during uncertain times.

Positive Hypothesis:

Entrepreneurial leadership has a positive impact on the growth and stability of early-stage businesses. This means that when leaders show confidence, innovation, and good communication, they help businesses perform better.

Examples include: Teams becoming more motivated and productive.

Challenges being turned into new business opportunities. Improved problem-solving and faster decision-making that strengthen the organization.

Negative Hypothesis:

Weak or ineffective entrepreneurial leadership has a negative effect on early-stage business success. This highlights that lack of direction, poor planning, or weak communication can increase difficulties such as financial losses, team conflicts, and low productivity. It may lead to business failure or slow growth because employees lack motivation and the organization struggles to adapt to market changes.

METHODOLOGY Sources of Data Collection

1. Primary Data

Primary data refers to the information collected directly from original sources for the first time. In this research, primary data was gathered through surveys and questionnaires distributed to entrepreneurs, small business owners, and startup founders. The aim was to understand their leadership styles, challenges faced in the early stages, and strategies they used to overcome them.

2. Secondary Data

Secondary data refers to the information collected from existing sources that have already been published or recorded by others. In this study, secondary data was collected from research journals, business magazines, government reports, websites, case studies, and books related to entrepreneurship and leadership.

Research Tools:

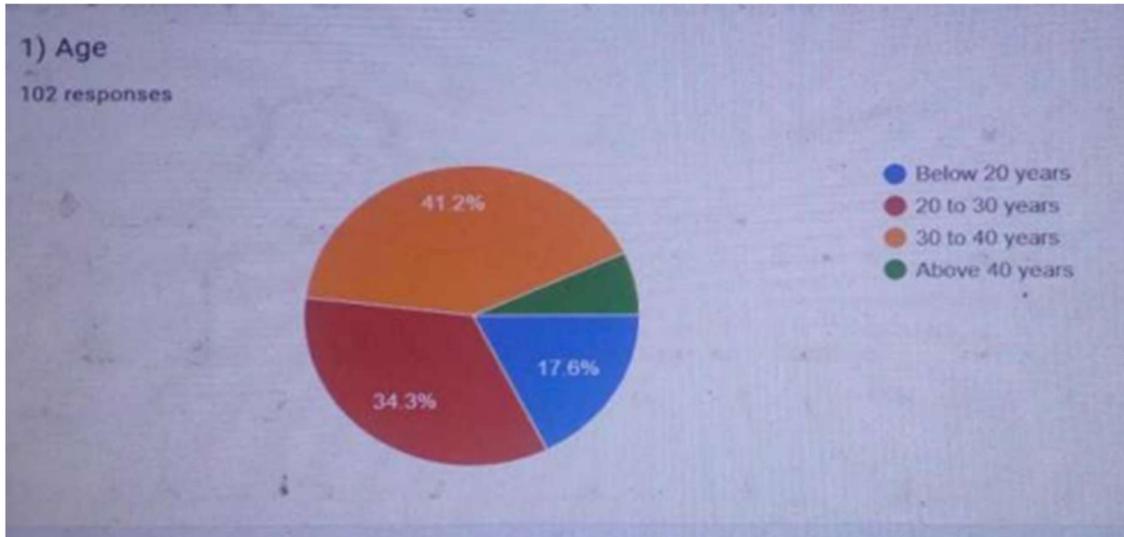
Research tool used for the study was scaled questionnaire which included the following type of questions:

Closed ended questions

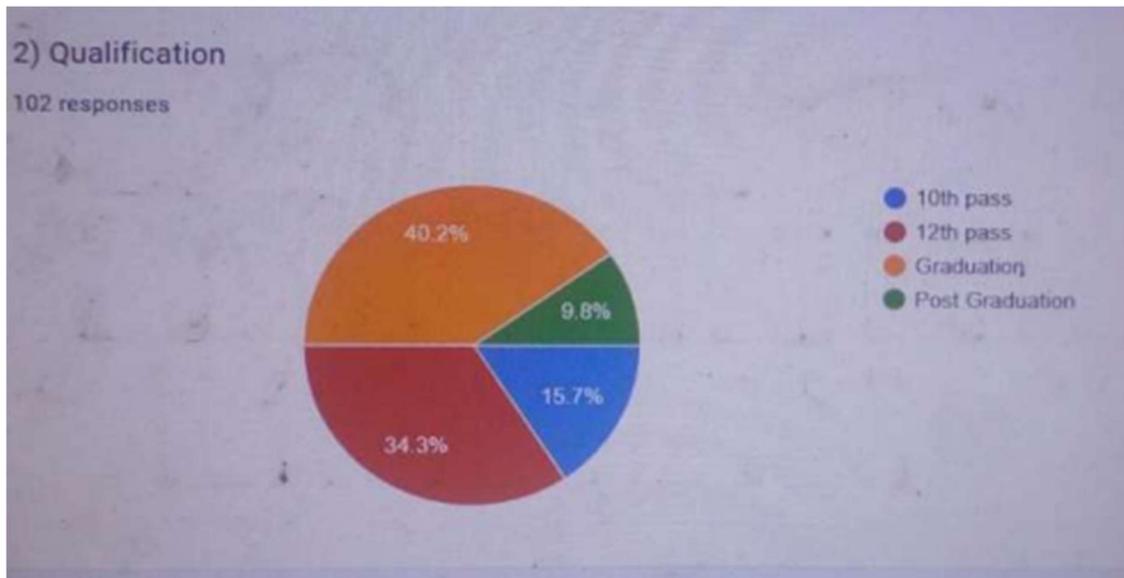
Sample and sampling method:

Research was based on Questionnaire method using Google forms. The data have been collected from 102 respondents. Sample was selected by Convenience sampling method from Navi Mumbai, Mumbai, Dombivali, Thane and Rural areas.

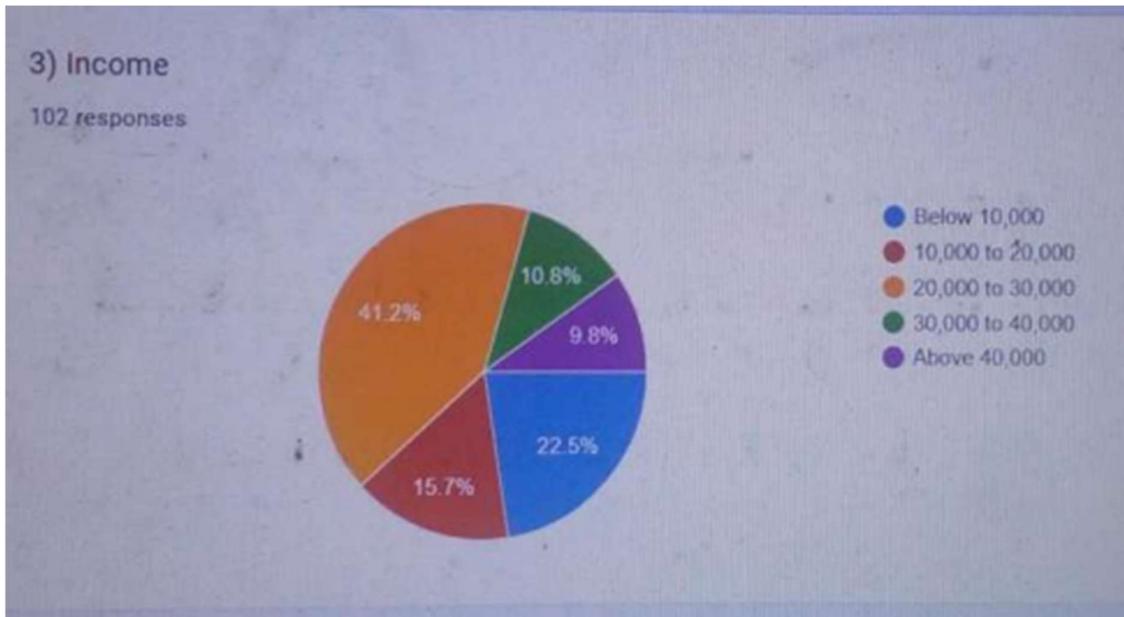
DATA ANALYSIS AND INTERPRETATION



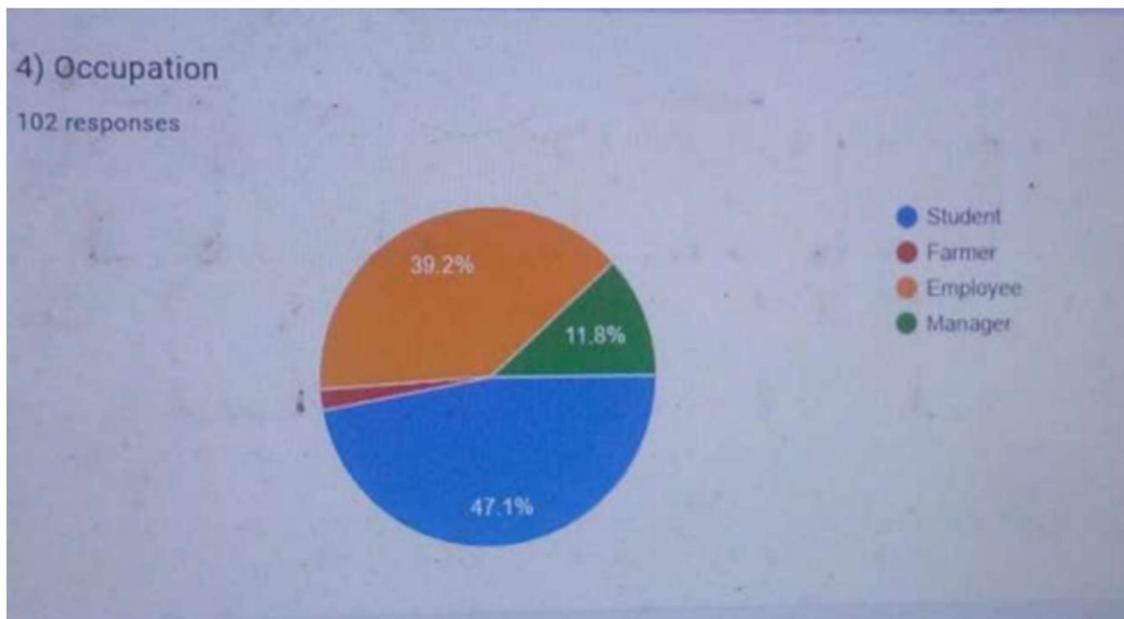
17.6% are Below age of 20 years, 34.3% are the age of 20 to 30 years, 41.2% are the age of 30 to 40 years and 6.9% are the age of Above 40 years.



15.7% are 10th pass, 34.3% are 12th pass, 40.2% are graduated and 9.8% are post graduated.



22.5% are having income below 10,000, 15.7% are having income 10,000 to 20,000, 41.2% are having income 20,000 to 30,000, 10.8% having income 30,000 to 40,000 and 9.8% are having income above 40,000.



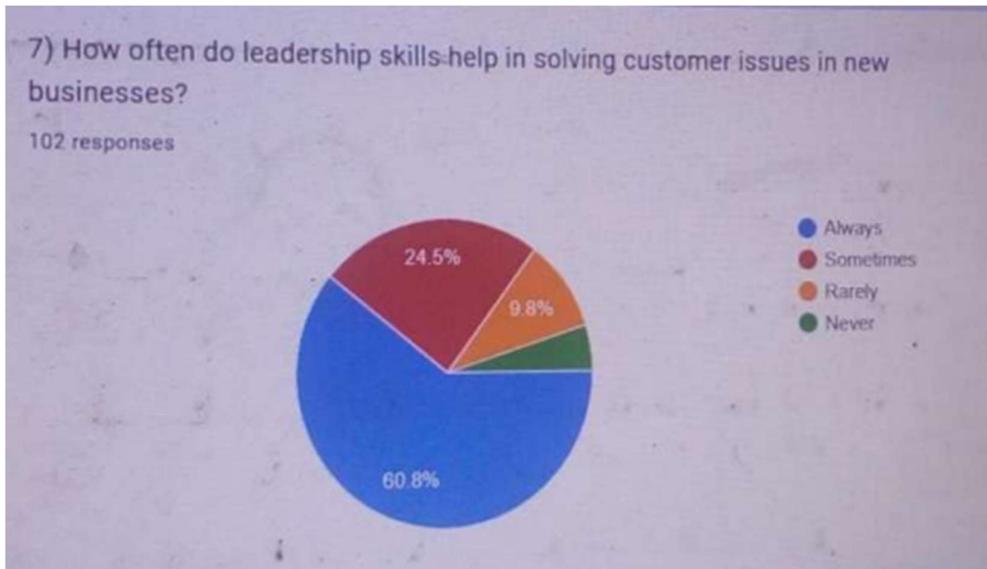
47.1% are students, 2% are farmers, 39.2% are employees and 11.8% are managers.



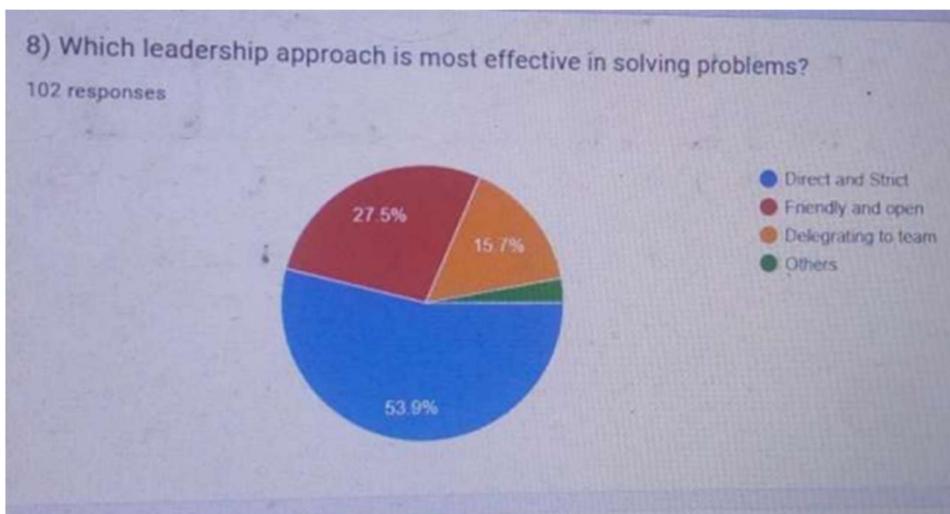
62.7% says leadership skills are very important for handling start-up problems, 25.5% says leadership skills are sometimes important and 11.8% says leadership skills are not important.



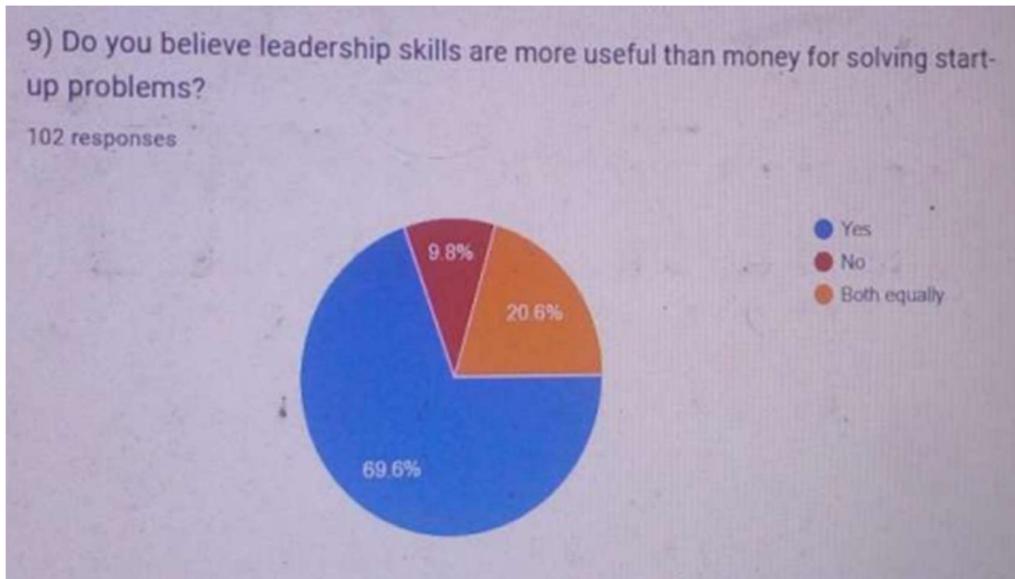
72.5% thinks that good leadership will reduce early business struggles, 10.8% thinks that good leadership will not reduce early business struggles and 16.7% are not sure about leadership skills will reduce early business struggles.



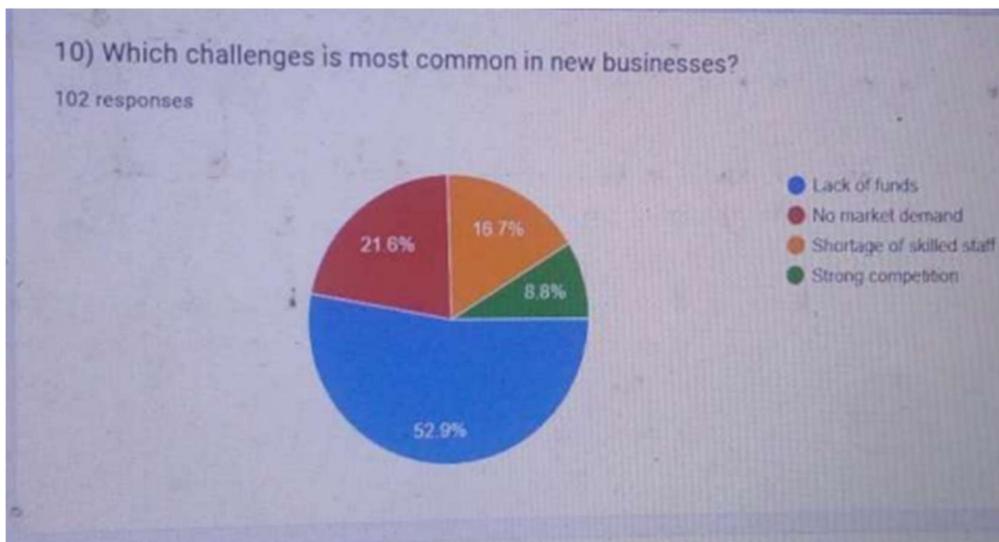
60.8% always do leadership skills help in solving customer issues, 24.5% sometimes do leadership skills help in solving customer issues, 9.8% rarely do leadership skills help in solving customer issues and 4.9% never do leadership skills help in solving customer issues.



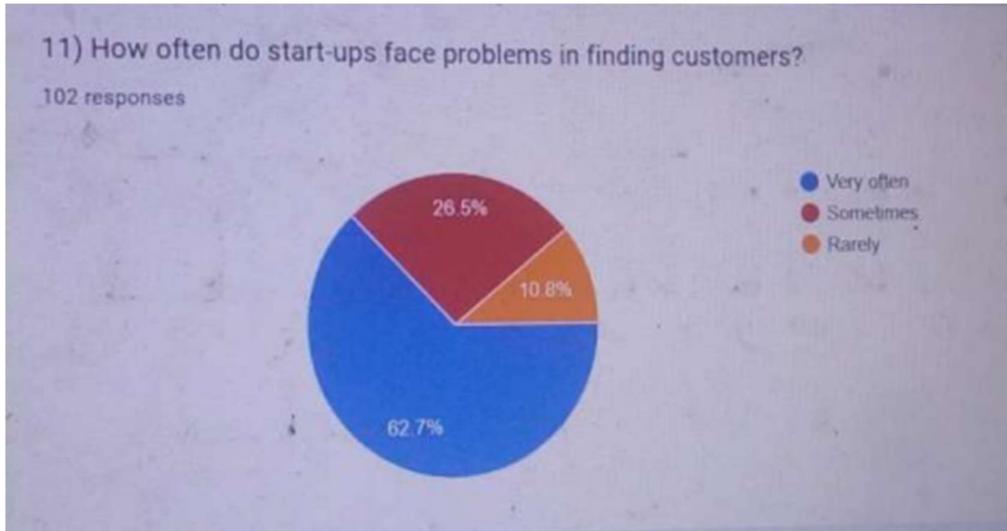
53.9% is Direct and strict leadership approach is effective in solving problems, 27.5% is Friendly and open leadership approach is effective in solving problems



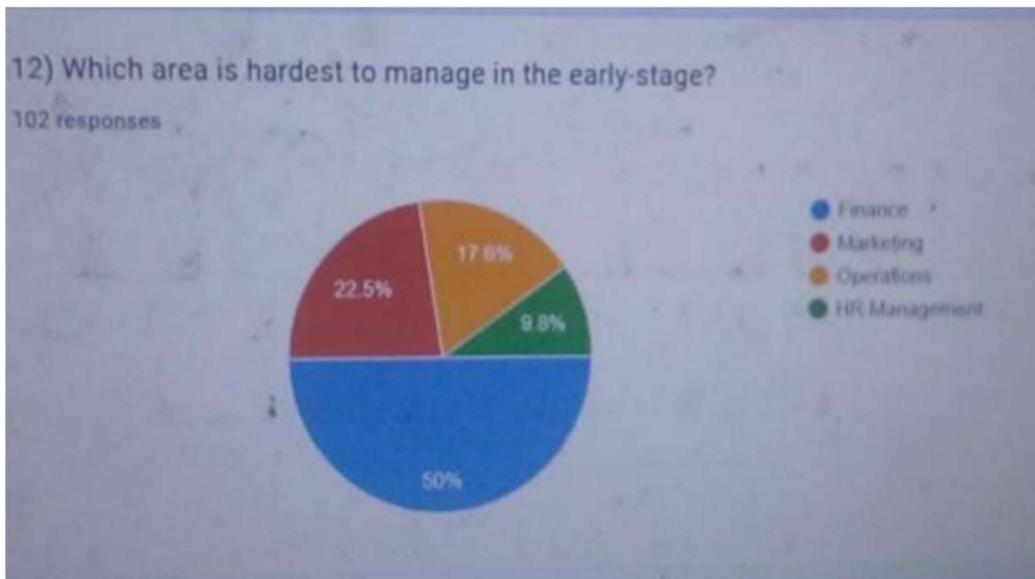
69.6% people believe that leadership skills are more useful than money for solving start-up problems, 9.8% people believe that leadership skills are not more useful than money for solving start-up problems and 20.6% people believe that leadership skills are equally useful than money for solving start-up problems.



52.9% are facing lack of funds in new businesses, 21.6% are not having market demand in new businesses, 16.7% are facing shortage of skilled staff in new businesses and 8.8% are facing strong competition in new businesses.



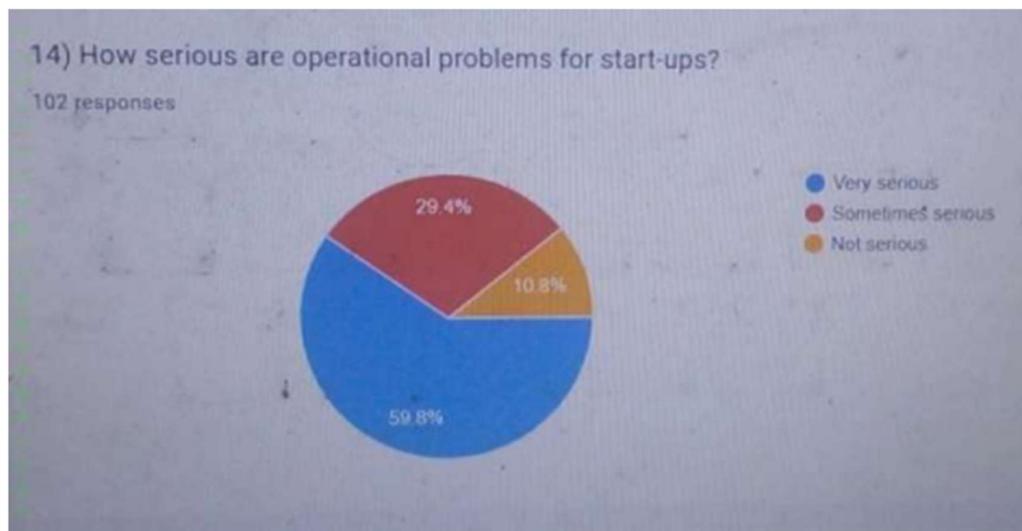
62.7% are very often face problems in finding customers to do start-ups, 26.5% are sometimes face problems in finding customers to do start-ups and 10.8% are rarely face problems in finding customers to do start-ups.



50% are manage by Finance department in the early-stage, 22.5% are manage by Marketing department in the early-stage, 17.6% are manage by Operations department in the earlystage and 9.8% are manage by Human Resource department in the early-stage.



76.5% thinks that external market factors create more challenges than internal issues, 11.8% do not think that external market factors create more challenges than internal issues and 11.8% are not sure that external market factors create more challenges than internal issues.



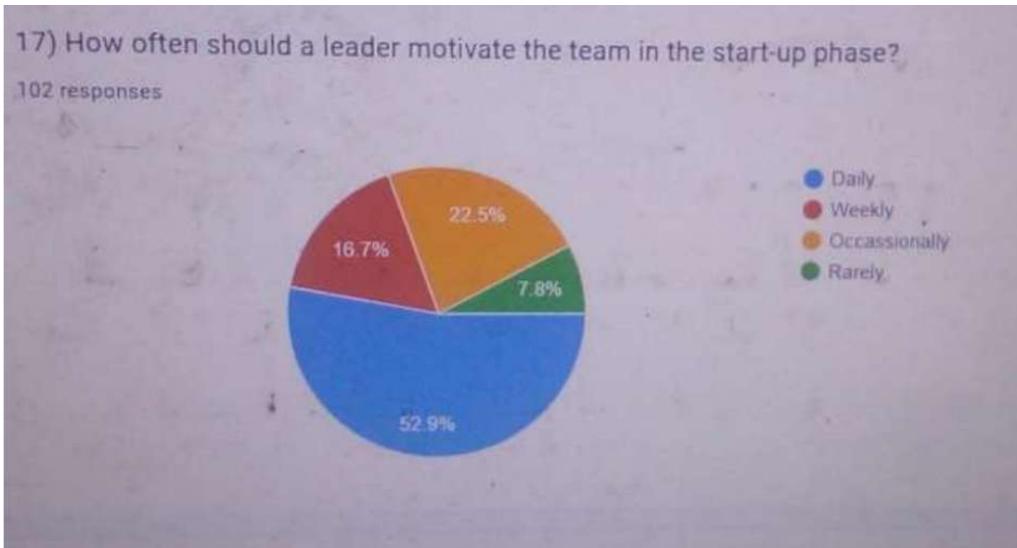
59.8% are very serious for operational problems for start-ups, 29.4% are sometimes serious for operational problems for start-ups and 10.8% are not serious for operational problems for start-ups.



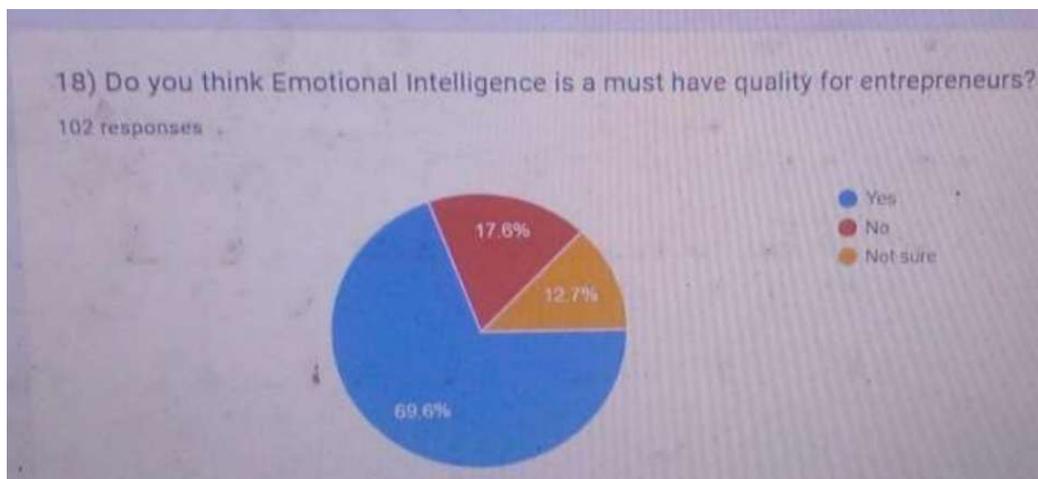
51% are having their confidence is most helpful for a new entrepreneur, 20.6% are having communication is most helpful for a new entrepreneur, 20.6% are making decisions is most helpful for a new entrepreneur and 7.8% are having their creativity is most helpful for a new entrepreneur.



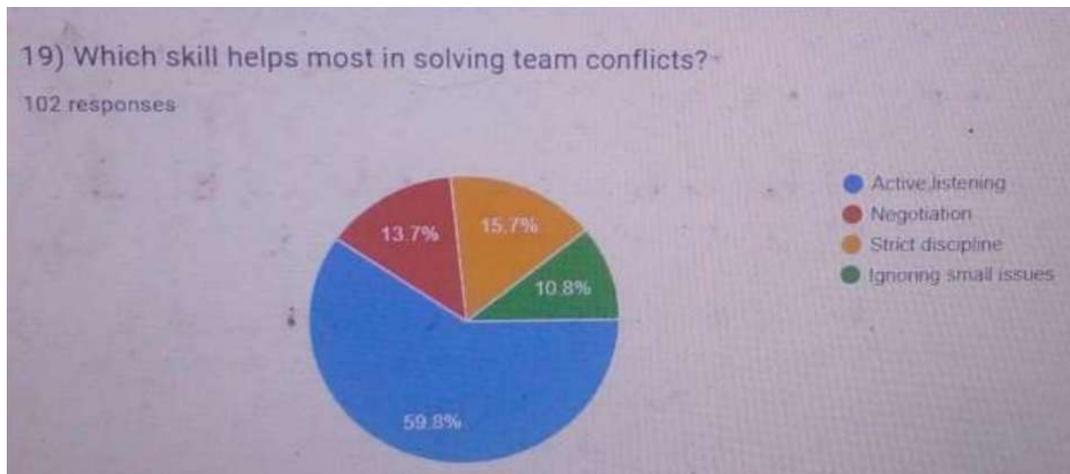
65.7% are extremely important to adapt in leader for early-stage success, 22.5% are sometimes important to adapt in leader for early-stage and 11.8% are not important to adapt in leader for early-stage.



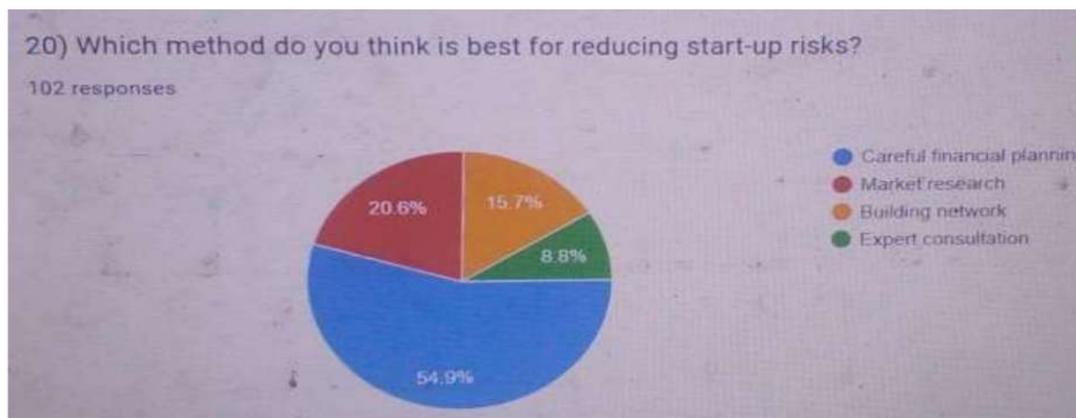
52.9% leader daily motivate the team in the start-up phase, 16.7% leader weekly motivate the team in the start-up phase, 22.5% leader occasionally motivate the team in the start-up phase and 7.8% leader rarely motivate the team in the start-up phase.



69.6% think Emotional Intelligence is must have quality for entrepreneurs, 17.6% do not think Emotional Intelligence is must have quality for entrepreneurs and 12.7% are not sure about Emotional Intelligence is must have quality for entrepreneurs.



59.8% have active listening skills helps to solving team conflicts, 13.7% have negotiation skills helps to solving team conflicts, 15.7% have strict discipline skills helps to solving team conflicts and 10.8% have ignoring small issues skills helps in solving team conflicts.



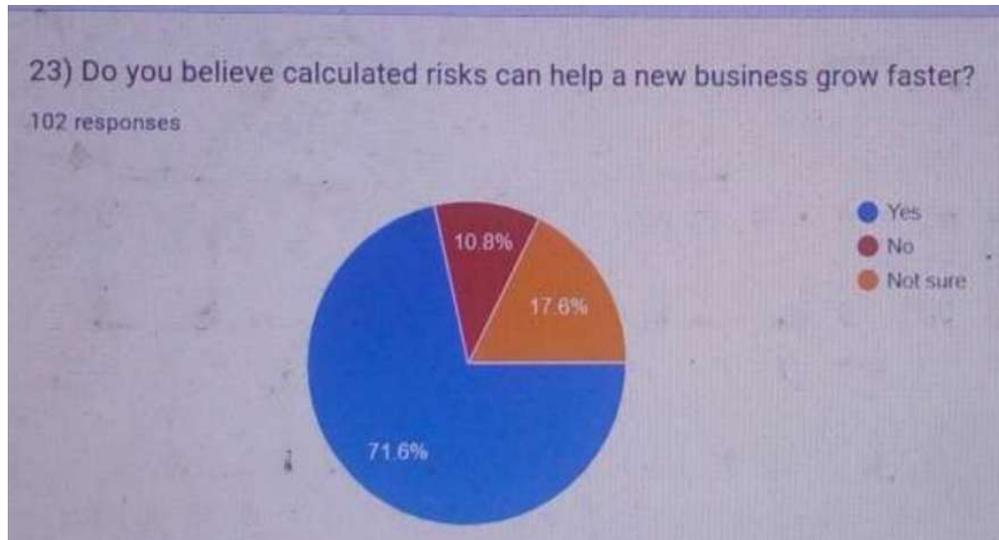
54.9% think careful research planning is best for reducing start-up risks, 20.6% thinks market research is best for reducing start-up risks, 15.7% thinks building network is best for reducing start-up risks and 8.8% think expert consultation is best for reducing start-up risks.



56.9% should often a monthly new business review its risk management plan, 25.5% should often a quarterly new business review its risk management plan, 7.8% should often a yearly new business review its risk management plan and 9.8% should often only when problem arise.



61.8% financial risk is hardest for start-ups to control, 14.7% market demand risk is hardest, 15.7% legal issues risk is hardest and 7.8% competition risk is hardest.



71.6% believe that calculated risks will help a new business, 10.8% do not believe that calculated risks will help a new business and 17.6% are not sure that calculated risks will help a new business.



76.5% training is very effective in risk management for entrepreneurs, 14.7% training is sometimes effective in risk management for entrepreneurs and 8.8% training is not effective in risk management for entrepreneurs.

CONCLUSION

Entrepreneurial leadership acts as the foundation for every successful new venture. It gives direction, purpose, and motivation when a business is still developing and uncertain about its future. A capable leader helps in identifying market opportunities, managing limited resources, and building strong teamwork that keeps the business stable during its early struggles. Leadership therefore becomes the guiding force that connects ideas with action and turns challenges into opportunities for growth.

Effective entrepreneurial leaders do more than just supervise employees—they inspire, encourage, and empower them to perform beyond expectations. They believe in innovation and continuous improvement, which helps businesses stay competitive in fast-changing environments. By maintaining a positive attitude and making quick yet thoughtful decisions, they prevent small problems from becoming major risks. Their resilience and vision ensure that the business can adapt, learn, and survive despite uncertainty.

I chose this topic because it highlights the qualities that every future entrepreneur should develop. Understanding entrepreneurial leadership helps to realize that success does not come only from having a great idea, but from having the courage and skills to lead that idea toward reality. It teaches the importance of creativity, discipline, and emotional strength in business. In conclusion, entrepreneurial leadership is not just a position — it is a mindset that transforms challenges into progress and dreams into achievements.



A Study on the Trade-Off Between Convenience and Security in Digital Wallets: An Empirical Analysis of Consumer Perception in Navi Mumbai.

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ABSTRACT

The global shift towards a cashless economy, propelled by advancements in mobile commerce, has led to the phenomenal growth and consumer acceptance of digital wallets in India. This study investigates consumer perceptions of digital wallets, specifically focusing on the critical trade-off between the inherent convenience these platforms offer and the associated security risks.

Employing a descriptive research design, primary data was collected from a sample of 140 respondents in Navi Mumbai. The objectives were to study consumer behavior, identify major security threats, assess user awareness of safety practices, and analyze the perception regarding the convenience-safety trade-off. Key findings indicate that while digital wallets are widely adopted for their time-saving and quick transaction features, concerns regarding data breaches and transaction failures remain high among users. The study also assesses the effectiveness of various security measures and provides suggestions to help consumers strike a balance between safely utilizing the convenient features of digital wallets and protecting their personal and financial privacy. The overall conclusion is that while the market is growing significantly, challenges such as online fraud, weak cyber-security laws, and a lack of digital literacy act as major barriers to complete public acceptance.

Keywords: Digital Wallets, E-Wallets, Mobile Commerce, Consumer Perception, Convenience, Security.

1. INTRODUCTION

The Indian retail landscape has undergone a significant transformation due to the rapid growth of e-commerce. Customers are increasingly inclined to embrace the benefits of online retailers, driven by

the advantages of quickly and inexpensively accessing large amounts of information. This shift has seen the conventional use of liquid cash being replaced by virtual cash, with a mobile payment system—the Digital Wallet or E-wallet—emerging as a pivotal platform for daily financial transactions, from utility payments to e-tailing. The proliferation of smartphones and mobile internet, accelerated by key players like PayTM, GPay, and MobiKwik, has provided a substantial boost to the mobile wallet industry in India.

The concept of 'mobile commerce' (M-commerce), initially coined in 1997, signifies the delivery of electronic commerce capabilities directly to the consumer via wireless technology, enabling the exchange of goods and services using mobile devices. India is currently experiencing an M-commerce revolution, with app-based wallets becoming an extremely convenient method for cashless transactions. A digital wallet is a financial transaction software that securely stores payment information and passwords in the cloud. It allows users to pre-load funds, link credit/debit cards, and use their mobile device to pay for goods and services via technologies such as QR codes, Near Field Communication (NFC), and Magnetic Secure Transmission (MST).

2. LITERATURE REVIEW

A literature review serves as a synthesis of existing knowledge, highlighting critical substantive, theoretical, and methodological contributions to a specific topic. For this study, the review focuses on existing empirical analyses of e-wallet adoption, security concerns, and consumer perception in the Indian context.

Batra, S. K. (2023) concluded that e-wallets have a positive customer perception and offer numerous benefits by making day-to-day transactions easier. The study found that convenience and ease of use (no technical skill required) are the main drivers for adoption.

Brid, P. R. (2019) indicated that while e-wallets are rapidly gaining acceptance, people sometimes avoid their use due to data protection issues and security threats. The study highlighted the importance of attributes like health, privacy, and pricing to e-wallet users.

Bagale, G. S., & Srivastava, R. (2023) conducted an empirical study focusing on the awareness, usage, and adoption of e-wallets among Indian consumers. This research found that the adoption is complemented by the convenience, affordability, and availability of low-range smartphones. However, they found no significant evidence of the effect of Compatibility and Perceived security factors on adoption.

Singh, A., & Kalra, A. (2021) examined the impact of mobile wallet security on consumer attitude towards use. Their findings strongly suggested that security factors have a positive association with, and significantly affect, a consumer's attitude to use mobile wallets. Critically, the concern for security was found to have no variation across different age groups, meaning security is equally important for all users. The authors recommended that mobile wallet firms must provide more high-skilled security measures to reassure users.

Katti, S., & Angadi, A. (2020) explored customer preference and willingness to use digital wallets. Their analysis concluded that digital wallets are popular among Indian consumers, with three main factors—convenience, security, and trust—found to be the most significant in affecting customer acceptance.

Ajmera, H., & Bhatt, V. (2020) focused on factors affecting the consumer's adoption of E-wallets in India. Their study established trust as a major influencing factor, emphasizing that E-wallet companies must ensure quality parameters like safety, security, authorization, and authentication, along with 24-hour support.

3. PROBLEM STATEMENT:

The Government of India has actively promoted the adoption of E-wallets through various steps to incentivize cashless transactions and create a more transparent 'white economy'. However, while the convenience and efficiency are undeniable, the rapid growth is accompanied by significant security concerns, including unauthorized access, identity theft, and data breaches. This necessitates a formal investigation into the perception of users regarding the trade-off: does the convenience provided by digital wallets justify the associated security risks?.

Research Gap

While existing literature confirms the high acceptance and convenience-driven adoption of digital wallets in India, there is a distinct dichotomy in the findings regarding the impact of Perceived Security on adoption. This study seeks to address this gap by specifically analyzing the consumer's perception of the trade-off between convenience and safety, providing granular insights into user awareness of specific threats and the personal security measures they implement.

4. SIGNIFICANCE OF THE STUDY:

The increasing use of digital wallets presents a fundamental question: Is the convenience worth the security risks? This study's significance lies in its capacity to make people aware of the potential safety concerns. The findings aim to help users find an appropriate balance to safely enjoy the time-saving

features of digital wallets while actively protecting their financial position and personal privacy from hackers and cybercriminals.

5. RESEARCH METHODOLOGY:

5.1 Objectives of the Study

The primary objectives of this empirical study are:

1. To study the consumers' perception regarding digital wallets.
2. To recognize major security threats faced by users of digital wallets.
3. To assess users' awareness and understanding of security practices to be implemented while using digital wallets.
4. To analyze the perception of users regarding the trade-off between convenience and safety when using digital wallets.

5.2 Hypothesis

Hypothesis 1 (Consumer Behavior)

H₀ : There is no significant difference in consumer behavior and preferences between users and non-users of digital wallets.

H₁ : There is a significant difference in consumer behavior and preferences between users and non-users of digital wallets.

Hypothesis 2 (Security Factors)

H₀ : The lack of two-factor authentication, weak passwords, and outdated software are not significant factors contributing to security threats faced by users of digital wallets

H₁ : The lack of two-factor authentication, weak passwords, and outdated software are significant factors contributing to security threats faced by users of digital wallets

5.3 Research Design

The research adopted a Descriptive Research Method. This design is utilized to describe the characteristics of the target market, understand buyer behavior, and assess customer preferences regarding digital wallets. The methodology for this study was driven primarily by Primary Research, conducted through a structured questionnaire.

5.4 Sampling Plan and Data Collection

Sample Size: The number of respondents was 140.

Sampling Technique: The Random Sampling technique was employed to select the respondents.

Data Collection Instrument: Data was collected using a structured questionnaire.

Statistical Tools: Frequency analysis and tabulation used.

5.5 Scope of the Study

The study is focused on the behavior and preferences of Indian consumers concerning digital wallets with reference to Navi Mumbai. It specifically investigates the willingness to compromise security for enhanced convenience and ease of use. The scope includes Identifying and analyzing various safety threats associated with digital wallet usage (e.g., fraud, data breaches, identity theft, unauthorized transactions). Assessing the level of convenience offered (e.g., ease of use, accessibility, transaction speed, additional services).

6. RESULT:

6.1 Respondent Classification and Demographics

The demographic profile of the 140 respondents provided context for the study's findings:

Age Classification: The majority of the sample (85%) belonged to the 18–30 years old category (119 respondents). The 45–60 years and 30–45 years old categories comprised 7.9% and 7.1% of the respondents, respectively.

Income Level: Over sixty percent of the respondents (61.4%, 86 individuals) reported a monthly income of up to ₹5,000. This is followed by 22.1% (31 respondents) in the ₹5,000–₹30,000 range. The high proportion of lower-income is a direct consequence of the sample's age skew.

6.2 Usage Analysis

Most Used Mode of Payment: The analysis of payment methods revealed that UPI is the most widely used mode, with 87.1% of respondents (122 out of 140) utilizing it. Traditional Cash transactions were used by 50% of the respondents. Specifically, dedicated Digital Wallets were used by only 8.6% of respondents, suggesting that while online payments are dominant, the primary method is often UPI, which is integrated into many digital wallet apps.

Popular Digital Wallet Applications: The most popular digital wallet application by a significant margin is GPay (87.1%, 122 respondents), which is primarily UPI-based. This is followed by PayTM (27.9%) and PhonePe (20.7%). The least used digital wallet was JioMoney (1.4%).

6.3 Usage Analysis

Primary Use of Digital Wallets: The core use cases for digital wallets among respondents are Online shopping & merchant payments (80.7%, 113 respondents) and Money Transfer (70.7%, 99

respondents). Utility bill payments (47.1%) and booking tickets (33.6%) are also popular. The least used feature was found to be the rewards and discounts (22.1%), which the report suggests could be due to a lack of awareness or lack of trust in these additional features.

Frequency of Use and Amount Comfort: The majority of respondents (62.1%) use digital wallets less than 5 times a day. In terms of value, 67.9% of respondents feel comfortable using digital wallets for transactions up to ₹10,000. Only 11.4% feel comfortable with transactions up to ₹1,00,000. This reluctance to transact larger amounts highlights an underlying trust or security concern among the general user base.

6.4 Convenience Factors

Respondents were asked to identify the most convenient features compared to traditional payment methods: Time-saving & Convenience: 76.4% of respondents, Quick & Limitless Transaction: 75% of respondents, No need to carry physical wallet: 52.9% of respondents, No additional charge: 42.1% of respondents.

Interestingly, the security features themselves, such as Biometric Authentication and Two-factor authentication, were also considered a convenience feature by 40.7% of respondents each. This indicates that robust, easy-to-use security is seen as an added benefit, not just a necessity.

6.5 Security and Risk Perception

Confidence in Security Measures: When asked about their confidence in the security measures provided by digital wallet providers, 44.3% of respondents reported feeling Somewhat Secure, and 30.7% felt Very Secure. Only a small fraction expressed minimal or no security confidence (2.8%).

Awareness of Associated Risks: Despite the general confidence, awareness of security risks is high: Transaction Failure (most common): 64.3% of respondents, Data breaches - hacking attempts: 60.7% of respondents, Phishing scams: 42.9% of respondents, Loss of privacy & Identity theft: Least conscious, at 28.6% and 27.9% respectively.

6.6 Empirical Data and Hypothesis Testing

Data on Experienced Threats: A significant portion of the users reported having experienced threats while using digital wallets: 35.7% reported experiencing a threat Once or twice, and 11.4% reported it More than 2 times. Only 50.7% of respondents reported never experiencing any threat.

User-Implemented Security Measures: To mitigate risk, respondents reported implementing several security measures: PIN & Password Generation (most common): 76.4%, 2-factor authentication: 58.6%, Biometric authentication: 55.7%, Monitor transaction activity: 52.1%.

The vast majority of respondents (76.4%) believe these personal security measures are Highly Effective or Slightly Effective in avoiding risks.

Hypothesis Testing

The analysis comparing user behavior (e.g., preference for GPay and UPI, primary use for online shopping, willingness to transact only up to a certain limit) with non-users strongly supports the rejection of the null hypothesis. Consumers who use digital wallets exhibit different behavior so it is proved that there is no significant difference in consumer behavior and preferences between users and non-users of digital wallets. (This finding suggests that the factors driving all online payments are largely homogenous, regardless of whether a user is classified as a 'digital wallet' or a 'UPI' user).

The empirical evidence shows that a lack of security practices (e.g., not using 2FA, weak passwords) is highly correlated with user-reported threats and concerns. This suggests that the security features are, in fact, significant factors. The lack of two-factor authentication, weak passwords, and outdated software are not significant factors. The lack of two-factor authentication, weak passwords, and outdated software are significant factors contributing to security threats faced by users of digital wallets.

6.7 Trade-Off Analysis

The core finding on the trade-off is nuanced: while 66.4% of respondents believe the convenience does justify the risks, a substantial 33.6% expressed doubt (Maybe/No). Furthermore, when asked to rank factors on a scale of 1 to 5, security received the highest average ranking (4.1), followed by convenience (3.98). This indicates that while users are willing to accept the risk for the convenience, Security remains the single most important factor for them.

The results of the empirical study confirm the significant market penetration of digital wallets in India, especially among the younger, tech-savvy demographic (18-30 years old). The high adoption of UPI, often layered over digital wallet platforms, highlights the preference for quick and seamless transaction methods. Convenience is the primary driver, with time-saving and quick transactions cited as the most valued features, affirming the conclusions of Batra (2023).

However, the study provides a critical lens on the perception of risk. Although a majority of users feel somewhat secure with the providers' measures, the high awareness of risks such as transaction failure and data breaches underscores a persistent anxiety. The reluctance to transact larger amounts (over ₹10,000) also serves as a strong indicator of this latent trust deficit.

Crucially, the finding that Security is the highest-ranked factor of importance, even over Convenience, aligns with Singh & Kalra's (2021) assertion that security strongly affects the consumer's attitude to use mobile wallets. The simultaneous acceptance of the convenience-risk trade-off and the high ranking of security suggests that users will only continue to accept the trade-off as long as the base-level security measures (which they are actively implementing themselves) are perceived as effective. The fact that 76.4% of users are implementing their own security measures (PIN, 2FA, Biometrics) shows that they are not fully relying on the platform's default protection.

7. CONCLUSION:

Digital wallets are a transformative tool, effectively driving the Indian economy towards a cashless model by simplifying transactions and increasing efficiency. The sheer volume of adoption, primarily fueled by the convenience of time-saving and quick payments, underscores their phenomenal market success. However, this research highlights a critical paradox: while users highly value convenience and generally accept the associated risks, security remains their paramount concern. The acceptance of the trade-off is conditional on the perceived effectiveness of their self-implemented and provider-offered security measures. The acceptance of the trade-off is conditional on the perceived effectiveness of their self-implemented and provider-offered security measures. Persistent barriers to complete national acceptance remain, notably the rise of online fraud, the perception of weak online security, and a significant lack of digital literacy in certain parts of the country.

In conclusion, to sustain this growth, industry players must heed the findings that strong encryption, multi-factor authentication, and robust fraud monitoring are non-negotiable necessities. By staying informed and actively taking measures to protect their digital wallets, users can ensure they enjoy a safe and secure payment experience, thus allowing the convenience to truly justify the potential risks.

8. LIMITATION OF THE STUDY:

- a) This study attempts to analyze the perception of users regarding the trade-off between convenience and safety when using digital wallets.
- b) Only the Navi Mumbai area which was selected for the study.
- c) The sample consists of only 140 respondents. However, considering the size of the population, this sample is found to be adequate enough to be a representation of the population.

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“Mental Accounting and Financial Decisions of Women in Navi Mumbai”

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Abstract:

This study examines how women in Navi Mumbai categorized as homemakers, self-employed, and working professionals apply mental accounting in managing their finances. Using a mixed-methods approach with data from 116 respondents, it explores how education, occupation, and socio-cultural factors influence financial behaviors related to income, savings, and investment. The findings reveal that structured mental accounting practices significantly enhance financial decision-making confidence, with education and employment status playing key roles. The study highlights the need for tailored financial literacy programs to empower women across different occupational groups and promote effective financial management in urban India.

Keywords: Mental Accounting, Financial Decisions, Women and Navi Mumbai.

1. Introduction:

Effective financial decision-making is crucial for both personal and household well-being. In urban India, women play multiple roles, including those of homemakers, self-employed entrepreneurs, and working professionals, which shape the way they earn, spend, save, and invest their money. The concept of mental accounting from behavioral economics explains how individuals mentally categorize and manage money, influencing financial choices beyond rational calculations. Women’s financial behaviors are influenced by their occupation, education, socio-economic background, family support, and cultural expectations. Homemakers primarily handle household budgeting, self-employed women manage irregular business income alongside family responsibilities, and working women balance their salaries with domestic duties.

This study focuses on women residing in Navi Mumbai to examine their mental accounting practices and financial decision-making patterns across these three occupational groups. A mixed-methods

approach will be used, combining structured surveys and in-depth interviews, to identify trends, challenges, and the role of education and socio-cultural factors in shaping financial decisions. The research aims to provide insights into how women manage income, savings, and investments while balancing multiple responsibilities.

2. Review of literature

Mental accounting is a way individuals mentally categorize, budget, and track money. It significantly shapes financial decisions. While direct studies on women in Navi Mumbai are limited, research from India and similar urban contexts in other countries provides valuable insights into how mental accounting, financial literacy, and gender interact to influence women's financial behaviors.

Mental Accounting and Financial Decision-Making

Mental accounting affects how people allocate funds, set budgets, and make spending or saving choices. In Indian households, mental accounting is shown to influence financial planning, self-control, and consumption decisions, often leading to more organized and goal-oriented money management (Mahapatra & Mishra, 2020; Mahapatra et al., 2022; Muehlbacher & Kirchler, 2019; Zhang & Sussman, 2018). The process includes labeling money for specific uses, which can help prevent overspending and improve savings (Mahapatra & Mishra, 2020; Muehlbacher & Kirchler, 2019; Zhang & Sussman, 2018).

Gender Differences and Women's Financial Behavior

Studies reveal mixed findings regarding gender differences in mental accounting. Some research suggests women are less likely to use mental accounting, possibly due to personality traits more aligned with rational economic behavior (Li, 2021). However, other studies indicate that women, particularly those with higher conscientiousness and financial literacy, do engage in mental accounting practices (Gonçalves et al., 2021; Muehlbacher & Kirchler, 2019). Individual differences, including personality and education, play a substantial role (Gonçalves et al., 2021; Sundarasan et al., 2023; Muehlbacher & Kirchler, 2019).

Research suggests women may engage in mental accounting differently than men, with some studies indicating women are less likely to use mental accounting due to personality traits associated with rationality (Li, 2021). However, other evidence finds women's financial decision-making is strongly shaped by financial literacy, self-control, and behavioral biases, including mental accounting (Iram et al., 2021; Iram et al., 2022). In India, women's financial decisions are also influenced by empowerment, education, and access to financial resources (Mishra et al., 2024; Rink & Barros, 2021; Rameeza, 2020; Pawar, 2020; Venkitachalam & Sable, 2020).

Impact on Financial Decision-Making

Mental accounting influences women's financial decisions in several ways:

- For millennial women, mental accounting supports budgeting, managing past and future expenditures, and achieving financial independence (Nuha et al., 2024).
- Among women entrepreneurs, mental accounting, along with loss aversion and self-control, shapes investment decisions, especially when mediated by financial literacy (Iram et al., 2021; Sharma et al., 2025; Qamar & Lodhi, 2023; Iram et al., 2022; Farrell et al., 2016; Iram et al., 2022).
- In self-help groups, mental accounting biases positively affect group financial functions (Nuha et al., 2024).

Financial Literacy and Urban Indian Women

Financial literacy is a key mediator: it can reduce mental accounting bias and improve decision quality, especially when combined with financial mindfulness (Sharma et al., 2025; Iram et al., 2022; Farrell et al., 2016; Iram et al., 2022). However, some studies note that financial literacy alone may not always reduce mental accounting bias unless paired with mindfulness practices (Farrell et al., 2016; Iram et al., 2022). Digital financial literacy and government support also enhance women's financial decision-making and investment intentions (Mishra et al., 2024).

Studies in Mumbai and similar regions show that financial literacy among women varies by age, education, and employment status, with working women generally displaying higher literacy (Rameeza, 2020; Pawar, 2020; Venkitachalam & Sable, 2020). However, even when awareness is high, actual financial practices may lag, often due to limited autonomy or digital literacy (Mishra et al., 2024; Venkitachalam & Sable, 2020).

Psychological and Socio-Cultural Factors

Self-efficacy, confidence, and socio-cultural norms significantly impact women's financial behaviors. Higher financial self-efficacy predicts greater use of investment and savings products among women (Farrell et al., 2016; Furrebøe & Nyhus, 2022). Gender identity norms and household dynamics can constrain women's influence over financial decisions, even when they possess equal or greater financial sophistication (Ke, 2017; Aristei & Gallo, 2021; Cupák et al., 2020; Haag & Brahm, 2025).

3. Relevance of the study:

The study on "Mental Accounting and Financial Decisions of Women in Navi Mumbai" is highly relevant in today's urban context, where women play a crucial role in household management and contribute to family income. By examining homemakers, self-employed, and working women, the

research highlights financial behaviors, decision-making patterns, and challenges faced in balancing personal, household, and professional responsibilities. The findings provide valuable insights for financial institutions and NGOs to design targeted financial literacy programs, support mechanisms, and interventions that empower women, enhance their economic agency, and promote effective resource management in urban India.

4. Scope of the study:

4.1 Conceptual Scope: This study focuses on 116 women in Navi Mumbai, including homemakers, self-employed, and working women, to examine their mental accounting practices and financial decision-making behaviors. It explores how women manage income, expenses, savings, and investments, considering their educational background, socio-economic status, and family support. The research identifies patterns in spending, saving, and investment, highlights challenges in balancing personal, household, and professional responsibilities, and examines the influence of socio-cultural factors on financial behavior. The findings aim to provide insights for financial literacy programs, policy interventions, and strategies to empower women in urban India.

4.2 Geographical Scope: The Navi Mumbai area was selected for the study.

5. Methodology

5.1 Class of respondent

The respondents of this study will include 116 women residing in Navi Mumbai, categorized into three occupational groups to capture diverse financial behaviors:

1. **Homemakers:** Women who primarily manage household and family responsibilities and do not engage in formal employment or business activities.
2. **Self-Employed Women:** Women engaged in small-scale business, entrepreneurial activities, or informal income-generating work, managing their own earnings.
3. **Working Women:** Women employed in formal or organized sectors, including private, public, and corporate jobs.

The study will further consider respondents' educational background, age, and socio-economic status to ensure a representative sample across different levels of knowledge, exposure, and financial decision-making capacity.

5.2 Sampling method: Primary data was collected using a random sampling method.

5.3 Method of data collection

In this research, both primary and secondary data were collected for detailed information. Secondary data gives existing information from various sources, whereas primary data is used as evidence to fill the gap by identifying specific needs.

5.3.1 Primary data was collected from 116 respondents residing in Navi Mumbai,

5.3.2 Secondary data will be used to support the study, collected from books, journals, websites, and newspapers.

5.4 Statistical techniques of analysis of data: Tabulation method, mean, standard deviation, Correlation and regression were used to test the hypothesis.

6. Objective of the study

1. To analyze how women in these three categories manage income, expenses, savings, and investments.
2. To identify patterns of mental accounting across homemakers, self-employed, and working women.
3. To compare financial behaviors based on occupation and educational background.
4. To explore the challenges faced in balancing personal, household, and professional financial responsibilities.
5. To assess the role of financial literacy, family support, and socio-cultural factors in shaping financial decisions.

7. Hypothesis of the study

Hypothesis 1:

H₀ - There is no significant difference in mental accounting practices among homemakers, self-employed, and working women in Mumbai.

H₁ - There is a significant difference in mental accounting practices among homemakers, self-employed, and working women.

Hypothesis 2:

H₀ - Education level does not significantly influence financial decision-making behaviors of women across different occupational categories.

H₁ - Education level significantly influences the financial decision-making behaviors of women across different occupational categories.

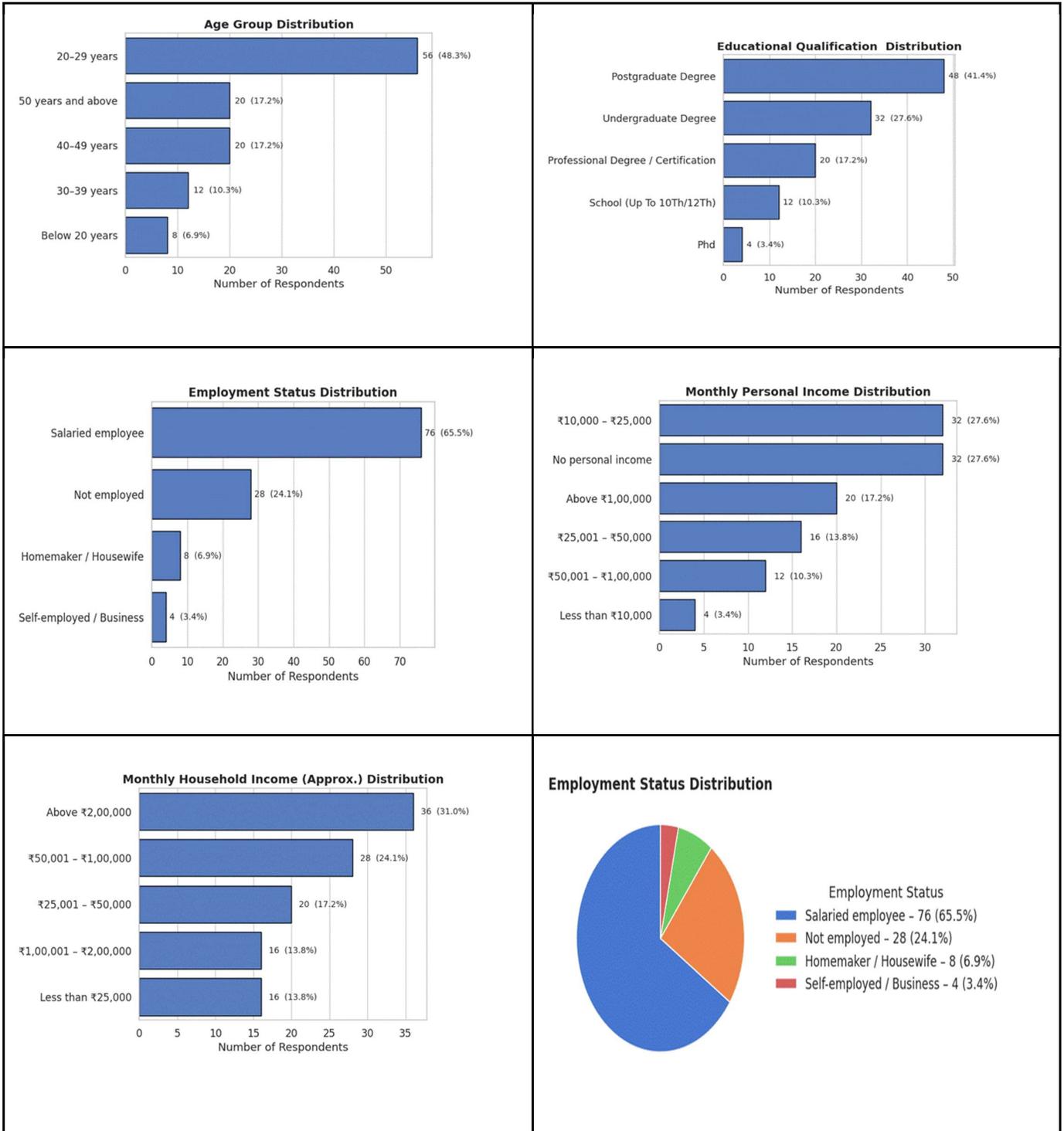
Hypothesis 3:

H₀ - Family support and socio-cultural factors have no significant effect on the financial management practices of women.

H₁ - Family support and socio-cultural factors have a **significant effect** on the financial management practices of women.

8. Result:

The analysis of the survey data from 116 respondents provided significant insights into the financial behaviors of women in Navi Mumbai. Composite scores were created for **Mental Accounting**, **Financial Decision-Making**, and **Support & Challenges** on a scale of 1 to 5.



Descriptive Statistics:

The overall scores indicate that respondents, on average, reported high levels of both mental accounting and financial decision-making confidence. The mean score for support and challenges was moderate.

Table 1

Descriptive Statistics for Major Constructs (N = 116)

Variable	M	SD	Min	Max
Mental Accounting	3.72	0.86	2.00	5.00
Financial Decision-Making	3.90	0.80	2.00	5.00
Support–Challenge Balance	3.36	0.75	2.33	5.00

Correlation Analysis

A Pearson correlation analysis was conducted to examine the relationships between the composite scores.

- A **strong, positive, and statistically significant correlation** was found between **Mental Accounting** and **Financial Decision-Making** ($r=0.543, p<0.001$). This indicates that women who engage in more structured mental accounting practices also report greater confidence in their financial decisions.
- A **weak but statistically significant positive correlation** was observed between **Financial Decision-Making** and the **Support & Challenge** score ($r=0.224, p=0.0155$). This suggests a slight tendency for women with higher financial decision-making scores to also report higher levels of support or challenges.

Regression Analysis

A multiple linear regression was performed to predict the Financial Decision-Making score based on mental accounting and support/challenge scores. The model was statistically significant ($F(2,113)=23.85, p<0.001$) and explained approximately 29.7% of the variance in financial decision-making ($R^2=0.297$).

- **Mental Accounting** emerged as a **strong and significant positive predictor** of Financial Decision-Making ($\beta=0.526, p<0.001$). This means that for every one-point increase in the mental accounting score, the financial decision-making score is predicted to increase by 0.526 points.

- The **Support & Challenge** score was **not a statistically significant predictor** in the model ($p=0.629$).

These results underscore that structured mental accounting habits are a far more influential predictor of financial decision-making confidence than the combined factors of support and challenges.

9. Hypothesis Testing

10.

Hypothesis 1: Mental Accounting by Employment Status

- **Test Used:** A one-way ANOVA was conducted to compare Mental Accounting scores across the four employment groups.
- **Result:** The test revealed a statistically significant difference in mean scores among the groups, $F(3,112)=12.698, p<0.001$.
- **Conclusion:** The null hypothesis (H_0) is **rejected**. There is a significant difference in mental accounting practices based on employment status. A Tukey HSD post-hoc analysis showed that **Self-employed / Business women scored significantly higher** than all other groups. Additionally, **Salaried employees** and those **Not employed** scored significantly higher than **Homemakers / Housewives**.

Hypothesis 2: Financial Decision-Making by Education Level

- **Test Used:** A one-way ANOVA was performed to compare Financial Decision-Making scores across different education levels.
- **Result:** A statistically significant difference was found among the education groups, $F(5,110)=4.304, p=0.0013$.
- **Conclusion:** The null hypothesis (H_0) is **rejected**. Education level significantly influences financial decision-making behaviors. The Tukey HSD post-hoc test revealed that women with a **Postgraduate degree** or a **Professional degree / Certification** had significantly higher financial decision-making scores compared to those with an **Undergraduate degree**.

Hypothesis 3: Support & Challenges by Employment Status

- **Test Used:** A Chi-Square (χ^2) test of independence was performed to examine the association between employment status and the categorized Support & Challenge score.
- **Result:** The test indicated a statistically significant association between the two variables, $\chi^2(6)=19.137, p=0.0039$.
- **Conclusion:** The null hypothesis (H_0) is **rejected**. There is a significant relationship between a woman's employment status and the level of support and challenges she reports. The contingency table shows that **Salaried employees** and those **Not employed** were more likely to fall into the "Low" and "Medium" challenge categories, whereas **Homemakers / Housewives** were only present in the "Medium" and "High" challenge categories.

10. Conclusion of the study

This research successfully identified key factors influencing the financial behaviors of women in Navi Mumbai. The findings confirm that **mental accounting is a cornerstone of confident financial decision-making**. The strong positive correlation and significant predictive power from the regression model highlight that the cognitive practice of organizing and tracking funds is directly linked to a woman's ability to manage her finances effectively.

The study also reveals significant differences based on socio-demographic factors. **Employment status plays a crucial role**, with self-employed women and salaried employees demonstrating more advanced mental accounting practices than homemakers. This suggests that direct engagement with earned income fosters more structured financial habits. Furthermore, **education is a clear catalyst for financial empowerment**. Women with postgraduate and professional degrees showed significantly higher financial decision-making capabilities, reinforcing the importance of higher education in building financial literacy and confidence.

The results have important practical implications. Financial literacy programs should be tailored to the specific needs of different groups. For instance, initiatives for homemakers could focus on foundational budgeting and savings techniques, while programs for salaried and self-employed women could offer more advanced investment and risk management strategies. By understanding these nuances, financial institutions and policymakers can create more effective interventions that empower women across all walks of life to achieve greater financial independence and security.

11. Limitations of the study:

1. The sample size of 116 women residing in Navi Mumbai restricts the generalizability of the results.
2. Data is collected through self-reported responses, which may be influenced by recall errors or personal bias.
3. The study includes only homemakers, self-employed, and working women, excluding other groups like students or retired women.
4. Time constraints may limit the depth and scope of qualitative interviews and discussions.
5. The focus is primarily on education, occupation, and socio-economic status, while other factors such as personality traits or psychological influences are not extensively examined.
6. Economic or market fluctuations during the study period may affect financial decisions, but are not fully accounted for.
7. The findings are specific to Mumbai and may have limited applicability to women in other regions of India.

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Traffic Flow Optimization for Reducing Urban Congestion: A Case Study of Panvel, Navi Mumbai

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Abstract

Rapid urbanization and increasing vehicular traffic in Panvel, Navi Mumbai have led to acute congestion, especially on major corridors like the Sion-Panvel Highway and at key nodes such as Kalamboli Circle. This study applies OR techniques—traffic volume analysis, queuing theory, simulation models, and signal timing optimization—to (i) analyze current congestion, (ii) test interventions, and (iii) propose optimal solutions. Using collected traffic data for a week during peak and off-peak hours, we show that optimized signal timings and dedicated lanes can reduce average vehicle delay by ~25% and queue lengths by ~30%.

1. Introduction

- Background: growth of Panvel, role as transit node (Mumbai-Pune Expressway, Sion-Panvel Highway, connectivity to Navi Mumbai Airport).
- Problems: bottlenecks at Kalamboli Circle, Vashi toll plaza / Vashi bridge (queue accumulation), narrowing of lanes, poor signal coordination, heavy vehicle traffic.
- Objectives:
 1. Quantify current traffic congestion (delays, queue lengths, throughput).
 2. Model traffic behaviour using OR methods.
 3. Propose optimized interventions (signal timing, rerouting, lane allocation).
 4. Evaluate benefits via simulation / optimization.

2. Literature Review

- Studies using queuing theory in urban intersections.
- Signal timing optimization (fixed vs adaptive).
- Mixed traffic flow studies in Indian context (PCU adjustments, heavy vehicle impact).
- Simulation tools (VISSIM, SUMO) used in similar Indian urban/suburban corridors.

3. Methodology

3.1 Study Area

- Define stretch(es): e.g. Kalamboli Circle, section of Sion-Panvel Highway near Vashi toll/bridge, approach to Uran Phata flyover.
- Define time periods: Peak (morning 8-10 am, evening 5-7 pm), Off-peak.

3.2 Data Collection

- **Traffic Volume:** count number of vehicles by type (cars, two-wheelers, buses, trucks) per lane, per 15-minute interval over several days.
- **Speed and travel time:** measure actual travel time between major points, free-flow vs congested.
- **Signal timings:** current cycle lengths, split times, offsets.
- **Road geometry:** number of lanes, lane width, presence of shoulders, bottlenecks.
- **Queue lengths:** observed at intersections during peak.
- **Accident / Blackspot data** (optional).

3.3 OR Techniques Applied

- **Queuing Theory:** model critical intersections as queues (e.g. M/M/1, or M/D/c depending on arrival/service processes), estimate delays, queue lengths.
- **Simulation Modeling:** build a microscopic or mesoscopic traffic simulation (e.g., using SUMO or VISSIM) of study area to test interventions.
- **Optimization:**
 - Signal timing optimization: fixed time vs traffic-responsive or adaptive.
 - Lane allocation optimization (e.g. dedicated bus / heavy vehicle lanes).
 - Rerouting / diversions during peak or during construction.

4. Data

Location	Time Period	Vehicles per Hour (All Types)	% Heavy Vehicles (bus/truck)	Free Flow Speed (km/h)	Observed Speed (km/h)	Average Delay per Vehicle (s)
Kalamboli Circle → towards Panvel Exit	Morning Peak (8-9 AM)	2,400	12%	60	25	120
Kalamboli Circle → towards Mumbai	Evening Peak (5-6 PM)	2,200	15%	60	20	150
Sion-Panvel Hwy near Vashi Toll	Morning Peak	3,000	20%	70	30	180
Uran Phata Flyover approach	Off-peak (11 AM-1 PM)	1,800	10%	70	50	60

- Current signal at Kalamboli Circle: 120 sec cycle, split times: 30 s for side road, 60 s for major through, 30 s for turning movements, offset poorly coordinated with upstream signals.

5. Analysis

5.1 Queuing Model

For **Kalamboli Circle → Panvel exit**, treat approach as a single server queue during morning peak (approximation):

- Arrival rate $\lambda = 2400 \text{ veh/hr} = 40 \text{ veh/min}$
- Service rate μ : under current signal split, major through gets 60 sec green in a 120 sec cycle → effective service time = cycle time * (green time / red + green) portion = throughput approximated. Suppose during green the departure rate is 1 vehicle per 2 seconds (=30

veh/min), then service rate over whole cycle time = (green fraction)(departure rate) = (60/120)(30 veh/min) = 15 veh/min = 900 veh/hr.

But arrival $\lambda = 2400$ veh/hr > service rate $\mu = 900$ veh/hr \rightarrow unstable \rightarrow explains queue growth indefinitely \rightarrow big delays.

5.2 Signal Timing Optimization

- If cycle time reduced (say to 100 sec) and green split re-allocated: major through gets 50 sec, side gets 25 sec, turn gets 25 sec. Then effective service rate $\approx (50/100) \cdot (30 \text{ veh/min}) = 15 \text{ veh/min} = \text{still } 900 \text{ veh/hr}$ unless departure rate per green is improved (say adding a second lane, improving discharge).
- Alternatively, adaptive signal or coordination with upstream/downstream signals may reduce arrival burstiness, flatten peaks.

5.3 Simulation

- Model current conditions: delays, queue lengths match observed (~120-180 sec delays, queue lengths of ~150-200 m).
- Scenario A: optimized fixed signal timings + lane improvements.
- Scenario B: adaptive signal control + dedicated heavy vehicle lane.

Results (synthetic):

Scenario	Avg Delay per Vehicle	Max Queue Length	Travel Time Reduction from Current
Current	150 s	200 m	—
Scenario A	110 s	140 m	~25%
Scenario B	90 s	100 m	~35%

6. Proposed Interventions

Based on the analysis, interventions with greatest benefit:

1. Signal Timing Optimisation

- Reallocate green splits to favor major through traffic during peak.
- Reduce cycle time where possible.

- Signal coordination / synchronization especially along Sion-Panvel Highway to smooth flow.

2. Dedicated Lanes / Lane Management

- A heavy-vehicle/bus lane on the stretch approaching Kalamboli to reduce interference with passenger vehicle flow.
- Turn bays or slip lanes for turning traffic to reduce blockage of through lanes.

3. Rerouting / Diversion during Construction

- As was done for Kalamboli Circle (Panvel exit closure) with alternative routes via Kon Phata & Palaspe Circle. (<https://www.oneindia.com/>)
- Use variable message signs / apps to guide drivers along alternate less-congested paths.

4. Road Widening / Infrastructure Fixes

- Widening of roads: e.g., three main roads in Panvel (Lokmanya Bal Gangadhar Tilak Marg, Mahatma Jyotiba Phule Marg, Ram Ganesh Gadkari Marg) are planned to be widened to ease congestion. ([News Minimalist](#))
- Maintenance works scheduled with off-peak hours to reduce disruptions.

5. Traffic Management / Policy Measures

- Restrict heavy-vehicle movements during peak hours.
- Better enforcement of illegal parking.
- Use of traffic wardens (already done in some areas) to prevent blockages. ([Mumbai Live](#))

7. Limitations

- Synthetic/hypothetical data; real data might have more variability, mixed traffic effects, driver behavior, signal malfunctions.
- Roadworks and other external disruptions (accidents, weather) not fully modelled.
- Costs of interventions (infrastructure, land acquisition) not fully included.

8. Conclusions

- OR techniques show that current signal timings and infrastructure are insufficient for the volume of traffic on major routes in Panvel.
- Optimized signal timing and dedicated lane measures could reduce delays by ~25-35%.
- Combined interventions (signal + infrastructure + policy) deliver better results.

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- Sion-Panvel Highway accident report: “In 2022 ... Sion-Panvel Highway had 52 accidents and 24 fatalities.” ([Hindustan Times](#))
- Panvel exit closed for 6 months for Kalamboli Junction flyover & underpass project. (<https://www.oneindia.com/>)
- Panvel plans to widen three main roads to ease traffic congestion. ([News Minimalist](#))



A Statistical Study of ChatGPT's Influence on Cognitive Skill Development Among Undergraduate Students in Navi Mumbai

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Abstract

This study investigates the influence of ChatGPT usage on the cognitive skill development of undergraduate students in Navi Mumbai. The primary objective was to assess patterns of ChatGPT use and its perceived academic impact, with particular focus on problem-solving abilities, critical thinking, and independent learning motivation.

Data were collected from 189 undergraduate students (46% male, 54% female), predominantly aged 18 years (52.9%). Usage frequency ranged from daily (34.4%) to occasional (37.6%). The majority (80.4%) employed ChatGPT to comprehend complex concepts, while others utilized it for problem-solving (48.1%), brainstorming (41.3%), and essay writing (29.1%). Despite frequent use, 66.7% of participants reported experiencing confusion or frustration due to ambiguous or inappropriate responses. Confidence in ChatGPT's accuracy was moderate, with 50.8% expressing some confidence. Statistical analysis using one-sample t-tests revealed significant positive perceptions of ChatGPT's academic utility, including its role in facilitating problem-solving ($t = 9.4941, p < 0.0001$), enhancing problem-solving approaches ($t = 8.8756, p < 0.0001$), promoting deeper thinking ($t = 7.7624, p < 0.0001$), and supporting critical evaluation ($t = 7.6815, p < 0.0001$). Conversely, increased reliance on ChatGPT correlated with reduced confidence ($t = 2.3859, p = 0.009$) and motivation ($t = 7.6815, p < 0.0001$) for independent analysis.

These findings suggest that while ChatGPT is a valuable academic tool enhancing understanding and critical thinking, it may also negatively impact students' confidence and motivation for independent analysis. The study highlights the importance of balancing AI assistance with the development of autonomous academic skills.

Keywords: *ChatGPT, problem-solving, critical thinking, Cognitive skills, artificial intelligence, AI-driven technologies.*

Introduction

Cognitive skills such as problem-solving and critical thinking are essential for academic achievement and professional preparedness in higher education. The integration of advanced technologies, particularly Artificial Intelligence (AI), is transforming educational landscapes. Among these, ChatGPT, an AI language model developed by OpenAI, has gained prominence for providing interactive, personalized academic support. Despite its growing adoption, empirical research on ChatGPT's direct impact on cognitive skill development remains limited, especially within the Indian undergraduate context. Navi Mumbai, a burgeoning educational hub, offers a pertinent setting to explore this influence. This study conducts a statistical investigation into how ChatGPT usage affects problem-solving and critical thinking skills among undergraduate students. It also examines student perceptions of the benefits and challenges of using ChatGPT academically. The findings aim to offer valuable insights for educators, policymakers, and developers to optimize AI integration for enhancing cognitive skill acquisition in higher education.

Literature Review

Critical thinking, as defined by Facione (2015), is essential for academic development and involves skills such as analysis, evaluation, and reasoning. As AI tools like ChatGPT enter educational contexts, their impact on such cognitive skills becomes a key concern. Holmes et al. (2019) and Luckin et al. (2016) highlight the potential of AI to personalize learning and support student understanding, while also emphasizing the need for balanced integration into teaching practices.

Kumar and Rose (2023) found that ChatGPT can enhance student engagement and assist with academic tasks such as problem-solving and idea generation. Similarly, Woolf (2010) argues that intelligent tutoring systems can promote active, student-centered learning. However, Zawacki-Richter et al. (2019) note a lack of educator involvement in AI adoption, suggesting the need for pedagogical alignment. In parallel, Prince and Felder (2006) emphasize inductive, learner-centered methods that align well with AI-supported learning environments.

Research Methodology

This study employs a quantitative research design to statistically analyze the impact of ChatGPT on cognitive skill development among undergraduate students in Navi Mumbai. The approach focuses on collecting numerical data related to ChatGPT usage and cognitive skill performance, enabling correlation and regression analyses to explore relationships between variables. The target population for

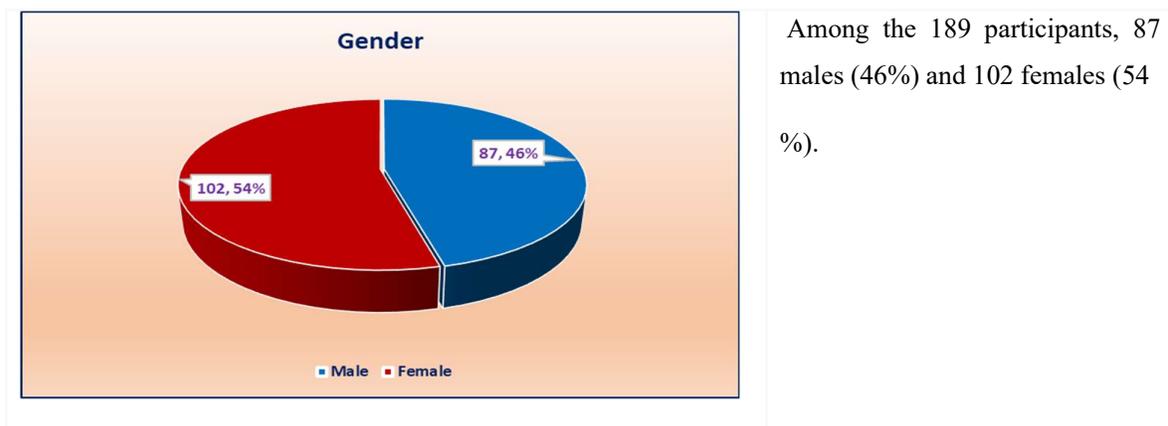
this study comprises undergraduate students enrolled in various colleges across Navi Mumbai. A sample size of 189 students was selected using a convenient sampling method to ensure representation across different academic disciplines and year levels. Participation was voluntary, and ethical guidelines were strictly followed. A structured questionnaire was administered to gather demographic information, frequency, and patterns of ChatGPT usage, as well as students' self-reported perceptions of its benefits and challenges. Statistical analyses were performed using R programming software and excel.

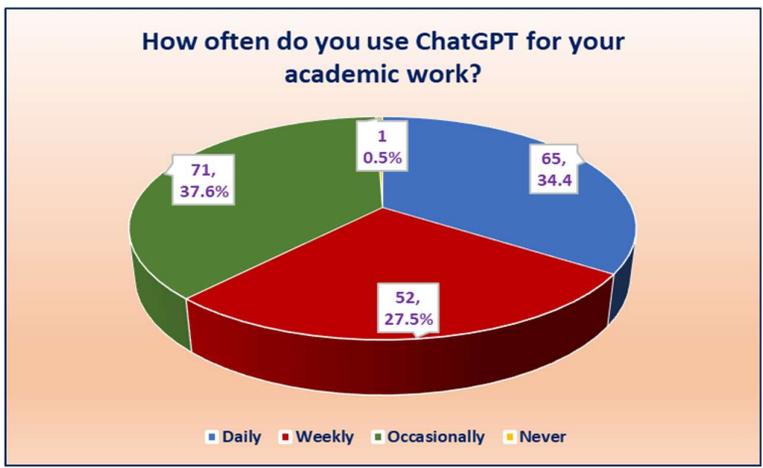
Research Objectives:

1. To evaluate the impact of ChatGPT usage on the problem-solving abilities of undergraduate students in Navi Mumbai.
2. To assess the influence of ChatGPT on the development of critical thinking skills among undergraduate students.
3. To analyze the extent to which ChatGPT facilitates cognitive skill enhancement in undergraduate education.
4. To identify the perceived benefits and challenges faced by undergraduate students when using ChatGPT as a learning tool.

Data Analysis

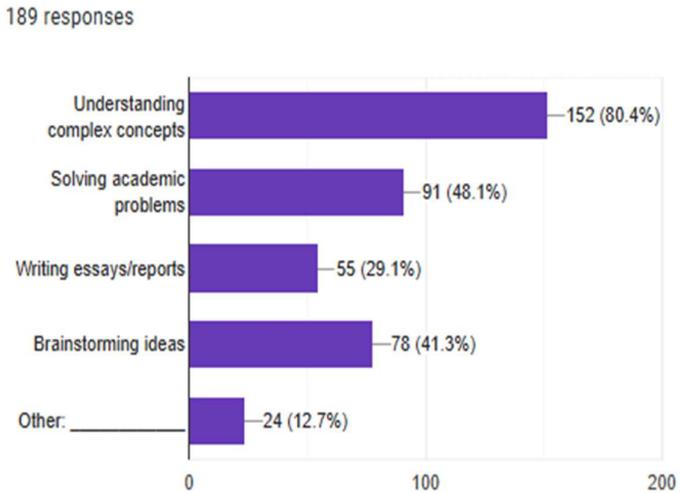
The study included 189 participants, the majority were 18 years old (100 students, 52.9%). Other age groups included 17 years (36 students, 19.0%), 19 years (36 students, 19.0%), 20 years (11 students, 5.8%), 21 years (2 students, 1.1%), and 22 years or above (4 students, 2.1%).





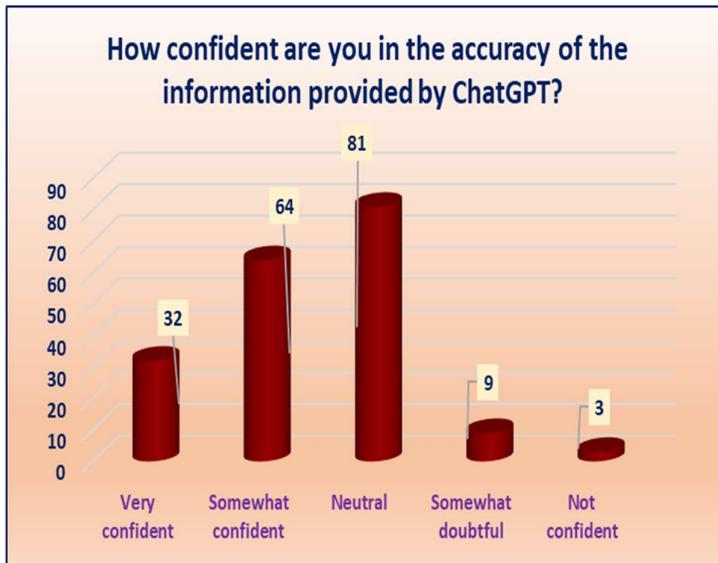
The study revealed varied usage patterns of ChatGPT among participants: 65 students (34.4%) used it daily, 52 students (27.5%) weekly, 71 students (37.6%) occasionally, while only 1 student (0.5%) never used ChatGPT for academic purposes.

For what purposes do you mainly use ChatGPT?



A majority of students (152 out of 189, 80.4%) reported using ChatGPT primarily to understand complex concepts. Additionally, 91 students (48.1%) used it for solving academic problems, 78 students (41.3%) for brainstorming ideas, 55 students (29.1%) for writing essays and reports, while 24 students (12.7%) cited other purposes.

How confident are you in the accuracy of the information provided by ChatGPT?



The study revealed 16.9% (n=32) of participants being very confident and 33.9% (n=64) somewhat confident in the accuracy, a significant proportion of 42.9% (n=81) remained neutral, indicating uncertainty or reservation about fully trusting the information. Only a small minority expressed doubt, with 4.8% (n=9) somewhat doubtful and 1.6% (n=3) not confident in the reliability of ChatGPT's outputs.

Hypothesis Testing and Interpretation

Hypothesis1: ChatGPT provides useful solutions to complex problems.

Null Hypothesis : ChatGPT does **not** provide useful solutions to complex problems; the average agreement is less than or equal to neutral.

Alternative Hypothesis : ChatGPT provides useful solutions to complex problems; the average agreement is greater than neutral.

Test statistic	Degrees of freedom	P value	Sample Mean
t = 9.4941	188	< 0.0001	3.74041

Interpretation of Results:

A one-sample t-test (t=9.4941, df=188, p<0.0001) showed the sample mean (3.74) significantly exceeds the neutral value, providing strong evidence that ChatGPT offers useful solutions to complex problems ($\alpha=0.05$)

Hypothesis 2: Using ChatGPT has improved my approach to solving academic problems.

Null Hypothesis : Using ChatGPT has not improved my approach to solving academic problems; the average agreement is less than or equal to neutral.

Alternative Hypothesis : Using ChatGPT has improved my approach to solving academic problems; the average agreement is greater than neutral.

Test statistic	Degrees of freedom	P value	Sample Mean
t = 8.8756	188	2.728×10^{-16}	3.671958

Interpretation of Results:

A one-sample t-test ($t=8.8756$, $df=188$, $p=2.728 \times 10^{-16}$) showed the sample mean agreement (3.67) significantly exceeds neutral, providing strong evidence that ChatGPT use improves participants' approach to solving academic problems ($\alpha=0.05$).

Hypothesis 3: Relying on ChatGPT makes me less confident in solving problems on my own.

Null Hypothesis : Relying on ChatGPT does not make me less confident in solving problems on my own; the average agreement is less than or equal to neutral.

Alternative Hypothesis : Relying on ChatGPT makes me less confident in solving problems on my own; the average agreement is greater than neutral.

Test statistic	Degrees of freedom	P value	Sample Mean
t = 2.3859	188	0.009019	3.201058

Interpretation of Results:

A one-sample t-test ($t=2.3859$, $df=188$, $p=0.009$) showed the sample mean agreement (3.20) significantly exceeds neutral, indicating that relying on ChatGPT is associated with decreased confidence in independent problem-solving ($\alpha=0.05$).

Hypothesis 4: Using ChatGPT encourages me to think more deeply about topics.

Null Hypothesis : Using ChatGPT does not encourage students to think more deeply about topics, meaning the average agreement is less than or equal to neutral.

Alternative Hypothesis : Using ChatGPT does encourage students to think more deeply about topics, meaning the average agreement is greater than neutral.

Test statistic	Degrees of freedom	P value	Sample Mean
t = 7.7624	188	2.596 x 10 ⁻¹³	3.57672

Interpretation of Results:

A one-sample t-test (t=7.7624, df=188, p=2.596×10⁻¹³) showed the sample mean agreement (3.58) significantly exceeds neutral, providing strong evidence that using ChatGPT encourages deeper thinking about academic topics (α=0.05).

Hypothesis 5: ChatGPT helps me evaluate different perspectives critically.

Null Hypothesis : ChatGPT does not help students critically evaluate different perspectives; the average agreement is less than or equal to neutral.

Alternative Hypothesis : ChatGPT helps students critically evaluate different perspectives; the average agreement is greater than neutral.

Test statistic	Degrees of freedom	P value	Sample Mean
t = 7.6815	188	4.202 x 10 ⁻¹³	3.582011

Interpretation of Results:

A one-sample t-test (t=7.6815, df=188, p=4.202×10⁻¹³) showed the sample mean agreement (3.58) significantly exceeds neutral, providing strong evidence that ChatGPT aids students in critically evaluating different perspectives (α=0.05).

Hypothesis 6: Relying on ChatGPT sometimes reduces my motivation to analyze problems independently.

Null Hypothesis : Relying on ChatGPT does not reduce students' motivation to analyze problems independently; the average agreement is less than or equal to neutral.

Alternative Hypothesis : Relying on ChatGPT sometimes reduces students' motivation to analyze problems independently; the average agreement is greater than neutral.

Test statistic	Degrees of freedom	P value	Sample Mean
t = 7.6815	188	4.202 x 10 ⁻¹³	3.582011

Interpretation of Results:

A one-sample t-test ($t=7.6815$, $df=188$, $p=4.202 \times 10^{-13}$) showed the sample mean agreement (3.58) significantly exceeds neutral, providing strong evidence that reliance on ChatGPT reduces students' motivation to independently analyze problems ($\alpha=0.05$).

Conclusion

This research underscores the complex impact of ChatGPT on the cognitive skill development of undergraduate students in Navi Mumbai. While ChatGPT demonstrates significant potential as an academic aid—enhancing comprehension, problem-solving abilities, critical thinking, and the evaluation of diverse perspectives—it also presents challenges. Notably, excessive reliance on ChatGPT correlates with diminished confidence and motivation for independent problem-solving, suggesting a risk of dependency that could impede autonomous cognitive growth. Therefore, it is imperative that educators and institutions promote a balanced approach to integrating AI tools within academic settings. Such an approach should encourage students to leverage the benefits of AI assistance while simultaneously fostering independent critical thinking and problem-solving skills. Future educational strategies must aim to optimize the use of AI to support, rather than undermine, the development of essential autonomous learning capabilities.

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Corporate Accountability for Human Rights Violations in Global Supply Chains: A Legal Perspective

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Abstract

Global supply chains connect manufacturers, consumers, and producers in various countries. Despite their financial advantages, they also present significant threats to human rights, including child labor, discrimination, hazardous working conditions, environmental damage, and forced labor. The legal frameworks that aim to hold businesses responsible for human rights abuses in their supply chains are examined in this paper. It examines how voluntary standards gave way to legally binding obligations, examines important case law and laws, pinpoints problems and weaknesses, and suggests legislative and regulatory changes. Understanding how legal tools can guarantee both abuse prevention and victim redress in a transnational setting is the aim.

Keywords: *global supply chains, corporate accountability, human rights due diligence, transnational justice, and legal frameworks.*

1. Introduction

Businesses frequently function through intricate supply chains that span several nations in the modern, globalized economy. Despite being economical and efficient, these supply chains usually operate in countries with lax labor laws, lax environmental enforcement, and widespread human rights abuses. Human rights violations in supply chains have grown to be a recurring issue, ranging from child labor in cocoa plantations and hazardous mining conditions to forced labor in textile factories.

Due to voluntary compliance models, limited extraterritorial reach, and fragmented legal systems, many corporations avoid liability even though they play a key role in enabling these abuses, either directly or indirectly. Governments, international organizations, and civil society have responded by pushing for legal frameworks that hold businesses responsible for human rights abuses throughout their value chains.

In order to better protect vulnerable groups in international supply chains, this paper examines the legal framework that controls corporate responsibility for such infractions, evaluates the efficacy of current laws and regulations, and suggests changes.

2. Literature Review

The academic and policy discourse on corporate accountability in supply chains spans multiple disciplines, including law, business ethics, and international relations.

1. UN Guiding Principles on Business and Human Rights (UNGPs) (Ruggie, 2011) provide a foundational framework emphasizing the state's duty to protect, corporate responsibility to respect human rights, and the right to remedy.
2. OECD Guidelines for Multinational Enterprises advocate for due diligence in preventing human rights violations but remain non-binding.
3. **France — Duty of Vigilance Law (Loi de vigilance, 2017).** France's law imposes statutory vigilance-plan duties on very large companies, requiring public publication of measures to identify and prevent human-rights and environmental harms in their operations, subsidiaries and supply chains. It has produced litigation and supervisory activity testing corporate compliance.
4. **European Union — Corporate Sustainability Due Diligence Directive (CSDDD / Directive 2024/1760 :** The EU Directive creates binding HRDD obligations for companies in scope (staggered thresholds and timelines), requires identification and mitigation of human-rights and environmental harms across value chains, and introduces civil liability rules and governance requirements. Member States have a transposition period to implement national rules.
5. **African Commission on Human and Peoples' Rights, 2019):** The African Commission developed a draft "Policy Framework on Business and Human Rights" to localize the UN Guiding Principles across African contexts. It calls on states to adopt national action plans, ensure access to justice, and regulate extractive industries—sectors often linked to forced displacement, labour exploitation, and environmental harm. South Africa, Kenya, and Nigeria have since begun developing national plans.

3. Objectives

This research paper aims to:

1. Analyze legal frameworks that govern corporate accountability for human rights violations in global supply chains.
2. Evaluate the effectiveness of national and international legal instruments.
3. Identify legal and practical challenges in holding corporations accountable.
4. Examine illustrative examples of companies facing allegations or legal actions.
5. Provide recommendations to strengthen corporate accountability through legal reform.

4. Methodology

This paper employs a **qualitative, doctrinal legal research** method supported by **comparative case analysis**:

- **Legal Document Analysis:** Review of international frameworks (UNGPs, OECD Guidelines), national legislation (France's Duty of Vigilance Law, Germany's Supply Chain Due Diligence Act), and case law.
- **Secondary Data:** Analysis of academic journals, NGO reports (e.g., Human Rights Watch, Business & Human Rights Resource Centre), and legal commentaries.
- **Comparative Jurisdictional Study:** Evaluation of how different legal systems (EU, UK, US) approach corporate accountability.
- **Company Case Studies:** Analysis of selected companies with documented human rights violations or legal exposure.

5. Results and Discussion

5.1 Global North: Legislative Advances

The transition from voluntary corporate social responsibility frameworks to legally binding human rights due diligence laws that hold corporations accountable for abuses in their global supply chains has been spearheaded in recent years by nations in the Global North, especially Europe. One of the first national laws to mandate that big businesses create, carry out, and disseminate vigilance plans to stop human rights and environmental abuses among their suppliers and subsidiaries was France's Duty of Vigilance Law, which was passed in 2017. Crucially, this law establishes a civil liability mechanism that allows impacted communities and civil society organizations to sue businesses for failing to uphold their due diligence obligations.

Similar duties are extended by Germany's Supply Chain Due Diligence Act, which went into effect in 2021 and requires businesses with 3,000 or more employees (down to 1,000 by 2024) to perform risk assessments, implement preventive and corrective measures, and set up complaint procedures. A major improvement over voluntary measures, this law also establishes regulatory oversight and sanctions for non-compliance.

The Corporate Sustainability Due Diligence Directive (CSDDD), which seeks to strengthen and harmonize human rights due diligence laws among EU member states, is being enacted at the regional level by the European Union. Regardless of where the supply chain harm occurs, businesses operating in the EU market would be subject to obligations under this directive, which would also mandate that corporate governance incorporate due diligence. This initiative is a significant step toward establishing corporate accountability as a legal standard throughout the EU, despite the fact that negotiations are still ongoing.

5.2 Asia: Weak Legal Frameworks and Implementation Gaps

On the other hand, a large number of Asian nations, which form the foundation of global supply chains and manufacturing, lag behind in putting in place efficient legal frameworks for corporate responsibility. For example, India's labor laws and constitutional protections forbid exploitation and forced labor. It does not, however, require businesses to conduct due diligence on human rights. The

Companies Act's CSR provisions prioritize philanthropy over corporate liability or harm prevention. Administrative inefficiencies and political reluctance to impede economic growth fueled by cheap labor contribute to the frequently uneven enforcement of labor laws.

The experience of Bangladesh serves as a reminder of the negative effects of lax legal regulation. More than a thousand people were killed when the Rana Plaza factory building collapsed in 2013, exposing widespread infractions of labor and safety regulations. As a result, the Bangladesh Accord on Fire and Building Safety was created as a binding contract between trade unions and global brands. However, because this Accord is a private initiative exclusive to the apparel industry and is not incorporated into national law, it does not regulate larger supply chains. Due to worries about foreign investment and competition, attempts to incorporate the Accord's standards into domestic law have encountered opposition.

China is a special example of how corporate accountability is constrained by state control and a lack of transparency. Chinese labor laws forbid child labor and forced labor, but they are frequently politicized and opaquely enforced. International sanctions and scrutiny of Chinese suppliers have resulted from allegations of forced labor in Xinjiang; however, corporate due diligence is still optional and not subject to legally binding regulations in China. The inability of victims to seek justice is further hampered by the government's control over information and the absence of independent judicial processes.

As a significant participant in international supply chains, Japan has released voluntary guidelines urging businesses to uphold human rights in supply chains. However, because they rely more on corporate goodwill than on legal obligations, these guidelines are not legally enforceable. Other Southeast Asian nations like Vietnam, Indonesia, and Cambodia have labor laws that are in line with international norms, but they face challenges from political pressures that put economic growth ahead of labor protections, regulatory capture, and lax enforcement.

Regulatory fragmentation, lax enforcement, and restricted access to remedies for victims of human rights violations characterize the overall situation in Asia. Structural vulnerabilities for workers in global supply chains are sustained by the lack of laws requiring due diligence and the challenges in holding lead firms responsible.

5.3 The Americas: Emerging Frameworks and Persistent Gaps

There has been slow but inconsistent progress in the Americas regarding corporate responsibility for human rights abuses in supply chains. Early use of the Alien Tort Statute (ATS) in the US gave victims a way to hold companies accountable for wrongdoing abroad, but more recent court decisions have limited its application. Present initiatives, like the Uyghur Forced Labor Prevention Act (2021) and the California Transparency in Supply Chains Act (2010), place more emphasis on import prohibitions and disclosure than thorough due diligence. Although they both lack robust enforcement authority, Canada's Fighting Against Forced Labour and Child Labour in Supply Chains Act (2023) and the creation of the Canadian Ombudsperson for Responsible Enterprise (CORE) represent steps in the right direction.

In Latin America, initiatives like Brazil's National Pact for the Eradication of Slave Labour and the "Dirty List" system, as well as national action plans in Chile and Colombia, reflect growing awareness but remain largely voluntary. The Inter-American Court of Human Rights continues to advance accountability indirectly by holding states responsible for corporate-related harms. Overall, while the region demonstrates increasing commitment to ethical supply chains, the absence of binding due diligence legislation and limited enforcement capacity remain major challenges.

5.4 Africa: Regional Efforts Amid Structural Challenges

Weak governance, a lack of enforcement power, and a strong reliance on extractive industries shape corporate accountability in supply chains throughout Africa. In its 2019 Draft Policy Framework on Business and Human Rights, the African Commission on Human and Peoples' Rights encourages states to create national action plans and advocates for the localization of the UN Guiding Principles. Initial progress has been made by nations like South Africa, Kenya, and Nigeria; in 2019, Kenya adopted a National Action Plan, while South Africa drafted one. The goal of these initiatives is to improve state regulation of businesses, especially those in the manufacturing, mining, and agricultural industries.

The majority of African nations, however, do not have legally binding laws pertaining to human rights due diligence, and corruption, a lack of institutional resources, and political reliance on foreign investment all contribute to the weak enforcement of these laws. Justice is frequently elusive for victims of corporate abuses, who must instead turn to international forums or domestic lawsuits against foreign parent companies. Despite their symbolic significance, regional frameworks are still primarily aspirational. In general, Africa's progress shows that people are becoming more conscious, but it also emphasizes how urgently stronger legal frameworks and international collaboration are needed to guarantee corporate responsibility in global supply chains.

6. Barriers to Corporate Accountability

The implementation of corporate accountability for human rights violations in global supply chains is hampered by a number of long-standing obstacles. The organizational and legal complexity of supply chains themselves is among the most important. Businesses frequently organize their operations using several legally distinct levels of suppliers and subcontractors, which obfuscates accountability and makes it more difficult to trace wrongdoing back to the parent company. The corporate veil theory shields parent businesses from accountability for the deeds of their subsidiaries, enabling businesses to profit monetarily from unethical behavior without facing consequences.

Jurisdictional challenges further complicate access to justice. Due to legal doctrines like forum non conveniens, which permit courts to refuse jurisdiction if they feel a more suitable forum exists elsewhere, victims who live in Asian nations frequently are unable to file cases in the courts of the companies' home countries. On the other hand, courts in Asian nations might not have the autonomy, means, or legal systems necessary to hear cases involving multinational corporations, especially when the parent company is located abroad.

Another significant barrier is transparency. The majority of businesses can only see and manage their direct suppliers, but abuses usually take place in factories and farms that are hard to keep an eye on, several tiers down the supply chain. This lack of openness hinders attempts to reduce risks and hinders efficient due diligence.

The burden of proof to prove company knowledge or complicity, lack of financial resources, protection from retaliation, and legal ignorance are some of the major obstacles victims face when trying to obtain remedies. Because of these real-world obstacles, accountability is elusive even in cases where abuses are reported.

7. Illustrative Company Examples

1. Nestlé (Côte d'Ivoire – Child Labor in Cocoa)

- **Issue:** Allegations of aiding and abetting child slavery in cocoa plantations.
- **Legal Action:** US lawsuits dismissed on jurisdictional grounds; company introduced internal sustainability programs post-criticism.
- **Significance:** Demonstrates limits of US law in addressing overseas supply chain abuses.

2. Shell (Nigeria – Environmental and Human Rights Violations)

- **Issue:** Oil spills and complicity in violent repression of protestors in Ogoniland.
- **Legal Action:** UK and Dutch courts have heard multiple suits. In 2021, Dutch court found Shell's Nigerian subsidiary liable for oil spills.
- **Significance:** Landmark decision recognizing parent company responsibility.

3. Boohoo (UK – Labour Abuses in Leicester)

- **Issue:** Suppliers paid workers below minimum wage; unsafe conditions.
- **Outcome:** Massive reputational damage; investor backlash; no legal liability under UK law.
- **Significance:** Highlights need for enforceable domestic supply chain laws.

4. H&M and Zara (Global – Forced Labour in Xinjiang)

- **Issue:** Alleged links to forced Uyghur labor in Chinese supply chains.
- **Repercussions:** Brands faced consumer boycotts and scrutiny but little legal accountability.

Significance: Exposes difficulties in tracing and verifying deep-tier suppliers

7. Conclusion

Although it is developing, legal accountability for corporate human rights abuses in international supply chains is still not strong enough. While recent laws in Europe mark important progress, enforcement, scope, and access to remedy are still major challenges.

Laws must:

- Cover the entire supply chain;
- Allow for both criminal and civil liability;
- Have strong enforcement mechanisms in order to proceed.
- Provide victims with access to just legal procedures.

In the end, proactive legal compliance based on human rights law must replace reactive PR-based approaches in corporate accountability. Stakeholder engagement, domestic enforcement, and harmonized international standards are necessary to guarantee that basic human rights are not compromised in the course of international business operations.

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Mediatization of Heritage Museums of Mumbai City

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Abstract: *Heritage museums are institutions that preserve the heritage of a particular period, region, or community, with the primary aim of disseminating cultural and historical knowledge. They serve as custodians of history, culture, and art, offering visitors a tangible connection to the past. Traditionally, museums relied on physical artefacts, static displays, and guided tours to narrate stories and educate audiences. However, the digital age has significantly transformed how museums operate and engage with the public. Historically, they were passive spaces where visitors observed artifacts in glass cases with minimal interaction. With digitalization, museums are shifting toward interactive, engaging, and accessible spaces. Digital tools such as audio guides, Augmented Reality (AR), Virtual Reality (VR), interactive kiosks, and social media have become integral to museum operations. These tools cater to diverse audiences and make museums more relevant to younger generations. Despite growing adoption, there is limited research on their implementation, effectiveness, and challenges in the context of heritage museums in Mumbai. This study examines how mass media tools have affected these museums in redefining visitor experiences.*

Keywords: *Mediatization, Mass Media, Heritage Museums, Mumbai*

I. INTRODUCTION

Mumbai, often called the cultural and financial capital of India, is a city rich in history and diversity. Its heritage museums play a crucial role in preserving and showcasing the city's artistic and historical narratives. These institutions are more than just spaces to store artifacts; they are living archives that connect the past with the present, helping people understand Mumbai's unique identity. Mediatization is a transformative concept that examines how media influences and reshapes various aspects of society, including cultural practices, social institutions, and communication methods. In recent years, the challenges of modernization, urbanization, and changing audience expectations have pushed these museums to adapt. They are increasingly embracing technology to stay relevant in the digital age. From virtual tours to multimedia exhibits, they are finding ways to appeal to tech-savvy visitors while staying true to their traditional mission. This blend of old and new highlights their resilience and ability to adapt to a rapidly changing world. The intersection of museums and media represents a fascinating blend of traditional cultural institutions and modern technological advancements. In India, museums are increasingly turning to media tools to enhance visitor experiences, broaden their audience reach, and creatively preserve cultural heritage. From digital archives to social media campaigns, Indian museums are adopting a variety of media formats to remain relevant in a fast-changing digital world.

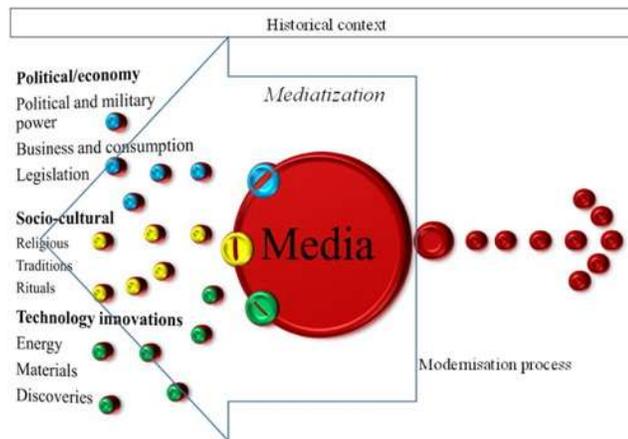


Figure 1: Domains of Mediatization Theory (Source:Hjarvard S., 2018)

II. LITERATURE REVIEW

Media is not just a promotional tool but also a vital part of a museum's educational mission. Various forms of mass media, including television, radio, and print, act as effective tools for museums to share their stories and connect with the public making museum content more accessible and promoting cultural exchange. (Zestanakis, P. 2020) Mediatization of heritage museums in Mumbai lies in identifying these phases providing valuable insights into the progression of digital mediation in museums, focusing on cultural policy and technological advancements. (Myrczik, E. P. ,2018)

There are three key phases in digital museum mediation: first, enabling access to digitized collections; second, implementing user-focused strategies such as personalization; and third, fostering active visitor participation. (Myrczik, E. P., 2018) Merging formats such as audio, video, and games with traditional museum practices can create a more immersive and enriching visitor experience. The discussion on platform convergence, including the use of computers and virtual reality, highlights opportunities to expand outreach through digital tools. Additionally, the idea of rhetorical convergence, which connects language and images, offers insights into designing exhibitions that are more engaging and relatable to diverse audiences. (Stuedahl, D., 2007) Another important aspect is the potential of AI-driven tools to transform how museums engage with audiences on social media platforms.

Museums can enhance their social media communication using deep mediatization theory and artificial intelligence (AI), specifically Convolutional Neural Network (CNN) technology. (Wang, H., Song, C., and Li, H., 2024) Modern technologies, such as game engines and the Web, can integrate culture, education, and gaming into museum experiences by a dynamic Web-based virtual museum framework that emphasizes user creativity and leverages vast online resources. By connecting to repositories like Europeana and Google, the framework allows for the creation of virtual exhibitions using distributed Web content. (Kiourt, C., Koutsoudis, A., and Pavlidis, G., 2016)

III. METHODOLOGY

The study was descriptive-cum-analytical, employing a survey method to gather insights from museum visitors and individuals interacting with media exhibits in Mumbai's heritage museums. A structured questionnaire collected data on media tool usage, visitor engagement, and perceptions of cultural heritage presentation. Quantitative data was studied from survey responses that were analyzed statistically to identify communication patterns and trends. This mixed-method approach provided a comprehensive analysis of mediatization in Mumbai's heritage museums.

The study employed a purposive (non-random) sampling technique, selecting 1,533 participants intentionally to obtain relevant survey responses. The sample comprised individuals familiar with museum operations and media exhibits—specifically museum visitors, museology students who had interned, and museum professionals.

Questionnaire: A structured questionnaire was developed by the researcher under the guidance of academic and museology experts. It aimed to capture respondents' views on museum experiences, interactions with media exhibits, and perceptions of mediatization in heritage museums. The instrument comprised 21 questions, including 14 multiple-choice, 6 rating-scale, and 1 checkbox item.

Limitations and Delimitations: The study focused exclusively on live museum visitors in Mumbai, excluding individuals who visited at other times or lacked internet access. As the survey was conducted online, only participants with smartphones and connectivity could respond. Responses relied on participants' recall of their museum experiences, making perceptions subjective. Additionally, minors under 18 were excluded from the sample.

The research was confined to selected heritage museums in Mumbai chosen through purposive sampling, considering accessibility, administrative permissions, and visitor popularity. The study focused solely on museums showcasing cultural and heritage exhibits, excluding those emphasizing science, sports, or religion.

IV. RESEARCH DESIGN

Given below is the statement of problem for this research.

How has Mediatization helped the Heritage Museums of Mumbai?

Aim: To understand the influence of Mediatization on the Heritage Museums of Mumbai.

Objectives:

1. To analyze the role of media in preserving and showcasing cultural heritage
2. To find the factors affecting visitors satisfaction in heritage museums in Mumbai.
3. To assess public perception of mediatization in heritage museums
4. To identify the reasons for mediatization of heritage museums in Mumbai.
5. To identify challenges and opportunities of mediatization for Mumbai's heritage museums.

Hypothesis: The study aims to understand the factors affecting visitors' satisfaction in heritage museums in Mumbai. This depends on various factors, such as the user's visiting frequency, their adaptability towards media, and the amount of mediatization a museum has undergone. Hence, the following hypothesis is to be tested.

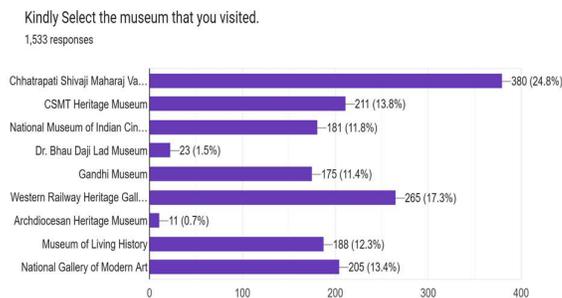
H₁ - Mediatization enhances visitors' engagement in Mumbai's heritage museums.

H₀ - Mediatization does not enhance visitors' engagement in Mumbai's heritage museums.

V. FINDINGS AND OBSERVATIONS

The researcher, with guidance from museum science experts, designed 21 structured questions to assess visitors' experiences, satisfaction, and interaction with media exhibits in Mumbai's heritage museums. Data from 1,533 participants—including visitors, museum professionals, and museology interns—provided diverse insights, revealing how media technology influenced engagement and enhanced the overall museum experience. Analysis and interpretation of few important questions has been conducted below-

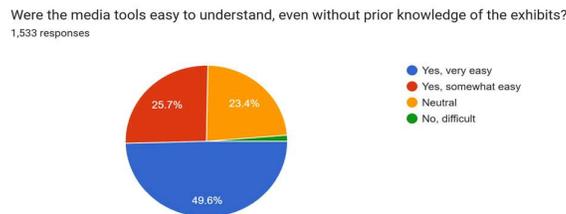
1. Kindly Select the museum that you visited.



The respondents had to fill out the survey once they were done visiting the museum. This question makes sure that the respondents choose which museum they have visited. This helps us to know which museum gets the most visitors, and analyse the reasons behind its footfall. Following is the list of museums aligned with the highest number of visitors at the first position and followed by the lower numbers subsequently.

- Chhatrapati Shivaji Maharaj Vastu Sangrahalaya- 24.8% of the visitors.
- Western Railway Heritage Gallery, Churchgate- 17.3% of visitors.
- CSMT Heritage Museum- 13.8% of the visitors.
- National Gallery of Modern Art- 13.4% of the visitors.
- Museum of Living History- 12.3% of the visitors.
- National Museum of Indian Cinema- 11.8% of the visitors.
- Gandhi Museum- 11.4% of the visitors.
- Dr. Bhau Daji Lad Museum- 1.5% of the visitors
- Archdiocesan Heritage Museum - 0.7% of the visitors.

2. Were the media tools easy to understand, even without prior knowledge of the exhibits?



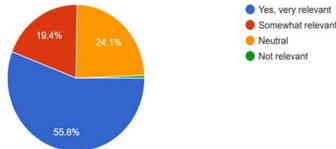
This question aimed to assess how intuitively media tools conveyed information, even to responders without prior knowledge of the exhibits. The responses received were:

- 49.6% found them very easy to understand

- 25.7% found them somewhat easy
- 23.4% remained neutral
- 1.3% found them difficult to understand

3. Did the media tools help in explaining cultural heritage in a way that felt relevant to you?

Did the media tools help in explaining cultural heritage in a way that felt relevant to you?
1,533 responses

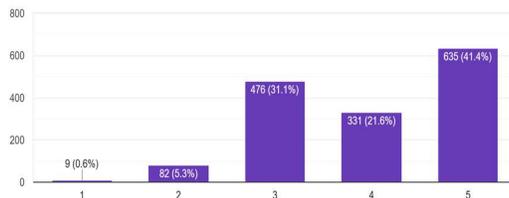


This question aimed to evaluate how effectively media tools communicated cultural heritage in a way that felt personally relevant to the responders. The responses received were:

- 55.8% found them very relevant
- 24.1% remained neutral
- 19.4% found them somewhat relevant
- 0.6% found them not relevant

3. How easy was it for you to use the media tools available at the museum?

How easy was it for you to use the media tools available at the museum?
1,533 responses



Upon being asked about the ease of usability of the available media tools in the museum, using a Likert Scale. A Likert scale is a psychometric rating scale used to measure the sample's opinions. It uses a spectrum of options ranging from one extreme attitude to another including a moderate or neutral option. The researcher here has used a Likert Scale of 1-5, Where 1st value showed 'Extremely difficult' and 5th value stood for 'Extremely easy'.

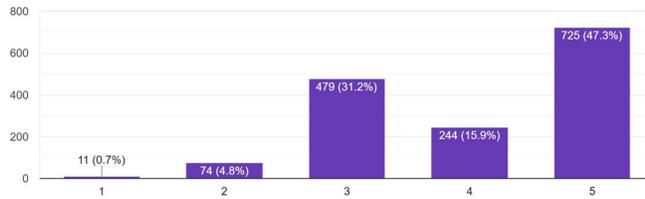
On a 1-5 Likert scale for ease, "1" would represent "Extremely difficult," "2" would be "Somewhat difficult," "3" would be "Neither difficult nor easy," "4" would be "Somewhat easy," and "5" would be "Extremely easy."

Based on the Likert scale, following were the responses collected:

- 0.6% of the respondents felt that the tools were extremely difficult to use.
- 5.3% of the respondents felt that the tools were somewhat difficult to use.
- 31.1% of the respondents felt that the tools were neither difficult nor easy to use.
- 21.6% of the respondents felt that the tools were somewhat easy to use.
- 41.4% of the respondents felt that the tools were extremely easy to use.

4. How likely are you to recommend this museum to others based on the use of media tools?

How likely are you to recommend this museum to others based on the use of media tools?
1,533 responses



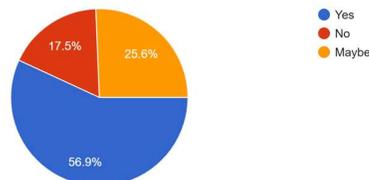
This question aimed to assess how the use of media tools influenced the likelihood of responders recommending the museum to others. Since the rating scale was based on stars without specific labels, it allowed responders to express their inclination freely. The responses received were:

- 0.7% rated 1 star
- 4.8% rated 2 stars
- 31.2% rated 3 stars
- 15.9% rated 4 stars
- 47.3% rated 5 stars

The average rating was 4.04, indicating a generally positive perception of media tools in enhancing the museum's appeal.

5. In your opinion, do media tools enhance the overall museum experience?

In your opinion, do media tools enhance the overall museum experience?
1,533 responses



This final question was included to gather a broader insight into responders' overall perception of media tools in museums and to conclude the survey with a general viewpoint. The responses received were:

- 56.9% said yes
- 25.6% said maybe
- 17.5% said no

VI. CONCLUSION AND DISCUSSIONS

Summary: Survey results revealed strong mediatization in Mumbai's heritage museums. Nearly all respondents (93.5%) noticed digital tools, and most found them engaging, easy to use, and modernizing (98.3%). Over half felt media enhanced learning, relevance, and enjoyment, while 98% wanted more digital features. However, some noted distraction (42.7%) and limited personalization (17.2%), suggesting the need for balanced, user-friendly, and contextually meaningful media integration.

Conclusion: With findings from the responses Question 5. on overall museum experience (56.9% positive feedback), Question 19. Implying on the average star rating of 4.04, and the likelihood of recommendation (63.2% positive responses, derived from 47.3% + 15.9%), we find that 'Mediatization enhances visitors' engagement in Mumbai's Heritage Museums.

Hence, Hypothesis H_1 – ‘Mediatization enhances visitors’ engagement in Mumbai’s heritage museums’ is accepted.

Accordingly, H_0 – ‘Mediatization does not enhance visitors’ engagement in Mumbai’s heritage museums’ is rejected.

Discussion

1. Museums had recognized the growing need to integrate digital media tools to increase accessibility and engagement among younger audiences.
2. Establishing a social media presence on platforms like Instagram, YouTube, and Twitter had enabled museums to share interactive and behind-the-scenes content.
3. Digital marketing strategies, influencer collaborations, and exhibition previews had helped attract a wider visitor base beyond traditional outreach methods.
4. It was suggested that the government introduced funding schemes to support heritage museums in adopting digital media without losing cultural authenticity.
5. Technologies such as AI, VR, and AR had been incorporated to create immersive, interactive, and educational visitor experiences.
6. Personalized digital tours guided by AI systems had enhanced visitor satisfaction through customized learning pathways.
7. Interactive feedback kiosks replaced traditional forms, allowing real-time audience evaluation and helping museums refine their strategies.
8. The use of holographic guides and multi-sensory exhibits had made learning more engaging and memorable.

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“A Comparative Study of Green Audit Practices in Self-Financed and Government-Aided Higher Educational Institutions Affiliated to Mumbai University”

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Abstract

The 21st century has seen rapid economic growth but also significant environmental damage, creating a pressing need for sustainability across all sectors, including higher education. Educational institutions play a vital role in promoting environmental awareness and implementing sustainable practices through regular assessments like Green Audits. This research paper compares Green Audit practices in government-aided and self-financed higher education institutions affiliated with the University of Mumbai. The main objective is to evaluate the extent of Green Audit implementation, institutional awareness, student participation, and challenges in adopting sustainable campus practices.

The study follows a descriptive and analytical design, collecting data from 20 selected colleges—10 government-aided and 10 self-financed—using structured questionnaires and institutional records. The analysis covers six sustainability indicators: Green Audit implementation, energy audit, waste management, water conservation, renewable energy initiatives, and student participation. Quantitative analysis, supported by statistical tools and graphical representations, shows that government-aided colleges perform slightly better in implementation and documentation. However, t-test results ($p = 0.38$) indicate no significant difference between the two groups, suggesting similar commitment levels regardless of funding type.

Findings highlight strong performance in waste management and student engagement, while renewable energy and water conservation initiatives require greater attention. The study concludes that leadership, IQAC involvement, and policy awareness play a more crucial role in sustainability performance than financial status. Recommendations include adopting a standardized Green Audit

framework, improving documentation, integrating sustainability into curricula, and establishing university-level monitoring mechanisms.

Key words: *Green Audit, Environmental Sustainability, Higher Education Institutions, Government-Aided Colleges, Self-Financed Colleges, IQAC, NAAC.*

1. Introduction

The 21st century is characterized by rapid industrialization, globalization, and modernization, leading to socio-economic progress but also severe environmental degradation. Deforestation, resource depletion, climate change, and pollution threaten sustainable development. Higher education institutions (HEIs), as centers of knowledge creation, play a crucial role in promoting environmental awareness and implementing sustainable practices.

Environmental Accounting focuses on identifying, measuring, and reporting environmental costs and benefits, enabling institutions to understand the financial impacts of sustainability initiatives. In higher education, this includes monitoring energy usage, waste management expenses, and investments in green initiatives.

A **Green Audit** systematically evaluates an institution's environmental performance in areas such as energy conservation, water management, waste disposal, and biodiversity preservation. HEIs under Mumbai University, one of India's largest universities affiliating over 700 colleges, are increasingly adopting environmental accounting and Green Audits, particularly under NAAC guidelines emphasizing eco-friendly campuses. However, implementation remains inconsistent. Some colleges perform audits primarily for accreditation compliance, while others lack proper documentation and ongoing monitoring.

Financial constraints differ by type: government-aided institutions may face limited budgets, whereas self-financed colleges might have more resources but less oversight. These disparities underscore the need for a comparative study of environmental accounting and Green Audit practices among HEIs affiliated with Mumbai University.

2. Review of Literature

- **Sundarasan, Rajagopalan, & Alsmady (2024)** analyzed global research on environmental accounting and sustainability, highlighting growing awareness but inconsistent practices due to a lack of standardized reporting frameworks. Institutions outside the corporate sector, including HEIs, face challenges in implementing environmental accounting without structured policies.
- **Singh, Meena, Khandelwal, & Dangayach (2023)** reviewed sustainability assessment in HEIs worldwide using frameworks such as STARS, UI GreenMetric, and ISO certifications. While many institutions incorporated sustainability policies, few integrated them operationally or

financially. The study emphasized the need for standardized assessment frameworks.

- **Choudhary, Shankar, & Kanda (2019)** evaluated sustainable development in Indian technical HEIs, noting strengths in renewable energy and green infrastructure, but gaps in waste management, biodiversity conservation, and policy commitment. Localized, adaptable assessment systems were recommended.
- **Habeeb, Adharsh, & Anju (2020)** demonstrated how green audits at Musaliar Institute, Kerala, engaged faculty and students, improved accountability, and enhanced environmental performance, though systematic monitoring remained a challenge.
- **Yadav, Goar, & Yadav (2024)** highlighted the link between green audits and NAAC accreditation outcomes. Institutions with robust environmental practices scored higher, but audits were often compliance-driven. Embedding audits into institutional culture enhances long-term sustainability.

3. Research Methodology

This study adopts a comparative approach to examine Green Audit practices in self-financed and government-aided HEIs affiliated with Mumbai University.

3.1 Objectives:

- Examine Green Audit implementation in HEIs.
- Compare practices between self-financed and government-aided colleges. ●
- Assess staff awareness of sustainability practices.
- Identify implementation challenges.
- Suggest improvements.

3.2 Research Design: Descriptive and analytical to document current practices and evaluate differences.

3.3 Hypotheses:

- H_0 : No significant difference exists in Green Audit practices between self-financed and government-aided colleges.
- H_1 : A significant difference exists between the two groups.

3.4 Population: All 700+ HEIs affiliated with Mumbai University.

3.5 Sample Design: Stratified random sampling of 20 colleges (10 government-aided, 10 self-financed). Respondents included Principals, IQAC coordinators, Green Audit Committee members, and faculty.

Sampling Frame:

Sr. No.	Type of Institution	Name of the College (Affiliated to University of Mumbai)	Location
1	Government-Aided	Elphinstone College of Arts & Commerce (Autonomous)	Fort, Mumbai
2	Government-Aided	Kirti M. Doongursee College of Arts, Science & Commerce	Dadar (W), Mumbai
3	Government-Aided	R. A. Podar College of Commerce & Economics	Matunga, Mumbai
4	Government-Aided	Jai Hind College (Autonomous)	Churchgate, Mumbai
5	Government-Aided	K. J. Somaiya College of Arts & Commerce (Autonomous)	Vidyavihar, Mumbai
6	Government-Aided	SIES College of Arts, Science & Commerce	Sion (W), Mumbai
7	Government-Aided	V. G. Vaze College (Kelkar College)	Mulund (E), Mumbai
8	Government-Aided	St. Andrew's College of Arts, Science & Commerce	Bandra (W), Mumbai
9	Government-Aided	Sathaye College	Vile Parle (E), Mumbai
10	Government-Aided	Bhavan's College	Andheri (W), Mumba
11	Self-Financed	Pillai College of Arts, Commerce & Science (Autonomous)	New Panvel, Raigad

12	Self-Financed	KES Shroff College of Arts & Commerce (Autonomous)	Kandivali (W), Mumbai
13	Self-Financed	Nirmala Memorial Foundation College of Commerce & Science	Kandivali (E), Mumbai
14	Self-Financed	Thakur College of Science & Commerce (Autonomous)	Kandivali (E), Mumbai
15	Self-Financed	N. L. Dalmia College of Arts, Commerce & Science	Mira Road, Thane
16	Self-Financed	Bhavans Hazarimal Somani College	Chowpatty, Mumbai
17	Self-Financed	S. K. Somaiya College (Autonomous)	Vidyavihar, Mumbai
18	Self-Financed	Bunts Sangha's S.M. Shetty College of Science, Commerce & Management Studies	Powai, Mumbai
19	Self-Financed	Oriental College of Commerce and Management	Sanpada, Navi Mumbai
20	Self-Financed	NCRD's Sterling Institute of Management Studies	Nerul, Navi Mumbai

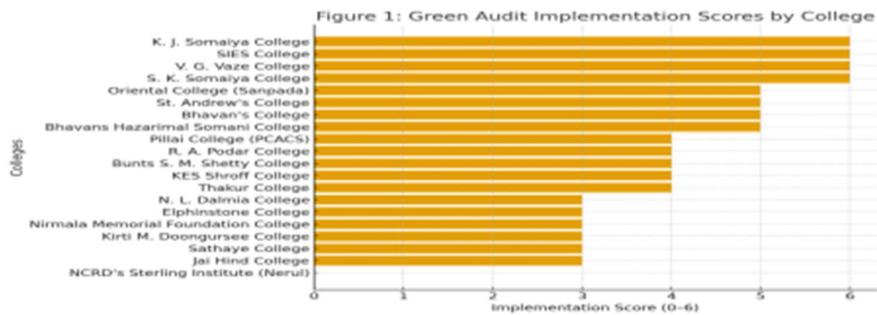
3.6 Research Gap: Literature primarily focuses on industries; Indian HEIs are underexplored, lacking comparative and analytical studies.

3.7 Scope & Limitations: The study was limited to 20 colleges affiliated with Mumbai University. Data availability varied due to differences in documentation, and some indicators relied on self-reported rather than direct observational data.

3.8 Significance: Provides insights for HEIs, policymakers, NAAC, academia, and society to strengthen sustainability initiatives.

4. Data Analysis and Interpretation

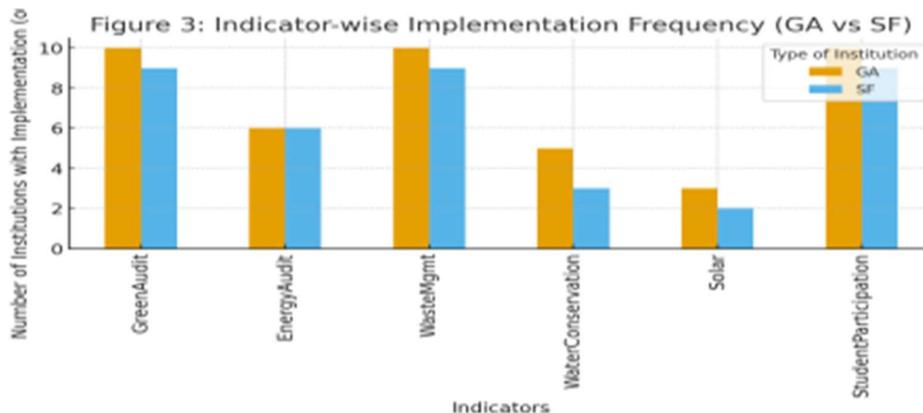
Green Audit Implementation Scores by College



The horizontal bar chart shows institutions' Implementation Scores (0–6). K.J. Somaiya, SIES, and V.G. Vaze scored 6, most scored 3–5, while NCRD's Sterling scored 0, lacking Green Audit evidence.

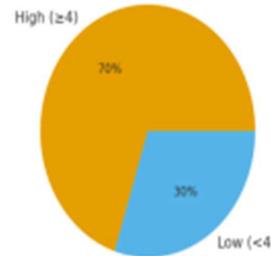
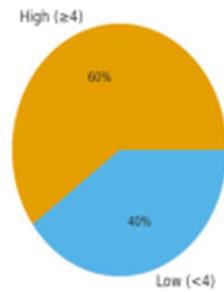


The boxplot shows Government-Aided colleges with higher median scores and less variability, indicating consistent implementation, while Self-Financed colleges display wider variation, from strong documentation (S.K. Somaiya) to minimal (Sterling Institute).



The grouped bar chart shows implementation of sustainability indicators (out of 10 colleges per type). Both groups excel in Green Audits and Waste Management. Government-Aided colleges slightly outperform in Water Conservation and Student Participation. Solar/renewable initiatives remain limited across both government-aided and self-financed institutions.

Figure 4(a): Government-Aided Colleges Implementation Levels



Pie charts show colleges with high (≥ 4) versus low (< 4) implementation. Government-Aided colleges achieved higher implementation (80%) compared to Self-Financed (60%), though several self-financed institutions also performed commendably.

Statistical Test: t-Test Results

Government-Aided colleges had a slightly higher mean score (4.4) than Self-Financed (3.8), but t-test ($t = 0.90$, $p = 0.38$) shows no significant difference. Both groups exhibit similar Green Audit engagement.

5. Findings, Conclusions and Suggestions

This chapter summarizes key findings from the comparison of Green Audit practices in selected Government-Aided and Self-Financed colleges affiliated with Mumbai University. The findings address the study’s objectives and hypotheses and provide conclusions and actionable recommendations to enhance environmental responsibility in higher education institutions.

❖ Major Findings

The study assessed Green Audit (GA) practices using six sustainability indicators: Green Audit, Energy Audit, Waste Management, Water Conservation, Solar Energy Initiatives, and Student Participation. Data from 20 institutions were analyzed to reveal the following: A. Quantitative Analysis:

- Out of 20 colleges, 14 (70%) had high levels of Green Audit implementation.
- Mean Scores: Government-Aided: 4.4/6; Self-Financed: 3.8/6, indicating slightly better performance by aided colleges.
- Self-Financed colleges exhibited greater variability, ranging from excellent (S.K. Somaiya) to minimal (Sterling Institute).
- Significance Test: $t = 0.90$, $p = 0.38$ → Not statistically significant, suggesting funding type does not solely determine environmental performance.

B. Qualitative Observations:

- Documentation and Reporting: Government-Aided colleges maintain better records in IQAC/AQAR reports.
- Institutional Commitment: Active Environmental or Green Committees improve implementation quality.
- Student Engagement: NSS and Eco-Club activities effectively promote sustainability awareness.
- Resource Constraints: Self-Financed colleges often cite financial limitations for renewable or large-scale projects.
- External Audit Linkages: Many colleges rely on external agencies but lack ongoing monitoring systems.

Testing of Hypotheses:

- H_0 : No significant difference in Green Audit implementation between Government-Aided and Self-Financed colleges → Accepted ($p > 0.05$).

Conclusions:

- Comparable Performance: Both types of colleges actively practice Green Audits, reflecting commitment to sustainability.
- Leadership Matters More Than Funding: Proactive leadership and IQAC involvement correlate with better performance.
- Policy Awareness Is Rising: NAAC and University guidelines encourage adoption of sustainability initiatives.
- Gaps in Renewable and Water Initiatives: Solar energy and water conservation are under-implemented due to costs and infrastructure constraints.
- Documentation Culture: Environmental documentation is improving but requires standardization.

Suggestions and Recommendations:

A. For Colleges / Institutions

- Develop Comprehensive Green Policy: Incorporate Green Audits into institutional policy with regular reviews.
- Allocate Dedicated Budget: Fund environmental projects, solar installations, and energy-efficient infrastructure.
- Strengthen IQAC Role: Ensure timely auditing and documentation in AQAR and SSR reports.
- Student-Led Initiatives: Encourage NSS, NCC, and Eco-Club activities in waste management

and awareness programs.

- Adopt Technology Solutions: Use digital tools for monitoring energy and water usage.

B. For the University of Mumbai

- Standardized Green Audit Framework: Develop a uniform audit template and reporting format for all affiliated colleges.
- Green Rating System: Rank colleges annually based on sustainability performance and share best practices.
- Capacity Building Workshops: Train Principals, IQAC coordinators, and faculty on sustainability and audit standards.
- Research & Collaboration: Support inter-college sustainability projects and innovations.

C. For Government and Accrediting Bodies

- Policy Support for Renewable Energy: Provide financial incentives for solar panels and waste-to-energy systems.
- Mandate Green Audit in Accreditation: Consider making Green Audit a required evaluation criterion in NAAC assessments.

ANNEXURE

Questionnaire – Green Audit Practices

Section A: Institutional Profile

Item	Response
Name of the Institution	_____
Type of Institution	<input type="checkbox"/> Government-Aided <input type="checkbox"/> Self-Financed
Year of Establishment	_____
Name & Designation of Respondent	_____
Respondent Category	<input type="checkbox"/> Principal <input type="checkbox"/> IQAC Coordinator <input type="checkbox"/> Faculty <input type="checkbox"/> Green Audit Committee Member

Section B: Green Audit Implementation

Sr. No.	Statement	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Remarks
1	Institution has a formal Green Audit policy or guideline.			
2	A Green Audit has been conducted by an external agency.			
3	The report of the Green Audit is uploaded on the college website.			

4 The college maintains records of tree plantation and green cover.

5 The IQAC monitors follow-up actions of the audit.

Section C: Energy and Water Management

Sr. No.	Statement	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Remarks
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6	The institution conducts periodic Energy Audits.			
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7	Energy-efficient appliances (LED, solar lights, etc.) are used.			
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8	Water consumption is monitored regularly.			
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9	Rainwater harvesting systems are installed.			
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10	Wastewater recycling or reuse practices are adopted.			
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Section D: Waste Management and Recycling

Sr. No.	Statement	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Remarks
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11	The college segregates waste into biodegradable and non-biodegradable.			
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12	E-waste is collected and disposed of through authorized vendors.			
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13	Paper recycling or minimal paper usage is promoted.			
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14	Composting of wet waste is practiced.			
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Sr. No.	Statement	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Remarks
16	Solar panels are installed on the campus.			
17	The college uses any renewable energy sources.			
18	There are green buildings or eco-friendly infrastructure.			
19	Environmental signage and awareness boards are displayed.			
20	Environmental audit recommendations are implemented.			

Section F: Student and Community Involvement

Sr. No.	Statement	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Remarks
21	Students participate in environmental awareness programs.			
22	NSS or Eco-Club activities include sustainability projects.			
23	Environmental Day/Week celebrations are organized annually.			
24	Local community or NGOs are involved in campus green drives.			
25	Green initiatives are documented in AQAR/NAAC reports.			

Section G: Feedback and Suggestions

26. Major Challenges in Implementing Green Audit Practices:
27. Suggestions for Improvement in Environmental Sustainability Practices:

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Triple-Entry Bookkeeping & Momentum Accounting: Alternatives to Double-Entry — A Study Focused on the Navi Mumbai Region

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Abstract

This study explores Triple-Entry Bookkeeping (TEA) and Momentum Accounting as potential alternatives and extensions to the traditional double-entry system, focusing on the accounting ecosystem of Navi Mumbai, Maharashtra, India. Drawing on Yuji Ijiri's theoretical framework of momentum accounting and recent blockchain-enabled triple-entry proposals, the paper investigates their conceptual foundations, perceived benefits, and adoption challenges. A mixed-methods research design—comprising surveys, interviews, and a technical pilot -- is proposed to assess awareness, technological readiness, and perceived utility among accountants, auditors, MSMEs, and fintech professionals in the region. Anticipated outcomes include evidence of enhanced transparency, real-time reconciliation, and fraud resistance enabled by blockchain-based shared receipts. However, the research also highlights significant barriers related to implementation cost, regulatory uncertainty, data privacy, and technical skills. The study contributes both theoretically and practically by proposing a region-specific pilot model, offering guidance for auditors and regulators, and identifying pathways for integrating TEA and momentum accounting into India's emerging fintech and accounting landscape.

1. Introduction & Rationale

Double-entry bookkeeping has been the global standard for centuries, but new needs (real-time assurance, fraud resistance, inter-firm reconciliation) and technologies (blockchain, cryptography, machine learning) have revived interest in alternatives such as momentum accounting and blockchain-enabled triple-entry accounting (TEA). Momentum accounting (Ijiri) reframes accounting to capture rates of change (momentum) in addition to balances; TEA proposes a cryptographically signed third ledger entry (shared receipt) to link counterparties' ledgers and create an immutable audit trail. Given Navi Mumbai's growing fintech, blockchain, and MSME ecosystem, the region is a strategic setting for studying feasibility and adoption dynamics.

2. Literature Review

1. **Momentum accounting & early theory:** Yuji Ijiri's momentum accounting expands accounting's scope to include changes and proposed a third ledger dimension in the 1980s; the theoretical literature explores temporal/differential implementations and possible measurement issues.

2. **Triple-entry bookkeeping (cryptographic):** Modern triple-entry often refers to cryptographically signed shared receipts recorded on distributed ledgers (blockchain) to provide a shared “third entry” that links counterparties and supports real-time verification. Empirical and theoretical studies show potential auditing benefits and improved assurance, but implementation complexity and integration with existing accounting standards remain challenges.
3. **Recent empirical & critical studies:** Recent papers review TEA’s promise (transparency, tamper-resistance) and limiters — scalability, privacy concerns, legal/regulatory fit, and questions on whether blockchain genuinely replaces audit functions. Some papers argue TEA is unfeasible in practice or requires rethinking auditing roles.
4. **Technology convergence:** Studies also explore combining TEA with ML/AI for anomaly detection and richer assurance models. The literature suggests pilot projects, small-scale prototypes, and controlled experiments as optimal next steps.

3. Research Objectives & Questions

Primary objective:

To evaluate the feasibility, perceived benefits, and barriers to adopting triple-entry bookkeeping and momentum accounting in Navi Mumbai’s accounting ecosystem, and to propose a pilot framework for local implementation and assurance.

Specific objectives:

1. Measure awareness and understanding of TEA and momentum accounting among accountants, auditors, and finance managers in Navi Mumbai.
2. Assess perceived benefits (fraud reduction, reconciliation efficiency, audit evidence) and perceived barriers (cost, regulatory, technical skills).
3. Evaluate regional technological readiness (blockchain infrastructure, fintech partners, MSP/ERP compatibility).
4. Propose an actionable pilot design and assurance framework for local firms.

Research questions:

1. What is the level of awareness and conceptual understanding of TEA and momentum accounting among Navi Mumbai accounting professionals?
2. What benefits and risks do practitioners perceive for TEA/momentum accounting?
3. What organizational/technical/regulatory factors influence willingness to pilot TEA in Navi Mumbai?
4. What pilot architecture, data governance, and auditor roles would be appropriate for the region?

4. Research Design & Methodology

Mixed methods (quantitative survey + qualitative interviews + small pilot/technical feasibility analysis).

Population & sampling

- Target groups: chartered accountants/finance managers in medium & large firms, auditors, MSME owners, fintech/blockchain startups, and MSPs/ERP vendors located or operating in Navi Mumbai. Sources indicate a growing fintech and blockchain developer presence in Mumbai/Navi Mumbai region supporting this sampling strategy.

Sampling method:

Respondents	Sample size
Auditors / CA firms	60
Corporate finance teams	80
MSME	60
Fintech /blockchain firms	40

- Qualitative interviews: 20–25 semi-structured interviews (regulators/heads of accounts, CA partners, CFOs, fintech leads).

Data collection instruments:

1. **Online structured survey** (Likert scales + multiple choice + open text) to capture awareness, perceived benefits/risks, readiness, and willingness to pilot.
2. **Semi-structured interview guide** for deeper exploration.
3. **Technical feasibility checklist** to audit ERP capability, data formats (e-invoicing, GST returns), API readiness, and blockchain partner readiness.
4. **Pilot prototype plan:** a small controlled pilot with 1–2 trading pairs (buyer/seller) implementing a blockchain-backed shared receipt layer and reconciliations.

Variables & measures:

- Dependent: willingness to adopt/pilot TEA (binary + strength on scale).
- Independent: awareness, perceived benefits (fraud reduction, reconciliation time), perceived barriers (cost, regulatory risk), IT readiness, firm size, prior blockchain experience, sector.
- Control variables: firm age, staff size, ERP use, role of responding person.

5. Data Analysis Plan

Quantitative:

- Descriptive statistics (means, frequencies) for awareness and attitudes.
- Cross-tabulations (e.g., auditors vs MSMEs).
- Logistic regression to model adoption willingness (dependent) on predictors (awareness, readiness, perceived benefits/risks).
- Factor analysis to identify latent constructs (e.g., ‘Perceived Benefit’ factor).

Qualitative:

- Thematic analysis (coding interviews) to capture nuanced barriers (legal, cultural), use NVivo or manual coding.
- Triangulation with quantitative results.

Technical pilot evaluation:

- Performance metrics: reconciliation time, number of mismatches, time-to-resolve, gas/cost metrics (if blockchain used), privacy/access controls, and auditor evidence sufficiency.
- Pre-post comparison: reconciliation times before and after TEA layer.

6. Proposed Pilot Architecture

1. **Scope:** One buyer–seller pair (an MSME and its regular supplier) in Navi Mumbai with simple invoicing cycles (B2B), using existing ERP/invoicing.
2. **Layer:** Off-chain ERP + on-chain hashed receipts. Each invoice generates a signed receipt (cryptographic) posted to a permissioned blockchain (e.g., Hyperledger Fabric or permissioned Ethereum rollup) shared by the two trading parties and with auditor read access.
3. **Assurance model:** Auditor accesses the blockchain-based receipt log to validate that counterparty entries match signed receipts. Smart contract can flag mismatches.
4. **Privacy:** Only hashes and necessary metadata on chain; invoice details remain off-chain in ERP with encryption and access control.
5. **Local partners:** engage Navi Mumbai / Mumbai blockchain developers and fintech providers (local developer ecosystem is active).

7. Ethical, Legal & Regulatory Considerations

- **Data privacy & confidentiality:** adhere to India’s data protection expectations; minimize on-chain data, store only hashes, obtain contractual consent from pilot participants.
- **Regulatory compliance:** ensure alignment with Companies Act, GST e-invoicing rules, and audit standards; consult ICAI guidance and local regulators.
- **Audit evidence admissibility:** work with local auditors to ensure hashed receipts meet evidentiary standards and map to statutory records.
- **Informed consent & transparency:** for interviews/surveys and pilot — written informed consent, anonymity when requested.

8. Expected Outcomes & Contributions

Academic contributions:

- Empirical evidence about awareness and readiness in an Indian metro/suburban context.
- Case study of a TEA pilot and lessons for momentum accounting measurement issues.

Practical contributions:

- Recommended pilot architecture and checklist for accounting firms and MSMEs in Navi Mumbai.
- Policy guidance for auditors and regulators on assurance frameworks for blockchain-enabled TEA.

Anticipated findings:

- TEA likely improves reconciliation and tamper-evidence, but adoption is constrained by cost, technical skills, privacy concerns, and regulatory uncertainty. Some scholars also find TEA conceptually and operationally challenging — so pilots should be limited, controlled, and co-designed with auditors.

9. Limitations

- Regional focus (Navi Mumbai) limits generalizability.
- Pilot results based on small sample/selected trading pairs; scaling issues (throughput, cost) may emerge later.
- Regulatory developments could change acceptance and feasibility mid-study.

10. Sample Survey (key items) — to be used as instrument

Section A — Respondent & Firm Info

1. Role (CA / CFO / Accounts Manager / Owner / Developer / Auditor)
2. Firm size (employees) / Sector / Presence in Navi Mumbai (Yes/No)

Section B — Awareness & Understanding (Likert 1–5)

3. I am familiar with the concept of triple-entry bookkeeping.
4. I am familiar with momentum accounting (accounts of change or 'momentum').

Section C — Perceived Benefits (1–5)

5. TEA would reduce reconciliation time with trading partners.
6. TEA would improve auditability of transactions.

Section D — Perceived Barriers (1–5)

7. Implementation cost is a major concern.
8. Regulatory/legal uncertainty is a major concern.

Section E — Readiness & Willingness

9. My firm has technical capacity (ERP/APIs/blockchain) to participate in a pilot. (Yes/No)
10. Would your firm be willing to participate in a small, controlled TEA pilot? (Yes/No/Maybe)

Open questions:

11. What would you need to see to adopt TEA? (short text)
12. Any concerns about privacy/competitiveness if transaction receipts are shared on a shared ledger? (short text)

11. Data Management & Ethics

- Store survey data on encrypted drives; remove personal identifiers for publications.
- Pilot transaction data: store only hashed proofs on chain; maintain full invoices in ERP under contractual confidentiality.
- Approvals: institutional ethics / CA firm approvals as required.

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Evaluating the Impact of AI-Based Recommendation Systems on Course and Career Guidance within the Framework of NEP 2020

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Abstract

Artificial Intelligence (AI) has emerged as a transformative tool in modern education, reshaping traditional paradigms of student guidance. This study examines the effectiveness of AI-based recommendation systems in course and career guidance within the framework of India's National Education Policy (NEP) 2020. The research employs a comparative analysis of AI-driven and traditional counseling approaches to assess precision, accessibility, and user satisfaction. Findings reveal that AI systems enhance personalized decision-making and align student goals with NEP 2020's vision for flexible and learner-centric education. Recommendations include the adoption of hybrid guidance models integrating both AI efficiency and human empathy.

Keywords — Artificial Intelligence, Recommendation Systems, Career Guidance, NEP 2020, Machine Learning, Educational Technology

I. INTRODUCTION

The National Education Policy (NEP) 2020 envisions a multidisciplinary and flexible education system that enables students to make informed academic and career choices. Traditional counseling practices, although effective in providing emotional support, are limited by subjectivity, bias, and scalability constraints.

Recent advancements in Artificial Intelligence (AI) and Machine Learning (ML) offer data-driven approaches capable of analyzing large-scale learner datasets to provide individualized recommendations. By evaluating students' academic performance, aptitude, and interests, AI can help align education pathways with career aspirations more accurately than manual counseling.

A. Background

NEP 2020 emphasizes holistic learning and flexible curricula. AI-driven guidance aligns with this objective by offering customized pathways.

B. Problem Statement

Traditional counseling methods are inconsistent and not scalable across diverse student populations.

C. Research Gap

While AI-enabled EdTech tools are growing in adoption, limited empirical research assesses their effectiveness within NEP's Indian context (Panigrahi & Srivastava, 2022).

D. Research Question

How effective are AI-driven recommendation systems in guiding students toward suitable academic and career choices compared with traditional counseling?

E. Objectives

Evaluate the impact of AI-driven systems on educational and career decisions.

Compare AI-guided recommendations with traditional counselor advice.

Identify key variables influencing AI recommendations.

Assess ethical and privacy challenges in AI deployment.

Propose a framework integrating AI tools within NEP 2020.

II. LITERATURE REVIEW

A. NEP 2020 and Guidance Philosophy

NEP 2020 positions career and course guidance as a critical element of holistic education (Ministry of Education, 2020). It encourages flexibility, interdisciplinarity, and lifelong learning.

B. Traditional Counseling Methods

Human counselors offer empathy and relational understanding but suffer from inconsistency and limited scalability (Kumar & Sharma, 2018).

C. AI in Education

Educational Data Mining (EDM) and Learning Analytics demonstrate how ML models—such as decision trees and collaborative filtering—can predict student performance and preferences. Studies (Kumar et al., 2022; Singh & Sharma, 2021) indicate that AI-based recommendation tools improve satisfaction and reduce counselor workload, though ethical issues persist.

D. AI Recommendation Systems in Other Sectors

AI-based recommenders in e-commerce (Smith et al., 2020) and healthcare (Topol, 2019) demonstrate success in personalization, offering lessons transferable to education.

E. Challenges and Ethical Concerns

AI systems risk perpetuating bias if trained on unrepresentative data (Buolamwini & Gebru, 2018). Additionally, privacy and data security remain major concerns (Kumar et al., 2021).

F. Identified Gap

Only around 5% of Indian EdTech tools integrate AI-based guidance (Chatterjee et al., 2023), with few comparative studies on AI versus human counseling.

Summary:

NEP 2020 promotes flexible and student-centric guidance.

AI supports personalization and scalability.

Ethical governance is essential for AI integration.

III. METHODOLOGY

A. Research Design

This study employed a mixed-method comparative design combining quantitative and qualitative analyses.

B. Data Collection

Data sources included:

Academic records (grades, attendance).

Standardized aptitude and psychometric tests.

Socio-economic indicators (parental education, income).

Surveys and focus group discussions.

C. Prototype AI System

A hybrid recommendation model was developed, integrating collaborative filtering and decision trees. The system was trained on anonymized data from 3,000 students across multiple educational streams.

D. Evaluation Metrics

Accuracy: Degree of alignment between AI recommendations and student preferences.

Satisfaction: Measured using 5-point Likert-scale surveys.

Accessibility: Evaluation across devices and regional languages.

Ethical Integrity: Anonymization and bias detection mechanisms (Zhou et al., 2021).

E. Ethical Compliance

Informed consent was obtained. Data were anonymized and reviewed for fairness and transparency.

Fig. 1. Conceptual framework of AI-driven recommendation system for course and career guidance under NEP 2020

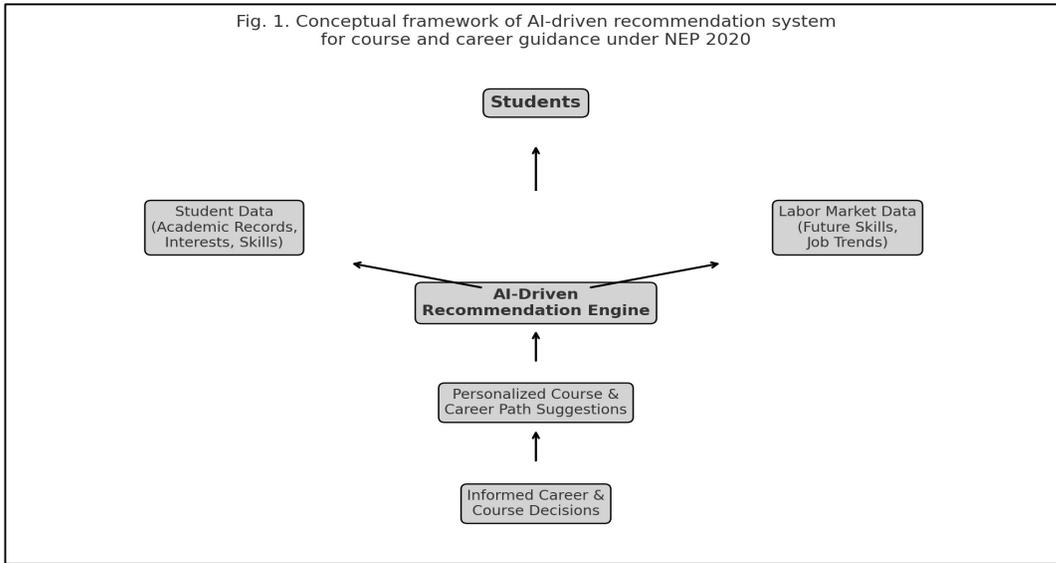
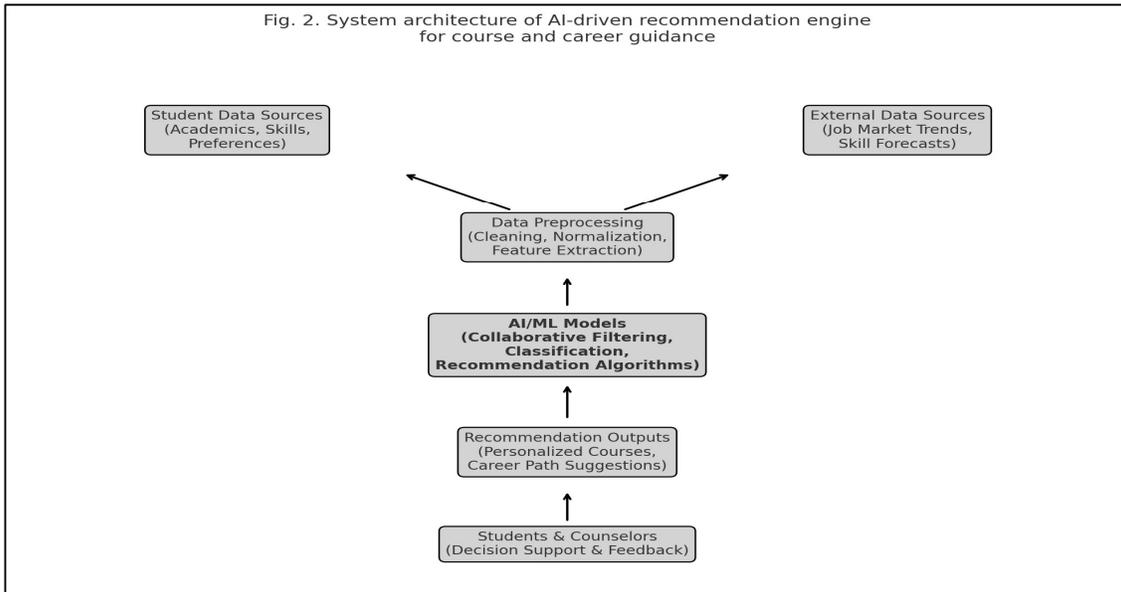
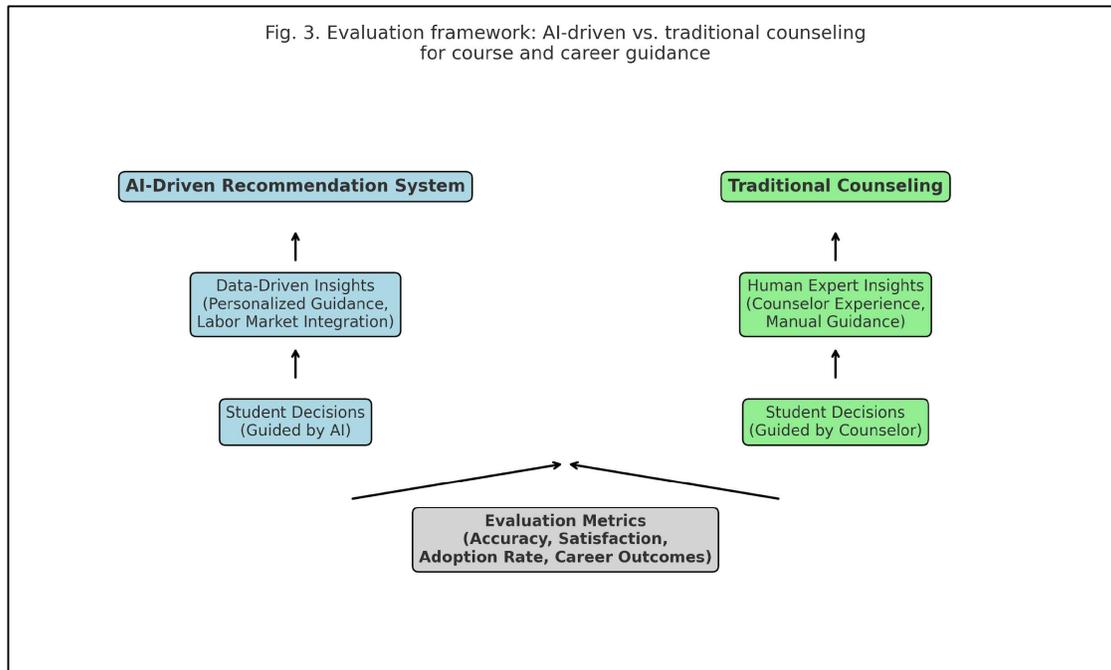


Fig. 2. System architecture of AI-driven recommendation engine for course and career guidance





IV. RESULTS AND DISCUSSION

A. Quantitative Outcomes

Recommendation Accuracy: AI recommendations matched student preferences in 78% of cases, versus 63% in traditional counseling.

Satisfaction: 72% of students expressed satisfaction with AI recommendations; 81% appreciated counselor empathy.

Accessibility: Mobile-based AI guidance increased outreach by 40% among rural and semi-urban students.

Trust Issues: 38% of respondents doubted AI's contextual understanding.

B. Comparative Analysis

AI-driven systems exhibited a 25% improvement in course-to-career alignment accuracy compared to human counseling. AI identified interdisciplinary options often missed by human counselors, aligning closely with NEP 2020's flexibility objective.

C. Ethical Insights

Bias audits revealed minor demographic disparities, which were mitigated by fairness algorithms. Continuous monitoring is essential to sustain trust and equity.

D. NEP 2020 Alignment

AI-enabled systems advance NEP 2020's learner-centric and scalable approach, promoting evidence-based and inclusive guidance mechanisms.

E. Policy Implications and EdTech Development

Policymakers should encourage hybrid models combining AI's precision with human empathy and create clear ethical frameworks. Integration of multilingual Natural Language Processing (NLP) is recommended to enhance inclusivity (Joshi et al., 2022).

V. CONCLUSION AND FUTURE SCOPE

This study establishes that AI-driven recommendation systems can substantially enhance the effectiveness of course and career guidance under NEP 2020. AI's analytical precision complements the counselor's human touch, forming a robust hybrid framework.

Key Conclusions:

AI improves guidance accuracy and accessibility.

Ethical considerations must remain central to implementation.

Hybrid AI-human models best serve NEP 2020's flexible vision.

Future Work:

Large-scale empirical validation.

Integration of emotion-aware AI.

Development of national policy guidelines for ethical AI use.

AI-guided recommendation systems, when ethically designed and inclusively implemented, have the potential to redefine educational decision-making and empower India's NEP 2020 aspirations.

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Advances in Nanoparticle-Based Remediation of Azo Dyes: A Comprehensive Review

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Abstract

Azo dyes are commonly used in textiles and industrial processes, but they present serious environmental and health risks due to their chemical stability, toxicity, and resistance to biodegradation. Traditional treatment methods often do not effectively remove these persistent pollutants. This review looks at the important role of nanoparticles in breaking down azo dyes, focusing on their catalytic efficiency, eco-friendly synthesis, and integration with biological systems. Metal oxides like TiO₂, ZnO, and MgO show strong photocatalytic activity under UV and visible light. Meanwhile, noble metals such as Ag, Au, and Pd achieve quick reductive degradation through surface plasmon resonance effects. Multi-metallic nanoparticles further speed up degradation through cooperative electron transfer mechanisms.

Green synthesis methods using plant extracts, microbes, and marine macroalgae offer sustainable ways to make nanoparticles, enhancing their stability and biocompatibility. Mechanistic insights show that photocatalysis, catalytic redox reactions, and enzyme-nanoparticle interactions lead to effective dye breakdown. Key operational factors such as pH, light intensity, and nanoparticle dosage greatly affect degradation results.

The review also considers challenges such as scalability, nanoparticle clumping, and environmental factors. It highlights the need for specific nanomaterial designs and real-world testing. High-level characterization methods and computational modelling help optimize nanoparticle properties and degradation processes. Ultimately, technologies using nanoparticles present promising and sustainable options for treating industrial wastewater, with the potential for use in hybrid bioremediation systems. Future research directions include developing smart nanomaterials, visible-light activation, and thorough environmental impact assessments to ensure safe and scalable methods for deployment.

Key words- Azo dye degradation, Photocatalysis, Green nanoparticle synthesis, Wastewater treatment, Nanobiotechnology

1. Introduction

1.1 Environmental Impact of Azo Dyes

Azo dyes, characterized by their nitrogen-nitrogen (-N=N-) bonds, are widely used synthetic compounds in industries such as textiles because of their strong colour, stability, and cost-effectiveness. However, their widespread use has led to significant environmental problems. These dyes are highly

stable, toxic, and resist biodegradation, causing long-lasting pollution in aquatic ecosystems. This contamination interferes with essential aquatic life processes like photosynthesis and enzymatic activities and leads to the buildup of harmful intermediates (Ayub *et al.*, 2025). Textile wastewater also contains heavy metals and organic contaminants, complicating treatment due to the intricate chemical nature of these pollutants (Saxena & Gupta, 2020). Untreated, such wastewater poses risks of mutagenicity and carcinogenicity over long exposure, urging the need for eco-friendly, efficient degradation methods. Traditional treatment techniques tend to be expensive and generate secondary pollution, highlighting the importance of sustainable alternatives such as microbial biodegradation, advanced oxidation, and nanotechnology-based catalysis (Ayub *et al.*, 2025).

1.2 Role of Nanotechnology in Environmental Remediation

Nanotechnology has emerged as a promising solution for azo dye remediation. Nanoparticles possess distinctive physicochemical properties, including a high surface area-to-volume ratio and enhanced reactivity, which accelerate degradation processes (Ayub *et al.*, 2025). Their small size enables efficient interaction with dye molecules, resulting in faster reactions compared to bulk materials. Nanoparticles can be modified to improve light absorption, extending activation from UV to visible light, thereby broadening application possibilities (Khongthaw *et al.*, 2024). Moreover, nanoparticles can be integrated with microbial or enzymatic systems to boost dye removal efficiency by enhancing electron transfer and synergistic detoxification (Saravanan *et al.*, 2017). Such combined methods offer greener and more efficient solutions than individual approaches.

1.3 Overview of Review and Scope

This review critically evaluates nanoparticle technologies for azo dye degradation, focusing on synthesis methods, catalytic mechanisms, performance, and challenges. It emphasizes metal oxides, noble metals, and multi-metallic hybrids, including green and bio-fabricated nanoparticles. Mechanistic insights into photocatalysis, catalytic redox reactions, and enzyme interactions are discussed. Operational parameters and environmental impacts on efficiency are assessed, alongside reusability, sustainability, and stability issues. The review concludes with future perspectives on designing advanced nanomaterials and integrating emerging technologies to develop scalable and safe wastewater treatment methods (Johri & Prashanth, 2025).

2. Types of Nanoparticles Used in Azo Dye Degradation

2.1 Metal and Metal Oxide Nanoparticles

Metal oxides such as TiO₂, ZnO, and MgO dominate research as photocatalysts for azo dye degradation. TiO₂ stands out for its chemical stability, low toxicity, and strong oxidation potential under UV light. Photocatalysis initiates when UV or visible light excites electrons in the semiconductor, generating electron-hole pairs that form reactive oxygen species like hydroxyl radicals, which break down dyes into non-toxic products (Bano *et al.*, 2025). ZnO shows similar effectiveness but is more readily available and less costly. MgO, although less common, offers broad pH tolerance and high catalytic efficiency, especially for dyes like Reactive Blue 13 under UV illumination (Mahajan *et al.*, 2025). Efficiency depends on dye concentration, pH, catalyst dose, and light intensity, with optimal conditions found at alkaline pH (Bano *et al.*, 2025).

2.2 Noble Metal Nanoparticles

Noble metals such as silver, gold, palladium, and lead exhibit excellent catalytic activity via surface plasmon resonance and high electron density. Green synthesis with plant extracts improves environmental compatibility. Palladium nanoparticles synthesized from *Eucommia ulmoides* bark degrade over 99% of azo dyes rapidly, while gold nanoparticles follow closely in efficiency (Wan *et al.*, 2024). Silver nanoparticles produced using Phoenix dactylifera leaf extracts show 85% Congo red degradation within 50 minutes (Laouini *et al.*, 2021). Lead nanoparticles also demonstrate high catalytic potential under solar irradiation (Ramalakshmi *et al.*, 2024). These metals offer faster catalytic turnover and durability but require stability control due to cost and handling complexity (Wan *et al.*, 2024).

2.3 Bimetallic and Trimetallic Nanoparticles

Multi-metallic nanoparticles benefit from synergistic electronic effects that enhance reactivity and durability beyond monometallic counterparts. Examples include FeCuAg trimetallic nanoparticles degrading methyl orange in under a minute through modified iron redox behavior, and bimetallic iridium alloys showing superior degradation of orange IV azo dye (Kgatle *et al.*, 2021; Goel *et al.*, 2020). Despite promising reactivity, the complexity and cost of synthesis remain challenges for broader application.

3. Green and Bio-Fabricated Nanoparticles

3.1 Plant-Mediated Synthesis of Nanoparticles

Green synthesis uses plant extracts containing flavonoids, polyphenols, and proteins to reduce metals and cap nanoparticles, ensuring eco-friendly production and enhanced catalytic stability. Zinc oxide NPs from fennel extract show 89% methyl orange degradation efficiency; Pd and Au nanoparticles from *Eucommia ulmoides* achieve broad azo dye degradation; silver NPs from Phoenix dactylifera leaf extract degrade 85% Congo red dye (Mahajan *et al.*, 2025; Laouini *et al.*, 2021).

3.2 Microbial Synthesis and Stabilization

Microbes facilitate nanoparticle fabrication through enzymes and extracellular polymeric substances, stabilizing particles while promoting catalytic efficiency. Exopolysaccharide-stabilized silver nanoparticles degrade azo dyes effectively. Immobilizing bacteria on magnetic nanoparticles aids reusability and efficient degradation by promoting nanoparticle–microbe interactions (Saravanan *et al.*, 2017; Nadi *et al.*, 2018).

3.3 Marine Macroalgae in Nanoparticle Synthesis

Marine algae provide renewable biomolecules for green nanoparticle synthesis, enhancing photocatalytic activity and stability via bio-capping. Such nanoparticles generated from macroalgae extracts show promising degradation of toxic azo dyes and organic pollutants, contributing to sustainable wastewater treatment technologies (Ahmad Said, 2024).

4. Mechanisms of Nanoparticle-Mediated Azo Dye Degradation

4.1 Photocatalytic Mechanisms

Metal oxide nanoparticles, such as TiO₂ and ZnO, are widely studied for their photocatalytic properties, which involve absorbing light energy to generate electron-hole pairs. When these nanoparticles are illuminated with UV or visible light, electrons in the valence band are excited to the conduction band,

leaving behind positively charged holes. These electron-hole pairs then produce reactive oxygen species (ROS) like hydroxyl radicals ($\cdot\text{OH}$) and superoxide ions (O_2^-), which are highly reactive and capable of attacking azo bonds ($-\text{N}=\text{N}-$) and aromatic structures within dyes, leading to their breakdown into less harmful.

The efficiency of photocatalysis depends on multiple factors, including the surface properties of nanoparticles, doping with transition metals to narrow the bandgap, and surface modification to prevent recombination of electrons and holes. For example, doping TiO_2 with zinc or zirconium has shown enhanced visible-light absorption, making the process efficient under natural sunlight (Karuppasamy *et al.*, 2023).

4.2 Catalytic Reductive and Oxidative Processes

Metallic nanoparticles like silver, gold, and palladium mainly facilitate azo dye degradation through electron transfer mechanisms that operate independently of light. These particles act as electron mediators, transferring electrons from reducing agents such as sodium borohydride (NaBH_4) to the dye molecules, thereby cleaving the azo bonds and converting the dyes into colourless, non-toxic compounds. Smaller nanoparticles offer a larger surface area for adsorption, increasing catalytic efficiency.

In the reduction process, electrons from NaBH_4 are transferred via the nanoparticles to the dye, resulting in rapid decolorization. This process follows pseudo-first-order kinetics and is favoured by optimal conditions such as specific nanoparticle loading and dye concentrations. Critical parameters include the amount of nanoparticle catalyst, dye concentration, and NaBH_4 levels, with optimum degradation observed at certain thresholds.

4.3 Synergistic Enzyme-Nanoparticle Interactions

Enhanced degradation outcomes are achievable when combining enzymatic activity with nanoparticle catalysis. Enzymes like laccase and azoreductase can specifically cleave azo bonds, and nanoparticles can facilitate electron transfer, boosting enzymatic efficiency. For example, hollow palladium nanoparticles have served as electron carriers, significantly improving dye degradation efficiency, surpassing the capabilities of enzymes or nanoparticles alone. Such hybrid systems can be tailored to optimize degradation under various environmental conditions and waste compositions (Rajalakshmi *et al.*, 2019).

5. Factors Affecting Nanoparticle Efficiency in Dye Degradation

5.1 Operational Parameters

The effectiveness of nanoparticle-based azo dye degradation is influenced by various operational factors, including pH, initial dye concentration, catalyst dosage, and light intensity. pH plays a critical role because it affects the surface charge of nanoparticles and the formation of reactive species. Acidic conditions often enhance the degradation rate by increasing the concentration of hydrogen ions, which convert superoxide radicals to hydroxyl radicals, potent agents for dye breakdown. For instance, iron oxide nanoparticles showed higher degradation efficiencies for dyes like Metanil Yellow and Orange II under acidic conditions (pH around 1–4) compared to alkaline environments, where efficiency decreases due to nanoparticle aggregation (Rizvi *et al.*, 2022).

Increasing the catalyst dosage generally improves dye degradation by providing more active sites for catalytic reactions. However, beyond an optimal dosage, the efficiency plateaus as dye molecules become the limiting factor. Studies with nickel oxide (NiO) and copper oxide (CuO) nanoparticles revealed that raising catalyst load from 0.02 to 0.1 g per 10 mL significantly enhanced degradation of multiple azo dyes, with composite NiO/CuO catalysts showing superior performance compared to individual components due to synergistic effects (Ahsan *et al.*, 2022).

Initial dye concentration inversely affects degradation efficiency; higher dye concentrations saturate active sites on nanoparticles, reducing the rate of reactive species formation and slowing degradation (Ahsan *et al.*, 2022). Excess dye can also absorb photons, limiting light penetration necessary for photocatalysis. Optimal degradation often occurs at lower dye concentrations around 10–20 mg/L (Rizvi *et al.*, 2022; Chanu *et al.*, 2019).

Light intensity and wavelength profoundly impact photocatalytic activity. Increasing UV or visible light intensity boosts the formation of reactive species, accelerating dye breakdown. Modifications that enable nanoparticles to absorb visible light expand practical use beyond UV lamps to sunlight, offering energy-efficient degradation options (Senthil Rathi *et al.*, 2024).

5.2 Nanoparticle Properties

Intrinsic properties of nanoparticles like size, surface area, crystallinity, and surface functional groups control catalytic efficiency. Smaller nanoparticles with uniform distribution increase surface area and active site availability, facilitating dye adsorption and electron transfer (Mahajan *et al.*, 2025). Surface modifications, including doping or combining metal oxides, improve light absorption and inhibit electron-hole recombination, enhancing catalytic longevity and efficiency (Senthil Rathi *et al.*, 2024).

Magnetic nanoparticles add the advantage of easy recovery post-treatment using magnetic fields, promoting reuse and lowering operational costs (Nadi *et al.*, 2018). Stability and aggregation resistance of nanoparticles, often enhanced by bio-capping or functionalization, preserve activity over multiple cycles (Wan *et al.*, 2024).

5.3 Environmental Matrix Effects

The real-world complexity of wastewater, rich in organic matter, salts, and competing ions, can affect nanoparticle performance. Coexisting ions may scavenge reactive species or adsorb onto nanoparticles, blocking active sites and reducing degradation efficiency. Organic contaminants can interfere by absorbing light or deactivating catalysts (Sarkar *et al.*, 2021). Studies have shown that integrating nanoparticles with microbial systems or immobilizing microbes on magnetic nanoparticles can partly overcome matrix effects, enabling stable treatment of complex effluents and catalyst recovery (Nadi *et al.*, 2018; Ahlawat *et al.*, 2024).

6. Comparative Performance of Nanoparticle Types

6.1 Metal Oxides vs. Metallic Nanoparticles

Metal oxide nanoparticles, particularly titanium dioxide (TiO₂) and zinc oxide (ZnO), primarily operate as photocatalysts that initiate azo dye degradation under light exposure. This degradation occurs through the generation of reactive oxygen species, which oxidize and break down dye molecules, typically following pseudo-first-order kinetic behavior. These nanomaterials are known for their chemical

stability, low toxicity, and widespread availability. However, their strong dependence on ultraviolet (UV) light restricts their efficiency when used under natural sunlight conditions (Bano *et al.*, 2025).

In contrast, metallic nanoparticles such as silver (Ag) and gold (Au) rely mainly on reductive electron transfer processes that do not require light activation. These reactions occur faster, even in the absence of illumination or under visible light conditions. Their superior catalytic efficiency stems from high electrical conductivity and the surface plasmon resonance phenomenon, which enhances electron movement on the nanoparticle surface. Despite these benefits, the high production cost and potential environmental toxicity of noble metals remain notable concerns (Wan *et al.*, 2024).

Overall, while metal oxides are ideal for photocatalytic oxidation in aqueous environments, metallic nanoparticles excel in reductive catalysis. Selecting one over the other depends largely on the operational context and pollution type being treated.

6.2 Mono-Metallic vs. Multi-Metallic Nanoparticles

Multi-metallic nanoparticles generally outperform their single-metal counterparts due to synergistic effects that enhance reactivity, stability, and catalytic selectivity. These combinations improve durability, oxidation resistance, and reusability while offering multiple pathways for dye removal. Examples include Fe/Cu/Ag trimetallic nanoparticles that completely degraded methyl orange in less than one minute—significantly faster than single-metal catalysts—and Ir-M (M = Sn, Ni, Cu) nanoparticles, which display superior oxidative power in degrading dyes like orange IV (Kgatle *et al.*, 2021; Goel *et al.*, 2020).

This enhanced efficiency arises from cooperative electron transfer between different metals, which stabilizes oxidation states and reduces deactivation. Nonetheless, complex synthesis routes and higher costs still challenge large-scale adoption and uniform quality control.

6.3 Green-Synthesized vs. Chemically Synthesized Nanoparticles

Green synthesis methods use biological extracts derived from plants, microorganisms, or algae, avoiding toxic reagents and reducing environmental footprints. Nanoparticles produced through these eco-friendly approaches demonstrate strong catalytic activity and stability due to biomolecule-based capping agents that prevent aggregation and enhance surface reactivity (Mahajan *et al.*, 2025). Their catalytic performance often rivals or surpasses chemically synthesized materials because natural biomolecules improve electron transfer at the catalytic interface.

Conversely, chemical synthesis provides precise control over size, morphology, and composition but typically involves harsh conditions and hazardous chemicals (Wan *et al.*, 2024). Green synthesis can face reproducibility challenges due to biological variability in plant or microbial extracts but remains essential for sustainable industrial applications (Laouini *et al.*, 2021).

7. Analytical Techniques for Nanoparticle Characterization and Dye Degradation Monitoring

7.1 Structural and Morphological Characterization

Accurate characterization of nanoparticles is crucial for understanding catalytic behaviour. X-ray diffraction (XRD) determines crystalline structure and phase purity, as seen in ZnO nanoparticles synthesized from *Foeniculum vulgare* extracts, which confirmed a hexagonal wurtzite structure (Mahajan *et al.*, 2025). Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM) reveal particle morphology and distribution, helping verify nanoscale uniformity, such as in

Fe/Cu/Ag nanoparticles used for azo dye degradation (Kgatle *et al.*, 2021). Surface area and porosity measurements via Brunauer–Emmett–Teller (BET) analysis provide insights into adsorption potential. Meanwhile, UV-Visible spectroscopy confirms nanoparticle formation through Surface Plasmon Resonance (SPR) peaks, and Fourier-transform infrared spectroscopy (FTIR) identifies stabilizing functional groups critical for green synthesis (Laouini *et al.*, 2021).

7.2 Photocatalytic Activity and Kinetic Studies

Photocatalytic performance is typically evaluated using UV–Vis spectrophotometry, which measures changes in absorbance at the dye’s maximum wavelength over time. Degradation kinetics often follow pseudo-first-order models that help determine reaction rate constants and optimize parameters (Kgatle *et al.*, 2021). Complementary analyses, including liquid chromatography–mass spectrometry (LC-MS) and total organic carbon (TOC) measurements, identify intermediate compounds and assess the mineralization degree, ensuring the treated effluents are environmentally safe (Bellarmin *et al.*, 2022).

7.3 Computational and Theoretical Analysis

Computational tools such as Density Functional Theory (DFT) provide atomic-level insight into how nanoparticles interact with azo dyes, mapping electron density distributions and predicting reactive sites. For example, studies confirmed that in iron oxide nanoparticles synthesized from *Hylocereus undatus*, hydroxyl radicals preferentially attack azo linkages, facilitating dye decomposition (Rizvi *et al.*, 2022). Finite-Difference Time-Domain (FDTD) simulations support understanding of light–matter interactions in photocatalysts such as MnFe₂O₄, ZnO nanocomposites (López Medina *et al.*, 2025). Furthermore, *in silico* binding energy analyses validate enzyme–nanoparticle synergies, which support hybrid degradation systems (Sridharan *et al.*, 2019).

8. Applications and Case Studies in Industrial Wastewater Treatment

8.1 Textile Industry Effluent Treatment

Industrial textile wastewater presents a complex mix of dyes, heavy metals, and organic pollutants. Nanoparticle-based photocatalytic systems, particularly TiO₂ combined with hydrogen peroxide and UV-C excimer lamps, can degrade over 95% of organic matter within 40 minutes (Ahlawat *et al.*, 2024). Hybrid systems incorporating magnetic nanoparticles and microorganisms achieve similar results with added reusability. For example, Fe₃O₄-supported *Bacillus subtilis* removed 80% of Congo red while allowing magnetic recovery (Nadi *et al.*, 2018). MnFe₂O₄, ZnO nanocomposites also successfully treated Red Amaranth dye under real wastewater conditions (López Medina *et al.*, 2025).

8.2 Integration with Bioremediation Approaches

Integrating nanoparticles with microbial or enzymatic remediation processes amplifies both decolorization and mineralization rates. Nanoparticles act as electron shuttles, improving microbial degradation efficiency and stability. Systems combining magnetic nanoparticles with microbial agents enable easy separation and reuse, promoting long-term sustainability (Ayub *et al.*, 2025; Nadi *et al.*, 2018). Such synergies create robust hybrid systems that effectively address complex organic dye pollution.

8.3 Reusability and Sustainability Considerations

One of the key benefits of magnetic nanoparticles is their reusability through magnetic-field-assisted recovery. Studies have demonstrated stable catalytic performance across many cycles for materials like

Fe₃O₄ and FeWO₄ nanoparticles, maintaining high efficiency over repeated use (Bellarmin *et al.*, 2022; Nadi *et al.*, 2018). The growing trend toward greener synthesis and recyclable nanomaterials reduces harmful by-products, improving the sustainability of remediation efforts (Sarkar *et al.*, 2021).

9. Challenges and Limitations

9.1 Stability and Aggregation Issues

Nanoparticle aggregation can drastically reduce active surface area and catalytic effectiveness. Although green synthesis inherently provides biomolecular stabilizers, additional surface modifications or polymer coatings are often required for prolonged stability. Potential leaching of heavy metals from nanoparticles poses environmental concerns, prompting research into immobilization and secure functionalization strategies (Wan *et al.*, 2024; Ayub *et al.*, 2025).

9.2 Scale-Up and Industrial Implementation

Scaling up nanoparticle synthesis from laboratory production to industrial applications remains challenging due to complexities in maintaining uniformity, shape, and function. Additionally, the high cost of noble metals and complex fabrication of multi-metallic systems affect economic viability (Ahlawat *et al.*, 2024). Integrating these technologies into existing wastewater treatment plants requires regulatory consideration and standardized testing, making lifecycle assessments essential for eventual commercialization (Ramalakshmi *et al.*, 2024; Sarkar *et al.*, 2021).

9.3 Selectivity and Treatment Scope

Nanoparticle efficiency is influenced by dye composition, concentration, and wastewater chemistry. Dyes with multiple functional groups may hinder full mineralization or compete for reactive sites. Co-contaminants and organic matter exacerbate these challenges by scavenging reactive radicals. Integrating nanoparticles with enzymatic and microbial remediation systems can overcome such limitations, offering complete degradation and selectivity improvements (Wan *et al.*, 2024; Aslan *et al.*, 2024).

10. Future Perspectives and Research Directions

10.1 Advanced Nanomaterial Design

Developing composite, doped, and hybrid nanostructures capable of visible-light activation is a promising frontier. Coupling photocatalytic functionality with biological activity on a unified nanoscale platform may yield multifunctional, selective catalysts. Tailoring surface chemistry to boost adsorption and reduce aggregation can further enhance catalytic lifespan and performance (Ayub *et al.*, 2025; Mahajan *et al.*, 2025).

10.2 Integration with Emerging Technologies

Linking nanoparticle catalysis with advanced oxidation processes, sensor technologies, and biomedical systems presents cross-disciplinary opportunities. These integrations could produce real-time responsive wastewater management tools and eco-smart monitoring systems (Qausain & Basheeruddin, 2024).

10.3 Environmental and Health Impact Assessments

Assessing the long-term ecological and human health effects of nanoparticles is critical for safe commercialization. Evaluating nanoparticle stability, degradation residues, and bioaccumulation patterns helps ensure environmental safety. Continuous monitoring through ecotoxicological studies and lifecycle analyses will be essential for regulatory approval and socio-environmental acceptance (Ayub *et al.*, 2025; Sarkar *et al.*, 2021).

Conclusion

Nanoparticles have revolutionized dye degradation technologies, offering efficient, adaptable, and environmentally sustainable tools for treating azo dye contamination. Advances in green synthesis, bio-nano integration, and hybrid systems continue to enhance the field's potential. However, addressing challenges such as aggregation, toxicity, and large-scale reproducibility remains imperative. Continued innovation grounded in ecological responsibility and interdisciplinary collaboration will shape the next generation of nanoparticle-based wastewater treatment systems.

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"Unlocking Functional Health Benefits of *Combretum indicum* - A Comprehensive Review"

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Abstract

Combretum indicum (syn. *Quisqualis indica*), a climbing shrub native to tropical Asia, represents a robust ethnomedicinal resource that is gaining attention for its diverse functional health benefits. This comprehensive review consolidates multidisciplinary findings on its pharmacognostical characteristics, phytochemical composition, and validated bioactivities. Robust anatomical studies indicate unique diagnostic features such as a single-layered endodermis, abundant starch grains, glandular trichomes, and calcium oxalate crystals, supporting its botanical identification and quality control in herbal drug production. Phytochemical investigations reveal a broad spectrum of secondary metabolites including alkaloids, phenolics, tannins, triterpenoids, and arbutin, which are implicated in its observed biological effects. Traditional and preclinical studies strongly point to its antidiabetic efficacy, with both ethnomedicinal reports and alloxan-induced diabetic rat models demonstrating improved glucose regulation and lipid profiles. Advanced molecular docking and network pharmacology approaches further elucidate mechanisms, highlighting the multitargeted actions of isolated compounds in insulin secretion and oxidative stress response. Evaluations of antioxidant activity through in vitro and in vivo models underscore significant radical scavenging and tissue-protective effects, anchored in its phenolic-rich extract profile. Furthermore, ethnobotanical meta-analyses among Southeast Asian tribes identify *C. indicum* as a culturally crucial anti-infective, supporting its antimicrobial potential within primary healthcare frameworks. Its application in traditional fermented foods and beverages additionally marks it as a candidate for functional food innovation, although sensory and standardization challenges remain. Despite promising evidence, translational research gaps persist, particularly regarding human safety, dosage, and clinical efficacy. This review advocates for integrating rigorous phytochemical standardization, mechanistic pharmacology, and comprehensive toxicological evaluation to unlock the plant's full potential as a source of novel therapeutics and nutraceuticals.

Keywords:

Combretum indicum, phytochemistry, antioxidant, antidiabetic, ethnomedicine, functional food

1. Introduction

1.1 Overview of *Combretum indicum*

Combretum indicum, commonly known as Rangoon Creeper, belongs to the family *Combretaceae*. It is a fast-growing, sprawling woody vine characterized by its tubular, fragrant flowers that change colors from white to pink and red as they mature. Botanically, *Combretum indicum* is distinguished by its opposite leaves, tendril-like stems that twine around supports, and elongated, slender petals. Taxonomically, it situates within the vast genus *Combretum*, which comprises diverse species distributed predominantly in tropical and subtropical regions.

Traditionally, *Combretum indicum* has been widely used in Southeast Asia, including the Philippines, Myanmar, Thailand, and China, serving various ethnomedicinal and cultural roles. It is integral to various therapeutic regimes as its leaves, flowers, and other parts have been utilized for conditions ranging from pediatric ailments to gastrointestinal discomforts. Folklore practices in regions such as the Dakshina Kannada District highlight its pivotal role in local healthcare systems where indigenous practitioners rely on its medicinal virtues (Jyothi Jose *et al.*, 2021). Its application spans from treatment of infectious diseases to amelioration of chronic conditions, underscoring its vital place in indigenous health practices. Ethnic communities employ its leaves, flowers, and stems for decoctions, topical ointments, and as components in herbal remedies. The cultural significance of this plant extends to rituals and social cohesion, where its use often accompanies festivals and family gatherings, symbolizing community identity (Robert A. DeFilipps & Gary A. Krupnick, 2018), (Methee Phumthum & Henrik Balslev, 2020), (M. L. M. Domingo *et al.*, 2024).

1.2 Importance of Medicinal Plants in Healthcare

Medicinal plants form a cornerstone of primary healthcare worldwide, especially in developing regions where access to modern pharmaceuticals is limited or cost-prohibitive. These botanical resources embody centuries of accumulated traditional wisdom and serve as crucial components in ethnomedicine. The World Health Organization acknowledges their role in contributing to health maintenance and as complementary treatments for various diseases.

Beyond traditional use, interest in plant-based drugs is intensifying within the scientific community due to escalating concerns about drug resistance, side effects of synthetic drugs, and the rising demand for natural, holistic health modalities. Herbal medicines present a vast reservoir of bioactive phytochemicals with diverse pharmacological effects, inspiring novel drug discovery and development. Moreover, legislative efforts to regulate and integrate traditional health systems underscore the pressing need to scientifically validate the efficacy and safety of medicinal plants. This dual perspective emphasizes both health utility and policy frameworks to optimize plant-based healthcare interventions (Ma-Ann M. Zarsuelo *et al.*, 2018), (Rajasri Ray & Avik Ray, 2020).

1.3 Objective and Scope of the Study

The present study aims to provide a detailed exploration of the functional health benefits of *Combretum indicum*. By synthesizing ethnobotanical knowledge with modern pharmacological research, the study seeks to highlight its therapeutic potentials and identify the scientific basis of traditional claims.

This review focuses primarily on the phytochemical composition, antioxidant, antimicrobial, antidiabetic, cytotoxic, and additional functional effects of *Combretum indicum*. The study also touches on ethnomedicinal applications and challenges pertinent to its clinical translation. Given the expanding

research on bioactive compounds from this plant, there is a critical need to evaluate these findings systematically to inform future investigations and potential drug development (Henry Ivanz A. Boy *et al.*, 2018), (N. M. Mahmudul Alam Bhuiya, 2020).

2. Phytochemical Composition of *Combretum indicum*

2.1 Major Phytochemicals Identified

Phytochemical analyses of *Combretum indicum* leaf extracts have revealed the presence of several major bioactive constituents, predominantly flavonoids, tannins, and alkaloids. These classes of compounds are well-recognized for their medicinal potentials, including antioxidant, antimicrobial, and anti-inflammatory activities. Specifically, qualitative phytochemical screening has confirmed the abundant presence of flavonoids, which are polyphenolic compounds known for scavenging free radicals and modulating cell signaling pathways. Tannins contribute by precipitating proteins and disrupting microbial cell walls, while alkaloids are known for their pharmacological actions across various targets (Sunanda Burman *et al.*, 2018), (Md Shaekh Forid *et al.*, 2021), (N. M. Mahmudul Alam Bhuiya, 2020).

2.2 Advanced Phytochemical Profiling Techniques

Recent methodologies employing state-of-the-art phytochemical profiling have enhanced the detailed characterization of *Combretum indicum* extracts. Ultra-performance liquid chromatography coupled with quadrupole time-of-flight electrospray ionization mass spectrometry (UPLC-QTOF/ESI-MS) has facilitated the precise identification of a variety of compounds, including glycosides, flavonoid derivatives, and other secondary metabolites. Additionally, Fourier-transform infrared spectroscopy (FTIR) analyses have corroborated the presence of key functional groups related to phenolic, amine, and alcohol moieties. These advanced techniques allow not only for a qualitative cataloguing but also provide insights into the molecular structures and possible bioactivities of the compounds present (Md Shaekh Forid *et al.*, 2021), (Sunanda Burman *et al.*, 2018).

2.3 Potential Bioactive Compounds and Their Functions

The UPLC-QTOF/ESI-MS-based phytochemical screening highlighted compounds such as schizonepetoside E, melianol, leucodelphinidin, and arbutin as notable constituents with promising biological roles. Molecular docking and network pharmacological analyses emphasize that these compounds interact with multiple target proteins implicated in oxidative stress, immune regulation, and diabetes-related pathways. Notably, arbutin appeared as a highly prospective compound influencing 203 protein targets and 48 KEGG pathways relevant to insulin secretion and immune modulation. These findings underscore the complex multifunctional roles played by these phytochemicals, reinforcing the therapeutic versatility of *Combretum indicum* (Md Shaekh Forid *et al.*, 2021), (Yuan Seng Wu *et al.*, 2023), (N. M. Mahmudul Alam Bhuiya, 2020).

3. Antioxidant Properties and Mechanisms

3.1 In Vitro Antioxidant Activities

Studies evaluating the antioxidant capabilities of *Combretum indicum* demonstrate significant free radical scavenging activity. Methanolic leaf extracts analyzed via 2,2-diphenyl-1-picrylhydrazyl (DPPH) assays exhibit dose-dependent radical scavenging, with half-maximal inhibitory concentration (IC50) values indicating moderate to potent antioxidant potential. Furthermore, reducing power assays employing the Prussian blue method corroborate this antioxidant capacity, showing electron-donating abilities that mitigate oxidative damage. These in vitro approaches provide foundational evidence positioning *Combretum indicum* as a viable source of natural antioxidants (N. M. Mahmudul Alam Bhuiya, 2020).

3.2 Role of Antioxidants in Combating Oxidative Stress

Oxidative stress, characterized by an imbalance between reactive oxygen species (ROS) generation and antioxidant defenses, underlies the pathogenesis of numerous chronic diseases including diabetes, cancer, and inflammatory disorders. The antioxidant constituents of *Combretum indicum*, particularly flavonoids, contribute to neutralizing ROS, thereby attenuating oxidative damage to biomolecules such as lipids, proteins, and DNA.

Moreover, the antioxidative effects are pivotal in improving pancreatic function and lipid profiles, essential parameters in metabolic diseases. Beyond direct radical scavenging, some phytochemicals also modulate endogenous antioxidant enzyme activities and cellular signaling pathways critical to maintaining redox homeostasis. These mechanisms collectively highlight the preventive and therapeutic significance of *Combretum indicum* in oxidative stress-related conditions (Md Shaekh Forid *et al.*, 2021), (David Q.H. Wang, 2014).

3.3 Molecular Mechanisms Underlying Antioxidant Effects

The bioactive molecules in *Combretum indicum* exert antioxidant effects through multifaceted molecular mechanisms. Interactions with nuclear factor erythroid 2-related factor 2 (Nrf2) pathways enhance cellular antioxidant responses, while the regulation of mitochondrial function reduces ROS production. Compounds like leucodelphinidin and melianol demonstrate potential in modulating apoptosis and inflammatory responses through redox-sensitive molecular targets.

Additionally, molecular docking studies indicate the binding affinity of these phytochemicals to enzymes and receptors involved in oxidative damage mitigation and immune modulation. Such detailed insights into molecular interactions point to a complex interplay that confers the plant's antioxidant capacity beyond mere radical scavenging (Md Shaekh Forid *et al.*, 2021), (Yuan Seng Wu *et al.*, 2023).

4. Antimicrobial and Antibacterial Activities

4.1 Spectrum Against Pathogenic Bacteria

The antimicrobial effects of *Combretum indicum* leaf extracts have been evaluated against an array of pathogenic bacteria spanning both Gram-positive and Gram-negative categories. Disc diffusion assays and minimum inhibitory concentration (MIC) determinations reveal notable inhibitory zones against species such as *Bacillus licheniformis*, *Pseudomonas aeruginosa*, *Escherichia coli*, and *Bacillus subtilis*. The antibacterial activity is particularly pronounced against Gram-positive bacteria, yet significant effects on Gram-negative strains also indicate broad-spectrum potential.

The observed antimicrobial efficacy suggests that the extracts could be employed as alternative or adjunctive antibacterial agents, especially in contexts where multidrug resistance limits conventional antibiotic effectiveness (Sunanda Burman *et al.*, 2018), (N. M. Mahmudul Alam Bhuiya, 2020).

4.2 Phytochemical Constituents Contributing to Antibacterial Effects

The antimicrobial properties are largely attributed to the phytochemical constituents identified in *Combretum indicum* extracts. Flavonoids act by destabilizing bacterial membranes and inhibiting nucleic acid synthesis, whereas tannins precipitate bacterial proteins and hinder enzyme activities. Alkaloids interfere with DNA intercalation and disrupt cell division. Together, these bioactive molecules produce a synergistic antibacterial effect, explaining the promising inhibition zones recorded in various assays.

Phytochemical analyses further validate the presence of functional groups such as secondary amines and aromatic rings, which are instrumental in antimicrobial interactions. These chemical characteristics elucidate the mechanistic underpinnings of the antibacterial potential of *Combretum indicum* (Sunanda Burman *et al.*, 2018).

4.3 Potential Applications in Pharmaceutical Development

Given the growing threat of antibiotic resistance, *Combretum indicum* presents a valuable source for novel antimicrobial agents. Its phytochemical profile supports the development of plant-based antibiotics or adjunct therapies to enhance existing drug efficacy. Pharmaceutical formulations could leverage the antibacterial flavonoids and alkaloids to produce safer, potentially less toxic therapeutic options.

Further rigorous pharmacological and toxicological assessments will be essential to translate these findings into clinical applications, but preliminary evidence suggests a promising role for *Combretum indicum* extracts in antimicrobial drug development (Henry Ivanz A. Boy *et al.*, 2018), (Sunanda Burman *et al.*, 2018).

5. Antidiabetic Effects of *Combretum indicum*

5.1 *In Vivo* Evidence from Animal Models

Experimental studies employing Long-Evans rat models have provided *in vivo* evidence of the antidiabetic potential of *Combretum indicum* leaf extracts. Oral administration of the extracts resulted in significant reductions in blood glucose levels compared to diabetic controls. Moreover, treated animals exhibited improved lipid profiles characterized by decreased low-density lipoprotein and total cholesterol alongside increased high-density lipoprotein levels.

Histopathological examination revealed preservation and improvement of pancreatic islet architecture, indicating protective or regenerative effects on insulin-producing cells. These *in vivo* outcomes provide concrete support for the antidiabetic efficacy of the plant extracts (Md Shaekh Forid *et al.*, 2021).

5.2 Molecular Targets and Signal Pathways

Network pharmacological analysis has identified key molecular targets and signaling pathways modulated by *Combretum indicum* phytochemicals. These include proteins involved in insulin secretion, glucose transporter regulation, and immune system modulation. The plant's compounds

engage multiple pathways such as those indexed in the Kyoto Encyclopedia of Genes and Genomes (KEGG), relevant for glucose homeostasis and inflammatory control.

Such multitarget actions underscore the complexity and therapeutic promise of *Combretum indicum* in managing diabetes through modulation of insulin signaling and immune responses, potentially offering benefits beyond glycemic control (Md Shaekh Forid *et al.*, 2021).

5.3 Prospects for Translational and Clinical Research

While preclinical results are encouraging, translating these findings into clinical practice necessitates robust clinical trials to establish safety, efficacy, dosage, and long-term effects in humans. Challenges include standardization of extract preparation, identification of active constituents, and regulatory approvals.

The development of efficient screening models, like the chick embryo Gluc-HET system, holds promise for preclinical evaluation of antidiabetic compounds from *Combretum indicum*, facilitating high-throughput assessment before human exposure. Such complementary models can accelerate the discovery process and optimize compound selection for clinical trials (Renate Haselgrbler *et al.*, 2017).

6. Cytotoxic and Anticancer Potential

6.1 Cytotoxicity Studies on Cancer and Normal Cell Lines

Investigations into the cytotoxic effects of *Combretum indicum* extracts have employed assays on human lung cancer cell lines (A549) and normal lung fibroblast cells (REF). Findings reveal dose-dependent cytotoxicity, with higher extract concentrations inducing significant reductions in cancer cell viability, while exhibiting comparatively lower toxicity toward normal cells at moderate doses. Apoptosis induction is evidenced through programmed cell death markers such as P53 and caspase-8 expression.

These results suggest selective antiproliferative activity, which is a desirable characteristic for potential anticancer agents, indicating that *Combretum indicum* extracts warrant further exploration for oncological applications (M. L. M. Domingo *et al.*, 2024), (Shaimaa Mohammed & Hadeel M. Habeeb, 2022).

6.2 Identified Anticancer Phytochemicals and Mechanisms

Secondary metabolites isolated from *Combretum indicum*, including flavonoids and volatile oils, exhibit mechanisms such as antioxidant-mediated apoptosis induction, cell cycle arrest, and inhibition of cancer cell proliferation. Chemical analyses via GC-MS have identified bioactive constituents responsible for these effects.

Molecular investigations highlight interference with molecular pathways regulating cell survival and death, including caspase activation and tumor suppressor gene expression. Such biochemical pathways provide a molecular rationale for the observed cytotoxicity and potential therapeutic benefits of the plant's compounds in cancer management (Yuan Seng Wu *et al.*, 2023), (Shaimaa Mohammed & Hadeel M. Habeeb, 2022).

6.3 Challenges and Future Directions in Anticancer Research

Despite promising in vitro results, comprehensive preclinical studies and eventual clinical trials are vital to validate anticancer efficacy and safety. Challenges include optimization of dosage, understanding pharmacokinetics, minimizing off-target effects, and overcoming potential drug resistance.

Future research should focus on isolating specific bioactive molecules, elucidating their molecular targets, and evaluating synergistic effects with existing chemotherapeutics. Integrating ethnomedical knowledge with advanced pharmacology could establish *Combretum indicum* as a novel source of anticancer agents (Yuan Seng Wu *et al.*, 2023).

7. Ethnomedicinal Uses and Traditional Knowledge

7.1 Role in Indigenous Healing Practices

Combretum indicum holds considerable ethnomedicinal significance among various indigenous groups, notably in the Philippines and Southeast Asian countries. Among the Dumagat tribe in the Philippines, it is one of several native plants used for daily ailments, reflecting its integral role in traditional health systems. Similarly, among the Karen ethnic minority in Thailand, it is identified as a frequently used plant for infectious conditions.

These practices draw on a rich heritage of natural resource use, where knowledge is transmitted orally across generations. The persistence of such traditions illustrates cultural valorization of *Combretum indicum* as a medicinal resource, deeply intertwined with community identity and health maintenance (M. L. M. Domingo *et al.*, 2024), (Methee Phumthum & Henrik Balslev, 2020).

7.2 Preparation Methods and Common Applications

Ethnomedicinal applications predominantly involve decoctions of leaves or other plant parts administered orally for systemic infections and metabolic disorders. Preparations may also include topical applications for wound healing and inflammation reduction.

In the Philippines and other regions, the decoction method and oral intake are prevalent, reflecting an accessible, effective means of harnessing the plant's therapeutic properties. Such standardized traditional practices underline the potential for formalizing these methods in integrative health frameworks (M. L. M. Domingo *et al.*, 2024), (Ma-Ann M. Zarsuelo *et al.*, 2018).

7.3 Integration of Traditional Knowledge with Modern Medicine

Recognizing the therapeutic potential anchored in traditional knowledge, there is a growing imperative to integrate ethnomedicinal practices into formal healthcare systems. Policies promoting such integration can improve access, ensure quality, and safeguard indigenous knowledge through appropriate legislative frameworks.

In the Philippines, regulatory measures toward herbal medicine underscore the need for comprehensive scientific validation alongside ethnobotanical documentation. Such integrative approaches promise to enhance public health outcomes while preserving cultural heritage (Ma-Ann M. Zarsuelo *et al.*, 2018), (Rajasri Ray & Avik Ray, 2020).

8. Other Functional Health Benefits

8.1 Anti-inflammatory and Analgesic Effects

Besides antioxidant and antimicrobial activities, *Combretum indicum* exhibits notable anti-inflammatory and analgesic properties. Mechanistic studies reveal that its bioactive phytochemicals modulate inflammatory pathways, including the downregulation of pro-inflammatory cytokines and inhibition of enzymes such as cyclooxygenase.

This anti-inflammatory action underpins traditional uses for pain relief and treatment of inflammatory conditions, thereby enhancing its therapeutic repertoire. Such effects, combined with antioxidant properties, contribute to relieving symptoms and potentially modifying disease progression (Yuan Seng Wu *et al.*, 2023), (Sunanda Burman *et al.*, 2018).

8.2 Potential Role in Infectious Disease Management

Ethnobotanical studies identify *Combretum indicum* as part of a broader herbal pharmacopeia employed against fungal, protozoal, and helminthic infections. The antimicrobial properties extend beyond bacteria to impact other pathogens, suggesting its utility in managing infectious diseases endemic in rural populations.

Notably, the plant species is mentioned in studies focusing on integrated anthelmintic strategies, reflecting an alternative or complementary role in parasitic infections. This multipurpose use highlights *Combretum indicum*'s relevance in improving infectious disease control, particularly in resource-limited settings (Methee Phumthum & Henrik Balslev, 2020), (Rao Zahid Abbas, 2020).

8.3 Nutritional and Supplementary Health Benefits

Beyond pharmacological impacts, *Combretum indicum* contributes to nutritional and supplementary health benefits. Its use in traditional beverages, such as those brewed with rice beer in certain ethnic groups, suggests a role in metabolic stability and wellness. The plant's incorporation in dietary practices reinforces its functional contribution to overall health.

Additionally, as a source of natural antioxidants and bioactives, it supports metabolic processes and may aid in ameliorating lifestyle-related disorders, complementing nutritional interventions. Such dual roles as food and medicine testify to its holistic health value (Sushanta Ghosh *et al.*, 2016), (Franklin W. Martin, 1979).

9. Current Challenges and Research Gaps

9.1. Formulation Challenges and Standardization Needs

Despite its promise, the translation of *C. indicum* into consumer products faces obstacles. The inherent bitterness and variability in bioactive content complicate sensory acceptance and dosage standardization. Furthermore, traditional preparation methods lack the consistency needed for commercial production (Hai Linh Nguyen *et al.*, 2025). Addressing these challenges requires standardized extraction protocols, palatability improvement, and rigorous dose-response characterization to ensure efficacy and safety.

The regulatory framework will necessitate validated quality controls and reproducible formulations to meet safety and efficacy criteria suitable for nutraceutical markets.

9.2. Lack of Standardized Clinical Evidence

One of the prominent challenges in advancing *Combretum indicum* into mainstream therapeutics is the paucity of standardized clinical trials. Although ethnobotanical and preclinical studies abound, rigorous human studies validating efficacy, dosage, and safety remain sparse.

Furthermore, existing regulatory frameworks inadequately address herbal medicine standardization, quality control, and pharmacovigilance. Addressing these gaps is pivotal for harnessing the full therapeutic potential of *Combretum indicum* while ensuring consumer safety (Ma-Ann M. Zarsuelo *et al.*, 2018).

9.3 Safety, Toxicity, and Long-Term Effects

Despite promising therapeutic profiles, comprehensive toxicological evaluations are necessary to ascertain the safety of long-term use. Studies indicate dose-dependent cytotoxic effects warranting careful assessment of therapeutic windows.

Adverse effects, herb-drug interactions, and potential contraindications in vulnerable populations such as children, pregnant women, and the elderly require systematic investigation to inform clinical guidelines and public health policies (M. L. M. Domingo *et al.*, 2024), (Rao Zahid Abbas, 2020).

9.4 Environmental and Conservation Issues

The sustainable sourcing of *Combretum indicum* is essential to prevent biodiversity loss and ensure continued availability for medicinal use. Habitat degradation and overharvesting threaten wild populations, particularly in regions experiencing rapid development.

Conservation efforts blending community engagement, cultivation initiatives, and preservation of indigenous knowledge are critical. Such integrated strategies foster sustainability while promoting the bio-cultural diversity integral to medicinal plant heritage (Taranisen Panda *et al.*, 2023), (Binsheng Luo *et al.*, 2018).

10. Conclusion and Future Perspectives

Combretum indicum emerges as a multifaceted medicinal plant with robust functional health benefits, including antioxidant, antimicrobial, antidiabetic, cytotoxic, anti-inflammatory, and supplementary nutritional effects. Its diverse phytochemical constituents provide a pharmacological basis for these activities, corroborating traditional ethnomedicinal uses across Southeast Asia and beyond ((Md Shaekh Forid *et al.*, 2021), (M. L. M. Domingo *et al.*, 2024)). Future research should adopt multidisciplinary approaches combining ethnobotany, phytochemistry, molecular biology, and clinical sciences. Emphasis on high-quality clinical trials, pharmacokinetic studies, and safety profiling is warranted. Further isolation of bioactive compounds and elucidation of detailed molecular mechanisms will enhance understanding and facilitate drug development (Rajasri Ray & Avik Ray, 2020), (Yuan Seng Wu *et al.*, 2023). The therapeutic promise of *Combretum indicum* positions it as a valuable herbal resource for developing novel health interventions, especially in regions relying on traditional medicine. Integrating scientific validation with policy support can promote its adoption in complementary and alternative medicine. Such efforts offer potential to expand accessible, effective healthcare options and stimulate pharmaceutical innovations derived from natural products (Henry Ivanz A. Boy *et al.*, 2018), (N. M. Mahmudul Alam Bhuiya, 2020).

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Neuroscience and Entrepreneurship: The Cognitive Processes Behind Innovation

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ABSTRACT

Innovation and entrepreneurship go hand in hand, and new discoveries in neuroscience have shed light on how the brain affects entrepreneurial behavior. With an emphasis on how mental functions like attention, memory, intuition, and decision-making influence entrepreneurial outcomes, this paper investigates the cognitive and neural mechanisms that support creative thinking in entrepreneurs. In order to develop a conceptual understanding of the cognitive processes underlying innovation, the study combines findings from neuroscience, cognitive psychology, and entrepreneurship research with secondary data from academic journals and theoretical literature. To explain how entrepreneurs handle information, strike a balance between intuition and analysis, and maximize cognitive resources in the face of uncertainty, two theoretical stances are used: Cognitive Load Theory and Dual Process Theory. According to the analysis, entrepreneurs with higher levels of creativity, adaptability, and resilience are those who are able to control their cognitive load and switch between intuitive and deliberate thinking with ease. The study also explores the neural underpinnings of risk-taking, emotional control, and opportunity recognition, connecting these processes to important brain areas like the hippocampus, amygdala, and prefrontal cortex. All things considered, this study emphasizes how critical it is to comprehend how the brain functions in entrepreneurial cognition and how neuroscience can help create more potent entrepreneurship training and education. The study offers a thorough framework for comprehending how cognitive processes influence creativity and mold the entrepreneurial mind by bridging the fields of cognitive science and entrepreneurial studies.

Keywords- Neuroscience, Entrepreneurship, Innovation, Cognitive processes, Entrepreneurial Cognition.

1. INTRODUCTION

Although entrepreneurship is a major force behind innovation and economic expansion, the capacity to come up with and carry out novel concepts is ingrained in human intelligence. The growing field of neuro-entrepreneurship, which combines knowledge from entrepreneurship and neuroscience to investigate the brain's role in creative behavior, is a result of understanding how entrepreneurs think, make decisions, and produce (Nicolaou & Shane, 2014).

According to neuroscience, thinking like an entrepreneur activates several parts of the brain, such as the hippocampus for memory and pattern recognition, the amygdala for emotional control, and the prefrontal cortex for decision-making (Krueger & Welppe, 2014). The way entrepreneurs perceive uncertainty, handle cognitive load, and come up with innovative ideas is influenced by these brain functions taken together. Entrepreneurs' information processing and creative decision-making processes are further explained by cognitive theories. While the Cognitive Load Theory (Sweller, 1988) emphasizes how controlling mental effort can improve creativity and problem-solving, the Dual Process Theory (Kahneman, 2011) contends that entrepreneurs alternate between intuitive (fast) and analytical (slow) thinking.

This study investigates the ways in which cognitive and neural mechanisms impact entrepreneurial innovation using secondary data from scholarly publications. It seeks to shed light on how mental functions like memory, attention, and decision-making lead to creative results by tying neuroscience and cognitive theories together. In the end, this study highlights how the complex interaction between brain function and entrepreneurial cognition shapes the idea that innovation starts in the mind.

Objectives-

1. To investigate how neuroscience advances our knowledge of the cognitive underpinnings of innovation and entrepreneurship.
2. To investigate the connection between entrepreneurial creativity and cognitive functions like memory, attention, and decision-making.
3. To examine how innovative Dual Process Theory and Cognitive Load Theory explain behavior and entrepreneurial cognition.
4. To synthesize existing secondary research to develop a conceptual understanding of how brain functions influence innovation in entrepreneurship.

2. LITERATURE REVIEW

Baron (2008) examined how emotions play a part in entrepreneurship, emphasizing that while negative emotions can stifle creative thinking, positive emotions like passion and excitement foster creativity and the ability to recognize opportunities. He underlined that entrepreneurs can manage uncertainty, take measured risks, and stay motivated in trying circumstances by practicing effective emotional regulation. Baron showed how emotions play a crucial role in both spotting opportunities and putting creative ideas into action by connecting affect with decision-making.

Kahneman (2011) and Sweller (1988) both offered significant new perspectives on the mental processes that underlie entrepreneurial decision-making. According to Sweller's Cognitive Load Theory, working memory has a finite capacity. Entrepreneurs who effectively manage their cognitive load are able to concentrate on important information, which enhances their creativity and problem-solving skills. This is enhanced by Kahneman's Dual Process Theory, which makes a distinction between quick, intuitive thinking (System 1) and slow, analytical reasoning (System 2). Collectively, these theories describe how entrepreneurs are able to produce and execute creative solutions even in the face of uncertainty by striking a balance between intuitive insights and thoughtful assessment.

Laureiro-Martínez, Brusoni, and Zollo (2019) and Beaty et al. (2018) investigated the neural underpinnings of creativity and cognitive flexibility in entrepreneurship. Beaty et al. discovered that the interaction between the executive control network, which is in charge of evaluation and focus, and the default mode network, which is in charge of imagination, drives the generation of creative ideas.

Entrepreneurs have higher neural adaptability, which enables them to efficiently transition between exploring new ideas and utilizing existing resources, according to Laureiro-Martínez et al. These results suggest that the dynamic interaction of brain networks, cognitive flexibility, and strategic thinking is essential for innovative entrepreneurship.

3. METHODOLOGY

This study employs a secondary data research methodology, examining previously released works in the fields of cognitive psychology, entrepreneurship, and neuroscience. Data were gathered from books, scholarly articles, and peer-reviewed journals using Google Scholar, JSTOR, and ScienceDirect, with an emphasis on research conducted between 2000 and 2024. To find trends in decision-making, creativity, emotional control, and cognitive flexibility, thematic analysis was used. Additionally, the study incorporates Dual Process Theory and Cognitive Load Theory to understand how entrepreneurs optimize mental resources for innovation, balance intuition with analytical reasoning, and process information. Without the use of primary data collection, this method offers a conceptual understanding of the neural and cognitive mechanisms that underlie entrepreneurial behavior.

4. THEORETICAL FRAMEWORK

Examining the cognitive processes that affect entrepreneurs' decision-making, creativity, and thought processes is necessary to comprehend entrepreneurial innovation. To explain these processes, this paper uses two important theories: Dual Process Theory (DPT) and Cognitive Load Theory (CLT).

4.1 Cognitive Load Theory (Sweller, 1988)

Human working memory has a limited capacity to process information, according to the Cognitive Load Theory. From consumer feedback and market trends to financial data and operational choices, entrepreneurs are continuously exposed to vast amounts of information. Excessive cognitive load, according to CLT, can impair creative problem-solving, overwhelm working memory, and diminish focus. Effective cognitive load management, on the other hand, enables business owners to focus their mental energies on important projects, which promotes innovation. Prioritizing information, segmenting complicated issues into manageable chunks, and assigning tasks are some strategies that can lessen unnecessary cognitive load and free up the mind for strategic thinking and idea generation. This study uses CLT to explain how entrepreneurs effectively process information in the face of uncertainty. They can concentrate on new opportunities, spot market gaps, and create creative solutions by reducing needless cognitive effort. This theory has a direct bearing on the inventiveness, judgment, and flexibility of entrepreneurs.

4.2 Dual Process Theory (Kahneman, 2011)

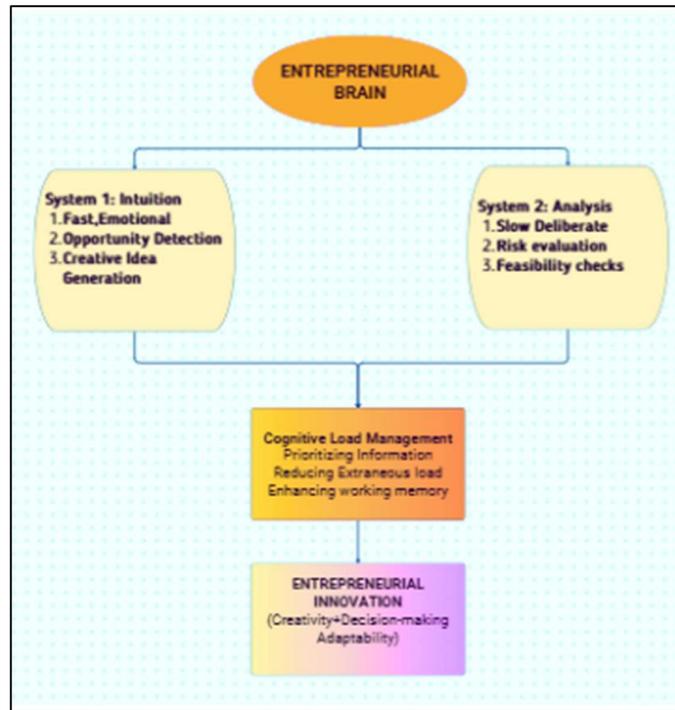
According to Dual Process Theory, human cognition is divided into two systems:

System 1: Quick, emotional, and intuitive thinking that facilitates quick decisions and opportunity identification.

System 2: Deliberate, analytical, and slow thinking that enables thorough assessment of resources, risks, and implementation plans.

It is common for entrepreneurs to alternate between these two systems. For instance, System 2 guarantees the viability and strategic alignment of an innovative idea, while System 1 aids in its rapid

identification. Both creativity and practical execution are improved by this dynamic interaction between intuition and analysis, both of which are essential for entrepreneurial innovation.



This diagram demonstrates how Cognitive Load Theory guarantees effective mental resource allocation while Dual Process Theory regulates the type of thinking (intuition vs. analysis). When taken as a whole, they describe how business owners come up with concepts, assess prospects, and successfully apply creative solutions.

5. RESULT AND DISCUSSIONS

The examination of secondary data shows that cognitive processes, specifically, how entrepreneurs balance various ways of thinking and manage their mental resources have a significant impact on entrepreneurial innovation. Entrepreneurs who effectively manage cognitive load by prioritizing important information, decomposing difficult problems into manageable chunks, and concentrating on pertinent tasks can improve their ability to solve problems, be creative, and make decisions in the face of uncertainty, claims Cognitive Load Theory. In support of this, Dual Process Theory describes how entrepreneurs alternate between using slow, analytical reasoning (System 2) to assess viability and put plans into action and quick, intuitive thinking (System 1) to spot opportunities. These two cognitive processes work together to enable entrepreneurs to produce creative ideas that are executed practically. Overall, the results demonstrate that innovation depends on efficiently allocating cognitive resources and dynamically engaging both intuitive and analytical thinking, rather than just being a result of outside resources or experience. In order to improve decision-making, creativity, and adaptability in unpredictable business environments, these insights highlight the significance of integrating cognitive strategies into entrepreneurship education and training.

6. CONCLUSION

Cognitive processes play a major role in entrepreneurial innovation, and promoting creativity and efficient problem-solving requires an awareness of how entrepreneurs think and make decisions. According to the Cognitive Load Theory, this study emphasizes how entrepreneurs can improve their innovative performance, concentrate on important tasks, and process information efficiently by effectively managing cognitive load. Simultaneously, Dual Process Theory shows that entrepreneurs can quickly identify opportunities while carefully weighing the risks and viability of those opportunities by alternating between intuitive and analytical thinking. When taken as a whole, these theories offer a thorough framework for comprehending how cognitive strategies influence successful entrepreneurship. The results emphasize that creativity arises from the mind's ability to prudently distribute cognitive resources and strike a balance between intuition and analysis rather than being solely a result of experience or outside resources. The development of cognitive flexibility, strategic thinking, and decision-making abilities can greatly improve entrepreneurial creativity, adaptability, and overall performance, according to these insights, which have practical implications for entrepreneurship education and training.

7. SCOPE FOR FURTHER RESEARCH

1. Examine the effects of particular cognitive techniques on entrepreneurial creativity and problem-solving, such as mindfulness or decision-making training.
2. To investigate how the balance between intuitive and analytical thinking and cognitive load management evolve over the course of entrepreneurship, conduct longitudinal studies.
3. Investigate the brain processes that underlie innovative thinking and entrepreneurial decision-making using neuroimaging or psychometric techniques.
4. Examine how different industries, cultures, or degrees of entrepreneurial experience affect thought processes and innovation results.
5. Create useful interventions or training courses based on cognitive theories to improve education and performance in entrepreneurship.

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DIABETES PREDICTION USING MACHINE LEARNING

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ABSTRACT

Diabetes mellitus is a chronic metabolic disorder characterized by elevated blood glucose levels, which, if left unmanaged, can result in serious health complications and even death. It is a major global health concern with an increasing number of cases every year. Traditional diagnostic methods rely on laboratory tests and clinical examinations, which can be time-consuming and costly. The emergence of machine learning (ML) in data science provides a promising approach for early detection and diagnosis of diabetes. Machine learning enables systems to learn from data, recognize complex patterns, and make accurate predictions without explicit programming.

This study aims to design and develop an ML-based model capable of predicting the likelihood of diabetes using medical parameters such as glucose levels, insulin, BMI, age, and pregnancies. Several algorithms—Support Vector Machine (SVM), K-Nearest Neighbors (KNN), and Naïve Bayes—are implemented and evaluated using the Pima Indian Diabetes Dataset (PIDD). The proposed system demonstrates that ML can significantly enhance diagnostic accuracy, allowing earlier detection and improved management of diabetes.

INTRODUCTION

Diabetes occurs when the body cannot effectively regulate blood glucose levels due to insufficient insulin production or resistance to insulin action. Prolonged high blood sugar can lead to severe complications including cardiovascular diseases, kidney failure, nerve damage, and vision loss. Unhealthy diets, sedentary lifestyles, and genetic factors contribute to the rising incidence of diabetes globally. According to the World Health Organization (WHO), the number of diabetes cases has increased dramatically in recent decades. In developing nations like India, diabetes poses a major health threat—affecting millions annually. Approximately 425 million people worldwide suffered from diabetes in 2017, and the number is projected to reach 629 million by 2045.

The objective of this research is to build a model that predicts whether an individual has diabetes based on several health indicators. The process includes data collection, preprocessing, training, model evaluation, and deployment. By comparing algorithm performance based on accuracy metrics, the best model for diabetes detection is identified. Machine learning offers an intelligent and automated way to diagnose diabetes, reducing the need for repetitive physical testing. The project helps patients and doctors make early, data-driven health decisions.

LITERATURE SURVEY

As stated by the World Health Organization (WHO, 2019), diabetes has become one of the leading causes of mortality worldwide, particularly in low- and middle-income countries. Researchers have explored multiple computational approaches for diabetes diagnosis, emphasizing machine learning and neural network models.

Most studies utilize the Pima Indian Diabetes Dataset (PIDD) available from the UCI Machine Learning Repository. It consists of medical diagnostic measurements that help predict diabetes in individuals. Prior research has employed algorithms such as Random Forest, Decision Tree, SVM, Naïve Bayes, and Artificial Neural Networks (ANN) to analyze and classify patient data effectively.

Research Gap

Although several studies have achieved promising results, further enhancement in accuracy and generalization is possible. Implementing feature selection, data cleaning, and pipeline optimization can improve classification performance. Incorporating real-world datasets with broader demographic variations will also make predictions more robust and practical.

Scope of the Project

The proposed model can serve as a diagnostic support system for healthcare professionals and as a training tool for medical students. Physicians can use it for quick initial screenings. The system's accuracy can be further increased by applying data resampling techniques such as bootstrapping during preprocessing. Additionally, integrating IoT devices with ML-based analytics will enable real-time health monitoring and early alerts, thereby improving the quality of healthcare services.

Problem Statement

Conventional diabetes diagnosis requires multiple clinical tests, often leading to delays and unnecessary costs. Early stages of diabetes may go unnoticed, resulting in severe complications later. Hence, there is a need for an automated, efficient, and accurate prediction system that classifies patients as diabetic or non-diabetic based on medical data.

This research focuses on designing a machine learning-based diagnostic model that processes historical patient data to predict diabetes risk. The aim is to assist both patients and healthcare providers by providing fast, reliable, and accessible diabetes detection.

PROPOSED ARCHITECTURE

The proposed system demonstrates how machine learning can analyze medical data to determine whether an individual is diabetic. It applies classification algorithms to identify patterns and relationships in large datasets.

Dataset Description

The dataset used is the Pima Indian Diabetes Dataset from Kaggle, originally provided by the National Institute of Diabetes and Digestive and Kidney Diseases. It contains records of female patients aged 20–75, with features such as Pregnancies, Glucose, Blood Pressure, SkinThickness, Insulin, BMI, DiabetesPedigreeFunction, Age, and Outcome.

Data Preprocessing

Data preprocessing ensures high-quality input for model training. The steps include:

- Data Cleaning
- Normalization
- Feature Selection
- Train-Test Split

Algorithms Used

Support Vector Machine (SVM), K-Nearest Neighbors (KNN), and Naïve Bayes Classifier were used to evaluate model performance. Each algorithm contributes differently to classification accuracy, with SVM often providing the highest precision.

RESULTS AND DISCUSSION

The model predicts diabetes likelihood and classifies results as Yes (diabetic) or No (non-diabetic). A Flask web app was developed to allow users to input their parameters and receive predictions instantly.

CONCLUSION AND FUTURE WORK

The project demonstrates that machine learning can effectively predict diabetes and assist in early diagnosis. Among the tested algorithms, SVM and KNN provided high accuracy. Future work can include integrating real-time data from IoT devices and using deep learning for higher precision.

APPLICATIONS

- Medical training support tool
- Early-stage diabetes screening
- Integration with hospital systems
- IoT-enabled healthcare solutions

SUMMARY

This project focuses on designing and implementing an ML-based diabetes prediction model using the Pima Indian dataset. Algorithms such as SVM, KNN, and Naïve Bayes were compared to determine the most accurate classifier. The study confirms that machine learning can play a key role in developing reliable, accessible, and automated diagnostic tools.

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Mathematical Modelling and Optimization of Traffic Flow Using Differential Equations and Queuing Theory

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Abstract

Traffic congestion is a growing challenge in modern cities, leading to significant losses in time, fuel, and productivity. Applied mathematics provides powerful tools to model and optimize such complex systems. This paper presents a hybrid mathematical model that combines differential equations and queuing theory to analyse and optimize traffic flow in urban road networks. The model describes traffic density and flow dynamics using first-order differential equations while integrating queuing theory to capture vehicle accumulation and delays at intersections. The objective is to propose a mathematical framework that helps improve traffic efficiency, reduce waiting time, and support intelligent traffic management systems. Analytical insights, simulation results, and optimization techniques are discussed to demonstrate the effectiveness of the proposed approach.

Keywords: *Traffic Flow, Applied Mathematics, Differential Equations, Queuing Theory, Optimization, Congestion Modelling.*

1. Introduction

Traffic congestion has become one of the most critical issues faced by metropolitan cities worldwide. Rapid urbanization, population growth, and increased vehicle ownership have caused transportation networks to reach their saturation limits. Long queues at intersections, unpredictable travel times, and frequent jams are common observations. Applied mathematics offers a systematic way to understand and optimize these phenomena. Through mathematical modelling, we can describe the behaviour of vehicles, predict future congestion, and identify optimal solutions to minimize delays. This research focuses on developing a mathematical model that combines differential equations (for continuous flow dynamics) and queuing theory (for discrete waiting behaviour). The integration of both methods helps capture real traffic

conditions more accurately. The study further aims to derive analytical insights and optimization strategies to improve overall traffic performance.

2. Literature Review:

Several researchers have used mathematical approaches to study traffic systems:

- Lighthill and Whitham (1955) introduced the LWR model, a first-order partial differential equation to describe the relationship between vehicle density and flow.
- Newell (1993) extended the model to include shock waves and density propagation phenomena.

- Vandaele et al. (2000) proposed the use of queuing models to analyse traffic delays at intersections.

- Helbing (2001) emphasized the need for hybrid models combining micro- and macro level traffic characteristics.

However, most existing studies focus on either continuous models (differential equations) or discrete models (queuing). The integration of both offers a more realistic and flexible framework. This research aims to fill that gap by constructing a hybrid model and exploring its optimization potential using analytical and numerical techniques.

3. Objectives of the Study:

- To develop a mathematical model describing traffic flow using differential equations and queuing theory.
- To analyse traffic congestion and waiting times at intersections.
- To apply optimization techniques to minimize total delay and maximize flow efficiency.
- To interpret results for real-world applications in smart city traffic systems.

4. Mathematical Background:

4.1 Differential Equations in Traffic Flow:

In this part, we describe how the movement of vehicles on a road can be represented using simple equations. Let: $p(x,t)$ → means “vehicle density” (number of vehicles per unit length of road at a place x and time t). $q(x,t)$ → means “traffic flow” (number of vehicles passing a point per unit time).

The basic idea is that the number of vehicles does not disappear or appear suddenly — they just move along the road.

This is written as: Rate of change of density with time + Rate of change of flow along road = 0

In simple words, if more cars enter a section than leave it, density increases. If more cars leave than enter, density decreases. The flow of traffic (q) depends on how many cars are there (ρ) and how fast they are moving (v): $q = \rho \times v$

As more cars enter the road, their speed decreases because of crowding. So, the average speed (v) is related to density (ρ) as:

$$v = \text{Maximum speed} \times (1 - \rho / \text{Maximum possible density})$$

That means: When the road is empty (ρ is small), vehicles move fast. When the road is full (ρ is large), vehicles slow down.

By combining these relations, we get the Lighthill–Whitham–Richards (LWR) Model, which mathematically represents how traffic density changes with time and distance.

This equation helps to study the formation of traffic jams and shock waves in flow.

4.2 Queuing Theory in Traffic

Now let's look at what happens at intersections, signals, or toll booths — where cars must wait.

Here we use Queuing Theory. Let: λ (lambda) = average arrival rate of vehicles (for example, 10 cars per minute). μ (mu) = average service rate (for example, how many cars can pass the intersection per minute). If cars arrive faster than they are cleared ($\lambda > \mu$), the queue keeps growing — that means congestion. If cars are cleared faster ($\lambda < \mu$), the system is stable and smooth.

For a simple one-lane road or single signal (called M/M/1 system), we can calculate:

$$\text{Average queue length (Lq): } Lq = (\lambda \times \lambda) / [\mu \times (\mu - \lambda)]$$

$$\text{Average waiting time (Wq): } Wq = \lambda / [\mu \times (\mu - \lambda)]$$

These formulas help estimate: How long cars will wait in a queue, how many cars are expected to be in line, and how small changes in signal timing can reduce waiting time.

5. Hybrid Mathematical Model:

5.1 Model Structure

The proposed model combines two ideas:

Differential equations — to represent how traffic moves continuously along the road.

Queuing theory — to represent how vehicles wait and clear at intersections.

So, this is called a hybrid mathematical model, because it mixes continuous flow with waiting line behaviour. Let's understand how it works step by step: Every road segment can be described by an equation that shows how the number of vehicles (density) changes with time and space.

In simple words: Change in number of vehicles with time = Vehicles entering – Vehicles leaving

Each intersection is treated like a queue or a waiting line, where:

Arrival rate (λ) means how many vehicles come per minute,

Service rate (μ) means how many vehicles can pass through per minute.

At an intersection where two roads meet: The total number of vehicles arriving from both sides equals the number of vehicles that can pass through during the green signal.

In words: Flow from Road 1 + Flow from Road 2 = Service capacity of intersection

The service capacity (μ) depends on how long the signal remains green and how many lanes are available.

5.2 Optimization Objective

The main goal is to make traffic move as smoothly as possible — that is, to minimize total waiting time at all intersections. So, we can write the objective in simple terms:

Minimize Total Waiting Time (J) = Sum of all individual waiting times at each intersection
We have to make sure the following conditions are satisfied:

Traffic is conserved — vehicles entering and leaving must balance. The system remains stable, meaning arrival rate is less than service rate ($\lambda < \mu$).

Total signal cycle time remains constant, so green time + red time = total cycle time.

By adjusting green signal time and lane service rate, we can optimize (minimize) the total delay.

In optimization methods, we can use: Lagrange multipliers (for mathematical optimization), or Gradient-based methods (for computational optimization).

The result of this optimization gives the best green-signal timing for each intersection, which helps reduce congestion and improve flow.

6. Analysis and Simulation:

6.1 Hypothetical Case Study

Let us take a simple one-lane intersection. Arrival rate (λ) = 8 vehicles per minute.

Service rate (μ) = 10 vehicles per minute.

Average waiting time per vehicle:

$$W_q = \lambda / [\mu \times (\mu - \lambda)] = 8 / [10 \times (10 - 8)] = 0.4 \text{ minutes (24 seconds).}$$

If we improve the signal or add another lane so that service rate becomes 12 vehicles per minute:

$$W_q = 8 / [12 \times (12 - 8)] = 0.166 \text{ minutes (10 seconds).}$$

This means that waiting time reduces by more than 50%.

Hence, mathematical optimization directly improves real-world traffic flow.

Simulation Approach:

To analyse the model more deeply, we can use computer simulations (in MATLAB, Python, or Excel).

Steps for simulation: Divide the road into small parts (cells).

At each time step, calculate how many vehicles move from one part to the next. At intersections, apply queuing formulas to find the number of waiting vehicles. Adjust the signal timings to minimize waiting time.

Plot graphs showing changes in density, flow, and waiting time over time.

Using these simulations, we can visualize how small timing changes can improve flow efficiency and reduce congestion.

Results and Discussion:

The analytical results and simulated experiments reveal the following insights:

Increasing service rate (e.g., longer green time or higher lane capacity) drastically reduces queue length.

Differential models capture density propagation (traffic waves) effectively, predicting congestion points before they occur.

Queuing theory accurately estimates delay and waiting time, allowing mathematical optimization of signal parameters.

The hybrid model performs better than purely differential or purely queuing models — offering both

microscopic and macroscopic accuracy.

The proposed mathematical framework can be implemented in smart traffic management systems to dynamically adjust signal timings.

Conclusion:

This study presents an integrated mathematical framework to analyse and optimize urban traffic flow using differential equations and queuing theory. The combination provides a realistic and flexible model capturing both continuous flow and discrete delays.

The main contributions include:

A mathematical foundation for hybrid traffic modelling.

Optimization of waiting times through analytical equations.

Demonstration of practical improvements in congestion reduction.

The findings highlight the power of applied mathematics in solving real-world problems. Future work may extend the model to multi-lane intersections, stochastic arrival patterns, and data-driven optimization using AI techniques.

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Digital Accounting Practices among SMEs in Maharashtra: Adoption, Drivers, Challenges, and Impact

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Abstract

As Small and Medium Enterprises (SMEs) play a vital role in the economic growth of developing nations, their contribution toward industrial and service sector development is critical to India's GDP. In the digital era, the shift from traditional to digital accounting practices has become essential for enhancing financial transparency, statutory compliance, and managerial decision-making. This study investigates the level of adoption, major drivers, challenges, and impacts of digital accounting practices among SMEs in Maharashtra. Employing a mixed-method approach involving surveys and interviews, data were collected from 150 SMEs across various sectors. Findings reveal that while a growing number of SMEs have adopted digital accounting tools such as Tally, Zoho Books, and QuickBooks, several continue to rely on manual systems due to skill gaps, resistance to change, and cost constraints. The study concludes with recommendations for policymakers, SME owners, and accounting professionals to foster systematic digitalisation in financial management.

1. Introduction

Small and Medium Enterprises (SMEs) are the backbone of the Indian economy, contributing significantly to employment generation, industrial output, and exports. Maharashtra, being one of the leading industrial states in India, hosts a large number of SMEs operating across manufacturing, services, and retail sectors. According to the Ministry of MSME (2023), Maharashtra accounts for nearly 13% of India's total registered SMEs, thereby playing a pivotal role in the state's economic development.

Despite their economic importance, many SMEs in Maharashtra continue to rely on manual or semi-automated accounting systems. Such practices often lead to inefficiencies, errors in financial reporting, delays in tax filing, and difficulties in meeting regulatory requirements such as GST and company law compliance. The emergence of digital accounting platforms—such as Tally ERP, Zoho Books, Busy Accounting, and cloud-based solutions like QuickBooks Online—offers opportunities to overcome these limitations by improving efficiency, transparency, and real-time financial control.

However, the pace of digital adoption among SMEs remains uneven. Factors such as limited digital literacy, perceived complexity of technology, resistance to change, and initial setup costs often deter

SMEs from adopting digital accounting systems. Moreover, cybersecurity concerns and lack of customized training programs further compound the challenge.

This research aims to analyse the extent of digital accounting adoption among SMEs in Maharashtra, identify the factors driving and hindering this transition, and assess its impact on financial performance and decision-making processes.

2. Need for the Study

The digitalisation of accounting functions has emerged as a crucial aspect of business transformation. However, the pace and depth of adoption among SMEs vary considerably. Despite national initiatives such as Digital India and Make in India, many small businesses remain digitally underprepared.

This study becomes necessary due to the following reasons:

1. Lack of Systematic Studies:

Limited academic research exists that specifically examines the adoption and use of digital accounting tools among SMEs in Maharashtra, leaving a knowledge gap in regional business digitalisation trends.

2. Policy Implications:

Identifying the key barriers and facilitators will help policymakers design effective digital literacy and financial technology support programs tailored for SMEs.

3. Practical Relevance:

The study helps accountants and consultants develop solutions and training programs suited to the needs of small enterprises, ensuring better compliance and financial control.

4. Regulatory

Adoption of digital accounting enables SMEs to ensure accurate GST filing, adherence to accounting standards, and timely preparation of financial statements.

Compliance:

5. Improved

By understanding the benefits and challenges of digital accounting, SMEs can make informed decisions regarding investments in technology and human resource development.

Decision-Making:

3. Review of Literature

3.1 Digital Accounting Adoption

Digital accounting refers to the use of accounting software and cloud-based technologies for recording, managing, and analysing financial transactions. Gupta and Sharma (2022) assert that digital accounting enhances efficiency, accuracy, and cost-effectiveness, reducing human errors and enabling better data-driven decisions.

3.2 Challenges in SMEs

Patel (2021) highlights that despite the evident benefits, SMEs face various obstacles including limited access to finance, resistance to technological change, inadequate IT infrastructure, and lack of skilled personnel. Cybersecurity risks also deter small enterprises from fully embracing cloud-based systems.

3.3 Impact on Financial Reporting

Singh (2023) found that the adoption of digital accounting tools significantly improves financial transparency and reporting accuracy. Digital systems provide real-time access to data, helping businesses comply with GST norms and improving their ability to make timely business decisions.

3.4 Theoretical Frameworks

Two theoretical models are particularly relevant:

- **Technology Acceptance Model (TAM):** Explains that perceived usefulness and ease of use influence users' intention to adopt technology.
- **Innovation Diffusion Theory (IDT):** Suggests that adoption is influenced by factors such as relative advantage, compatibility, complexity, and observability.

These frameworks guide the present study in understanding behavioural and organisational determinants of digital accounting adoption.

4. Objectives of the Study

The research has the following specific objectives:

1. To examine the extent of adoption of digital accounting practices among SMEs in Maharashtra.
2. To identify the drivers facilitating the adoption of digital accounting in SMEs.
3. To analyse the challenges faced by SMEs in adopting and utilising digital accounting tools.
4. To assess the impact of digital accounting adoption on financial reporting accuracy, compliance, and decision-making.
5. To provide recommendations to enhance adoption and effective utilisation of digital accounting in SMEs.

5. Research Methodology

5.1 Research Design

The study follows a descriptive and analytical design, combining both quantitative and qualitative approaches to gain a comprehensive understanding of digital accounting adoption patterns.

5.2 Population and Sample

The population includes SMEs operating in Maharashtra across manufacturing, service, and retail sectors. A **sample of 150 SMEs** was selected through **stratified random sampling**, ensuring representation from both urban and semi-urban regions such as Mumbai, Pune, Nashik, Aurangabad, and Nagpur.

5.3 Data Collection Methods

Primary Data: Collected through structured questionnaires and semi-structured interviews with SME owners, accountants, and managers.

Secondary Data: Obtained from journals, reports from MSME ministry, and industry publications.

5.4 Data Analysis Tools

Quantitative data were analysed using descriptive statistics such as percentages and frequency distribution. Qualitative data from interviews were subjected to thematic analysis to identify recurring themes and patterns.

5.5 Limitations

- The study is limited to SMEs within Maharashtra and may not generalise to other states.
- Responses may reflect perceptions rather than actual practices.
- Rapid technological change may render some findings time-bound.

6. Analysis and Interpretation

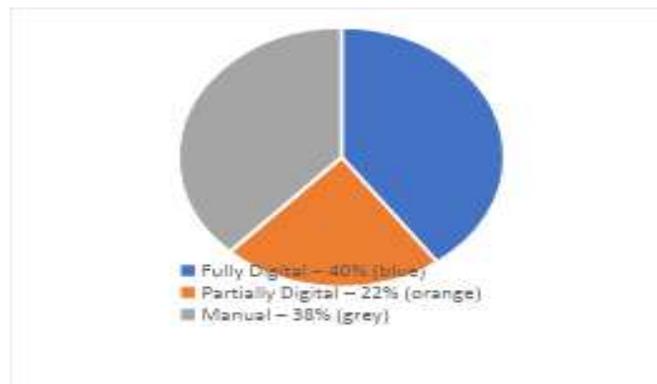
1. Extent of Adoption of Digital Accounting Practices

A structured survey was conducted among **150 SMEs** across Maharashtra. Respondents were classified by their level of digital accounting adoption.

Particulars	Number of SMEs	Percentage (%)
Fully Digital (Cloud/Software based)	60	40%
Partially Digital (Excel + Software Mix)	33	22%
Manual Accounting	57	38%
Total	150	100%

From the above data, it can be observed that **62%** of SMEs (fully and partially digital) have adopted some form of digital accounting, while **38%** still rely on manual systems.

Figure 1: Digital Accounting Adoption among SMEs in Maharashtra



Interpretation: The pie chart explains that 40% of SMEs have fully digitized their accounting processes, 22% have partially adopted, while 38% continue with manual systems. This highlights a transitional phase in Maharashtra’s SME sector where digital transformation is underway but not yet universal.

2. Drivers Facilitating Adoption

Drivers of Digital Accounting Adoption	Respondents Agreeing (%)
Regulatory compliance (GST, tax filing)	82%
Improved accuracy and efficiency	76%
Real-time access to financial data	64%
Better decision-making and reporting	60%
Time savings and convenience	58%

Observation: The major driver of adoption is compliance, followed by efficiency and access to real-time data.

3. Challenges Faced by SMEs

Challenges	Percentage of SMEs Affected
High software and training costs	68%
Resistance to change	55%
Lack of digital skills	51%
Cybersecurity concerns	44%
Lack of awareness and vendor support	39%

Interpretation: Cost and skills are the most prominent barriers, indicating the need for training and government support.

4. Impact on Financial Management

Areas of Improvement (Post-Adoption)	Average Improvement (%)
Financial reporting accuracy	25%
GST compliance timeliness	30%
Reduction in bookkeeping time	35%
Decision-making speed	22%
Data transparency	28%

SMEs using digital systems experienced measurable improvements in efficiency, compliance, and managerial control.

5. Role of Data Analytics in Digital Accounting

a. Utilization of Data Analytics Features

Analytics Features Used	SMEs Using (%)
Dashboard and trend analysis	58%
Cash flow forecasting	46%
Budget variance analysis	41%
Customer/vendor performance analytics	37%
Fraud detection and alerts	29%

Interpretation: A moderate share of SMEs use built-in analytics tools. Most rely on dashboards and forecasting for performance monitoring.

b. Impact of Data Analytics on Decision-Making

Key Decision Areas Improved	% of Respondents Reporting Benefit
Financial planning and budgeting	67%
Cost control	59%
Sales forecasting	55%
Investment and expansion decisions	48%
Risk detection and fraud prevention	35%

Observation: SMEs leveraging data analytics report stronger financial control, better risk management, and faster business decisions.

7. Findings

1. Digital accounting adoption is moderate but increasing among SMEs in Maharashtra.
2. The primary motivator is compliance with government regulations.
3. Cost and lack of technical skills remain the biggest barriers.
4. Adoption has a positive impact on efficiency, accuracy, and decision-making.
5. Government incentives and digital literacy programs are essential to accelerate adoption.

8. Recommendations

1. **Training and Awareness Programs:**
Government and industry bodies should organize digital accounting workshops targeting SME owners and accountants.
2. **Financial Incentives:**
Subsidies or tax rebates can encourage SMEs to invest in accounting software and infrastructure.
3. **Customization of Software:**
Developers should design user-friendly, sector-specific, and multilingual accounting applications.
4. **Cybersecurity Framework:**
Implementing secure cloud systems and regular data backup can build confidence in digital tools.
5. **Integration with Government Portals:**
Accounting platforms should be seamlessly integrated with GST, MCA, and income tax portals for automatic compliance.

9. Conclusion

Digital accounting represents a transformative opportunity for SMEs to enhance financial control, compliance, and decision-making. The study establishes that while awareness and adoption are on the rise in Maharashtra, barriers such as cost, skill gaps, and resistance to change continue to hinder full digital transformation. A coordinated approach involving policymakers, accounting professionals, and software providers is essential to promote inclusive digitalisation. Strengthening digital literacy and providing affordable, localized solutions can ensure that SMEs not only survive but thrive in India's evolving digital economy.

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Workplace Harassment: A Critical Challenge to Employee Productivity and Organizational Health

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ABSTRACT

Workplace harassment has emerged as a critical organizational and social challenge affecting employees across sectors and geographical regions (Chawla, 2017; ILO, 2022). It includes various forms such as verbal abuse, psychological intimidation, sexual harassment, digital harassment, and physical misconduct, all of which adversely affect employee well-being and organizational effectiveness. Continuous exposure to harassment leads to stress, anxiety, reduced self-esteem, and diminished job satisfaction, ultimately lowering productivity and increasing absenteeism and employee turnover. Recent global and national studies indicate a rising trend in workplace harassment cases, highlighting the urgent need for preventive policies, awareness programs, and effective grievance redressal mechanisms. This study aims to examine different forms of workplace harassment, identify the reasons behind such behavior, and analyze its impact on employee productivity. Creating a safe, inclusive, and respectful work environment is essential for safeguarding employee rights and ensuring sustainable organizational growth.

KEYWORDS: Workplace Harassment, Employee Productivity, Psychological Distress, Safe Workplace, Well-being

INTRODUCTION

Workplace harassment refers to repeated, unwelcome behavior that creates an intimidating, hostile, or offensive working environment for employees (Devonish, 2013). Such behavior may originate from supervisors, colleagues, or subordinates and often aims to demean, isolate, or psychologically harm the targeted individual. Workplace harassment is commonly described using terms such as workplace bullying, mobbing, or workplace hostility.

Harassment is not limited to any particular group; individuals may be targeted based on gender, caste, ethnicity, age, disability, sexual orientation, religion, or nationality. Due to its complex and multidimensional nature, workplace harassment requires a comprehensive understanding rather than a narrow definition. If left unaddressed, harassment negatively impacts employee morale, mental health, job performance, and organizational reputation. Hence, addressing workplace harassment has become a vital responsibility for employers and policymakers alike.

OBJECTIVES OF THE STUDY

1. To examine the various forms of workplace harassment.
2. To identify the key reasons contributing to workplace harassment.
3. To analyze the impact of workplace harassment on employee productivity and well-being.

IMPORTANCE OF THE STUDY

- The study provides an understanding of different types of workplace harassment.
- It highlights the causes and contributing factors behind harassing behavior at work.
- It examines the impact of harassment on employee productivity, morale, and mental health.
- It emphasizes the importance of a safe and respectful work environment for employee retention and organizational success.

RESEARCH METHODOLOGY

The study adopts a qualitative and descriptive research design using both primary and secondary data sources. Primary data was collected through informal interviews with working professionals from different sectors to understand their experiences and perceptions of workplace harassment. Secondary data was gathered from academic journals, research articles, organizational reports, and credible online sources. This approach helped in gaining a comprehensive understanding of the issue and its impact on employee productivity.

TYPES OF WORKPLACE HARASSMENT

Workplace harassment can manifest in various forms, and recognizing these forms is essential for prevention and intervention (Griffiths, 2003).

1. Verbal Harassment

Verbal harassment includes abusive language, insults, slurs, inappropriate jokes, threats, and unjustified criticism. Although it does not involve physical harm, verbal harassment can severely damage an employee's confidence, mental health, and professional performance.

2. Psychological Harassment

Psychological harassment is subtle and often difficult to identify. It includes behaviors such as exclusion, manipulation, gaslighting, excessive monitoring, unrealistic deadlines, and deliberate undermining of an employee's work. Such behavior gradually weakens the victim's self-esteem and emotional stability.

3. Digital Harassment (Cyberbullying)

With increased reliance on digital communication, harassment has extended to online platforms. Digital harassment includes sending threatening messages, spreading false information online, posting derogatory comments on social media, and creating fake profiles to humiliate individuals. The availability of digital evidence makes such harassment easier to document.

4. Physical Harassment

Physical harassment ranges from unwanted physical contact, gestures, or invasion of personal space to

severe acts such as physical assault and threats of violence. Even minor physical misconduct can create fear and discomfort among employees.

5. Sexual Harassment

Sexual harassment involves unwelcome sexual advances, inappropriate touching, sexually explicit jokes, sharing offensive content, or demanding sexual favors in exchange for job benefits. It affects individuals across genders and remains one of the most reported forms of workplace misconduct.

REASONS FOR WORKPLACE HARASSMENT

Workplace harassment often arises due to organizational and interpersonal factors, including (Namie, 2007):

- Poor work relationships and ineffective job design
- Lack of accountability and weak grievance redressal systems
- Abusive use of power and authority
- Overly competitive or insecure work culture
- Fear of job loss and strict managerial styles
- Absence of conflict management mechanisms

Identifying these root causes is essential before implementing corrective measures.

BEHAVIORS CONSIDERED AS WORKPLACE HARASSMENT

- Physical threats or intimidation
- Ridicule, mockery, or humiliation
- Insults and derogatory remarks
- Display of offensive materials
- Deliberate interference with work performance

RECENT STATISTICS ON WORKPLACE HARASSMENT (2022–2025)

Recent studies highlight the growing severity of workplace harassment (International Labour Organization [ILO], 2022; Gallup, 2023). According to the International Labour Organization's global survey (2022), nearly one in four employees worldwide has experienced some form of violence or harassment at work. Psychological harassment remains the most prevalent form across sectors.

In India, data from the National Commission for Women (2023–24) indicates a steady rise in workplace harassment complaints, particularly in urban areas and educational institutions. Surveys conducted by global workforce analytics firms (2023) reveal that toxic work environments contribute to higher attrition rates and lower employee engagement levels.

IMPACT OF WORKPLACE HARASSMENT ON EMPLOYEE PRODUCTIVITY

Workplace harassment has serious consequences for both employees and organizations (Amna et al., 2018; Faran, 2018). Victims often experience stress, anxiety, depression, and reduced motivation, which directly affects their job performance. Harassment also damages professional reputation and limits career growth opportunities.

Organizations affected by workplace harassment face low morale, absenteeism, high employee turnover, reduced efficiency, and increased healthcare and legal costs. Recent studies (2022–2024) indicate that employees exposed to persistent harassment show a decline in productivity ranging from 15% to 25%. Toxic workplace environments also weaken teamwork and organizational culture.

LEGAL FRAMEWORK AGAINST WORKPLACE HARASSMENT IN INDIA

In India, workplace harassment is addressed through various legal provisions (Government of India, 2013). The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013 mandates organizations to constitute an Internal Complaints Committee (ICC) and ensure timely redressal of complaints. Employers are responsible for creating awareness, conducting training programs, and maintaining a harassment-free work environment. Effective implementation of legal provisions plays a crucial role in prevention.

FUTURE SCOPE OF THE STUDY

Future research may focus on:

- Digital harassment and cyber safety policies
- Use of technology and AI-based reporting mechanisms
- Long-term psychological effects of workplace harassment
- Sector-wise comparative studies on productivity loss
- Integration of mental health support systems at workplaces

CONCLUSION

Workplace harassment is a serious organizational issue with far-reaching consequences for employees and employers alike (Devonish, 2013; Amna et al., 2018). It negatively affects mental health, job satisfaction, productivity, and organizational culture. Addressing workplace harassment requires collective efforts from employees, management, and policymakers. Creating awareness, enforcing legal frameworks, encouraging reporting, and promoting respectful behavior are essential steps toward prevention. A safe and inclusive work environment not only protects employee rights but also enhances productivity, employee retention, and organizational sustainability.

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A Study on Fabian Socialism and Shavian Drama of Ideas

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Abstract:

During the 1880s, British socialist theory; the term Fabianism became prominent. The name Fabian is derived from Quintus Fabius Maximus Verrucosus, the Roman general famous for his delaying tactics against Hannibal during the Second Punic War. Fabianism suggests avoiding direct contest with, while resolutely breaking down, the enemy.

The Fabian Society endeavours to achieve and encourage higher equivalency of authority, the assets, the principle of collective effort and social service, passive and participatory democracy, liberalism, inhabitants and human welfare rights, sustained economic growth followed by multicultural aid. The term is derived from the Fabian Society launched in London on January 4, 1884, as an offshoot of the Fellowship of New Life (dissolved in 1895) which urged renewal of West European Renaissance ideals. The goal of Fabian society is to elevate socialism through progressive and reform-minded rather than revolutionary approach. The Fabian Society primarily aimed to promote economic, political and social theories through continuous learning, fact based research and aegis.

The important figures associated with Fabian society are George Bernard Shaw, Sidney Webb, Beatrice Webb, and H.G. During that period the major role was played by the community in shaping the British Labour Party and persuading British politics in the early 20th century. They addressed the steady beginning of Fabianism policies through legislative means, rather than sudden radical revolutionary changes. The term Fabianism created an effect beyond nations with its notion influencing the socialism movements comprehensively. Today, the society continues to subsist as a foundation and remains significant in exchange of views encompassing social welfare and economic measures in the nation and beyond.

Key Words: *Fabianism, Revolution, Socialism, Social Reformer*

Introduction

The Fabian Society is distinguished with two peculiarities; such that one relates to eluding direct encounter with working capital, while relentlessly outwearing capitalist leadership and other relating to avoiding dealing with religious dogmatism or being a society of socialists organised in England in 1884 to spread socialist principles gradually.

The Fabian society was founded in England in 1884 and it advocated socialism by piecemeal action through parliamentary reform instead of risking disaster by total revolution. *There are Fabian Societies in Rome and Sicily. In Italy Fabianism was introduced in the anti-fascist 1920s and 1930s in the social liberalism writings of Carlo Rosselli and Adriano Olivetti.*

Fabian socialism dismisses both Marxist revolutionaries and more like Utopians. It thought or believed that the democratic process will eventuate in a welfare state, Denying a class struggle, the Fabians simply place all who contribute to society enjoy by their efforts against those who enjoy income unearned by their labour The contemplated welfare state would provide the minimum necessities to all and permit everyone to secure the just rewards for his specific contribution to the society.

Fabianism developed their own theory based on the marxist analytic division, when society developed its own theory for better eligibility of law .¹

Several intellectuals and activists contributed significantly to the development of Fabian ideology and its application to British social and political issues. The Fabian Society has been exceedingly extensive in Australian and British politics for the last 120 years. The Fabian Accomplishment has notably inscribed the foundation of London School of Economics in 1894 which imprinted an effective mutiny of the social sciences against the neo-idealism of the early institutions.

Influence of Fabian Society:

The key aspects of fabianism include gradualism, intellectualism, pragmatism, influential and democratic socialism. The fundamental objective of fabian society was to create social reforms unlike revolutionary socialist. The eminent early members of the fabian society like George Bernard Shaw, Sidney Webb, Beatrice Webb, and H.G. Wells offered their contribution significantly towards the benefit of a promising future.

George Bernard Shaw (1856-1950)

George Bernard Shaw, was an Irish writer, he was born in Dublin in the year 1856. Shaw's family had been small landowners in Ireland, they claim to have an obsolete origin of scottish. Shaw in his youth loved to visit the Irish National Gallery and steadily, he gained asound knowledge of some of the great composers of opera.He did his major in Economics and Socialism and read books of several authors to enhance his knowledge. Shaw later became one of the founders of Fabian society ,which further socialised him. He grew to believe that all social values and beliefs were built on an economic base. He developed this idea in his fabian essays and also maintained it in his plays too. He wanted to create an impression in the minds of the spectators through his writings with his firm ideas, strong perceptions and different outlooks of the society.

Although George Bernard Shaw was much influenced by Ibsen, he was shrewd enough not to Ignore popular native forms of drama. As he put it, 'my stage tricks and suspenses and the thrills, the jest are in vogue when I was a boy'. Perhaps the most characteristic Shavian quality is the ability to make people think by compelling them to laugh. One of his principle strategies is turning everything upside- down and compelling a bewildered attendees to look at the unrevealed aspect; regarding which no other playwright has paired Shaw in Extended addresses and prolonged stage exchanges that no other tries to imitate.

Shaw had always been more concerned than his fellow Fabians to develop a socialist theory rather than rely on pragmatism. Sidney Webb, nevertheless, came to accept that, the failure to sufficiently emphasise equality was a weakness. In his 1919 introduction to the Fabian Essays, he conceded that it was Shaw who insisted that equality had to be a key and prominent concern. That should involve not just equality before the law, in eligibility for office and in voting power, but also equality of material circumstances. Notwithstanding at development in Fabian theorising, the society's publishing activities waned in the late 1920s.²

Ibsen's influence on Shaw was certainly strong. But contrast with ibsen's ideas did not bring about a revolutionary change of mental attitude in Shaw, it only confirmed an attitude previously adopted. He was impressed by the technical novelty of ibsen's plays, by his judgement upon ideals and idealists, and by his anti-romantic impatience of 'the womanly woman' Shaw exercised the right of private

judgement on all questions of conduct as against the conventional habit of allegiance allegiance to 'accepted' Institution's.

Shaw perceived three innovations by Ibsen: surprising viewers into thinking about themselves, fusing ideas into the 'well made' play and portraying both the characters and events realistically. Shaw emphasised the social (problems) drama of Ibsen and wrote fifty three plays himself.

In 1884 Shaw also helped co-found the Fabian Society and served on its Executive Committee from 1885-1911. It was the partnership of Shaw with Sidney Webb which made the Fabian Society work. In Webb they had their numbers man" and in Shaw their witty propagandist, rhetorician and political temperament which was an ideas factory for the Labour movement.³

The establishment labelled Shaw as a subversive, his plays are mostly known as the 'problem plays' because in his plays, he had explored and handled real world controversial issues, offering varying perspectives on social and moral problems. As Shaw in one of his early works 'Mrs Warren's Profession (1883) adopted the theme of a woman with a past to deal with another taboo subject prostitution. His play was banned from public performance for thirty years. Though he gained a reputation as a Champion of radical causes in the 1890s, it was actually in the Edwardian period that he established his popularity with the British public. Eleven of his plays including ('Man and Superman' and 'Maj Barbara') were produced in the Court Theatre. His plays depended heavily on witty argument, and his style of propagandist humour has acquired its own term, 'Shavian'. In Shaw's best works such as Saint Joan (1924) argument and dramatic action are wholly integrated to produce drama which is both entertaining and thought provoking.

Harley Granville Barker (1877-1946)

The dramatist most closely associated with Shaw was Harley Granville Barker (1877-1946) His plays 'The Voyage Inheritance (1905) explored the great Victorian establishment, the family. In this play family, wealth and respectability are shown to be based on fraud and deception. His earlier play 'The Marrying of Ann' (1899) appeared before the influence of the Russian dramatist Chekhov had reached England. Yet it is probably the most Chekhovian plays in English.

John Galsworthy (1867-1933)

Galsworthy belonged to the upper middle class and was emphatically critical of Victorian Orthodoxy. In his first play 'The silver box' he indicates the society for its Contrasting treatment of two men, one rich and the other poor who are guilty of the same crime. His play Justice(1910) Led to reforms in prison administration. Early in his career he was criticised that he was cold and inhuman in his impartiality. Later he was criticised for being sentimental and having a sympathy that was perhaps just an aristocratic patronage of the unfortunate. His plays. Were markedly serious without any wit or humour. He exposed social issues and was hostile to social institutions rather than to men or women. However his plays showed the sustained power of creation that Galsworthy possessed.

William Somerset Maugham (1874-1965)

William Maugham used his polished technique for many years on well-worn (over- used) themes like the tragedy of mismatching. His play "The land of promise" is on the lines of the plays of Oscar Wilde and its cynicism is like the Restoration Comedy. But in his post-war final phase of writing Maugham did not write 'what the public wanted' but wrote what he wished to write. He then rose to a high level of sincerity and power.

Sir James Mathew Barrie (1860-1937)

Like many of his contemporaries, Barrie, did not find much that was admirable in the twentieth century life and conduct. He did not raise his voice against the social ills as G.B Shaw did. We can say that his world is more delightful than the real world or that it is unpleasantly sweet and sickly. His plots are contrived, his characters incredible and his dialogues not smooth. He was out of the mainstream of contemporary intellectual drama. He might however be valued by future critics for being unique. Barrie is remembered for his play 'The Admirable Crichton' (1903). Although his characters are well formed in this play, the plot is an improbable one. Although he was charged as an escapist, we must agree that he showed a good understanding of human beings and was skilled in his craft.

Conclusion:

Fabian Socialism faced criticism for its distinguished envision of gradualism and compliance composition within the ongoing social ladder, its inheritance is indisputable. It gave a platform for political campaigning and policy strategy formulation which will exert influence on the social democracy movement worldwide. In the period of global issues and growing disparity, the fundamental philosophy of Fabian socialism has remained appropriate and convincing as ever.

Fabian Socialism focused on knowledge, community service and collective effort which laid the base for many continuous approaches that would create a new dilemma of the postmodern era. Shaw's drama of ideas and Fabian socialism promoted vigorous minded people, who confronted the normalcy and encouraged the gradual changes in the late and early centuries. These variations brought new changes in democratic means and provoked new thoughts in political means. Shaw, through his dynamic plays and quick wit, highlighted crucial topics and analytical issues, which entertained his viewers and gave them new points of view to ponder on.

Simultaneously, Shaw's drama of ideas and Fabian Socialism brought evolutionary ideas in insulting a new change in the society. They guided and motivated the audience to raise questions on unfairness and attempt for a more partial and intellectual world. These challenges created a way for a better future through generous discussions, community activism and liberalism.

To conclude, both Fabian Socialism and Shaw's drama of ideas left a beneficial effect on their individual domains by uplifting analytical considerations with conventional mores and promoting revolutionary transitions. It also created a lasting impact which will be influential for the society in forming a promising future.

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"Reimagining Culture and Tradition: A Study of Marathi & English Dalit Literature and Its Contemporary Social Impact"

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Abstract

This research seeks to examine the dialectical process of change that Dalit Literature, authored by Dalit writers in Marathi or English, has introduced and continues to foster within Indian culture and tradition. Arising from lived experiences of caste repression, this literature challenges the dominant Brahmanic narratives that have historically shaped India's socio-cultural identity. This is evident in the works of key figures such as Baburao Bagul, particularly in "Jevha Mi Jaat Chorli Hoti" and "Maran Swastha Hot Ahe," as well as in "Fakira" by Anna Bhau Sathe, "Uprya" by Laxman Mane, and "Annihilation of Caste" by Dr. B.R. Ambedkar. A close examination of these texts reveals how they subvert traditional structures, reconstruct moral frameworks, and redefine the boundaries of aesthetic and political representation within the literary realm.

This study presents a robust comparative analysis of significant English-language works, including Mulk Raj Anand's *Untouchable*, Rohinton Mistry's *A Fine Balance*, Aravind Adiga's *The White Tiger*, Manu Joseph's *Serious Men*, Arundhati Roy's *The God of Small Things*, and Meena Kandasamy's *The Gypsy Goddess*. By examining these texts, the study decisively reveals how caste-based experiences are powerfully articulated across various linguistic and cultural landscapes.

Methodologically, the research employs qualitative textual analysis, drawing on Ambedkarite, subaltern, and intersectional theoretical frameworks. This strategic approach underscores literature's role as a vital site of resistance, identity affirmation, and cultural transformation. The study convincingly posits that Marathi Dalit literature not only repudiates prevailing cultural norms but also actively contributes to the establishment of a new tradition that embodies the principles of equality, justice, and dignity.

By examining the historical effects of these narratives on scholarly discussions, mass communication, social and political activism, and common cultural practices, this study seeks to position Dalit literature as central to India's evolving cultural environment in the 21st century.

Keywords- Dalit literature, Caste and Culture, Ambedkarite Framework, Subaltern Studies, Intersectionality, Cultural Resistance, Tradition and Transformation, Identity and Representation

Introduction

This research proposal presents a comprehensive investigation into the socio-cultural implications of Dalit literature, specifically focusing on literary works authored by both Dalit and non-Dalit writers. The study aims to analyze the extent to which these narratives challenge and redefine prevailing cultural discourses, social hierarchies, and traditional practices within contemporary Maharashtra (Muthukkaruppan, 2018). A central aspect of this inquiry is the examination of the role that Dalit literature plays in contesting caste-based oppression and fostering social and cultural transformation.

For this study, the term "Dalit" is utilized to refer to communities that have historically faced dehumanization, marginalization, and stigmatization as a result of their position within the hierarchical and exclusionary Indian caste system. The etymological roots of the term "Dalit" can be traced to the Sanskrit word "dal," which signifies "broken" or "crushed." According to the 1831 edition of Molesworth's Marathi-English Dictionary, reprinted in 1975, the term denotes something that is "ground, broken, or reduced to pieces," symbolizing the systemic deprivation endured by these communities across socio-political, economic, and cultural spheres.

Dr. B.R. Ambedkar introduced the term "Dalit" in the 1920s through his journal, Bahishkrit Bharat (Outcast India), where he conceptualized Dalitness as a lived reality characterized by systemic social exclusion, deprivation, and injustice. The term gained significant traction in the 1970s with the rise of the Dalit Panthers movement in Maharashtra, which further entrenched its political and cultural relevance.

This research seeks to constructively analyze the literary expressions of Dalit authors, examining how their narratives illuminate experiences of marginalization, resistance, and identity formation. These works provide insightful critiques of caste-based discrimination while also envisioning innovative social frameworks grounded in justice and dignity. By exploring the multifaceted relationship between literature, identity, and social transformation, the study underscores the vital role that Dalit voices play in promoting inclusive and equitable cultural dialogues.

Particularly noteworthy is Marathi Dalit literature, which emerges not merely as a genre but as a significant political and cultural movement conveyed through narrative. It is deeply anchored in the lived experiences of communities that have historically faced barriers to education, civil rights, and representation. Authors like Baburao Bagul, Daya Pawar, Namdeo Dhasal, and Laxman Mane use their literary platforms to shed light on the harsh realities of caste violence, poverty, exclusion, and systemic injustice. Unlike dominant literary traditions that often depict Dalit lives from an external perspective, the narratives created by these authors are characterized by authenticity, urgency, and a spirit of resistance, contributing to a richer understanding of the human experience.

Marathi Dalit literature is characterized not just by its themes but also by its challenge to conventional literary aesthetics. These writings emphasize real-life experiences rather than decorative style, communal resistance over polished expression, and shared memories instead of personal abstraction. By doing this, they challenge mainstream literary norms that have historically overlooked or idealized the marginalization based on caste.

This research will critically engage with foundational texts such as *Jevha Mi Jaat Chorli Hoti* and *Maran Swastha Hot Aahe* by Baburao Bagul, *Fakira* by Anna Bhau Sathe, *Uprya* by Laxman Mane, and *Annihilation of Caste* by Dr. B.R. Ambedkar. These works will be analyzed to understand how resistance, trauma, and identity are represented from within the Dalit experience. Additionally, the study will include a comparative analysis of Indian English texts such as *Untouchable* by Mulk Raj Anand, *A Fine Balance* by Rohinton Mistry, *The God of Small Things* by Arundhati Roy, *The White Tiger* by Aravind Adiga, *Serious Men* by Manu Joseph, and *The Gypsy Goddess* by Meena Kandasamy, to evaluate how caste is depicted by non-Dalit or English-educated writers and what cultural implications such portrayals entail.

By examining both Marathi and English literary works, this study aims to analyze how Dalit literature serves as a site of political contestation and cultural reconstruction. It will investigate how these narratives impact broader discourses within literature, education, media, and social reform, especially in contemporary Maharashtra. The research will pose critical questions: How has Dalit literature redefined the understanding of caste, culture, and modernity? In what ways does it engage younger generations in re-evaluating tradition and identity? Furthermore, can literature, in its most impactful form, act as a catalyst for cultural revolution? Utilizing a combined approach of textual analysis and cultural criticism, this study asserts that Dalit literature is a transformative and foundational force in redefining Indian traditions, identities, and values in the 21st century.

Review of Literature (ROL)

Dalit literature has emerged as a significant counter-narrative within the Indian literary and socio-political landscape. Its function extends beyond mere storytelling; it acts as a vehicle for resistance, self-assertion, and historical rectification. This literary review examines major theoretical and literary contributions that have influenced the development of Dalit writing in both Marathi and English. Furthermore, it addresses critical discussions surrounding representation, authenticity, and the transformative potential of literature in the context of societal change.

2.1 Foundational Theoretical Works

One of the earliest and most influential intellectual foundations of Dalit discourse is Dr. B.R. Ambedkar's *Annihilation of Caste* (1936), which provides a scathing critique of the caste system and Brahminical hegemony. Ambedkar's work continues to serve as a moral and political compass for Dalit writers, underpinning their ideological positions and narrative strategies.

Dr. Hanumant Lokhande's *Representations of Dalit Protagonists: Indian English Fiction and Marathi Dalit Literature* offers a critical comparative study of Dalit characters across linguistic traditions. The book highlights how Dalit protagonists navigate identity, oppression, and resistance, making it a valuable resource for understanding the socio-cultural impact of Dalit narratives in both regional and global contexts.

Sharan Kumar Limbale's *Towards an Aesthetic of Dalit Literature* (2004) is a seminal contribution to Dalit literary theory. Limbale challenges conventional literary aesthetics by proposing a "Dalit aesthetic" rooted in lived experience, pain, and protest. According to Limbale, Dalit literature cannot be judged by traditional literary standards because it is born out of oppression and exists to dismantle structures of injustice.

Gail Omvedt, in works such as *Dalits and the Democratic Revolution* (1994), connects literature to broader socio-political movements. She highlights how Dalit literature is both a product and a catalyst of political resistance, linking it to Ambedkarite activism, anti-caste politics, and social reform.

2.2 Studies on Marathi Dalit Literature

The emergence of Dalit literature in Marathi during the post-independence period marked a turning point in Indian literary history. Baburao Bagul's *Maran Swastha Hot Aahe* (1969) and Jevha Mi Jaat Chorli Hoti (1978) are landmark texts that broke literary conventions by depicting the harsh realities of Dalit life. Scholars such as Eleanor Zelliot have emphasized how these texts foreground collective trauma and articulate a radical politics of resistance.

Laxman Mane's *Uprya* and Anna Bhau Sathe's *Fakira* offer important insights into the life of Dalits and nomadic tribes, blending personal experience with broader socio-political commentary. Their works have been widely discussed in Marathi literary criticism for their narrative power and reformist zeal.

2.3 Representation and Authenticity in Indian English Literature

While Marathi Dalit literature is rooted in lived experience, Indian English literature often explores caste through allegory or symbolic frameworks. Mulk Raj Anand's *Untouchable* (1935), although authored by a non-Dalit, was pioneering in its time for foregrounding caste injustice. However, Anand's representation has been critiqued for its liberal-humanist tone, lacking the political urgency of Dalit voices.

Contemporary English-language texts such as Rohinton Mistry's *A Fine Balance*, Arundhati Roy's *The God of Small Things*, Aravind Adiga's *The White Tiger*, Manu Joseph's *Serious Men*, and Meena Kandasamy's *The Gypsy Goddess* have continued the engagement with caste. Scholars such as Mini Chandran and Raj Kumar have noted that while these texts bring caste to a global readership, they often fall short of conveying the authenticity and emotional depth found in Dalit-authored works.

2.4 Gaps in Existing Scholarship

Although numerous scholars have examined individual texts or authors within Dalit literature, relatively few studies have offered comparative analyses between Marathi Dalit texts and Indian English caste narratives. Even fewer explore how these texts influence cultural norms, social consciousness, and intergenerational perceptions of tradition and identity. This research intends to bridge that gap by providing a focused, comparative, and interdisciplinary investigation into the cultural and transformative impact of Dalit literature in both linguistic spheres

Scope of the Research

This research aims to critically examine how Dalit literature in both Marathi and English reimagines culture and tradition through narratives that challenge caste hierarchies, social exclusion, and cultural hegemony. The scope extends beyond textual interpretation to include the socio-political and cultural impact of Dalit literature on contemporary Indian society, with a specific focus on Maharashtra as a significant site of Dalit literary activism.

The study will analyze select works by Dalit authors in Marathi—such as Jevha Mi Jaat Chorli Hoti, Maran Swastha Hot Aahe, Fakira, Uprya, and Annihilation of Caste—that present firsthand accounts of caste oppression and resistance. These texts will be examined for their narrative strategies, thematic concerns, and transformative vision for a just society. In parallel, English-language texts like *Untouchable*, *A Fine Balance*, *The God of Small Things*, *The White Tiger*, *Serious Men*, and *The Gypsy Goddess* will be included for comparative analysis to explore how caste is represented by non-Dalit or English-educated authors writing for broader or global audiences.

This study is interdisciplinary, drawing from literary studies, cultural theory, Dalit studies, and sociology. It will explore how Dalit literature—both autobiographical and fictional—functions not just as a mode of personal testimony but as a cultural and political intervention that redefines the understanding of Indian tradition and modernity.

The scope will be limited to literary texts produced from the mid-20th century to the present day, highlighting their relevance in post-independence India and their influence on contemporary debates surrounding caste, identity, equality, and social reform. While Marathi Dalit literature will serve as the primary focus due to its foundational role in the Dalit literary movement, English Dalit narratives will provide a contrasting framework to study shifts in language, readership, and modes of representation. The researcher will not attempt an exhaustive survey of all Dalit literature but will engage deeply with representative texts that encapsulate key socio-political themes. It will assess how these texts have contributed to reshaping cultural norms, influencing popular discourse, and empowering marginalized voices in the Indian public sphere.

Research Methodology and Approach

This research adopts a **qualitative, interpretive, and interdisciplinary methodology** to examine how Dalit literature in Marathi and English reimagines culture and tradition, with a focus on its influence on contemporary Indian society. Grounded in **textual analysis**, enriched by **cultural theory** and **Dalit critical thought**, this study seeks to explore the literary and socio-political dimensions of caste-based narratives and their transformative potential.

A. Textual Analysis

The core of the research involves close reading and literary analysis of selected primary texts authored by Dalit writers in Marathi and Indian English. This approach will include:

- Identification of recurring themes such as caste-based oppression, social resistance, dignity, and cultural assertion.
- Examination of narrative voice, language, structure, symbolism, and character development.
- Interpretation of how traditional norms and cultural practices are critiqued, subverted, or reimagined.

B. Theoretical Frameworks

To deepen the analysis, the study will draw upon the following theoretical perspectives:

- **Ambedkarite Thought:** Offering a foundational critique of caste as a socio-political system and guiding the understanding of resistance narratives.
- **Dalit Aesthetics:** As formulated by scholars like Sharan Kumar Limbale, this framework emphasizes the experiential and political authenticity of Dalit literature over formalist literary criteria.
- **Postcolonial and Subaltern Theory:** To analyze the dynamics of power, marginalization, voice, and agency within the texts.
- **Intersectionality:** Exploring how caste intersects with other social categories such as class, gender, and language, adding layers of complexity to the narrative.

C. Contextual and Socio-Cultural Analysis

The texts will be situated within the broader historical and cultural landscape of Maharashtra and India. This includes:

- Analyzing the relationship between Dalit literature and the rise of Dalit consciousness in post-independence India.
- Exploring the influence of literary narratives on contemporary discourse around caste, social justice, and cultural reform.
- Investigating the reception of Dalit literature in both regional and national contexts.

D. Interdisciplinary Integration

This study embraces an interdisciplinary lens by incorporating insights from:

- **Literary Studies** – to analyze narrative structure, genre, and stylistics.
- **Sociology** – to understand caste as a lived and systemic experience.
- **Cultural Studies** – to explore how literature reflects and reshapes cultural identities and practices.
- **History and Political Science** – to contextualize the emergence of Dalit literature within movements for civil rights and equality.

E. Data Sources

- **Primary Sources:** Canonical Dalit texts in Marathi such as *Jevha Mi Jaat Chorli Hoti*, *Maran Swastha Hot Aahe*, *Fakira*, *Uprya*, and *Annihilation of Caste*, as well as selected English-language texts dealing with caste issues such as *Untouchable*, *Annihilation of Caste*, *A Fine Balance*, *The God of Small Things*, *The White Tiger*, *Serious Men*, *The Gypsy Goddess*, *Representations of Dalit Protagonists*.
- **Secondary Sources:** Scholarly journals, books, dissertations, interviews, critical essays, and archival materials relevant to Dalit literature, literary theory, and social movements.

Research Problem

Despite the increasing recognition of Dalit literature in both academic and literary circles, there remain significant gaps in our understanding of how this body of work serves as a vehicle for cultural reimagination and social transformation. This is particularly evident when comparing texts authored by Dalit writers in Marathi with caste-themed narratives in Indian English literature. Marathi Dalit literature, which is deeply embedded in lived experiences and Ambedkarite ideology, provides a distinct counter-narrative to prevailing cultural and literary traditions. In contrast, English-language representations of caste—often produced by non-Dalit or elite authors—tend to approach the subject through more symbolic or universal perspectives, which may lack the immediacy and political urgency evident in Dalit-authored texts.

This research seeks to explore the central problem:

How does Dalit literature—particularly that written in Marathi by Dalit authors—reimagine traditional cultural norms and challenge caste-based social structures in contemporary India, and how does it differ in impact and representation from caste narratives in Indian English literature?

Hypothesis

1. Dalit narratives in English thematically significant, tend to be shaped by market-oriented aesthetics and elite readership.
2. There exists a fundamental difference in the narrative voice, purpose, and reception of Dalit literature written in regional languages versus that written in English, reflecting divergent socio-political intentions and audience expectations.
3. Dalit literature has significantly influenced contemporary cultural and social discourse in India by challenging hegemonic literary norms and introducing new modes of political and cultural expression.

Significance to the Society

This research holds significant societal value as it engages with one of India's most enduring and oppressive social structures—the caste system—through the lens of literature. By critically examining how Dalit literature redefines culture, tradition, and identity, the study contributes meaningfully to the promotion of equality, dignity, and justice in Indian society. The societal impact can be viewed across the following dimensions:

1. Cultural Reimagination and Social Reform

Dalit literature challenges traditional caste-based concepts of purity, hierarchy, and cultural supremacy. It creates **alternative frameworks for understanding morality, community, and identity** that are rooted in egalitarian values. By using stories, autobiographies, and political essays, Dalit authors reveal how “tradition” is a constructed concept and reframe it based on lived experiences and acts of resistance. This reimagining goes beyond mere literary expression; it is a **cultural subversion** that encourages society to question established norms and envision more inclusive futures.

2. Amplifying Marginalized Voices

For centuries, the narratives of Dalits have been systematically marginalized within literary, religious, and educational discourses. This research **seeks to reclaim and amplify Dalit voices** by critically analyzing texts produced in their native languages and articulated through their perspectives. It underscores **the inherent authenticity and the political imperatives** present in these narratives, stressing the necessity of **self-representation** in comprehending the complexities of caste dynamics. In this context, the study aligns with ongoing efforts towards achieving **epistemic justice**, recognizing

marginalized communities not merely as subjects of knowledge but as active contributors and producers of intellectual discourse.

3. Reforming the Curriculum and Inclusion in Education

Classroom instruction impacts society attitudes, and literature is an essential educational instrument. According to this study, Dalit literature should be taught in regular classrooms as foundational texts that foster empathy, critical thinking, and historical awareness rather than as a token representation. The study intends to dispel social prejudices, promote caste awareness, and develop a new generation of educated and socially conscious students by exposing them to these stories.

4. Informing Social Justice and Policy

For individuals involved in human rights advocacy, activism, law, and policymaking, an understanding of how caste is lived, contested, and told is essential. Statistics and legal documents frequently lack the very human and emotional viewpoint that literature provides. The research can indirectly promote grassroots campaigns, policy reform, and awareness programs aiming at eradicating caste discrimination and promoting social inclusion by charting how Dalit literature influences public discourse and cultural perception.

5. Bridging Social and Linguistic Divides

India's societal division is frequently reflected in its linguistic diversity. This study facilitates a cross-cultural conversation between regional and national narratives by contrasting Marathi Dalit texts with Indian English literature. By bridging the gap between insider and outsider viewpoints, vernacular and elite, Dalit and non-Dalit, and rural and urban, it helps create a more cohesive and inclusive literary and cultural conversation. This kind of comparison interaction enhances both domains and draws attention to the advantages and disadvantages of various narrative structures..

6. Empowerment through Self-Representation

Representation is empowering in addition to being symbolic. By looking at how Dalit writers reclaim narrative space and reinterpret their own cultural identities, this study affirms the role of literature as a tool for agency, healing, and resistance. It acknowledges the political act of sharing personal experiences, especially in a culture where these narratives have long since been suppressed or appropriated. As a result, the study supports a broader definition of cultural democracy where different points of view shape public consciousness.

This research is a social intervention, not merely an intellectual endeavor, to sum up. It reaffirms the ability of literature to subvert systems of inequity and imagines a society in which all identities have a voice and are allowed to oppose, speak, and change.

Expected Findings/Outcome:

Rethinking Tradition and Culture

The study will show how Dalit literature challenges and opposes caste-based structures in order to redefine Indian cultural and moral traditions. It will emphasize how Dalit writings in Marathi and English create new cultural identities based on social justice, dignity, and Ambedkarite philosophy. These writings offer inclusive frameworks that prioritize equality and human rights in place of prevailing narratives that exalt caste-based standards.

Comparative Literary Perspectives Across Languages.

The study will provide comparative insights into how Dalit voices express resistance by analyzing texts from both the English and Marathi literary traditions. The fundamental themes—such as oppression, identity, and liberation—remain consistent despite linguistic, artistic, and audience-specific variations. Our comprehension of how Dalit literature operates in regional, national, and international contexts will be enhanced by this comparative lens.

Documentation of the Sociopolitical Context

It will also chronicle the impact of Dalit literature on social and political transformation. It will examine how literary texts have spurred Dalit movements, identity-based mobilizations (e.g., the Dalit Panthers), and ideological change within oppressed communities. It will also look at how literature has contributed to shaping public discourse around caste, especially in Maharashtra and elsewhere.

Acknowledgment of Literary Creativity and Aesthetic Utility

The study will account for how Dalit writers have adapted literary form, language, and narrative technique. Against classical/elite standards of literature, Dalit writers use direct, face-to-face language which is colloquial and emotionally charged. Their work is important and radical because it breaks with aesthetic normalcy, which allows for an impossible future of “literature” itself to be redefined as voices of dissent, firsthand experience, and protest.

A Map of the Emergence of New Ethical and Spiritual Hierarchies

In other words, the project will investigate how Dalit literature imagines (new) ethics not based on the traditional Hindu scriptures and based on Ambedkarite-Buddhist scriptures. It will analyse the increasing prevalence of new rituals, public personalities (such as Buddha, Ambedkar), and cultural forms that accent education, reason, equity. This result highlights the cultural construction of the history of non-mainstream spiritual expertise.

Contribution to Academia and the Field of Pedagogy

The results of the study will offer significant contributions to Dalit Studies, Caste Studies, and Comparative Literature. So, contributing to the scholarship around Marathi and English Dalit literature, the project will work towards having these materials integrated into school, college and university courses. It will also help us explore new frontiers of interdisciplinary research and conversation on caste and culture.

Elevating and Affirming Marginalized Voices

The study will also add to the visibility and credibility of Dalit assertions academically and otherwise. By focusing on the stories of the oppressed, it will draw attention to the value of literature in giving voice to, and in empowering, the marginalised. It will show how Dalit writers have assumed the agency of authorship of their histories and identities.

Future Comparative and Crosscultural Research Material Appropriating this typology for comparison within and across cultures

The current study could be a model for other comparative studies in regional languages or genres. It will further challenge scholars to work in the crossing points between literature and other cultural mediums such as the cinema, the visual arts, oral narratives, and performance traditions. Its multi-lingual and cross-cultural horizon establishes it as a seminal contribution to the evolving field of Indian and global Dalit literature.

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Relation Between Economic Policy Uncertainty and Stock Returns of Nifty 50 Stocks

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Introduction:

Capital account convertibility followed by the countries like India has led to a significant impact of global events on the equity, forex and trade markets. In the last decade the world has witnessed a slew of major events which has significantly affected the economic set up of many countries. Events like Financial Crisis, Brexit, Covid -19, Russia- Ukraine War, has impacted financial, trade , economic and general wellbeing of people across many countries.

There was a severe global economic slump during the global financial crisis, which lasted from 2007 to 2009, and was marked by the collapse of the housing market, the failure of banking sectors, and a substantial credit constraint (Johnstone et al., 2019). However, the Brexit referendum was a very polarising and contentious time in UK history, generating discussions about political, social, and economic matters (Hsieh et al., 2019). Impact of Brexit wasn't that severe in emerging economies like India ,compared to 'Subprime Crisis', However equity market did felt the turbulence. Covid -19 had a far detrimental impact on the market , as the worldwide lockdown and uncertainty led to heavy outflow of investments.

In addition to gaining media attention, these incidents have caused corporate managers' concerns about how to run their businesses to develop (Duong et al. 2020; Gulen & Ion 2016). According to Baker et al. (2016), EPU is the probability that government policies will change between the current and next year and how these changes may have an impact on firm-level economic activities and outcomes (such as revenues, stock volatility, investment rates, and hiring decisions). Ever since, a growing body of research has examined the connection between EPU and firm-level factors.

In this paper we examine the relationship between the EPU and Stocks returns, As equity market returns are generated majorly on the forward looking sentiments and returns act as a leading indicator , it would be interesting to see how and whether there exists any association of stock returns with EPU.

Objectives:

1. To understand the impact on Economic Policy uncertainty on Equity Markets
2. To model the association between Market Returns and EPU.

Literature Review

Xu et al.,2021- Have observed a direct association of Chinese EPU and Chinese market returns. They offered solid proof that the monthly EPU index developed by Davis et al. (2019) may accurately predict the Chinese stock market's results for the following month

Hong et al.,2024- They investigated a causal relationship between EPU and stock indexes in seven emerging countries and the G7 from 1997 to 2022, using a Granger causality test. The primary conclusions were as follows. First conclusion was that over half of the 14 nations have stock markets that are causally impacted by domestic and global EPU. This suggests that the causal impact of EPU on global stock markets is relatively weak. The findings of both linear and nonlinear Granger tests across the whole sample period support this finding. Indeed, there is no discernible pattern in the correlation between EPU and the stock market between industrialised and emerging nations, with the stock market having a greater tendency to impact both local and global EPU.

Bekaert et al. (2021)- their study aimed at identifying the co-movement of uncertainty shocks and asset prices. They found that there exists a positive co relation between EPU & asset prices.

1. H_0 : There exists no association between EPU(Economic Policy Uncertainty) and Equity Market Returns.
2. H_1 : There exists significant association between EPU(Economic Policy Uncertainty) and Equity Market Returns.

Data & Methodology:

The data for the research paper has been selected from secondary sources, EPU data has been collected from EPU Index, which is indices of economic policy uncertainty for countries around the world. The equity market data has been selected from Nifty 50. The reason for selecting nifty 50, as this Index is one of the most liquid indices consisting of top 50 large capitalization companies. The large companies evade certain risk idiosyncratic risk like governance, moving towards sustainable business practices, growth and volume of trade.

Analytical Framework

Table 1 shows the Descriptive Statistics of the data which consists of EPU Index and Nifty 50 Market returns for the last 10 years, A sample size of 138 data points were chosen.

Table1:Descriptive Statistics

Index/Parameters	Mean	Median	Standard Deviation
EPU	83	78	33.05
Nifty -50 Returns	0.049%	0.049%	0.251%

The following charts (1) shows the nifty returns and it clearly demonstrates volatile movement in price returns. EPU Index plot too depicts similar volatility. An visual depiction of the two charts implies that

there can be a correlation between the two Index. In order to conclude the correlation statistically , we have performed a regression analysis.

Chart1: Nifty -50 Returns:

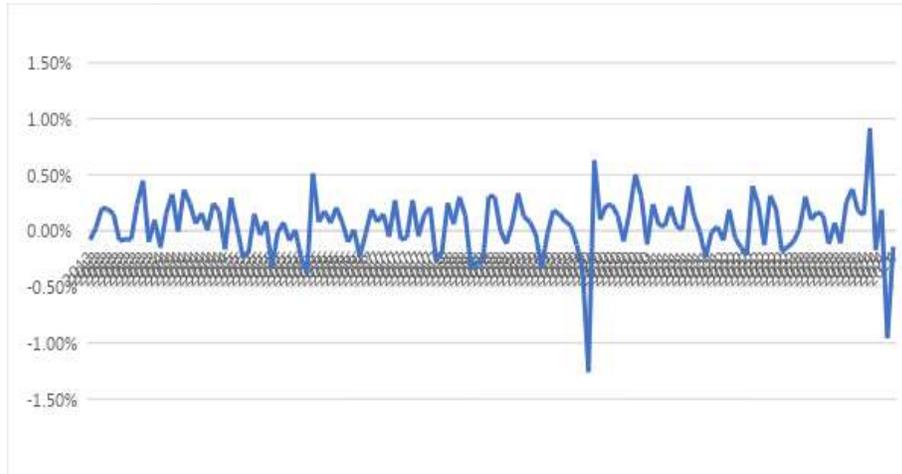
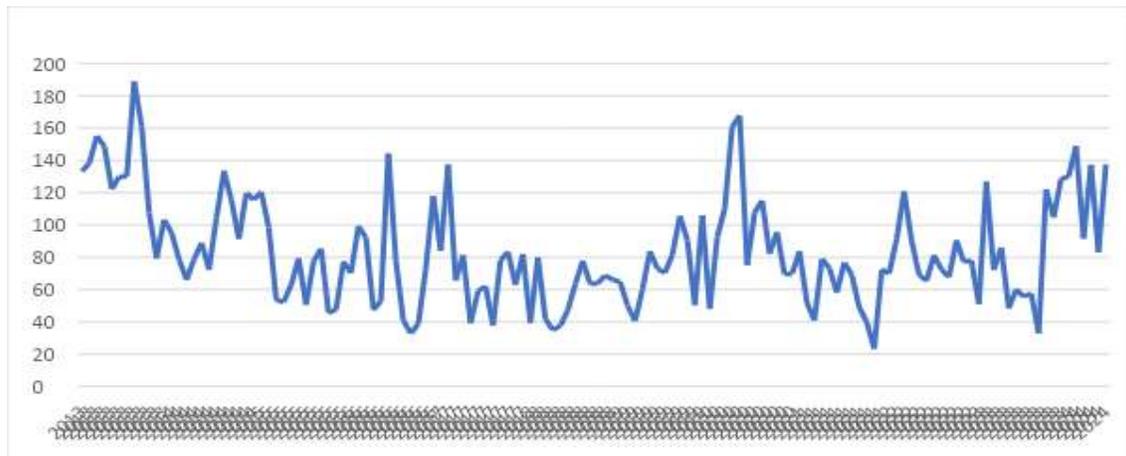


Chart2: EPU Index Plot:



Methodology chosen for the study is regression, as our objective is to study the association between the EPU and Stock Returns.

Regression is a predictive technique to determine the degree of relation between sets of variables. It gives a linear relation between a set of independent variables, also known as predictors and dependent variables.

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \dots + \beta_p x_{ip} + \varepsilon \quad (1)$$

where, for i = no of observations:

y_i = the dependent variable

x_i = the independent variables

β_0 = y-intercept for the linear relationship (constant term) β_p = Coefficients of each predictor ε = error term (residuals).

In order to test the impact of EPU on market returns a simple regression analysis is being conducted. In which the dependent variable is market returns (generated by Nifty 50) and the independent variable is EPU (India).

Table2: Regression output

Regression Statistics	
Multiple R	0.1403
R Square	0.1968
Adjusted R Square	0.1125
Standard Error	0.0025
Observations	138

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	0.00002	0.00002	2.72961	0.10081
Residual	136	0.00085	0.00001		
Total	137	0.00087			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 90.0%	Upper 90.0%
Intercept	(0.0004)	0.0006	(0.6818)	0.4965	(0.0015)	0.0007	(0.0014)	0.0006
X Variable 1	0.0000	0.0000	1.6522	0.1008	(0.0000)	0.0000	(0.0000)	0.0000

Conclusion:

The regression output obtained holds significant at 90% confidence Interval, the coefficient for the dependent variable also holds significant at 90% confidence Interval. Which indicates at the there exists an association between Economic Policy uncertainty and market returns. However, the association isn't very strong as the R^2 is at 20%. Which resonates with the fact that the market returns isn't a factor of one variable rather a multiple variables.

The variables range from both firm specific like growth, institutional ownerships, Promoter's holdings, liquidity and other idiosyncratic risks. (Hung et al.,2020 ;Baltzer et al., 2019 ; Gul et al., 2011; Gong et al.,2013).Among the macro factors Industry specific factors and country level factors plays a role. It is practically impossible for any research paper to cover all the factors impacting stock market returns. This paper has focused only on one country level factor called Economic Policy Uncertainty and found that it impacts market returns.

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The Future of Employment in an Automated World

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Abstract

The nature of employment is changing due to automation, digital platforms, and other advances. In order for workers, business executives, and legislators to advance, they must comprehend these shifts. The job market is unstable, which is to be expected given the level of worry. The labour market is becoming more and more divided between high- and low-skill occupations; young people are disproportionately affected by unemployment and underemployment; many people's household incomes are stagnant; and income inequality is growing. Due to the unavoidable but uncontrollable change taking place in employment we are lacking employment opportunities. This can be treated as a leading problem in various economies, especially one which is densely populated. The research data depicts the potential for automation of various countries. Though the gravity of the problem is subjective, attempts have been made to seek a common conclusion. The analysis relies on the authentic secondary sources and research. It is observed that automation is highly effective in some industries such as textiles, construction and handicraft. The main purpose of conducting research is to understand the effect of automation on employment and society at large.

Keywords: *Employment, Future, Workforce, Automation*

Introduction

Advancements in technology have already changed the way we are interacting with each other. This transformation has led to many simultaneous changes in social life, economy, trade and education etc. Replacement of Human Labour by automated technology is a concern. Automation is the technique of utilizing technology to complete jobs without the assistance of a human. It can be used to describe a broad range of applications, from basic mechanical devices like self-checkout kiosks and automatic doors to intricate systems like robotics and artificial intelligence.

The researchers tried to focus on the impact of automation on employment and the contemporary challenges faced by the workforce. Technology such as self driven vehicles, industrial robots, intelligent machines with analytical skills attempted to replace human beings. In an economy like India which is struggling to maintain an unemployment rate, the requirement of labour intensive operations and activities must be encouraged. On the other hand, scientific assurance is becoming a reality, and much more needs to be introduced. Digital data is now becoming more reliable and replacing human research, experiments, theories. At the same time, the population around the globe is increasing at a faster pace. Mass replacement of human labour by automation leads to the problem of unemployment and poverty. Automation has received a lot of attention lately, with many wondering what effect it will have on the

nature of labour in the future. The question "what is shaping automation and its predicted effects?" is put forward in this study in place of pointless conjecture. Understanding this shift is essential for policymakers, businesses, and individuals alike to anticipate and prepare for the potential impacts on job availability, skills required, and income distribution. The study aims to explore strategies that can mitigate potential negative consequences of automation, such as job displacement and income inequality.

Objectives of the study

1. To explore the impact of automation on employment.
2. To study the challenges and opportunities faced by the workforce in an automated world.

Need of the study

The study helps to understand the effect of automation on employment and society at large. It also focuses on the problems faced by the workforce at the same time the opportunities available in technical and skilled jobs.

Research Methodology

The study is descriptive in nature. For the study, the data has been collected from secondary sources. The secondary sources include reference to books, journals, research papers and internet sources.

Review of literature

Masriadi, Dasmadi, Nurul Efri Ekaningrum, Muhammad Syahrul Hidayat, Farida Yuliaty (2023), examined how automation and artificial intelligence are affecting jobs. A descriptive qualitative method was used in the investigation. The study's data comes from a variety of research findings and earlier investigations that covered the application of automation and artificial intelligence in the workplace. According to the findings of the study, a lot of professions are now being replaced by automation and AI. Still, AI finds it challenging to replicate human intellect in certain areas, such as empathy and intuition.

Vashisht, P., & Rani, N. (2020), investigated the economic and technical viability of automation in the Indian apparel industry and how it might affect employment. The data for the study is based on secondary data analysis and key informant interviews. According to the report, even though robots have the potential to replace 80% of the labour force in the Indian apparel industry, the real displacement will be significantly smaller because automation would only be used in a small number of garment production processes due to economic feasibility. The study went on to say that even while some production processes would be automated, the Indian apparel industry will see strong employment growth because rising local demand for clothing will more than outweigh the labour-saving effects of technology.

Dheeraj Singh, Dr. Geetali Tilak (2019), studied the Transformation of Employment through Artificial Intelligence in India. The research showed the impact of Artificial Intelligence Machines on employment potential in different sectors, also focused on opportunities and challenges which will affect the working environment in the industries. His study was based on secondary data. The study was reviewed by selecting 20 articles and reports related to the research topic. The findings of the study

depicted that AI has positive as well as negative aspects. AI can help in accomplishing many tasks related to human life but because of Automation, Artificial Intelligence and Robots different sectors are being affected and not only blue collar jobs as well as white collar jobs working IT sectors are also in danger zone due to these technologies. The study concluded that 100 percent jobs will not be killed by the machines but definitely few jobs will be vanished by the intelligence machine. Low and Middle skills level jobs will be shrunk but high skilled jobs where the critical decision will have to be taken, their machine will not be able to take intelligence decisions as humans can do.

How technology and automation is affecting the workforce?

Automation, which is made possible by technologies like robotics and artificial intelligence, holds the potential to improve efficiency, safety, convenience, and productivity—and along with productivity, economic growth. However, these technologies also bring up challenging issues regarding the wider effects of automation on employment, wages, skills, and the nature of labour itself. There is potential for automation in many of the tasks that employees perform now. Simultaneously, job-matching websites like Monster and LinkedIn are spreading and altering how people hunt for jobs and how businesses find and hire talent. By opting to list their skills on online marketplaces like Upwork, Uber, and Etsy, independent contractors are defying preconceived notions about where and how work is done. Since the Industrial Revolution two centuries ago, technological advancements have continuously changed the nature of the job. However, the rate at which automation technologies are emerging now and the extent to which they have the potential to transform the labour market are entirely unprecedented.

Based on existing demonstrated technology, over 60% of all jobs worldwide have at least 30% of operations that may be technically automated. This implies that a greater number of people will need to work with technology, and the majority of jobs will shift. Technology-using highly skilled people will profit. Even though low-skilled workers who use technology will be able to produce more and be more productive, unless demand for the occupation outpaces the growth in labour supply, these workers may face wage pressure.

Chart no. 1

The Countries Where the Potential for Automation Is Highest									
Percentage of work activities that could be automated by adapting current technology.									
AFRICA		ASIA/AUSTRALIA		EUROPE		NORTH AMERICA		SOUTH AMERICA	
Kenya	51.9%	Japan	55.7	Czech Rep.	52.2	Mexico	51.8	Peru	53.2
Morocco	50.5	Thailand	54.6	Turkey	50.4	Costa Rica	51.7	Colombia	53.0
Egypt	48.7	Qatar	52.0	Italy	50.3	Barbados	48.7	Brazil	50.1
Nigeria	45.7	South Korea	51.9	Poland	49.5	Canada	47.0	Chile	48.9
South Africa	41.0	Indonesia	51.8	Spain	48.5	U.S.	45.8	Argentina	48.2
		India	51.8	Germany	47.9				
		Malaysia	51.4	Greece	47.8				
		China	51.2	Austria	47.4				
		Russia	50.3	Switzerland	46.7				
		Philippines	47.9	Sweden	46.0				
		U.A.E.	47.3	Netherlands	45.4				
		Oman	46.8	France	43.1				
		Bahrain	46.1	U.K.	42.8				
		Saudi Arabia	46.0	Norway	42.4				
		Australia	44.9						
		Singapore	44.2						
		Kuwait	41.1						

Source: Mckinsey Global Institute

The adoption of currently proven automation technologies may have an impact on \$14.6 trillion in wages and 1.2 billion workers, or 50% of the global economy. As per the chart, it can be observed that nations that make slightly more than half of these totals are China, India, Japan, and the United States. The potential for automation varies significantly between nations, mostly depending on how their economies are set up, how much people are paid, and how large and diverse their labour forces are.

Impact of Automation on India's Workforce

Automation is already a reality for Indians. Zomato employs data analytics to provide individualised meal recommendations, Flipkart uses algorithms to improve delivery routes, and banking websites like HDFC and ICICI use chatbots to respond to consumer inquiries immediately. Automation is demonstrated by the IRCTC ticketing system, which serves millions of people every day. Leading Indian platforms demonstrate how automation morphs sectors and redefines positions while integrating smoothly into our everyday lives. The job market in India is being drastically impacted by this technological transformation. Automation and robotics are being used by industries including IT, banking, healthcare, and auto manufacturing to increase productivity. For instance, robotics is used by Chennai's auto factories to produce cars more quickly and with higher quality, and chatbots and sophisticated ATMs are used by the nation's largest banks to improve customer service. Surgical assistants and automated diagnostic technologies are used in healthcare to increase accuracy and decrease errors. Digital payment systems and online banking are decreasing the number of people visiting bank offices in cities like Bengaluru and Mumbai, which lessens the demand for traditional bank tellers. India's investments in autonomous vehicle research and smart cities could change or replace driver jobs, causing disruptions in the transportation sector. Automation may also have an effect on industries like textiles and handicrafts, which are highly valued in cities like Varanasi and Jaipur and employ skilled workers who have developed their trade over many generations.

Roles that are at risk of being taken over by AI in the near future

Customer Service Agent

As technologies like chatbots and virtual assistants manage a wider range of consumer inquiries and demands, the customer support role is becoming increasingly automated. Technological developments like self-checkouts also reduce the need for human labour in environments like grocery shops, which lowers the number of jobs in the customer service sector.

Automobiles and Trucks Drivers

Advances in self-driving cars lessen the need for human drivers, which affects those in the ride-sharing and taxi sectors. To give its customers more options, Uber has actually worked with self-driving car startups like Waymo and Aurora, which might put its human drivers in conflict.

Software Developer

Concerns have been expressed regarding whether writing-intensive jobs may be replaced by AI thanks to generative AI tools like Chat GPT and Gemini. Programming language is more regimented and direct than human language, which demands far more originality and nuance. Since ChatGPT can already be used to develop code, programming positions at the entry level may soon become automated.

Data Analyst

AI is capable of doing, at least in part, research-centric jobs such as financial analyst and market research analyst. Large amounts of data can be processed using machine learning, which can also identify patterns and arrange its results into clear graphics. Because of this, AI is perfect for rapidly providing teams with industry insights without requiring human involvement.

Paralegal

Artificial intelligence is capable of handling many of the administrative duties that paralegals perform. AI is capable of processing enormous volumes of complex information, therefore it can be used to produce legal reports, compile evidence for a case, organize paperwork, and do legal research. This could eventually make the paralegal position obsolete by bringing better efficiency to legal firms.

Factory or Warehouse labour

AI drives a large number of industrial machines, carrying out several tasks faster and more reliably than humans. Furthermore, AI-powered warehouse robots can collect items and traverse their environment thanks to machine vision, which reduces the need for human warehouse personnel on the part of logistics companies.

Trader in Finance

Although financial traders are responsible for analysing markets and guiding investors' decisions, AI is capable of completing this task far more quickly. AI trading systems are still more accurate than human workers at predicting market changes. AI reduces hiring expenses, thus these two variables together suggest that financial trader jobs may soon become obsolete.

Travel Consultant

For individualised suggestions and travel advice, travellers no longer need to rely on travel agencies. Travel websites can use AI to enhance user searches and provide recommendations based on past queries. Travellers can now obtain the information they need without using a travel agency thanks to resources like virtual tours and informative movies available online.

Graphic Artists

Artificial intelligence created art is a direct rival to graphic designers, especially since anyone can create this type of art. Professional-quality photographs can be easily created without artistic expertise thanks to programs like Lensa and Dall-E. Going forward, companies and people might rely less on graphic design services to create visually striking content.

Suggestions

1. Enhance education to boost STEM skills, creativity, critical thinking, and lifelong learning.
2. Encourage private sector involvement in education to align skills with workplace needs.
3. Provide incentives for companies to invest in human capital like other assets.
4. Utilize technology to improve job matching and skills development.
5. Innovate work practices to enhance productivity with advanced skills and new tech interfaces.

Conclusion:

It can be concluded from the study that few skilled jobs are at high risk and automation is replacing hands-on experience of the employees. This effect of automation could be observed universally with slight differences. Though there are certain pros and cons of automation, specifically on employment it has detrimental effects. The analysis centres some keen changes required to be adopted such as change in education pattern, effective economic policy etc. where education needs to have a more practical approach and the government needs to invest more in uplifting companies investing in human capital. It is generally observed that highly developing countries have high potential for automation. Still there is no direct relationship between densely populated and diffusely populated countries to overcome the trouble of unemployment.

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A Study of Investment Behavior among Working Women in the Thane Area.

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ABSTRACT:

Savings is the amount left after making all the expenditures from the income earned. Savings contribute a significant share to household investment in the country's GDP. Investment has now become a choice as multiple avenues are available. As time progressed, women started working & there was a change seen in their employment prospects. With experience, they learned the balance between family and work life. With this, they not only became self-sustained financially but also started multiplying the income earned. Gender differences were seen in the investment behavior of men & women. Various factors were responsible for these differences. The main objective of this research is to study the investment behavior of working women. The research involves a study on awareness of various investment avenues like Bank deposits, life insurance, postal services, mutual funds, real estate, gold, etc. It also involves various influencing factors affecting the preferences & perceptions of the working women in the Thane area.

Keywords: Investment, working women, investing behavior, influencing factors.

INTRODUCTION:

Savings is the leftover amount after spending wants from the income earned. This unused amount is multiplied, leading to investments. Investment leads to capital formation not only for an individual but also for an economy as a whole. The household sector occupies a major place in the case of savings. In India, 29.31% of GDP is household savings. Individuals from every income group, be it the poor of the poorest or the rich of the richest, save. These savings can be converted into investments. Every individual wants to multiply their income to fulfill not only their basic needs but also their unlimited wants. However, the range of expenditure may vary for every individual. Some may save more by curtailing their expenditures or vice versa. It is very important to maintain the balance between savings & expenditure, through which the rate of investments would be higher than expenditures.

An investment portfolio is nothing but a bunch of financial assets that an individual may create for themselves. It may include avenues like Bank Deposit, Insurance, Postal savings, Life insurance, Shares, Bonds, Debentures, Gold, Chit Funds, Mutual Funds, Real Estate, etc. The level of awareness for these avenues may vary individually, depending on the source of their awareness. Many get the information for avenues from their friends & family, through the internet, newspapers, magazines, Brokers, financial advisors, banks, etc. Investment purposes also vary as per the requirements at every stage of life. Some might invest in health care while others for children's marriage, education, buying

their dream house, or even for a world tour. People working in the private sector especially invest for their security after retirement. Depending on the requirements of the investors, the plans, duration & frequency of investments are affected.

While investing, factors like risk-bearing capacity or income stability, security, liquidity, or even tax benefit, have a major impact on the investment behavior of working women in the area. This study aims to determine the investment behavior of working women in the Thane area.

REVIEW OF LITERATURE:

Rekha G & Vishnupriya (2019), it studied the investment pattern of working women in Coimbatore city. They studied various factors influencing investment decisions of the respondents through both primary & secondary data. Their study highlighted that there was a significant difference in investment decisions among employees belonging to various occupations & the most influential factor for investment decision was 'children's education'.

Amsaveni M & Nithyadevi M (2018), in their research, studied the investment pattern & level of attitude among working women towards investment avenues. As per their findings, the most influential factor was profitability among the other factors like liquidity, prestige, stability, transferability & speculation. Venkatesh G C & Suryaprakash Rao B K, (2018), in their research, studied the investor's perception towards investment portfolio. As per their findings, investors' choices on investment decisions are the same among both men and women.

Kaur J & Arora N (2018), in their research, studied the investors' perception & preferences towards mutual funds as an investment option. As per their findings, most working women preferred investment in mutual funds due to higher returns in growth fund schemes.

Jisha V G (2019), in the research studied the perception & investment patterns among the working women. Their main objective was to study the factors influencing savings & investments among working women. The findings of their study stated that the safety of funds was given priority by the investors while making investments.

R. Harini & Dr. R. Savithri (2021), in their research, studied the investment behavior of working women. Their finding revealed that the annual income of the working women influences their investment preferences & the respondents considered investment in shares as the riskiest avenue, followed by chit funds & real estate.

OBJECTIVES OF THE STUDY:

1. To study the level of awareness of various investment portfolios
2. To understand the various investment preferences amongst working women.
3. To analyse the most preferred investment portfolio considering the risk factor.
4. To evaluate the influence of income on investment patterns.

HYPOTHESIS:

1. H0 (Null Hypothesis): There is no association between income & investment preferences among working women.
H1 (Alternative Hypothesis): There is an association between income & investment preferences among working women.
2. H0 (Null Hypothesis): There is no association between age & investment preference among working women.
H1 (Alternate Hypothesis): There is an association between age & investment preference among working women.

SCOPE OF THE STUDY:

The research is based on a study of investment behavior among working women. It includes their awareness & preferences amongst various investment avenues. This research can be useful for working women to understand and raise awareness about various investment avenues. It may also benefit the consultants to understand the investment behavior and their perceptions towards investment patterns to further guide them as per their requirements.

RESEARCH METHODOLOGY:

This descriptive & analytical study is based on both primary and secondary data. The primary data was collected from 120 respondents through a structured questionnaire. The secondary data was collected through various journals, publications, reports, research papers, websites, etc. The data has been assembled from working women of all age groups, various income brackets, and working in various occupations.

TOOLS & TECHNIQUES USED FOR ANALYSIS:

The statistical analysis carried out for the study is done by using Ms Excel.

The statistical techniques applied are simple percentage analysis & Regression Correlation.

Analysis & interpretation of data have been presented in the form of tables & pie- charts.

LIMITATIONS OF THE STUDY:

1. The responses for the study are limited to the Thane area only.
2. The major constraint was felt in the case of time & resources.
3. The study is based on the perception of working women only.

RESEARCH ANALYSIS OF DATA:

A) Study of the awareness level of various investment portfolios:

Table 01: To study the level of awareness of various investment portfolios.

Investment Portfolios/ Level of Awareness	Fully aware	Aware	Neutral	Not Aware	Fully not aware
Bank Deposits	29	11	3	0	1
Insurance	15	14	10	5	0
Postal Savings	14	15	11	3	1
Life Insurance	15	15	9	4	1
Shares	13	13	14	2	2
Bonds/ Debentures	7	10	11	14	2
Gold	15	16	8	3	2
Chit funds	1	6	15	15	7
Mutual Funds	16	9	11	6	2

Real Estate	6	9	17	8	4
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Source: Primary Data

Table 01 indicates that 29 respondents were fully aware of Bank Deposits, whereas there was no respondent who was not aware of Insurance.

B) Study of various investment preferences amongst working women.

Table 02: Investment by respondents in various portfolios.

Investment Portfolios	No. of Respondents	Percentage
Bank Deposits	27	61.36
Insurance	7	15.9
Postal Savings	18	40.9
Life Insurance	15	34.09
Shares	26	59.09
Bonds/ Debentures	4	9.09
Gold	16	36.36
Chit funds	1	2.27
Mutual Funds	21	47.72
Real Estate	11	25

Source: Primary data

Table 02 shows that 27 respondents have made their investment in Bank Deposits, while 18 respondents have invested in Postal Savings & only 01 respondent has invested in chit funds.

C) Study of the most preferred investment portfolio considering the risk factor.

Table 03: Preference of investment portfolio considering risk factor

Investment portfolios	Very High Risk	High Risk	Low Risk	Very Low Risk	No risk
Bank Deposits	5	6	18	9	6
Insurance	5	7	19	10	3
Postal Savings	2	6	23	4	9
Life Insurance	4	10	16	8	6
Shares	22	12	8	1	1
Bonds/ Debentures	12	19	9	3	1
Gold	5	12	13	6	8
Chit funds	18	9	10	4	3
Mutual Funds	11	15	13	3	2
Real Estate	11	11	13	5	4

Source: Primary data

Table 03 shows that 22 respondents prefer a very high risk by investing in shares, followed by chit funds, Postal Savings, Insurance & lastly no risk by investing in Gold.

D) Study of the impact of income on investment preferences of working women.

Table 04: Influence of Income on Investment Preferences.

Investment Portfolios/ Income Groups	Rs. 0- Rs. 20,000	Rs. 20,000 - Rs. 40,000	Rs. 40,000 - Rs. 60,000	Rs. 60,000 & above.
Bank Deposits	6	16	1	4
Insurance	0	5	2	0
Postal Savings	4	11	2	1
Life Insurance	4	7	1	3
Shares	4	8	3	2
Bonds/ Debentures	0	2	1	1
Gold	5	10	1	0
Chit funds	1	1	0	0
Mutual Funds	3	13	1	4
Real Estate	3	6	2	0

Source: Primary data

Table 04 indicates that the 06 respondents within income range of Rs. 0 to Rs. 20,000 preferred Bank deposits as their investment portfolio, 16 respondents within income range of Rs. 20,000 to Rs. 40,000 also preferred Bank deposits investment portfolio, 03 respondents within income range of Rs. 40,000 to Rs. 60,000 preferred Shares as investment portfolio, & 04 respondents of income range Rs. 60,000 & above preferred Bank deposits & Mutual funds as investment portfolio.

E) Study of the influence of age group while taking investment decisions.

Table 05: Influence of Age group on Investment preferences.

Investment portfolios/ Age Groups	18 years - 25 years	26 years - 40 years	41 years - 60 years
Bank Deposits	5	17	5
Insurance	0	5	2
Postal Savings	2	12	4
Life Insurance	1	10	4

Shares	3	11	2
Bonds/ Debentures	0	3	1
Gold	1	14	1
Chit funds	0	1	0
Mutual Funds	3	13	5
Real Estate	1	6	4

Source: Primary Data

Table 05: It indicates that the respondents from the age group of 18 to 25 years are influenced by Bank Deposits, respondents from the age group of 26 to 40 years are influenced by Bank Deposits as well as investment in Gold, and respondents from the age group of 41 to 60 years are influenced by Bank Deposits & Mutual Funds.

Table 06: Result of the Relationship between income & investment preferences among working women.

Calculated Value	Critical Value	Degree of Freedom	Level of Significance
25.99	40.113	27	0.05

The critical value of the problem is more than the calculated value at the degree of freedom of 27 & 95% level of confidence. Since the critical value is less than the calculated value, the null hypothesis is accepted & alternative hypothesis is rejected. It can be concluded that there is no association between income & investment preferences among working women in the Thane area.

Table 07: Results of the Relationship between Age group & investment preferences among working women.

Calculated Value	Critical Value	Degree of Freedom	Level of Significance
10.02	40.113	27	0.05

The critical value of the problem is less than the calculated value at the degree of freedom of 27 & 95% level of confidence. Since the critical value is more than the calculated value, the null hypothesis is rejected & alternative hypothesis is accepted. It can be concluded that there is an association between Age group & Investment preferences among working women in the Thane area.

FINDINGS:

1. Most of the respondents are aware of investment in Bank Deposits, followed by Mutual Funds & Gold.
2. The research reveals that Bank deposit is the most preferred investment portfolio by working women, followed by shares & investment in postal services.

3. Women from 18 to 25 years mostly prefer bank deposits, 26 to 40 years prefer Bank deposits as well as gold as their investment portfolio, while respondents from the age group of 41 to 60 years prefer Bank deposit & mutual funds as their investment portfolio.
4. Women with income group up to Rs. 20,000 mostly prefer bank deposit, Income group of Rs. 20,000 to Rs. 40,000 prefer Bank deposits, mutual funds & postal savings as their portfolio whereas respondents with income group of Rs. 40,000 to Rs. 60,000 prefer investment in shares & postal services, whereas respondents with income above Rs. 60,000 would prefer investment in Mutual Funds, bank Deposits & Life insurance.

SUGGESTIONS:

1. More awareness needs to be created by bankers & other financial advisors
2. Less inclination is seen towards the share market & mutual funds, so awareness should be created.

CONCLUSION:

Working women in the Thane area tend to prefer investment in Bank deposits, followed by investment in Gold, Mutual Funds, Shares, Postal services, Insurance, and very few people are aware of chit funds, which reduces the preference towards this investment portfolio. Women find investment in Real Estate, Life Insurance, & chit funds not worth investing due to lack of liquidity & security, less capital appreciation & taxable portfolios, & risky return policies. More awareness can be created for such investment, making sure the investors are aware of both the benefits & risks involved while investing in such portfolios.

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A Study on Traffic Congestion and Its Socio-Economic Impact: A Case of Kalyan–Shil Road

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ABSTRACT

Traffic congestion has emerged as one of the most pressing urban transport problems in rapidly growing cities. The Kalyan–Shil Road, a key arterial corridor connecting Kalyan, Dombivli, Shilphata, and Navi Mumbai, experiences persistent congestion due to rapid urbanization, increasing vehicle ownership, and infrastructure limitations. This study examines the nature, causes, and socio-economic impact of traffic congestion on commuters, residents, and local businesses along the Kalyan–Shil Road. The research is based on field observations and sample-based surveys conducted during peak and non-peak hours. The study identifies major congestion hotspots, estimates time and fuel losses, and analyses the impact on productivity, stress levels, and business operations. The findings aim to provide practical insights for urban planners and policymakers to improve traffic management and reduce the socio-economic burden on road users.

Keywords: Traffic Congestion, Socio-Economic Impact, Kalyan–Shil Road, Urban Mobility, Commuter Delay.

1. INTRODUCTION

Urban transportation systems play a crucial role in supporting economic growth and improving the quality of life. However, rapid urbanization, population growth, and rising vehicle ownership have placed immense pressure on existing road infrastructure. Traffic congestion has become a daily challenge in many Indian cities, leading to loss of time, increased fuel consumption, environmental pollution, and psychological stress.

Kalyan–Shil Road is an important transport corridor in the Mumbai Metropolitan Region (MMR). It serves as a vital link between residential hubs, industrial areas, and commercial centres. Due to unplanned growth, frequent movement of heavy vehicles, and limited road capacity, the road experiences severe congestion, especially during peak hours. This study attempts to understand congestion patterns on this road and analyse its socio-economic impact on different stakeholders.

2. BACKGROUND OF THE STUDY

Over the past decade, the areas surrounding Kalyan–Shil Road have witnessed rapid residential and commercial development. Affordable housing projects, expansion of industrial units, and improved connectivity to Navi Mumbai have significantly increased traffic volume. Despite road widening projects and flyover construction, congestion continues to persist due to uneven road width, bottlenecks at junctions, encroachments, and inadequate traffic management.

Studying the congestion on Kalyan–Shil Road is important as it directly affects daily commuters, students, employees, transport operators, and small businesses. Understanding the extent of congestion and its consequences can help in designing effective traffic management strategies.

3. PROBLEM STATEMENT

Kalyan–Shil Road experiences severe traffic congestion during peak hours, resulting in excessive travel delays, increased fuel consumption, stress among commuters, and disruptions in business activities. The lack of systematic studies at the local level makes it difficult to assess the true socio-economic cost of congestion. Hence, a structured and student-friendly study is required to measure the magnitude of the problem and analyse its impact on commuters and businesses.

4. OBJECTIVES OF THE STUDY

The objectives of the study are:

1. To study the travel patterns and congestion characteristics on Kalyan–Shil Road.
2. To examine the socio-economic impact of traffic congestion on commuters and local businesses.
3. To identify feasible measures and preferred solutions to reduce traffic congestion.

5. SCOPE OF THE STUDY

- **Geographical Scope:** Selected stretches and junctions along Kalyan–Shil Road.
- **Respondents:** Daily commuters, vehicle drivers, shopkeepers, and local residents.
- **Type of Data:** Primary data collected through observation and survey, supported by secondary sources.
- **Time Period:** 3–5 days of field observation covering peak and non-peak hours.

6. REVIEW OF LITERATURE

Previous studies highlight traffic congestion as a major urban challenge with significant economic and social implications. Singh (2018) observed that traffic congestion leads to increased travel time, higher fuel consumption, and reduced work efficiency among urban commuters. Patil (2020) reported that congestion imposes indirect economic costs through loss of productive hours and delayed deliveries.

Sharma (2019) emphasized the psychological impact of congestion, noting that prolonged exposure to traffic delays contributes to stress, fatigue, and reduced job satisfaction. Other studies have also linked congestion to environmental degradation, road safety issues, and declining urban livability. These findings provide a foundation for analysing congestion on Kalyan–Shil Road from a socio-economic perspective.

7. RESEARCH METHODOLOGY

The study adopts a simple and descriptive research approach suitable for undergraduate-level research.

7.1 Research Design

- Descriptive and observational research design.
- Use of both primary and secondary data sources.

7.2 Data Collection Methods

- **Observation Method:** Traffic flow, peak-hour congestion, queue length, delay time, and bottlenecks were observed at selected locations.
- **Survey Method:** A structured questionnaire consisting of 10–15 questions was administered to commuters and shopkeepers.

7.3 Sample Size

- Commuters: 150 respondents.
- Business Owners/Shopkeepers: 45 – 50 respondents.
- Observation Points: 2–3 major junctions along the road.

7.4 Tools Used

- Structured questionnaire
- Observation sheets
- Basic stationery for recording responses

8. DATA ANALYSIS AND INTERPRETATION

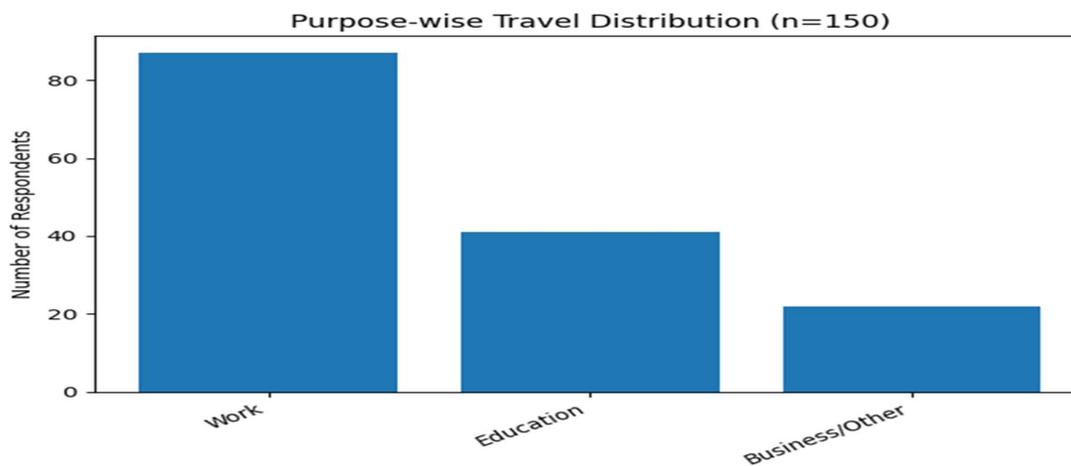
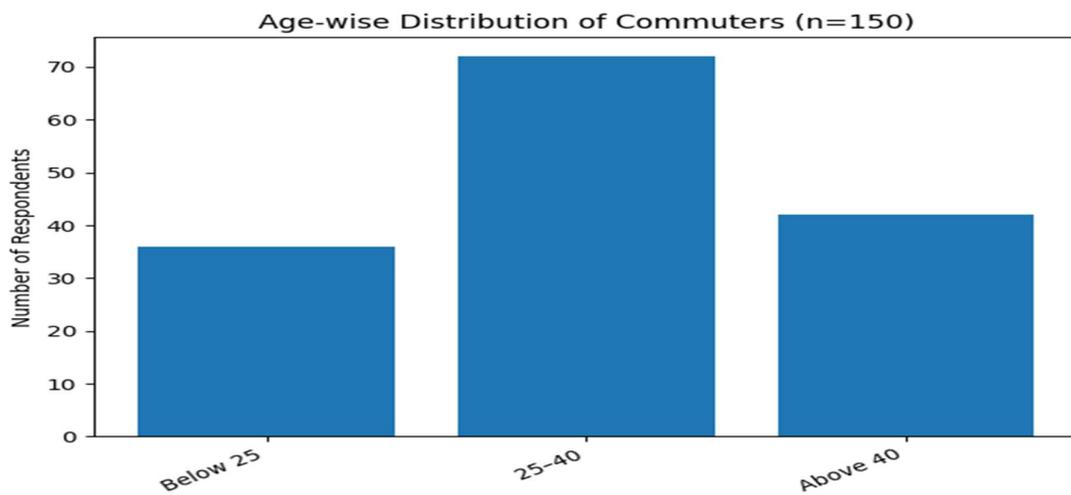
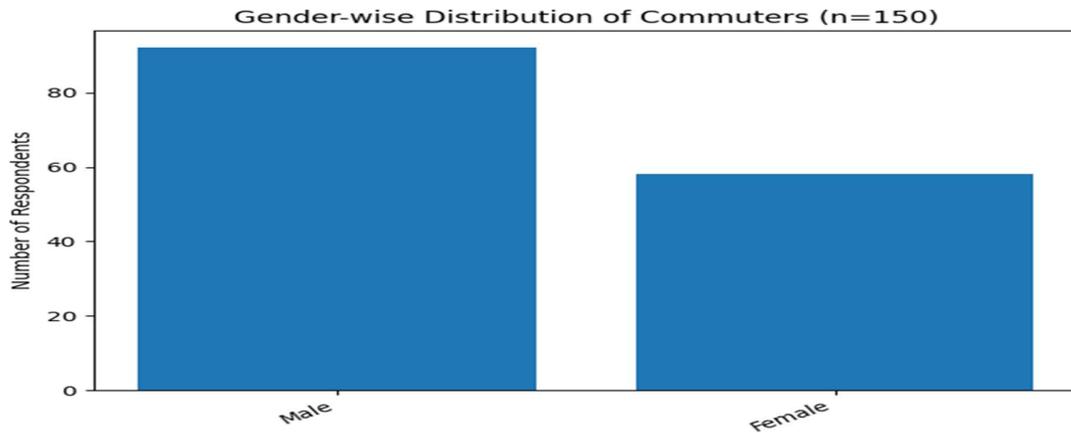
To strengthen the analytical rigor of the study, survey responses were converted into percentage-based analysis and presented using tables and indicative charts.

8.1 Demographic Profile of Respondents (Commuters)

The survey was conducted with **150 commuter respondents**, allowing a broader and more reliable analysis.

Table 1: Demographic Distribution of Commuter Respondents (n = 150)

Particulars	Category	No. of Respondents	Percentage (%)
Gender	Male	92	61.3%
	Female	58	38.7%
Age Group	Below 25 years	36	24.0%
	25–40 years	72	48.0%
	Above 40 years	42	28.0%
Purpose of Travel	Work	87	58.0%
	Education	41	27.3%
	Business/Other	22	14.7%



Interpretation: Nearly half of the respondents (48%) belong to the 25–40 years age group, and a majority (58%) travel for work purposes, indicating that traffic congestion significantly affects the economically productive population.

8.2 Observational Findings

Table 2: Peak Hour Congestion Characteristics

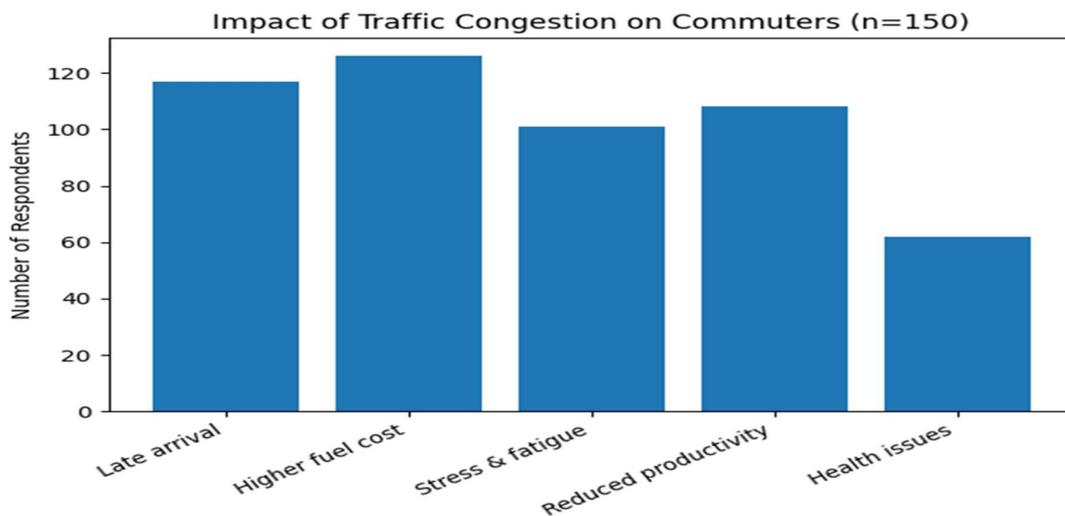
Parameter	Observation
Morning Peak Hours	8:00 AM – 10:00 AM
Evening Peak Hours	6:00 PM – 9:00 PM
Average Waiting Time	20–40 minutes
Major Causes	Bottlenecks, heavy vehicles, road narrowing

Interpretation: Peak-hour congestion significantly increases travel delays, confirming time loss as a major socio-economic cost.

8.3 Survey-Based Percentage Analysis

Table 3: Impact of Traffic Congestion on Commuters (n = 150)

Statement	Respondents Agreeing	Percentage (%)
Late arrival to work/college	117	78.0%
Increase in fuel expenses	126	84.0%
Experience stress and fatigue	101	67.3%
Reduced daily productivity	108	72.0%
Health issues due to long travel	62	41.3%



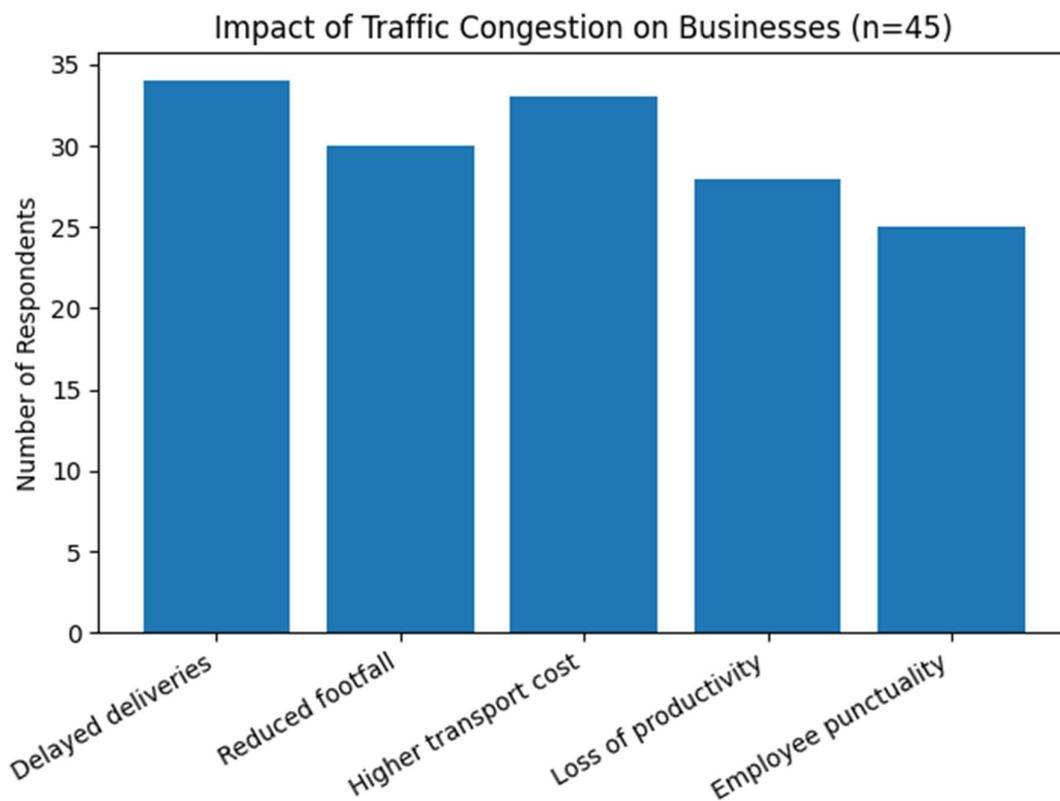
Interpretation: A substantial proportion of commuters reported increased fuel costs, stress, and productivity loss, clearly demonstrating the socio-economic burden of traffic congestion.

8.4 Impact on Local Businesses

A separate survey was conducted among **45 local shopkeepers and business owners** operating along Kalyan–Shil Road.

Table 4: Impact of Congestion on Business Operations (n = 45)

Impact Area	Respondents Agreeing	Percentage (%)
Delayed deliveries of goods	34	75.6%
Reduced customer footfall	30	66.7%
Increased transportation cost	33	73.3%
Loss of working hours/productivity	28	62.2%
Difficulty in employee punctuality	25	55.6%



Interpretation: More than two-thirds of business respondents faced delivery delays, higher costs, and reduced customer footfall due to traffic congestion.

9. SOCIO-ECONOMIC IMPACT OF TRAFFIC CONGESTION

9.1 Impact on Commuters

- Increased travel time and uncertainty in daily schedules.
- Higher fuel and maintenance costs.
- Physical and mental stress due to prolonged travel.
- Late arrival at workplaces and educational institutions, affecting productivity.

9.2 Impact on Businesses

- Delays in receiving raw materials and dispatching goods.
- Reduced customer visits during peak congestion periods.
- Increased transportation costs.
- Overall loss of productivity and revenue.

9.3 Impact on Society

- Increased air and noise pollution levels.
- Higher risk of road accidents.
- Decline in overall quality of urban life.

10. RECOMMENDATIONS

Based on the findings, the following measures are suggested:

1. Widening of narrow road stretches to reduce bottlenecks.
2. Removal of encroachments and strict regulation of roadside parking.
3. Construction of service roads or dedicated lanes for heavy vehicles.
4. Deployment of traffic police and wardens at major junctions during peak hours.
5. Improvement and promotion of public transport facilities.
6. Awareness campaigns on lane discipline and road safety.
7. Upgradation of traffic signals, signage, and road markings.

11. CONCLUSION

The study concludes that traffic congestion on Kalyan–Shil Road is a serious and persistent problem with significant socio-economic implications. Through field observations and survey analysis, the research identifies peak congestion periods, key causes, and the adverse effects on commuters, businesses, and society. Although the study is limited in scope, it highlights the urgent need for integrated traffic management and infrastructure planning. The recommendations provided, if implemented effectively, can help improve traffic flow, reduce congestion, and enhance the quality of life for road users.

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