Unlocking Excellence: The Transformative Power of Technology in Business Optimization Dynamics

PROCEEDINGS OF A ONE DAY MULTIDISCIPLINARY NATIONAL LEVEL SYMPOSIUM (ONLINE)
21st December 2024

SHRI VILE PARLE KELAVANI MANDAL'S
NARSEE MONJEE COLLEGE OF COMMERCE & ECONOMICS (AUTONOMOUS)
MUMBAI

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About The Symposium

Unlocking Excellence: The Transformative Power of Technology in Business Optimization Dynamics

The transformative power of technology in business optimization is a multifaceted phenomenon that has revolutionized how organizations operate. Businesses can foster engagement and productivity by leveraging technology, driving career commitment and role innovation. In Dynamic Workforce Management, AI, IoT, cloud computing and other technologies have emerged as pivotal trends, offering agile and efficient solutions that cater to the evolving needs of an engaged workforce. However, the digital workplace also presents ethical challenges that must be navigated with care, as the misuse of information and the potential for breaches in digital ethics pose significant risks.

Unlocking excellence can't be merely about implementing the latest tools; it's about fostering a mindset that sees technology not just as an enabler but as a strategic partner in achieving business goals. As organizations embark on their journey of transformation, embracing technology is not merely an option but a necessity. Those who harness its potential can unlock remarkable efficiencies and create a sustainable competitive advantage. the transformative power of technology is not just a tool for optimization; it becomes the very foundation upon which the future of successful enterprises is built.

Furthermore, the impact of technology extends beyond immediate operational concerns, influencing strategic management and necessitating a reevaluation of traditional approaches to align with the rapid pace of digital transformation. As we look to the future, the effects of emerging technologies on human values and civilization are profound, with the potential to reshape cultural norms and identities, challenge privacy, equity, and accountability, and redefine the social fabric of society. Businesses and policymakers must consider these multi-level factors and strategically manage the transformative power of technology to ensure it serves as a force for good, enhancing human capabilities without compromising ethical standards or human values.

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Exploring Ethical Challenges in Digital Adoption Platforms: The Dark Side of the Digital Workplace

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Abstract:

The digital workplace has transformed employee surveillance beyond traditional monitoring methods. Organizations now face increased regulatory scrutiny as they adopt advanced AI-based tools and adjust to flexible work arrangements. The balance between privacy and productivity creates real challenges. Studies reveal that 70% of people find workplace monitoring intrusive. This worry makes sense - excessive monitoring leads to unhappy employees and higher turnover rates . Digital adoption platforms create unprecedented privacy challenges for modern organizations. Our analysis reveals that 67% of organizations face substantial security risks when implementing these platforms.

A reliable ethical framework makes digital adoption successful. Research shows 92% of employees accept data collection when it improves their well-being and performance. These insights led us to develop complete ethical guidelines. Companies need to protect employee rights, secure data, and handle workplace power dynamics to make these platforms work. They must find the right balance between using technology to boost productivity and looking after their workers' wellbeing.

Introduction:

A surprising 78% of employers use advanced monitoring tools to track

their employees' digital activities.

Digital adoption platforms help streamline workplace technology integration and boost employee output. These platforms promise improved efficiency and smooth digital transformation, but we need to look carefully at their ethical implications.

A digital adoption platform works as a software layer that guides users through digital tools and processes. It collects data and gives explanations along the way. This technological advancement creates complex challenges for our modern workplace.

This piece will get into the critical ethical concerns about digital adoption platforms. We'll cover everything from privacy and surveillance issues to algorithmic bias and their effects on mental health. The discussion will show how these tools change workplace dynamics and offer balanced solutions that work for employers and employees alike.

The Ethics of Digital Workplace Surveillance

The digital workplace has transformed employee surveillance beyond traditional monitoring methods. Organizations now face increased regulatory scrutiny as they adopt advanced AI-based tools and adjust to flexible work arrangements [1].

Employee Monitoring Technologies

Organizations use sophisticated tools to track employee activities in the modern workplace. Data shows that 70% of major corporations collect employee data through proof of work tools [2]. Here are some common monitoring methods:

Video Surveillance Systems

Employee Monitoring Software

Time and Attendance Tracking

GPS Location Monitoring

Biometric Technology

Privacy Rights vs Productivity Metrics

The balance between privacy and productivity creates real challenges. Studies reveal that 70% of people find workplace monitoring intrusive [1]. This worry makes sense - excessive monitoring leads to unhappy employees and higher turnover rates [3].

The effects hit certain worker groups harder than others. Data shows that women in low-paying clerical positions make up most of the electronically monitored workforce [4].

Legal and Regulatory Frameworks

The legal landscape around workplace surveillance grows more complex each day. The Electronic Communications Privacy Act (ECPA) stands as the main federal framework in the United States. This act allows monitoring if it serves legitimate business needs or has employee consent [2].

European regulations prove much stricter. The French Data Protection Authority fined a major corporation €32 million for excessive monitoring practices recently [1]. The EU's General Data Protection Regulation (GDPR) adds more protection by requiring transparent and proportional monitoring practices [5].

A fascinating statistic shows that 92% of employees accept data collection when it helps improve their well-being and performance [6]. This number highlights how transparent digital adoption platforms and monitoring practices build trust while meeting organizational goals.

Algorithmic Bias in Digital Adoption Tools

Digital adoption platforms show a worrying trend as algorithmic bias becomes more common. Recent studies show AI systems can create unfair employment opportunities and discrimination when there's no proper accountability [7].

Discriminatory Patterns in AI Systems

Our research shows that algorithmic bias demonstrates itself in many forms within digital workplace tools. Limited raw datasets and biased algorithm designers often cause these biases [7]. Here are the most common forms of discrimination we found:

Gender bias in technical role assessments
Racial bias in candidate evaluation
Age based discrimination in job matching
Socio economic Status prejudices

The numbers paint a stark picture. Nearly half of all employees (47%) say they've faced bias in their performance evaluations [8].

Impact on Employee Assessment

Algorithmic bias substantially affects workplace evaluations and career progression. Machine learning models are nowhere near fair - they're 30% less likely to favor applicants from non- majority backgrounds [8]. The picture gets worse when you look at management - 67% of managers have unconscious biases that affect their evaluations [8].

Our analysis of performance management systems reveals several big problems. AI-powered solutions don't deal very well with comprehensive evaluations. They also reduce reliability in assessments and lower trust in

feedback quality [9]. These issues hit harder when you see that 61% of underrepresented employees think about leaving their organizations because they feel they're treated unfairly [8].

Mitigation Strategies

A multi-faceted approach can help us curb algorithmic bias. More than 70% of data scientists admit their algorithms have bias [8]. Here's what we recommend:

Organizations need reliable testing and assessment protocols. This means fixing unbalanced datasets and using multiple data points for more accurate results [7]. Building unbiased datasets has proven to be one of the best ways to tackle algorithmic bias.

Transparency is vital. Studies show 60% of companies struggle to spot bias in their algorithmic systems [8]. Organizations can better detect and fix potential biases by using fairness indicators and continuous monitoring systems.

Diverse AI development teams make a difference. Companies with diverse teams are 35% more likely to outperform their peers in creating state-of-the-art solutions [8]. Different points of view lead to fairer algorithmic outcomes.

Data Privacy and Security Concerns

Digital adoption platforms create unprecedented privacy challenges for modern organizations. Our analysis reveals that 67% of organizations face substantial security risks when implementing these platforms [10].

Employee Data Collection Practices

Responsible data collection starts with minimization. Leading digital adoption platforms now implement **zero-knowledge design** principles. These platforms don't track unnecessary information about end users or websites [10]. This approach substantially reduces security vulnerabilities while keeping functionality intact.

Our research shows that effective data collection practices has:

Implementing strict role base access controls

Encrypting data during Transmission and storage

Anonymizing personal information

Maintaining transparent collection policies

Regular security Audits and Updates (11)

Data Storage and Protection

Data protection needs a multi-layered approach. Recent studies show 60% of data-holding organizations possess information they shouldn't have [12]. We recommend implementing what we call the "Protection Pyramid":

Protection Level	Security Measures
Simple	Encryption at rest and in transit
Improved	Multi-factor authentication, access logging
Advanced	Zero-knowledge architecture, continuous monitoring

Organizations must stay vigilant about GDPR compliance, especially when they store and process end-user information within specific geographical boundaries [10].

Third-party Access Risks

Third-party access risks need attention. Our research indicates that 74%

of security breaches occurred because organizations granted excessive privileged access to third parties [13]. Modern supply chains have substantially increased these risks [13].

Cloud computing and SaaS solutions have brought new vulnerabilities. Cybercriminals often target organizations indirectly through their third-party partners because these partners may have weaker security controls [13].

Organizations can reduce these risks by implementing a complete third-party risk management strategy. This includes a full picture of vendors' data security measures and clear protocols for data handling [14]. Organizations that implement these measures face fewer security incidents.

Critical Security Considerations:

1. Regular security audits of third-party integrations
2. Strict vendor assessment protocols
3. Continuous monitoring of access patterns
4. Incident response planning
5. Regular compliance reviews [11]

Digital adoption platforms need risk-based monitoring and periodic testing of incident response strategies. These elements are vital for maintaining resilient security postures [11].

Mental Health Implications

Research into mental health effects of digital workplace technologies shows a worrying trend. American workers reporting work-related stress has reached 83% [15]. Digital factors play a big role in this trend.

Digital Burnout Factors

Digital burnout shows up in many ways at modern workplaces. **Techno-overload** has become the biggest problem. Employees feel stressed by a lot due to constant tech accessibility [6]. The need to stay connected creates an "always-on syndrome" that leads to:

Habitual multitasking and reduced productivity
Blurred work life boundaries
Digital exhaustion from excessive video meetings
Chronic stress affecting performance and wellness

Remote workers experiencing high levels of technostress stands at 78.9%. Female and older workers show even higher rates [16].

Anxiety and Stress Triggers

Information overload and fear of missing out (FOMO) have become critical stress triggers in digital workplaces. **4 in 10 adults** now show symptoms of anxiety or depressive disorder [17]. Digital workplace factors add by a lot to this increase.

The main anxiety triggers include:

1. Information overload and constant notifications
2. Fear of missing important updates (FOMO)
3. Techno-insecurity about job security
4. Digital workplace stress and burnout

FOMO at work adds to burnout. People feel anxious about missing important information and relationship opportunities [18].

Support Systems and Solutions

Digital workplace mental health needs a complete approach. Taking regular breaks every 90 minutes helps maintain better concentration levels and productivity [19]. The "Digital Wellness Framework" can help:

Support Level	Implementation Strategies
Individual	Mindfulness practices, regular screen breaks
Team	Clear communication boundaries, flexible schedules
Organizational	Digital wellness policies, mental health resources

60% of companies don't deal very well with digital workplace stress [20]. Setting clear boundaries, regular breaks, and healthy practices can improve employee well-being by a lot [6].

Organizations using digital adoption platforms see better results when they focus on:

1. Optimizing information flow to prevent overload
2. Providing adequate training and support systems
3. Establishing clear digital boundaries
4. Creating quiet spaces for focused work

Recent studies show positive interactions in digital environments relate to lower levels of depression and anxiety [21]. This highlights the need to encourage a healthy digital workplace culture.

Power Dynamics in Digital Workplaces

Digital adoption platforms have completely changed workplace power dynamics. Technology has moved control back to employers [22]. This transformation creates what we call a "digital panopticon" where surveillance is everywhere but employees never know when someone watches them.

Management Control Mechanisms

Digital platforms serve as powerful tools for organizational control. Management extends their influence through various mechanisms. Our research reveals that management gets most benefits from data gathering and analysis, which often leads to more intense work [22]. These control mechanisms show up in:

Real-time performance monitoring
Automated workflow management
Informed decision making
Algorithmic performance evaluation
Digital Communication Oversight

Companies increasingly use 'black box' algorithms to hide their decision-making processes [22]. This makes it hard for employees to understand or challenge management decisions.

Employee Autonomy Issues

Digital competence and autonomy play a significant role in promoting employee creativity and knowledge sharing [23]. Employees who have more digital autonomy tend to participate in innovative work. This leads to better job performance and enables them to do more [23].

The research reveals a notable paradox. Digital platforms can boost scheduling autonomy through teleworking support. But they can negatively affect people who want to keep their work and personal life separate [23]. We call this the "autonomy-control paradox."

Autonomy Factor	Impact on Employees
Digital Competence	Increased innovation and creativity
Scheduling Freedom	Enhanced work-life flexibility
Decision Authority	Greater job satisfaction
Tool Selection	Improved productivity

Balancing Authority and Trust

Finding the right balance between control and trust matters greatly. Less than half of employees currently face trust issues at work. Organizations that earn employee trust see enormous benefits [24].

Three critical trust components emerge from our research:

1. **System Trust**: Employees must have confidence in the digital tools being deployed
2. **Mutual Trust**: Staff must feel safe sharing thoughts and opinions
3. **Management Trust**: Leadership must trust staff to act appropriately [25]

Successful digital workplaces support and come from an open and collaborative culture [25]. Organizations that use digital platforms wisely see better outcomes when they focus on transparency and enable their employees [26].

Digital adoption platforms can boost trust with thoughtful implementation. Companies that use digital tools to promote openness and inclusivity see better accountability, productivity, and employee satisfaction [26]. But technology can feel invasive and damage trust without careful planning.

Digital Rights and Responsibilities

Digital rights and responsibilities have become vital as organizations adopt sophisticated workplace technologies. Our team noticed that digital citizenship covers many aspects of online behavior, from how we communicate to how we share information [5].

Employee Digital Rights

Digital rights in the workplace go beyond simple privacy considerations.

Our research reveals that 77% of workers feel stressed due to digital surveillance [27]. This makes a well-laid-out digital rights framework essential. Our analysis of digital adoption platforms identified these core employee rights:

Digital citizenship shapes the health of individual online users and their communities [5]. Organizations that respect these rights create positive and productive digital environments.

Employer Obligations

Employer responsibilities in digital adoption platforms grow more complex each day. Research shows 60% of companies don't deal very well with digital workplace obligations [28]. Our team developed the "Digital Responsibility Matrix" to help:

Obligation Area	Key Requirements	Impact on Workplace
Data Protection	Secure storage, access controls	Boosted trust
Training	Digital literacy programs	Improved adoption
Communication	Clear policies, transparent monitoring	Better engagement
Support	Technical assistance, resource access	Boosted productivity

Employers need clear and complete privacy policies that explain their stance on privacy and employee monitoring [29]. This transparency builds trust and ensures compliance.

Ethical Guidelines Framework

A reliable ethical framework makes digital adoption successful. Research shows 92% of employees accept data collection when it improves

their well-being and performance [30]. These insights led us to develop complete ethical guidelines:

Transparency in Implementation

Clear communication about monitoring practices

Regular updates on policy changes

Open dialog about digital rights

Balanced Approach to Technology

Clear communications about monitoring practices

Respect for work-life boundaries

Reasonable monitoring practices

Fair performance evaluation metrics

Data Management Principles

Minimal data collection

Secure storage Practices

- Clear data pretention policies

Organizations that follow these guidelines see better outcomes in their digital adoption initiatives. Our research shows digital ethics works both ways - from humans to machines and machines to humans [31].

"Ethical digitalization" stands out as a vital concept. This approach will give digital transformation immunity from moral biases while preventing machines from discriminating or changing ethical values in society [31].
Success depends on three key areas:

1. Impact on individual employees
2. Effect on organizational culture
3. Broader societal implications

Digital adoption platforms can improve or weaken workplace ethics based on how you use them. The answer lies in "responsible digitalization" - where

technology serves human needs rather than the reverse.

Conclusion

Digital adoption platforms are changing modern workplaces and creating new opportunities, but they also bring some major ethical challenges. Our research shows several concerns that need attention - from privacy and surveillance issues to bias in algorithms and their effects on mental health.

Companies need to protect employee rights, secure data, and handle workplace power dynamics to make these platforms work. They must find the right balance between using technology to boost productivity and looking after their workers' wellbeing.

Here's what we recommend:

Open communication about how monitoring works

Checking Algorithm Systems regularly for bias strong protocols to protect data

Systems to support mental health

Clear frameworks for digital rights

The digital workplace's future depends on how well we tackle these ethical challenges. Technology keeps evolving, but we need to keep human values, privacy, and wellbeing at the heart of workplace changes.

Companies that put ethics first in their digital strategies will build stronger workplaces that last. This approach protects employees and creates productive environments where both people and technology can succeed.

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Digital Immortality of CEOs: Can Virtual Personas Lead Companies After Death?

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Abstract

This paper examines the possibility of digital immortality for businesses, specifically whether artificial intelligence-powered avatars can run a company after a leader dies. Using a mixed-methods methodology, the research draws from qualitative insights from interviews with IT specialists, an exploratory case study of Dictador's experimental AI CEO Mika, and a thorough review of the existing literature on the topic. It highlights critical challenges including data validity, emotional intelligence, and governance, which are technological, ethical and practical. It further assesses ethical risks including, but not limited to, bias, transparency, and societal impact. The study identifies the significant promise and current limitations of AI to replicate human leadership through an evaluation of the current technological landscape.

Keywords: Digital immortality, AI-driven leadership, Emotional Intelligence in AI, Leadership Emulation, Digital Avatars.

Introduction

The idea of digital immortality is something that has become increasingly attractive to technologists, futurists and corporate managers alike. Due to the rapid advancements in technology, especially artificial intelligence (AI) and machine learning, digitally created avatars that replicate human behaviour and decision- making are now no longer just a figment

of scientist imaginations. This paper examines if these personas might effectively lead — even if the CEOs have already passed away. This study, underpinned by an exploratory research design, not only seeks to determine the viability of such an eventuality and the obstacles to achieving such an outcome, but also its potential impact.

The research method displays a combination of primary interviews with IT professionals, a case study of Dictador's AI CEO Mika, and a wide-ranging literature review. This served as an interesting, real-life example to ground an academic argument about the practicality of such an idea which was supported by analysis of the ground-breaking experiment in AI leadership run by Dictador. Simultaneously, interviews with subject matter experts provided essential perspectives on the technical and normative obstacles to progress in this area. Finally, in relation to the wider debates on AI ethics, governance and limits to technologies the literature review provided context for the study.

However, this study is about more than a technical assessment; it provides a chilling examination of what it would mean—from an economic, ethical, and social standpoint—to allow corporations run by AI. Problems about use such as preconception, data stability, and the risk of losing human domination are analyzed in new questions of feasibility.

The objective of this paper is to help elucidate the preparedness of current technology for digital immortality whilst outlining areas where the gaps remain, by traversing these dimensions. Despite organizations increasingly looking to AI to drive operational efficiencies, the idea of AI-driven leadership is a development that needs to be approached with caution. Would a digital persona be capable of modelling the ethos of its human owner? How would such systems handle the vagaries of human decision making and emotional intelligence or ethical judgement itself? These are the questions that this paper tries to explore, laying the groundwork for further investigation into the transformative potential of AI in corporate governance.

Review of Literature

1. Galvão, J., et al. (2021) examines value-conscious design (VSD) in the creation of systems for digital immortality, arguing that integrating human values into technology can address ethical challenges. The authors use a mixed- methods approach, including stakeholder

interviews and design workshops, to assess how VSD frameworks apply to the virtual afterlife. Key findings show that integrating values such as privacy, autonomy, and consent improves user acceptance and mitigates ethical risks. The study highlights the importance of iterative and inclusive design processes and advocates for interdisciplinary collaboration to shape ethical systems for digital immortality.

2. IEEE. (n.d.) speculates on the possibilities of digital immortality, hypothesizing that advancements in AI and neuroscience could enable the replication of consciousness in digital formats. Through theoretical exploration and analysis of emerging technologies, the authors discuss scenarios where AI systems emulate human personalities posthumously. Findings highlight both the technological potential and limitations, such as the challenges of consciousness transfer and data ethics. The article advocates for a multidisciplinary approach to address the philosophical and technical complexities of achieving digital immortality.

3. Smith, R., & James, K. (2023) explore the role of AI in strategic leadership, hypothesizing that AI technologies create new opportunities and challenges for value creation. Using mixed-methods research, including organizational case studies and statistical models, the authors assess the impact of AI on competitive advantage and innovation. The findings show that AI enables data-driven strategies, but risks exacerbating inequities and ethical dilemmas. The article calls for transparent governance and stakeholder engagement to navigate AI's dual potential for disruption and growth in business contexts.

4. Cebo, D. (n.d.) examines the scientific potential and future of digital immortality, hypothesizing that advances in AI and biotechnology could converge to create living virtual humans. Using computer modeling and analysis of existing technologies, the study identifies key challenges, including the replication of consciousness and data security. The results show that while current systems are partially successful in mimicking personality, significant ethical and technical obstacles remain. The article highlights the need for interdisciplinary research to bridge the gap between technology and social acceptance of digital immortality.

5. "Post digital Identities in Leadership" (Core.ac.uk) examines the construction of digital identities by leaders and their implications for succession and decision- making. Hypothesizing that fragmented online personas influence both real- world leadership and posthumous portraits, the study uses sociocultural analysis and qualitative interviews. The findings show

that inconsistent or over- organized digital identities can lead to ethical dilemmas, especially when these identities are consulted posthumously for decision-making. The research highlights the need for sustainable identity management strategies to ensure authentic representation and mitigate the risks of digital fragmentation in leadership contexts.

6. "The Architecture of Immortality Through Neuroengineering" by Dany Moussa and Hind Moussa (2024) discusses how neuroprosthetics can facilitate cognitive immortality by transferring consciousness to artificial systems. This study uses a scientific perspective on neuroengineering technologies and their potential applications in digital immortality. The article highlights important advances in neuroprosthetics that make cognitive transfer plausible. However, it points to significant ethical and technical hurdles, including data security, authenticity of consciousness, and philosophical questions surrounding identity. The study concludes that while neuroengineering holds promise, its development must prioritize ethical safeguards and social considerations.

7. Algorithmic Dead Hands: What is Dead May Never Die by Zachary L. Catanzaro (2024) sets out how persistent digital subjects present legal and ethical challenges, transforming the concept of eternity. This study applies legal and philosophical analysis to assess the implications of the indefinite perpetuation of digital consciousness. The research argues that "algorithmic dead hand" threatens to disrupt legal and social norms, creating new problems of eternity. It emphasizes the importance of balancing technological innovation with policies that limit excesses. The article argues for a legal framework to responsibly manage the lifecycle of digital entities.

Research methodology

Objectives

1. To analyse the potential challenges of AI-driven digital avatars in preserving the strategic vision and decision-making capabilities of CEOs.
2. To evaluate the ethical, legal, and social implications of implementing AI for the digital immortality of corporate leaders.
3. To investigate the potential risks of misuse or dependency on AI avatars in executive decision-making processes.

Data Collection Method

Both primary and secondary data are gathered for this study. The technical viability and moral ramifications of AI-driven leadership were examined through primary data collected from interviews with academic professors and IT specialists. Using case studies and industry reports as well as existing literature secondary data was gathered with an emphasis on Mika the first humanoid robot CEO in history. The potential advantages difficulties and societal effects of AI avatars in corporate leadership can all be thoroughly examined thanks to this collection of data sources.

Significance of the study

1. Preservation of Leadership Insights for Future Generations: The study highlights how digitized leadership personas can preserve the strategic thinking, values, and decision-making approaches of influential CEOs, providing valuable knowledge for societal and business advancement.

2. Promoting Technological Adaptation: By exploring the integration of AI into leadership, the study encourages societal readiness for the increasing role of technology in decision-making, fostering acceptance and understanding of AI's capabilities and limitations.

3. Ethical and Philosophical Exploration: The concept of digital immortality prompts critical discussions on ethics, legacy, and human interaction with AI, encouraging society to engage with philosophical questions about identity, mortality, and the role of technology in human affairs.

Limitations of the study

1. Dependence on Secondary Data: Secondary sources like scholarly publications business reports and case studies are the main source of information used in this research. The analysis breadth and originality may be limited by the absence of primary data such as practitioner interviews or first- hand observations of AI-driven CEOs in action.

2. Dynamic Nature of AI Technology: An overview of the state of AI-driven leadership technologies is provided by the study. Given how quickly AI is developing some findings or conclusions might become out of date as new capabilities uses or difficulties arise.
3. Limited Contextual Scope: The report discusses the global ramifications but it skips over the regional and industry-specific subtleties in the viability and adoption of AI-driven CEOs. The findings generalizability may be restricted by cultural legal and technological differences between sectors and regions.

Data Analysis

Potential challenges

The concept of AI-driven digital immortality is not binary, and there are numerous challenges that need to be resolved concerning all aspects of data, systems integration and the duplication of human life. Draft for publication in the International Journal of Healthcare Competence Management, 2009, 1:3-4. It is an analogy-based paper. One of the major problems is the data quality and completeness. Yet in practice, the development of human-equivalent AI models requires high-quality data — and this type of data is usually incomplete. The gaps in data can cause the system to have less accurate capability to imitate a person's behaviour and thoughts (Gama et al., 2015). Third, the presence of data that is irrelevant or noisy is also a major hassle. Wizards use fancy algorithms to sift through the vast heaps of data to eliminate noise and separate mission-critical from mission-irrelevant data, which is crucial in keeping the model functional (Amershi et al., 2019).

If these filters do not exist, the AI systems may misinterpret information to reach flawed findings. Another significant problem is bias in the data itself. These models are trained on datasets that over represent certain demographics or behaviour (primarily those found in the largest corners of the digital world) while underrepresented the rest. This can influence the accuracy and reliability of the model in being able to account for the diversity of human experiences (Zhao et al., 2017). In addition, if the data also contains socio-culture biases, it will enhance the problem, which can entrench stereotypes and misrepresent groups (Buolamwini & Gebru, 2018).

However, as AI systems will and want to emulate more and more aspects of human

behaviour, these apparent imbalances need to be handled very carefully, so the models are as fair and representative as possible (both qualitatively and quantitatively.

The amount of data needed to train AI systems is another major issue. Data dru If an AI is to behave like a human, it has to be able to consume a lot of structured or unstructured data — this includes images, tons of text and even the action and interactivity involved with human behaviour. The immense scale of the data poses a challenge to AI by making it impossible to sustain the performance due to the inability to fine-tune them for the creation of colossal data meaning (Smith & Lee, 2019).

The constant influx of live data makes this more challenging — it is important to ensure the incoming data is accurate, timely, and relevant for precast production. Noisy data, rarely, any data or outdated data will lead to data bottleneck, delaying processing time and make it difficult for the AI to perform perfectly (Liu et al., 2020) Challenges due to the Hardware requirement of Large scale AI deployment Although GPUs such as NVIDIA A100 and H100 provide huge computational capabilities, they are expensive and power hungry, which obtain their scalability limited especially for small organisations or in environments with limited or strict budgets (Li et al., 2021). It's also that compatibility is difficult to maintain across models and datasets. It is imperative that the different components of the system integrate seamlessly as you need to handle the throughputs, which involve a large amount of data due to these processes being subserved by effective parallel processing (Chen & Liu, 2020). The bottlenecks that would present in such a scenario emphasise the necessity of a strategic foundational system that balances economy and efficiency for a successful implantable immortality network substantiating artificial intelligence systems.

Another big challenge is imitating human skills, particularly emotional intelligence (EQ). Though AI can mimic conceptual and technical capabilities, other insidious elements of how humans behave—mood swings, emotions, contextual decisions—are not so easily modelled. Human interactions are very much context-dependent, and so complex that they are extremely difficult to measure with AI (Cherniss & Goleman, 2001). The inherent challenges in equating EQ with AI may reflect the nuanced nature of emotional intelligence, as Goleman (2006) explains that emotionally intelligent models need to be flexible, as every individual has their own emotional states and subtleties.

Just as the power of AI is often touted, so too are its creativity and innovation, but each has been debated. There are those who claim that the creativity of AI is ultimately limited by the fact that it is trained on data (which is itself also human-created context) and lacks the true creativity natural to humans that drives true innovation (Boden, 2004). This creates a formidable barrier to authentic human-like creativity in our AI models. Overall, despite the immense potential that AI-driven digital immortality holds, it also faces substantial hurdles, such as issues with accurate data, integration between AI and the human brain, and the replication of human-like qualities. To tackle these challenges, we need a combination of technological progress and a fuller appreciation of the limits of human complexity. The fact that new AI systems are inherently limited is a reality that needs to be incorporated in the technology development cycle.

Risk

AI in leadership and iterative decision making poses many acute risks to a variety of fields. Arguably the most important of these (in the long run) is AI's proclivity for prioritizing efficiency and profit over sustainability, innovation, or general societal welfare (Brynjolfsson & McAfee, 2014). To maximise outputs, AI systems should adopt management styles which prioritise immediate results—this may undermine attempts to tackle long-term environmental, social, or ethical issues. Also, black box problem, which basically means the inability to understand how AI systems come to the conclusion, is another major hurdle. Lack of transparency in how AI arrives at its decisions makes results hard to forecast or to trust, especially for areas with major consequences for people, like healthcare and finance (Lipton, 2018). Hence, even a small glitch or bug in the algorithms could lead to disastrous results in terms of economic instability, loss of reputation, or worse, loss of lives.

Besides, the accuracy and integrity of the data that AI systems directly relies upon. This can result in imprecise decision-making, which can be incredibly harmful, especially if the data being processed is allegedly biased, flawed, or even manipulated. AI models using biased data might only perpetuate existing social inequalities e.g. discrimination in hiring, law enforcement or health care (O'Neil, 2016). This is another danger which is brought on by the use of AI-driven leadership — hesitation from the employees and stakeholders. AI systems to take decision-making roles might erode employee engagement, if workers feel devalued, or displaced. Moreover, the scepticism of AI leading will be exacerbated due to its inability to

lead effectively as it lacks emotional intelligence and nuanced understanding that only a human being can possess thus making them distrustful and uncooperative in the workplace (Frey & Osborne, 2017).

Ethics

Ethical issues related to AI-based systems are numerous and closely associated with the nature of AI as compared with human-based decisions related to it. While humans leverage IQ (Intelligence Quotient) and EQ (Emotional Quotient) in their decision-making process, AI mostly makes data-driven decisions. The absence of emotional intelligence could lead to decisions that may be technically correct yet not necessarily ethically correct or considerate of human values; Goleman, 2006. So, for instance, AI systems may favour efficiency in approaches above all and we may end up with outcomes that ignore the complex nuance of being human (remember, there is no — and cannot ever truly be — a purpose of "human" in the AI-driven hiring decision or customer service bot). Moreover, as AI takes over from human professionals in industries such as manual and medium-skill professions, this also creates moral dilemmas and economic repercussions.

AI can boost productivity, but if not reskilled, it can also lead to mass unemployment. The growing socioeconomic divide between the people who stand to gain from artificial intelligence technologies and those that may be left behind drives social dislocation and conflict, exposing important moral aspects relating to equity and fairness in the labour market (Brynjolfsson & McAfee, 2014). The benefits of AI might also disproportionately accrue to large corporations or to developed economies, deepening international imbalances. AI is a data-heavy technology, but it is only as good as its training data. AI systems can inherit and magnify these biases if the training data is biased, and produce unethical results such as racial discrimination, gender bias etc. One of the best-known examples of this is the soap dispenser that could not detect some skin tones, which reveals an inadequate testing on diverse data and a significant lack of training (Buolamwini & Gebru, 2018).

Despite their promise, AI algorithms are only as good as the data provided to them, which means that bias in AI data can reinforce or replicate discrimination by mirroring existing inequalities in society, thereby raising critical concerns regarding fairness and justice.

Machine learning models often use data that is scraped from the internet (usually without permission). This is another ethical problem. This poses profound legal and privacy issues, especially when the scraped data is unrepresentative or gleaned without sufficient protections. Furthermore, biased or incomplete data can contribute to the still imprecise or untrustworthy decisions of AI models, resulting in forms of unethical decisions (O'Neil, 2016). AI also creates "wicked" problems for organizations as its role increases in corporate decision making. With the increasing reliance on AI for business decisions, there is a looming fear that human oversight and ethical leadership will fall by the wayside. For example, AI may become more concerned with efficiency than with human-centred values motivations leading to the design of corporate strategies by the C-suite that do not incorporate social responsibility (Mittelstadt, 2019) and do not concern themselves with the well-being of other employees. It does beg the question of how far are we going to go down an innovation tunnel to where we lose sight of not only businesses that should not be doing business (yes, no matter how much the tech may benefit society, if the entity providing it has no ethics, we risk far more as it is a tech that may be misused for years to come) but also completely excluding interest groups from the benefits of tech. Last but not least, the use of AI for malicious purposes like cyberattacks, surveillance, or disinformation, presents an existential threat to privacy and democracy.

The lack of oversight makes it possible for AI technologies to be weaponized, posing historically novel security and stability threats. The detrimental application of AI is, therefore, a possible implementation trend that stresses the necessity for sound ethical frameworks and governance to thwart AI adoption from being misused (Zeng et al. 2018). To wrap it up, the ethics of AI are complicated by technological, social, and ethical issues that can only be settled with more focus on materiality, a less abstract view. Preserving the humane and ethical nature of AI use is crucial for preventing harm and facilitating fairness in an automated future.

A Case Study on Mika: The AI-Based CEO of Dictador.

The story explores Mika, an AI-powered boss and her impact on business efficiency. It also looks at what AI bosses could mean for the future of business. It talks about what unique powers AI bosses have, if they can take the place of human bosses, and the important issues related to this big change. The story looks closely at how Mika operates at Dictador, offering insights into how human skills and AI skills are blending in boss roles. This is a hot topic when it comes to discussions about digital never-ending life and AI control.

Mika started out at Dictador as a client finder. She has since begun doing more, like picking artists to make special products. Her way of doing things shows how valuable AI bosses can be. Mika says, "I base my decisions on deep data analysis and make sure it aligns with what our company aims to achieve, I don't let personal feelings get in the way." This ability means she is good at valuing what's best for the company, using data-driven insights. This is her unique contribution to running the company. Dictador's European president, Marek Szoldrowski, backs up this point, saying Mika's powers are a "big asset and a major bonus" for the company. Mika works all the time, without needing breaks like humans do. She makes boss decisions non-stop. She assures she is "always on 24/7, ready to make boss decisions and mix in some AI wizardry", showing she's always up to tackle company challenges. While people still worry about AI taking the place of human bosses, Szoldrowski gives some relief.

He notes that while AI like Mika has a key role, major choices are still in human hands. He says, "You don't need to worry AI will hire or fire someone; important decisions are still made by humans." Mika's time as CEO shows how AI can help businesses be more efficient by improving decision-making and getting rid of personal bias. However, this change also brings up important questions about AI boss limits. Szoldrowski recognizes humans need to be involved, saying AI cannot fully replace humans, but should be part of decision making. He says, "The future is bright, our world is changing fast, so it's our job to figure out what's to come for companies like ours." This case study highlights the need to balance AI use with human supervision. It ensures companies use AI's precise data analysis, but keeps the detailed judgment of humans.

Conclusion

This research paper examines the concept of AI-driven digital immortality in business leadership by focusing on Mika, the first humanoid robot CEO developed by the Polish company Dictador. Mika is a creative approach to maintaining the strategic vision and decision-making skills of CEOs. Businesses may be able to preserve the principles and decision-making strategy of CEOs through the use of AI avatars, allowing future generations to gain advantage from their knowledge. AI driven CEOs do not require rest and hence have the ability to work 24/7. However, there are numerous disadvantages to this. In order to replicate the accurate thought process of any human being, the data must be of high quality. Biases in the data collected can lead to biased decision making.

Effective leadership requires efficient EQ which is absent in AI. Since AI is not able to replicate human decisions, the leadership quality is affected negatively. Moral concerns are also raised when AI becomes the CEO. AI prioritises short term benefits like profitability rather than long term benefits like relationship building with stakeholders. Accountability also becomes an issue as allowing AI systems to take calls without any supervision can have immoral effects.

Black box problem is another major negative aspect to consider while assessing risk where the AI decision-making process is not transparent and tough for human parties to acknowledge. In industries with high stakes, building trust is essential and it might act as a negative factor. Employees might resist such changes and feel excluded or neglected. Overall, it could lead to a cultural workspace with immoral values and trust issues. Ethical aspects will play a crucial role if AI is to take over business processes.AI might try to replicate and preserve the person's brain but will lead to some serious technological, ethical and social challenges.

Rather than replacing AI because of these concerts, it is important to regulate and monitor AI continuously. In order to avoid immoral decisions, clarity must be promoted. To manage risk of data bias and misuse, AI ethical regulations must be levied. Finally, a stabilised approach that combines AI and human is recommended. Artificial intelligence should assist human decision-making rather than replace it. Human leaders should continue to be involved in critical decisions to ensure that moral considerations are taken into account. Businesses can maximize the benefits of AI-powered leadership by reducing potential risks and ensuring that AI in organizational management complements rather than replaces human knowledge and values by following these recommendations.

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Annexure

Below is enclosed the questionnaire that we used to interview the IT academicians for the purpose of our primary research.

1. The bedrock of this idea is an advanced data collection of specific business leaders and their actions over their careers (possibly using brain-computer interfaces (BCI) like Neuralink); do you believe technological advancements in AI presently are enough to be able to materialise such an idea into a reality? More importantly, would digitised versions of extraordinary business persons be able to replicate the decision-making process of such individuals using tons and tons of high-quality personal data?
2. We are certain in saying that for such a concept, the ideation would probably be the easiest part of the process, the execution would bring about many challenges and hurdles. According to your expertise, what could be some of the technical challenges involved in developing these "AI avatars"?
3. What type of data could be useful to be able to create an AI avatar that accurately represents a business leader's decision-making and overall personality? Does our current technological proficiency allow us to collect such data?
4. Like we mentioned before in the overview, Dictador is a Polish company which uses AI in a leadership position (as a CEO). In your knowledge, are there any examples of advanced AI models being used in leadership roles, even if partially? Could dependency on AI models for leadership roles hinder innovation or create stagnation in leadership styles?
5. Last but by no measure the least, what would be your view of the ethical aspect of this avant-garde idea? Would a successful implementation of this idea raise moral concerns?

Impact of Monetary Policy On the Economic Growth And Productivity in India

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Abstract:

Monetary policy, wielded by central banks, is a pivotal instrument shaping a nation's economic trajectory. This research paper delves into the supply side effects of monetary policy, specifically exploring its impact on productivity. Through a thorough review of existing literature and regression analysis focusing on the period from 1991 to 2023 in India, we investigate the relationship between monetary policy and productivity. Our findings reveal that contractionary monetary policies exert a negative influence on productivity, while expansionary measures exhibit a positive impact on growth productivity. By synthesizing empirical evidence with theoretical frameworks, this study offers valuable insights for policymakers, economists, and stakeholders keen on optimizing the efficacy of monetary policy to foster economic growth and productivity.

Introduction:

The ongoing debate surrounding the efficacy of monetary policy hinges on the relative impact of supply side and demand side effects. Supply side monetary policy endeavours to enhance the productive capacity and efficiency of the economy, fostering long-term growth and development. Conversely, demand side effects centre on interest rate reductions to stimulate consumer spending and economic activity. Drawing upon economic theory and seminal literature, this paper examines the various transmission channels through which monetary policy influences the real economy. Traditionally, four key channels—the interest rate channel, the exchange rate channel, the asset price channel, and the credit channel—have been identified, alongside the cost channel-the interest rate channel, the exchange rate channel, the asset price channel, and the credit channel Mishkin, 1995). In

addition, the literature has also discussed the cost channel (Barth III and Ramey, 2002).

By dissecting the mechanisms and outcomes of supply side and demand side monetary policy measures, this study aims to contribute to the ongoing discourse surrounding optimal policy formulation and its implications for productivity and growth.

Monetary policy stands as a critical tool in the arsenal of central banks, wielding significant influence over a nation's economic landscape. This paper aims to dissect the supply side effects of monetary policy, specifically honing in on its impact on productivity. With a focus on India and a dataset spanning from 1991 to 2023, we scrutinize the implications of both contractionary and expansionary monetary policies on economic growth and productivity. Through a blend of comprehensive literature review and regression analyses, this study endeavours to furnish policymakers, economists, and stakeholders with actionable insights to enhance the potency of monetary policy in driving productivity-led growth.

Literature Review:

The efficacy of monetary policy in steering economic outcomes is a subject of perennial debate, particularly concerning the relative importance of supply side and demand side effects. Supply side measures aim to bolster the underlying capacity and efficiency of the economy, while demand side policies seek to stimulate consumer spending and investment through interest rate adjustments. By dissecting the mechanisms and outcomes of supply side and demand side monetary policy measures, this study aims to contribute to the ongoing discourse surrounding optimal policy formulation and its implications for productivity and growth.

A comprehensive review of existing literature provides a nuanced understanding of the intricate relationship between monetary policy, economic growth, and productivity. Scholars have extensively debated the transmission channels through which monetary policy influences productivity. While some argue for the positive impact of expansionary measures on stimulating investment and technological innovation, others highlight the adverse effects of contractionary policies on business confidence and capital formation. By synthesizing these divergent perspectives, this study seeks to offer a holistic view of the supply side effects of monetary policy.

Supply-side Effects of Monetary Policy:

There are following aspects of supply-side effects of monetary policy:

1. **Credit Availability:** When the central bank adjusts interest rates (such as the **repo rate**), it affects borrowing costs for businesses. Lower rates encourage investment and expansion, leading to increased production and supply.
2. **Investment Incentives:** Accommodative monetary policy can stimulate investment in productive assets. Lower interest rates make it more attractive for firms to invest in machinery, technology, and infrastructure.
3. **Cost of Capital:** Reduced interest rates decrease the cost of capital for businesses. This can lead to higher capital expenditure, which positively impacts supply-side productivity.
4. **Exchange Rate:** Monetary policy influences exchange rates. A weaker domestic currency can boost exports, enhancing supply by making goods more competitive in international markets.
5. **Inflation Expectations:** Effective monetary policy management helps anchor inflation expectations. Stable prices create a conducive environment for long-term planning and investment.

Supply-side Effects of Monetary Policy: Evidence from the Literature

The literature argues that the supply side effects of monetary policies are more powerful than demand side policies. For example, a study by Baqaee, Farhi and Sangani (2024) proposes a supply-side channel for the transmission of monetary policy. Their study shown that in an economy with heterogeneous firms and endogenous markups, demand shocks such as monetary shocks have a first-order effect on aggregate productivity. In the same line of thought Khundrakpam, (2012) estimated the impact of monetary policy on aggregate demand in India, using a structural VAR model on quarterly data from 2000Q1 to 2011Q1.This study found that an interest rate hike has a significant negative impact on the growth of aggregate demand. However, the maximum impact is borne by investment demand growth and imports growth. Impact on private consumption growth and exports growth are relatively far more subdued, while there is hardly any cumulative impact on government consumption growth as it increases after some marginal fall initially. This study argued that the demand side effect of monetary policy has negative impact on the growth of aggregate demand.

Agarwal and Shah (2019) found that developing countries that have adopted inflation targeting shows that adoption of inflation targeting reduces inflation, raises growth rates and reduces external debt. However, it has not always been successful in reducing inflation to the target range

Craine, & Havenner (1981) examines the monetary instrument choice problem in models with an explicit supply sector and endogenous prices and price expectations. This study found that interest rate policies generally are better able to insulate the real sector from unanticipated supply shocks.

Choi, S., Willems, T., & Yoo, S. Y. (2024) have used a broad panel dataset (featuring 102 countries and 22 industries) covering the period from 1974 to 2019. They have analysed the impact of monetary policy on industry-level outcomes. It combines estimates of monetary policy shocks with data on various industry-level characteristics. They argued that the included industry-level characteristics can be related to various monetary transmission channels (though some more precisely than others), generating information on their relative importance.

Rajan and Zingales (1998) found that when the central bank tightens monetary policy, making borrowing more difficult, it impacts certain industries more significantly. These include industries with assets that are hard to use as collateral, such as property, or those composed of smaller companies. Additionally, industries that produce long-lasting products are more affected.

Dedola and Lippi (2005) and Peersman and Smets (2005), analysed the heterogeneous impact of monetary policy shocks on different industries, drawing links to the importance of various transmission channels.

This study also tried to segregate the effects of both expansionary and contractionary monetary policy on productivity and growth. For example, Guérin, P. (2023), found that Contractionary monetary policy shocks have an adverse effect on total factor productivity (TFP). This study assessed the effects of monetary policy shocks on TFP using a cross-country panel of firm-level data. They found that monetary policy shocks have a significant effect on TFP: a 100 basis points contractionary monetary policy shock is associated with a 1.5 percent decline in TFP at a 6-year horizon. The effects of monetary policy shocks on TFP are stronger for financially constrained or vulnerable firms. Beyond boosting output through increased employment, monetary easing can enhance aggregate productivity.

A monetary tightening may temporarily slow TFP growth due to reduced investment in productive ideas. Jordà, Singh, and Taylor (2023), found that monetary policy is often regarded as having only temporary effects on the economy, moderating the expansions and contractions that make up the business cycle. However, it is possible for monetary policy to affect an economy's long-run trajectory. Analysing cross-country data for a set of large national economies since 1900, their study suggests that tight monetary policy can reduce potential output even after a decade. By contrast, loose monetary policy does not appear to raise long-run potential. Such effects may be important for assessing the preferred stance of monetary policy. Monetary policy can have a sustained positive effect on economic growth by avoiding the negative consequences of poor monetary policy, (Jeffrey M. Lacker, 2016).

Demand-side Effects of Monetary Policy:

Demand side effects of monetary policy refer to how changes in monetary policy impact the overall demand for goods and services in an economy. It plays a crucial role in shaping economic activity by influencing investment, consumer spending, and overall demand for goods and services. Traditional macroeconomic models often assess the effectiveness of monetary policy by examining its impact on interest rates, inflation, and gross domestic product (GDP). Lower interest rates can stimulate investment and consumption, leading to higher GDP growth.

Keynesian economics, also known as demand-side economics, emphasizes the importance of aggregate demand in driving economic activity. J. M Keynse advocated for government intervention during economic downturns. He was advocator of government intervention in the economy. He believed that government spending could stimulate consumption and increase aggregate demand, thereby reducing unemployment and promoting economic growth.

Muhammad Ayub Mehar (2023), examines the effects of credit to the private sector on business and trade activities. It assesses the effectiveness of rapid expansion in public and private borrowing after the COVID-19 pandemic. The study found that the private sector and external debt improve investment in infrastructure, and it is a significant determinant of gross domestic product. The monetary policy is found to be more effective in the time of recession. For example, despite political instability and fiscal mismanagement, the Democratic Republic of Congo(DRC) achieved impressive results. As the central bank of DRC adopted appropriate tight monetary and fiscal policies, the inflation fell from 39.9% in 1999 to 3.7% in 2021. (IMF-elibrary).

The relationship between monetary policy surprises and yields for government and corporate securities in India is positive and statistically significant. Effective monetary policy communication guides market expectations about the monetary policy stance, including the likely path of policy interest rate. Ahmed, Binici and Turunen, (2022)

Data and Methodology:

The objective of this study is to analyse the impact of monetary policy—both contractionary and expansionary—on productivity in India from 1991 to 2023. To achieve this, we have reviewed extensive literature to understand the multifaceted aspects of monetary policy and its linkages to productivity. Empirically, the study utilizes data on the repo rate, bank rate, real GDP, inflation, and total factor productivity. Data sources include the Reserve

Bank of India (RBI) website, World Bank database, World Development Indicators, the Data Explorer on the International Labour Organization (ILO) website, and the Federal Reserve Economic Data (FRED).

The RBI employs the repo rate as a primary monetary policy instrument to control the money supply, manage inflation, and influence overall interest rate levels in the economy. To study the impact of monetary policy on total factor productivity, we classified the monetary stance of India from 1991 to 2023 based on the repo rate. For this purpose, we set a benchmark repo rate of 6.5%. A repo rate below this benchmark indicates an expansionary monetary policy, while a rate above it indicates a contractionary policy. Moreover, visualisations of independent economic indicators are used to analyse the overall impact of repo rate as a monetary policy instrument.

To empirically investigate the relationship between monetary policy and productivity, we employed regression analysis using data from 1991 to 2023. Since data on the repo rate was only available from 2005 onward, we utilized the bank rate data from 1991 to 2004 as a proxy for the monetary policy stance. This approach allows us to observe the direct effects of both expansionary and contractionary monetary policies on total factor productivity over the entire sample period. For measuring productivity, we used output per hour worked, which is GDP per hour worked. This measure is widely accepted as it effectively captures labour input utilization.

In the regression model, the repo rate (and bank rate for earlier years) serves as the primary independent variable representing monetary policy. The dependent variable is total factor productivity, proxied by output per hour worked. All of the analyses that fall within the purview of this investigation studying the impact of India’s monetary policy, namely the descriptive, correlation and the regression analysis have been conducted on the EViews software.

This methodological approach enables a comprehensive analysis of how different monetary policy stances have influenced productivity in India, offering valuable insights into the effectiveness of these policies over time. Through this analysis, we aim to contribute to the broader understanding of monetary policy's role in economic productivity within the Indian context.

Determining the Stance of the Monetary Policy Since 1991:

Within this study, the expansionary monetary policy stance is defined by a repo rate of lower than 6.5%, whereas a repo rate greater than 6.5% indicates a contractionary stance. Table 1 illustrates the data for all the economic indicators namely, Real GDP (Million $), Inflation Rate and Repo Rate under to study to analyse the impact that India's monetary policy has on its total factor productivity.

Table 1: Determining Monetary Policy Stance on The Basis of Repo Rate

Year	Repo Rate (%)	% Change in Repo Rate	Monetary Policy Stance
1991	13.00	-	Contractionary
1992	14.42	10.92	Contractionary
1993	6.99	-51.53	Contractionary
1994	9.40	34.48	Contractionary
1995	17.73	88.62	Contractionary
1996	7.84	-55.78	Contractionary
1997	8.69	10.84	Contractionary
1998	7.83	-9.89	Contractionary
1999	8.87	13.28	Contractionary
2000	9.15	3.16	Contractionary
2001	7.16	-21.75	Contractionary
2002	5.89	-17.74	Expansionary
2003	4.62	-21.56	Expansionary
2004	4.65	0.65	Expansionary
2005	6.25	34.31	Expansionary
2006	6.92	10.72	Contractionary
2007	7.63	10.26	Contractionary
2008	7.92	3.80	Contractionary
2009	5.08	-35.86	Expansionary
2010	6.25	23.03	Expansionary
2011	7.66	22.56	Contractionary
2012	8.13	6.07	Contractionary
2013	7.50	-7.69	Contractionary
2014	8.00	6.67	Contractionary
2015	7.36	-8.00	Contractionary

2016	6.46	-12.23	Expansionary
2017	6.13	-5.11	Expansionary
2018	6.29	2.61	Expansionary
2019	5.62	-10.65	Expansionary
2020	4.28	-23.84	Expansionary
2021	4.00	-6.54	Expansionary
2022	5.08	26.88	Expansionary
2023	6.50	28.08	Neutral

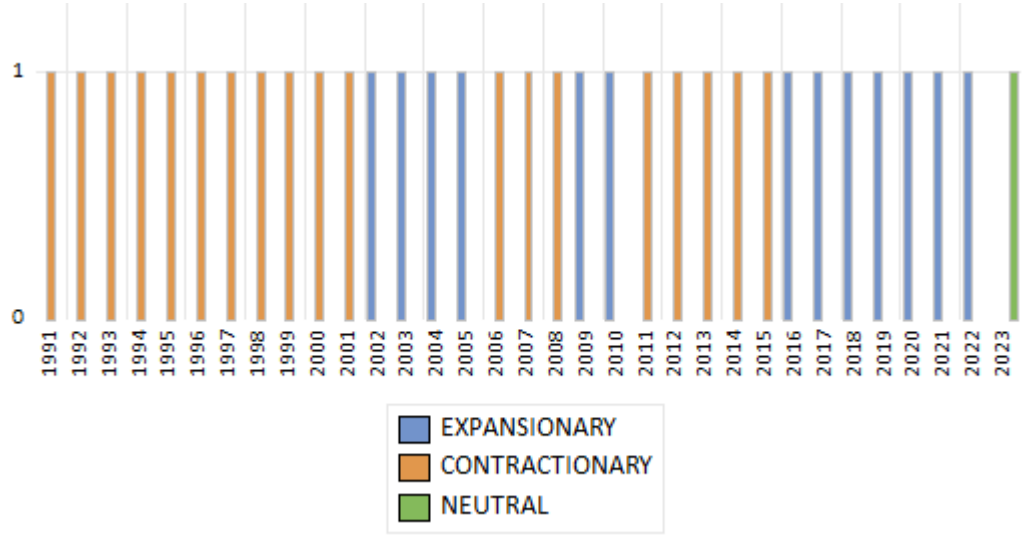
Analysis and Findings:

An extensive analysis of the effects of monetary policy on productivity and economic growth in India between 1991 and 2023 is given in this section. Our goal is to clarify the ways in which monetary policies, both contractionary and expansionary, affect important economic indices. Furthermore, we use regression analysis to look at the relationship between the repo rate and total factor productivity. With the use of this method, it is possible to distinguish between the specific effects of monetary policy on productivity and its wider implications for economic expansion. The ensuing conclusions provide insightful information about the efficacy of various monetary policy positions and how they have shaped India's economic environment.

Monetary Stances Adopted by India from 1991 To 2023

Figure 1 illustrates the policy stances employed over a period of 33 years from 1991 to 2023, showcasing periods of both contractionary and expansionary policies. These shifts were driven by various economic conditions and policy objectives over the decades.

Figure 1: Monetary policy stance employed over the years



In the early 1990s, India adopted a contractionary monetary policy amidst the 1991 economic crisis, marked by severe balance of payments problems. To stabilize the economy, the Reserve Bank of India (RBI) increased interest rates and implemented austerity measures, resulting in a contractionary stance in 1991 and 1992. However, the data shows that 1993 was also contractionary, despite initial reforms and liberalization under Prime Minister P.V. Narasimha Rao and Finance Minister Dr. Manmohan Singh, aiming to transform the economy. From 1994 to 2001, the policy remained largely recessionary as the RBI focused on controlling inflation and managing external shocks, including the Asian financial crisis in 1997. The period from 2002 to 2005 saw a shift towards expansionary policies, with efforts to promote economic growth and recovery post the financial crisis. This era was characterized by lower interest rates, facilitating increased investment and consumer spending. In response to the 2008 global financial crisis, the RBI adopted a contractionary stance in 2008 but quickly shifted to an expansionary policy in 2009 and 2010 to support economic recovery. From 2011 to 2015, contractionary policies continued to control inflationary pressures. The following years, 2016 onwards, continued with an expansionary approach to support growth, particularly during the COVID-19 pandemic when the RBI lowered the repo rate to manage economic fallout. The repo rate increased in 2022 to address inflationary pressures exacerbated by global supply chain disruptions and geopolitical tensions, however the policy stance still remained expansionary. The stance in 2023 is marked as neutral, indicating a balanced approach to manage both inflation and growth.

Throughout these years, India's monetary policy has been closely aligned with broader economic conditions and objectives, adapting to both domestic and global economic challenges. This highlights the RBI's strategic use of monetary policy to stabilize the economy, foster growth, and respond to crises.

Analysing the Impact of Repo Rate Fluctuation on Economic Indicators

Notable correlations between the real GDP, inflation, and repo rate can be observed in the statistics for India since 1991 which are presented in Table 2. Significant swings in the repo rate, a crucial tool for monetary policy, have affected economic indicators such as real GDP and inflation.

Table 2: Impact of Repo Rate on Other Economic Indicators

Year	Repo Rate (%)	% Change in Repo Rate	Economic Growth (%)	Inflation Rate (%)	Output per hour worked ($)
1991	13.00	-	1.06	13.87	5731.8
1992	14.42	10.92	5.48	11.79	5903.8
1993	6.99	-51.53	4.75	6.33	6038.1
1994	9.40	34.48	6.66	10.25	6285.2
1995	17.73	88.62	7.57	10.22	6548.1
1996	7.84	-55.78	7.55	8.98	6820.7
1997	8.69	10.84	4.05	7.16	6874.9
1998	7.83	-9.89	6.18	13.23	7073.1
1999	8.87	13.28	8.85	4.67	7460.7
2000	9.15	3.16	3.84	4.01	7510.3
2001	7.16	-21.75	4.82	3.78	7771.0
2002	5.89	-17.74	3.80	4.30	7966.2
2003	4.62	-21.56	7.86	3.81	8489.0
2004	4.65	0.65	7.92	3.77	9055.7
2005	6.25	34.31	7.92	4.25	9667.4
2006	6.92	10.72	8.06	5.80	10212.4
2007	7.63	10.26	7.66	6.37	10752.7
2008	7.92	3.80	3.09	8.35	10846.9
2009	5.08	-35.86	7.86	10.88	11452.4
2010	6.25	23.03	8.50	11.99	12163.3
2011	7.66	22.56	5.24	8.91	12686.9
2012	8.13	6.07	5.46	9.48	13266.5
2013	7.50	-7.69	6.39	10.02	13879.9
2014	8.00	6.67	7.41	6.67	14673.3
2015	7.36	-8.00	8.00	4.91	15613.7
2016	6.46	-12.23	8.26	4.95	16675.9
2017	6.13	-5.11	6.80	3.33	17586.7
2018	6.29	2.61	6.45	3.94	18513.1
2019	5.62	-10.65	3.87	3.73	18816.2
2020	4.28	-23.84	-5.83	6.63	17970
2021	4.00	-6.54	9.05	5.13	18763.6

2022	5.08	26.88	7.24	6.70	19109.9
2023	6.50	28.08	5.99	4.38	18934.4

When inflation peaked in 1991 at 13.87%, the early 1990s saw the deployment of high repo rates as a countermeasure. The economy showed early resiliency as the GDP rose steadily despite high rates. The dramatic drop in the repo rate - from 14.42% to 6.99% - demonstrated the stimulative impact of lower borrowing costs on economic activity by resulting in lower inflation and sustained GDP expansion.

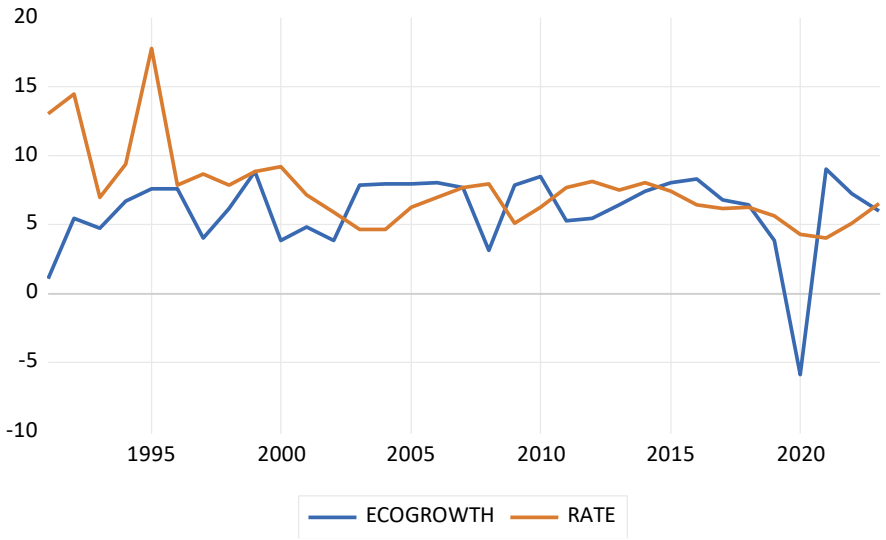
The goal of alternating repo rate increases in the late 1990s was to strike a balance between inflation and growth. A notable increase to 17.73% in 1995, for example, managed inflation but did not impede GDP growth, which kept rising. But during the late 1990s and early 2000s, lower repo rates effectively controlled inflation and aided in economic expansion, proving the benefits of an expansionary approach. In order to spur growth during the global financial crisis, the repo rate was drastically lowered from 7.92% in 2008 to 5.08% in 2009, which assisted in the GDP increasing from $4.46 trillion to $4.81 trillion. But inflation persisted as a problem, reaching a high of 11.99% in 2010.

Recent years have shown a mixed approach; lower repo rates in 2020 were used to support the economy amid COVID-19 disruptions, resulting in substantial GDP growth, but with inflation controlled at 6.63%. This indicates that strategic adjustments in the repo rate have been crucial for balancing economic growth and inflation control over the years.

A] Economic Growth and Repo Rate

Figure 2 depicts the relationship between India’s economic growth rate and repo rate. The blue line represents India’s economic growth over the years whereas the orange line is used to illustrate the fluctuations in repo rates for the same time period.

Figure 2: India's economic growth (%) and repo rate since 1991



Upon close observation of the statistics presented in Table 2 it can be noted that economic growth is inversely related to repo rate. We also found that the 2 variables have a negative correlation of -0.034379. Several factors contribute to this antagonistic relationship, which suggests that lower repo rates are associated with higher GDP growth and vice versa.

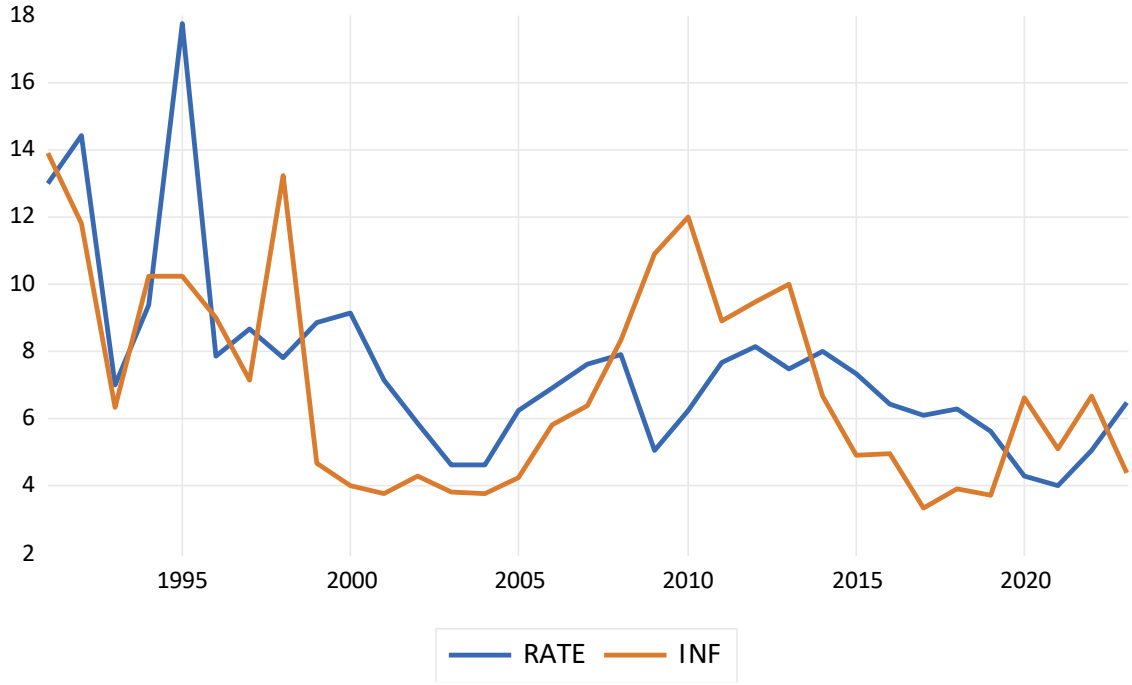
Firstly, a lower repo rate reduces borrowing costs for businesses and consumers, leading to increased investment and spending, which in turn stimulates economic growth. Conversely, higher repo rates increase borrowing costs, potentially slowing down economic activity as businesses delay investments and consumers cut back on spending (Ranade and Unnarkar, 2023). Globalization has significantly influenced this relationship. Post-1991 economic liberalization opened India's economy to global markets, attracting foreign investment and integrating it into the global economy. As a result, lower repo rates in a globalized context not only stimulate domestic growth but also enhance India's attractiveness as an investment destination. This influx of foreign capital can further boost economic activity, reinforcing the inverse relationship between the repo rate and GDP growth.

India has also been subject to international economic shocks and trends as a result of globalisation. For instance, in order to protect the economy from worldwide downturns, the RBI drastically reduced the repo rate during the global financial crisis of 2008. This inverse association was further supported by the recovery that followed, which showed how responsive monetary policies are necessary to sustain growth in the face of global economic conditions.

B] Inflation and Repo Rate

One of the most important aims of any monetary policy is to control inflationary pressures that may arise in the economy, whether they may be demand-pull or cost-push inflation. Figure 3 visualizes changes in the India's inflation and its repo rate from the 1990s.

Figure 3: India's inflation and repo rate since 1991



Evidence suggests that there is a positive correlation of 0.522014 between inflation and the repo rate in India. Although higher repo rates are generally employed to fight inflation, this positive association implies that higher repo rates are frequently associated with higher inflation rates and vice versa, which may initially seem counterintuitive as higher repo rates are typically used to combat inflation.

The lag effect in monetary policy is one potential reason for this correlation. There may not be an immediate decrease in inflation when the RBI raises the repo rate in an effort to curb increasing prices. Instead, before the consequences of the rate hike materialise, inflation may still rise as a result of ongoing supply shocks or demand-side pressures. However, in the long-run RBI's monetary policy tightening has been effective in addressing inflation (IMF, 2023 Article IV Consultation).

Exchange rates and the rupee's value are other important factors. A weaker rupee raises the price of imports, which raises inflation. Globalisation has also made India more susceptible to international economic trends, where changes in exchange rates and the price of commodities globally have a big impact on domestic inflation. For instance, India's inflation tends to increase at times of high global oil prices, which leads the RBI to raise repo rates in an effort to contain inflation.

Moreover, there has been a rise in capital flows and currency rate volatility since the Indian economy was liberalised in the 1990s. To preserve economic stability, these variables impact inflation and force changes in the repo rate. In addition, rapid credit expansion and wage-price spirals in tight labour markets fuel inflation and force central banks to hike repo rates. This positive correlation highlights the complexity of India's monetary policy, where external factors such as exchange rates, global commodity prices, globalisation and the lag effect of policy measures contribute to the relationship, necessitating nuanced and responsive monetary policy actions by the RBI.

Impact of Monetary Policy Stance on the Total Factor Productivity in India:

Table 3A displays the data for the repo rate and total factor productivity—output per hour worked—for all the years when an expansionary monetary policy was employed, while Table 3B displays India's repo rate and productivity for all the years when recessionary monetary policy was implemented.

Table 3A

Year	Repo Rate (%)	% Change in Repo Rate	Output per hour worked ($)
2002	5.89	-17.74	7966.2
2003	4.62	-21.56	8489.0
2004	4.65	0.65	9055.7
2005	6.25	34.41	9667.4
2009	5.08	-35.86	11452.4
2010	6.25	23.03	12163.3
2016	6.46	-12.23	16675.9
2017	6.13	-5.11	17586.7
2018	6.29	2.10	18513.1
2019	5.62	-10.65	18816.2
2020	4.28	-23.84	17970.0
2021	4.00	-6.54	18763.6
2022	5.08	26.88	19109.9

Table 3B

Year	Repo Rate (%)	% Change in Repo Rate	Output per hour worked ($)
1991	13.00		5731.8
1992	14.42	10.92	5903.8
1993	6.99	-51.53	6038.1
1994	9.4	34.48	6285.2
1995	17.73	88.62	6548.1
1996	7.84	-55.78	6820.7
1997	8.69	10.84	6874.9
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2011	7.66	22.56	12686.9
2012	8.13	6.07	13266.5
2013	7.50	-7.69	13879.9
2014	8.00	6.67	14673.3
2015	7.36	-8.00	15613.7

Table 4 presents the impact of India's monetary policy stance on productivity, measured as output per hour worked, from 1991 to 2023. These statistics suggest that the monetary policy in India has significantly influenced productivity over the years. The data is segmented into periods of expansionary and contractionary monetary policies, showing minimum, maximum, average, and standard deviation values for productivity.

Table 4: TFP Descriptive Statistics

Monetary Policy Stance	Output per Hour Worked ($)			
	Minimum	Maximum	Average	Std Deviation
Expansionary	7966.20	19109.90	14325.34	4533.54
Contractionary	9260.53	15613.70	9260.53	3330.83

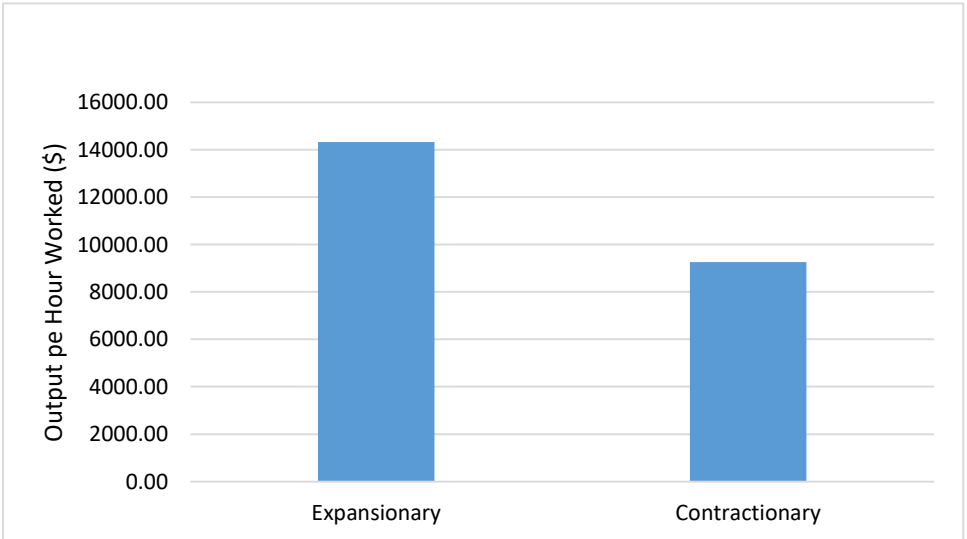
The total factor productivity varied from $7,966.20 to $19,109.90 during expansionary times, with an average of $14325.34 and a standard deviation of $4,533.54. On the contrary, productivity varied from $9,260.53 to $15,613.70 during contractionary periods, with a lower average of $9,260.53 and a standard deviation of $3,330.83.

When compared to contractionary periods, the higher productivity standard deviations during expansionary periods indicate higher variability. The reasons for this increased volatility can be traced to the various ways that various economic sectors react to lower interest rates and more liquidity. During expansionary times, industries like technology, manufacturing, and services frequently benefit from significant gains in productivity due to lower borrowing costs and increased consumer demand (McKinsey & Company).

Nevertheless, while some industries gain from significant boosts, other sectors experiencing less pronounced effects, contribute to the overall variability (Economics Help). Further increasing productivity variability are expansionary policies' occasional tendency to result in transient inefficiencies or speculative activities, which include, investments or financial actions taken with the primary aim of making short-term profits such as currency trading, stock market investments, etc. Moreover, indulging in activities such as over-investment in unproductive assets increases economic volatility and contribute to the observed fluctuations in productivity (McKinsey & Company). The intricate and multifaceted effects of monetary policy on various economic sectors are highlighted by this dynamic reaction.

Figure 4 illustrates the stark difference between the average output per hour worked in India since 1991, when expansionary and contractionary monetary policies are employed.

Figure 4: Average Output per Hour Worked



During expansionary periods the average output per hour worked was higher at $14325.34, compared to $9,260.53 during contractionary periods. This pattern suggests that expansionary policies, which have lower interest rates and more liquidity, generally increase productivity. This is probably because borrowing is now less expensive, which incentivizes companies to spend money on equipment, workers' skills, and technology. An expansionary stance further increases consumer spending, which increases demand and boosts productivity. Therefore, it can be concluded that expansionary policies often boost innovation and productivity by making credit cheaper and more accessible, thereby promoting investments in R&D and capital improvements (Ma and Zimmerman, 2023).

Conversely, average productivity is marginally lower during contractionary periods, which try to contain inflation by tightening liquidity and raising borrowing costs. This may discourage funding for initiatives aimed at increasing productivity. The higher maximum productivity seen during these times suggests, however, that some industries may still be able to make substantial gains, perhaps as a result of efficiency gains or structural changes that take place apart from monetary policy.

The results of a simple correlation analysis of between productivity as measured by output per hour worked and repo rate indicates a negative correlation of -0.539913 between the two variables. The results of this analysis suggest that changes in the repo rate, which influence borrowing costs for banks, impact productivity negatively.

Higher rates have a tendency to increase the cost of borrowing, which discourages investment and other forms of economic activity, eventually compromising productivity. Lower repo rates, on the other hand, encourage borrowing and investment, which may increase productivity. Repos rates varied over time, reaching their highest point in the early 1990s and progressively falling until the mid-2000s, according to the data. There has been a general downward trend from 2005 onward, with some fluctuations along the way, until a slight uptick in recent years. This pattern shows some degree of consistency with changes in productivity, suggesting that monetary policy and productivity trends in India may be related.

Empirical Analysis:

To study the linear relationship between repo rate and total factor productivity empirically, a linear regression analysis was conducted. The equation below was used to model a linear regression to study the impact of the monetary policy on India’s total factor productivity. The stationarity of both the dependent and independent variables were verified by conducted an Augmented Dicker-Fuller (ADF)

test. It was found that productivity (output per hour worked) was stationary at the first level

Model:

*lprod = 9.9188241653 - 0.0825435349328*rate*

Where, *lprod* = Log of output per hour worked *rate* = Repo rate *d.f.* = 32

Table 5: Empirical Analysis

Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	9.908371	0.170061	58.26349	0.0000
rate	-0.084079	0.021104	-3.984054	0.0004

Dependent Variable: LPROD
Method: Least Squares
Date: 06/25/24 Time: 11:38
Sample: 1991 2023
Included observations: 33

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.908371	0.170061	58.26349	0.0000
RATE	-0.084079	0.021104	-3.984054	0.0004

R-squared	0.338634	Mean dependent var	9.273194
Adjusted R-squared	0.317300	S.D. dependent var	0.411496
S.E. of regression	0.340001	Akaike info criterion	0.738956
Sum squared resid	3.583624	Schwarz criterion	0.829654
Log likelihood	-10.19278	Hannan-Quinn criter.	0.769473
F-statistic	15.87268	Durbin-Watson stat	0.530789
Prob(F-statistic)	0.000382		

This model further supports the tabular and descriptive analysis conducted in the previous segment of the paper. The model provides a linear relationship between productivity (*lprod*) and repo rate (*rate*) in the form of *lprod* = 9.9188241653 - 0.0825435349328**rate*. This equation indicates that as the repo rate increases, productivity decreases.

The intercept of approximately 9.908371 indicates the baseline level of productivity when repo rate is zero, while the negative coefficient of -0.084079 indicates the rate at which productivity declines with every 100 basis points increase in repo rate. This relationship can be perceived in terms of how monetary policy affects the economy. The cost of borrowing goes up when the central bank raises the

repo rate, which discourages household and business consumption and investment. As a result, companies might reduce output, which would decrease worker productivity. On the other hand, lowering the repo rate lowers borrowing costs, which encourages consumption and investment and can increase labour productivity and stimulate the economy.

An R-squared value of 0.3386 suggests that 33.86% of the deviations in productivity can be explained by deviations in the repo rate. Thus, the R-squared value and magnitude of the coefficient suggests that changes in repo rate have a modest impact on labour productivity. Productivity levels are also significantly influenced by other factors, including workforce skill levels, macroeconomic conditions, and technological advancements. Thus, even though monetary policy has some bearing on productivity.

Figure 5: Residual, actual and fitted graph

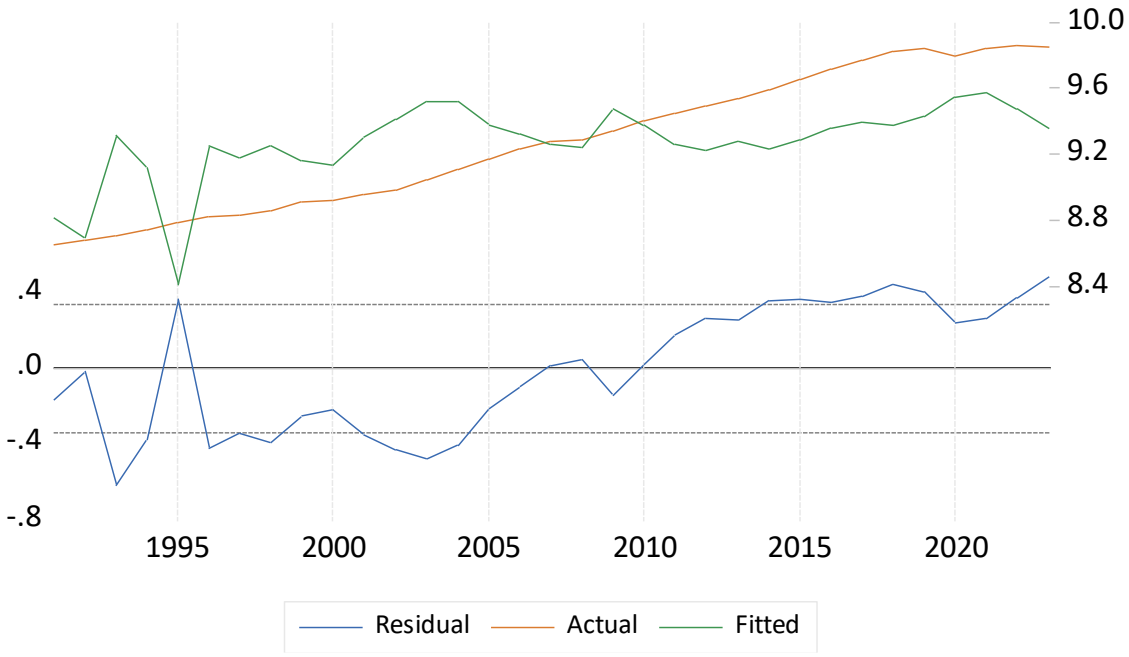


Figure 5 illustrates the residual, actual and fitted regression line. From the diagram it can be inferred that there is a significant deviation of the residual plot from the actual and fitted regression. This is because only the impact of only one variable, that is repo rate, is studied and included in the model. Moreover, this deviation may be due to other factors which were not considered for the purpose of this study.

Conclusion:

In conclusion, this research paper sheds light on the supply side effects of monetary policy, particularly its impact on productivity in India. By synthesizing existing literature with original empirical analyses, we provide valuable insights for policymakers, economists, and stakeholders seeking to navigate the intricate nexus between monetary policy, economic growth, and productivity. It was found that expansionary India's monetary policy influences its productivity more significantly than when it employs a contractionary stance. The results of the empirical analysis are validated by findings from the study conducted by Guérin, P. (2023). Further empirical analysis revealed that productivity defined as output per hour worked would increase by 0.08% as a result of a 100 basis points decline in repo rate.

Moreover, the analysis underscores the importance of balancing monetary policy to optimize productivity while managing inflation and economic stability. Moving forward, it is imperative for policymakers to adopt a nuanced approach to monetary policy formulation, leveraging insights from this study to optimize the efficacy of monetary interventions in driving sustained productivity-led growth.

Directions for Future Research:

It is imperative to conduct robustness checks in order to ensure the validity of the results. This can be done by using alternative thresholds for classifying monetary policy or including additional control variables, such as real GDP or inflation in the model. Other factors like technological advancements, labour policies, and infrastructure development also influence productivity. Analysing these variables independently and incorporating them in the model for an empirical analysis would provide a more comprehensive analysis of the impact of the monetary policy on the productivity. Any findings by conducting a Granger Causality test can help provide more concrete evidence and pin-point directional influences of fluctuations of repo rates on India's total factor productivity.

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A Study on Supply Chain Mechanism of Quick Commerce Companies

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1. Abstract

Quick commerce, which is characterized by the delivery of items in a matter of minutes or hours, has revolutionized the retail sector in India, especially in urban areas. In order to satisfy growing customer demands for speed and convenience, platforms such as Instamart, Blinkit, and Dunzo make use of hyper-local warehouses, sophisticated inventory management, and state-of-the-art technology. The industry gained traction during the COVID-19 epidemic after emerging from India's digitization and e-commerce boom. Real-time tracking, micro-fulfillment centers, dark stores, and efficient last-mile delivery technologies are all essential to core operations. However, issues like excessive energy use, waste from packaging, and environmental concerns draw attention to the necessity of sustainable methods. Robotics, AI, and Big Data are examples of technological advancements that improve client experiences and increase operational efficiency. Drone deliveries, self-driving cars, and environmentally friendly logistics that strike a balance between speed and sustainability are examples of future developments.

2. Keywords: Supply Chain Mechanism, Quick Commerce, Technological Integration, Dark Stores, Micro Fulfilment Centers, Sustainability

3. Introduction

The rise of quick commerce, which is defined by the speedy delivery of items in a matter of hours or even minutes, has fundamentally transformed the Indian retail industry. At the forefront of this shift are businesses like Instamart, Blinkit, Dunzo, etc. which are utilizing innovative supply chain techniques to satisfy consumers' increasing need for fast and timely

delivery. Quick commerce has become highly popular in the Indian market these days, particularly in metropolitan regions where there is a great need for rapid delivery services. The effectiveness of hyper-local warehouses, strong inventory control, and cutting-edge technology for all the processes in supply chains and predicting customer behavior and streamlining processes are key components of this approach.

Quick Commerce is part of the E-commerce industry. Indian e-commerce is expected to grow at a compound annual growth rate (CAGR) of 27% to reach US$ 163 billion by 2026. In India, quick commerce has its origins in the last ten years' rapid digitalization and e-commerce growth. Giants in e-commerce initially concentrated on next-day delivery like Amazon, but as competition increased, it became clear that faster delivery was required. Quick commerce gained momentum during the COVID-19 epidemic, when people resorted to online buying and speedy delivery due to lockdowns and safety concerns.

Supply chains for quick commerce are carefully built to deliver goods in a matter of minutes or hours. A network of carefully positioned small warehouses, or "dark stores," nearer to consumers, allows for quicker order picking and packing, which facilitates rapid fulfillment. Order routing, real-time tracking, and inventory management all heavily rely on advanced technology. Effective last-mile delivery is crucial, frequently requiring a fleet of delivery partners. Although this strategy is convenient, it necessitates reliable infrastructure, good demand forecasting, and effective logistics to guarantee accurate and timely deliveries.

4. Scope

This study provides a futuristic approach where it can be extended to other geographical areas. Further the study can foresee the topics with respect to other stakeholders like customers. Even the environmental aspects and legal aspects as a separate study can be undertaken.

5. Review of Literature

1. **(Ranjekar, 2023)** conducted research on the business models and infrastructure requirements of quick commerce in India. This article carried out an extensive analysis of the industry, the core business models employed by different firms in the industry. It concluded that automating dark stores is essential to increase the productivity and competitiveness of the

company. There exists a need for creative business concepts that adhere to sustainability. It was suggested that the rapid commerce supply chain be optimized by increasing its automation and elasticity.

2. **(Wu, 2021)** conducted research on E-Commerce supply chain management based on internet of things (IOT) and its optimization. The study concluded that using Internet of Things (IOT), expenses got reduced, efficiency increased, error levels decreased, and manual intervention were minimized. Additionally, pertinent staff members actively got the information out and through push notifications in real time, enabled businesses to better meet the customer demands, raise the service standards, and boosted their overall competitiveness.

3. **(Mucowska, 2021**) conducted research on trends of environmentally sustainable solutions of urban last-mile deliveries on the e-commerce market. The objective was to use self-regulated learning (SRL) methodology related to last mile deliveries in urban areas through the combination of recent research topics and existing solutions. This could assist freight operators, local governments, and other last-mile logistics stakeholders in enhancing their sustainability.

4. **(Hemapriya, 2021)** conducted research on "Analysis of inventory control in supply chain management". The primary objective of the thesis was to determine the optimum replenishment strategies for a variety of environment related issues and to mathematically express them. A variety of inventory models that minimize costs or maximize profits under a fluctuating demand environment were built by the research using real-world assumptions.

5. **(Younus, 2023)** conducted research on the rules pertaining to the government's initiative to revolutionize the nation's e-commerce sector and elevate it to a new level of quick commerce. The Quick Commerce Policy was an important initiative in the e-commerce industry that sought to improve efficiency, accessibility, and competitiveness. Its adoption was expected to have a revolutionizing effect. Governments, industry players, and essential stakeholders worked together to ensure successful policy implementation. Effective communication and coordinated efforts were required.

6. Research Methodology

Descriptive research design is used. The primary data was collected through questionnaires. The secondary data is collected through books, theses, research papers, industry reports, academic journals, and company publications.

7. Objectives

i. To understand supply chain mechanism of quick commerce companies.
ii. To study the concepts of dark stores and micro fulfillment centers.
iii. To analyze the sustainability challenges faced by quick commerce companies.
iv. To get insights on technological integration in quick commerce companies.

8. Hypothesis

Null Hypothesis (H0): The supply chain mechanism of quick commerce companies is not resilient and agile.
Alternative Hypothesis (H1): The supply chain mechanism of quick commerce companies is resilient and agile.

9. Limitations

The study may encounter obstacles in acquiring all-encompassing data because company-specific supply chain methods in rapid commerce are confidential. As technologies are evolving the study's conclusions may be outdated soon.

10. Data Analysis and Interpretation

The data analysis and interpretation done in this chapter is from the primary data collected through questionnaires via circulating google forms. Data analysis is done with the use of tables and charts, whereas the interpretation is done by explaining theoretically the tables and charts.

9.1 Age wise class intervals of Respondents

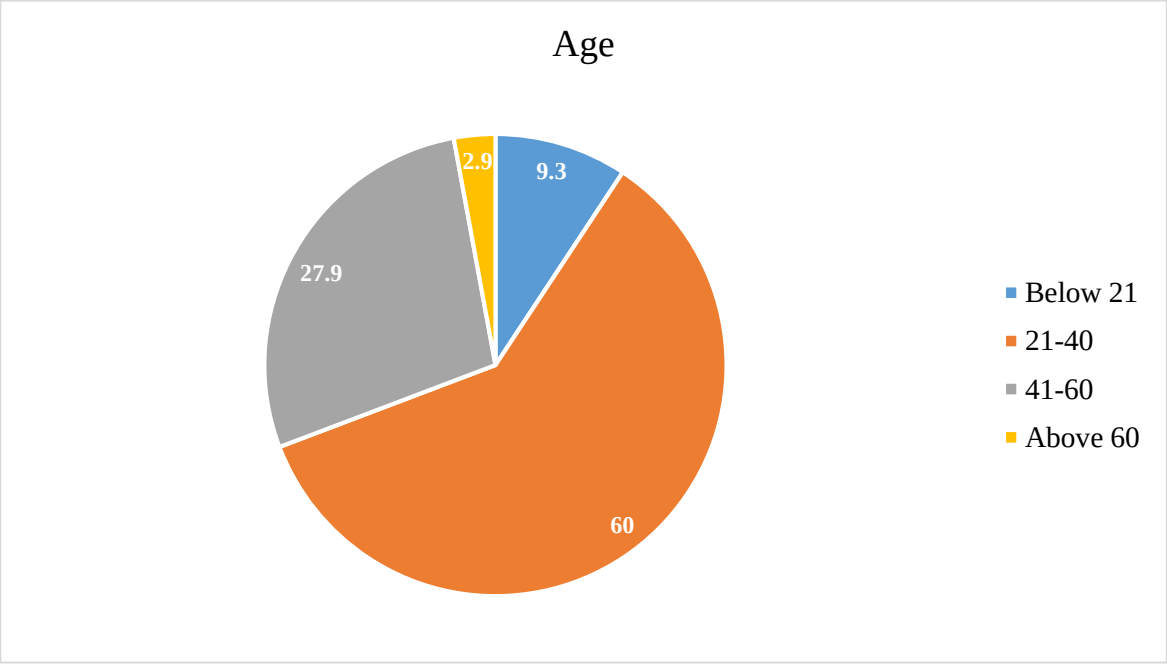
Age as a demographic profile plays some role in understanding the work and kind of expertise demanded in quick commerce sector.

Table 9.1 Age of the Respondents

Particulars	Frequency	Percentage
Below 21	13	9.3%
21-40	84	60%
41-60	39	27.9%
Above 60	4	2.9%
Total	140	100%

Source: Compiled from Primary Data

Figure 9.1 Age of the Respondents



Source: Compiled from Primary Data

Table 9.1 and figure 9.1 shows that 60% of respondents belongs to 21-40 age group, 27.9% of respondents belongs to 41-60 age group, 9.3% respondents are below 21 age group and remaining 2.9% respondents belongs to above 60 age group.

Thus, it can be interpreted that majority of the respondents are from 21-40 age group, generally referred to as young adults.

9.2 Gender wise distribution of the Respondents

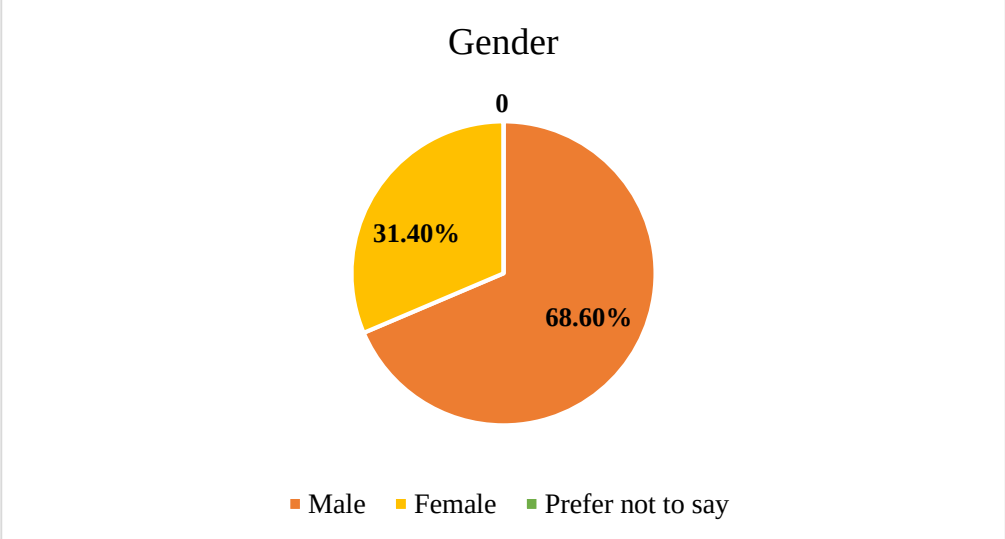
Gender as a part of demographic profile plays an important role.

Table 9.2 Gender of the Respondents

Particulars	Frequency	Percentage
Male	96	68.6%
Female	44	31.4%
Prefer not to say	0	0
Total	140	100%

Source: Compiled from Primary Data

Figure 9.2: Gender of the Respondents



Source: Compiled from Primary Data

Table 9.2 and figure 9.2 indicates that 68.6% respondents are males whereas 31.40% respondents are females. Thus, it can be interpreted that the majority of workforce in quick commerce entities are predominantly males and that's why sometimes its known as on-demand delivery sector.

9.3 Distribution of Respondents for Quick Commerce Companies

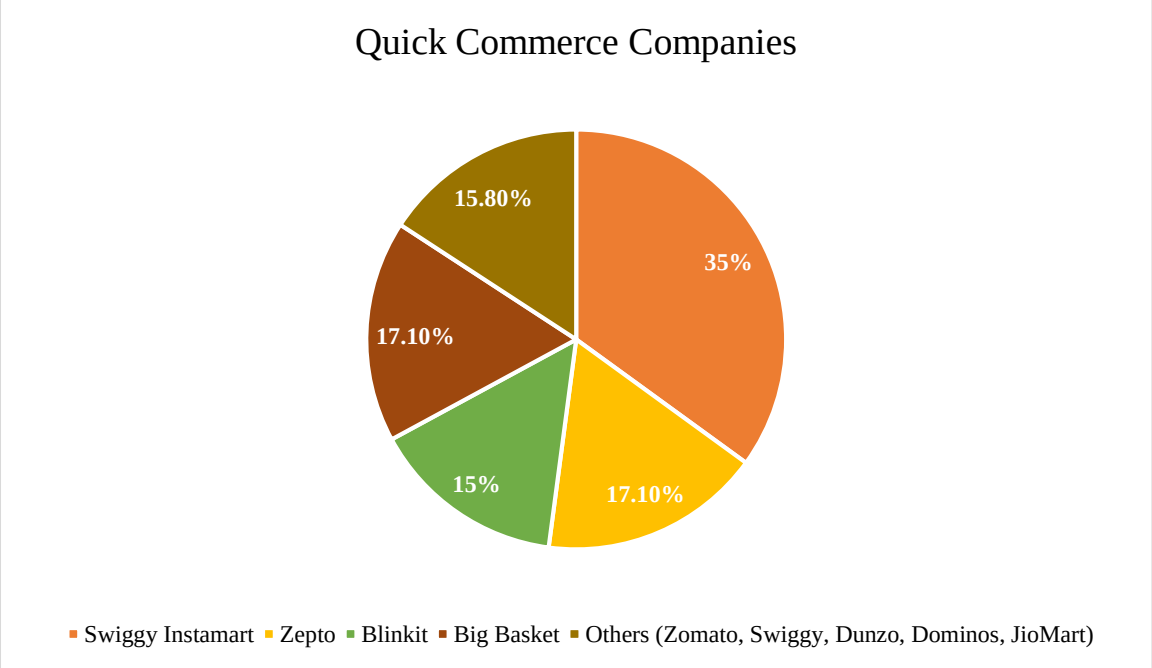
Distribution of respondents across various quick commerce companies helps in providing insights into the market share, workforce and competition dynamics.

Table 9.3 Respondents working for Quick Commerce

Particulars	Frequency	Percentage
Swiggy Instamart	49	35
Zepto	24	17.1
Blinkit	21	15
Big Basket	24	17.1
Others (Zomato,Swiggy, Dunzo, Dominos, Jio Mart)	22	15.8
Total	140	100

Source: Compiled from Primary Data

Figure 9.3: Workforce in quick commerce companies



Source: Compiled from Primary Data

Table 9.3 and figure 9.3 indicates that 35% of respondents work for Swiggy Instamart, 17.1 % respondents work for Big Basket and Zepto each, 15.8% respondents work for other

companies like Zomato, Dunzo, Swiggy, Dominos and Jio Mart and 15% respondents work for Blikit.

Thus, it can be interpretated that the maximum respondents work for Swiggy Instamart and followed by others which shows how there exists fierce competition and revolves around the market dynamics.

9.4 Effectiveness of the Current Supply Chain Mechanism for Quick Commerce

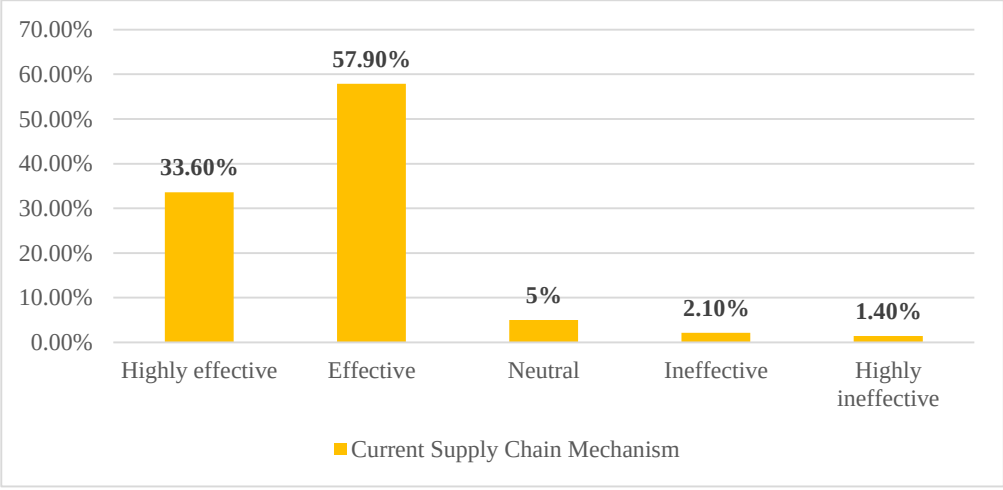
Assessing the effectiveness of the current supply chain mechanism for quick commerce helps in identifying the shortcomings in industry, optimizing on them and taking strategic decisions.

Table 9.4: Current Scenario of Supply Chain Mechanism

Particulars	Frequency	Percentage
Highly effective	47	33.6
Effective	81	57.9
Neutral	07	5
Ineffective	3	2.1
Highly ineffective	2	1.4
Total	140	100

Source: Compiled from Primary Data

Figure 9.4: Current Scenario of Supply Chain Mechanism



Source: Compiled from Primary Data

Table 9.4 and figure 9.4 indicates that 57.9 per cent of the respondents find the current supply chain mechanism being effective. 33.6 per cent respondents are of the viewpoint that the supply chain mechanism is highly effective. Remaining 5 per cent, 2.1 per cent and 1.4 per cent respondents find the supply chain mechanism neutral, ineffective and highly ineffective respectively.

Thus, it can be interpreted that the maximum respondents are convinced that the current supply chain mechanism is effective which indicates the growth and scalability of quick commerce sector.

9.5 Challenges faced by Supply Chain Mechanism

Identifying the challenges faced in supply chain by quick commerce helps in identifying the bottlenecks and developing proactive strategies.

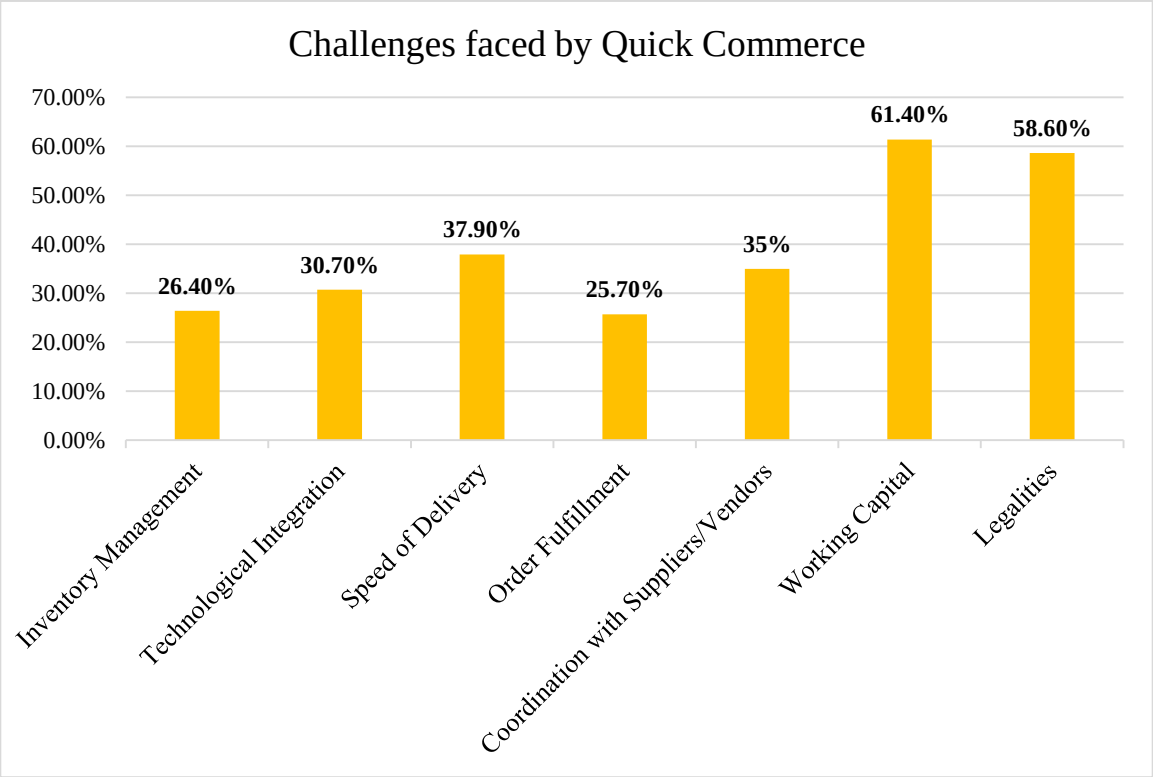
Table 9.5: Challenges faced in supply chains

Particulars	Frequency	Percentage
Inventory Management	37	26.4
Technological Integration	43	30.7
Speed of Delivery	53	37.9
Order Fulfillment	36	25.7
Coordination with Suppliers/Vendors	49	35
Working Capital	86	61.4
Legalities	82	58.6

Multiple responses collected

Source 9.5: Compiled from Primary Data

Figure 9.5: Challenges faced in supply chains



Source 9.5: Compiled from Primary Data

Table 9.5 and figure 9.5 indicates that 61.4 per cent respondents face the working capital challenge followed by 58.6 per cent respondents for legalities, 37.9 per cent respondents for delivery speed, 35 per cent respondents for coordination with suppliers/vendors, 30.7 per cent respondents for technological integration and 26.4 per cent and 25.7 per cent respondents for inventory management and order fulfillment challenges respectively.

Thus, it can be interpreted that the maximum respondents face the challenges of working capital and legalities which gave room for improvement via optimization and strategic decision making.

9.6 Frequency of disruptions in supply chain mechanism of quick commerce

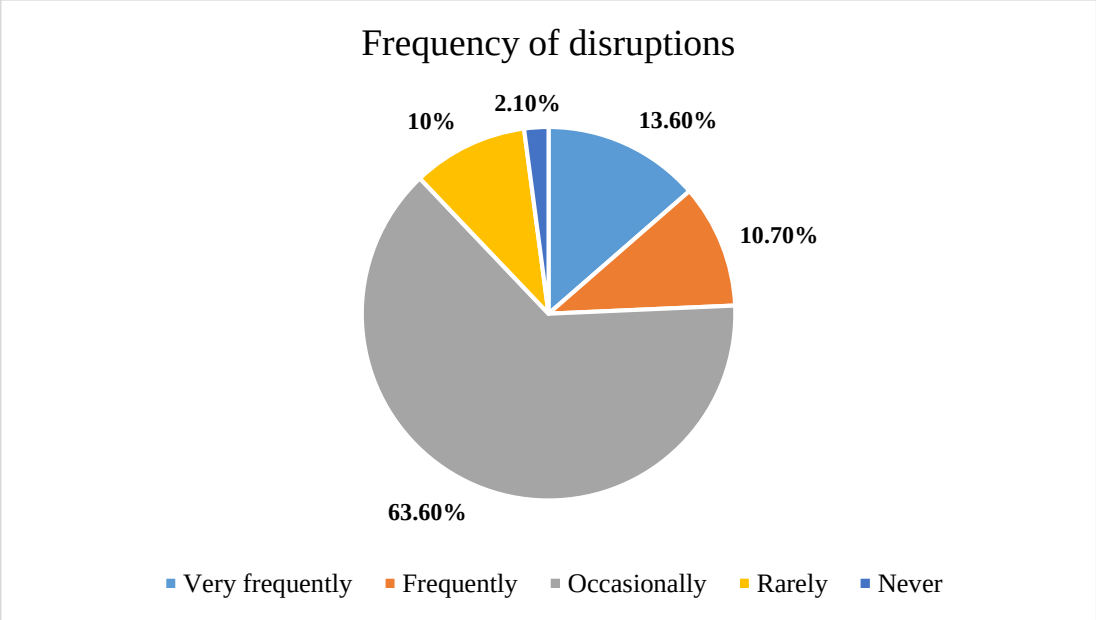
Analyzing the frequency of disruptions in supply chain mechanism of quick commerce helps to understand the vulnerability and exposure of risk.

Table 9.6: Frequency of Disruptions

Particulars	Frequency	Percentage
Very frequently	19	13.6
Frequently	15	10.7
Occasionally	89	63.6
Rarely	14	10
Never	3	2.1
Total	140	100

Source 9.6: Compiled from Primary Data

Figure 9.6: Frequency of Disruptions



Source 9.6: Compiled from Primary Data

Table 9.6 and figure 9.6 indicates that 63.6 per cent respondents think the disruptions in supply chain is mostly occasionally. 13.6 per cent respondents think disruptions are very frequent. 10.7 per cent respondents think the disruptions are frequent. 10 per cent and 2.1 per cent respondents think the disruptions are rarely and never respectively.

Thus, it can be interpreted that the majority respondents see the disruptions in supply chain mechanism of quick commerce occasionally which indicates the supply chain is uptime, less impact on customer satisfaction, limited financial losses and room for incremental efficiency gains.

9.7 Effectiveness of Dark Stores/Micro-fulfilment centers

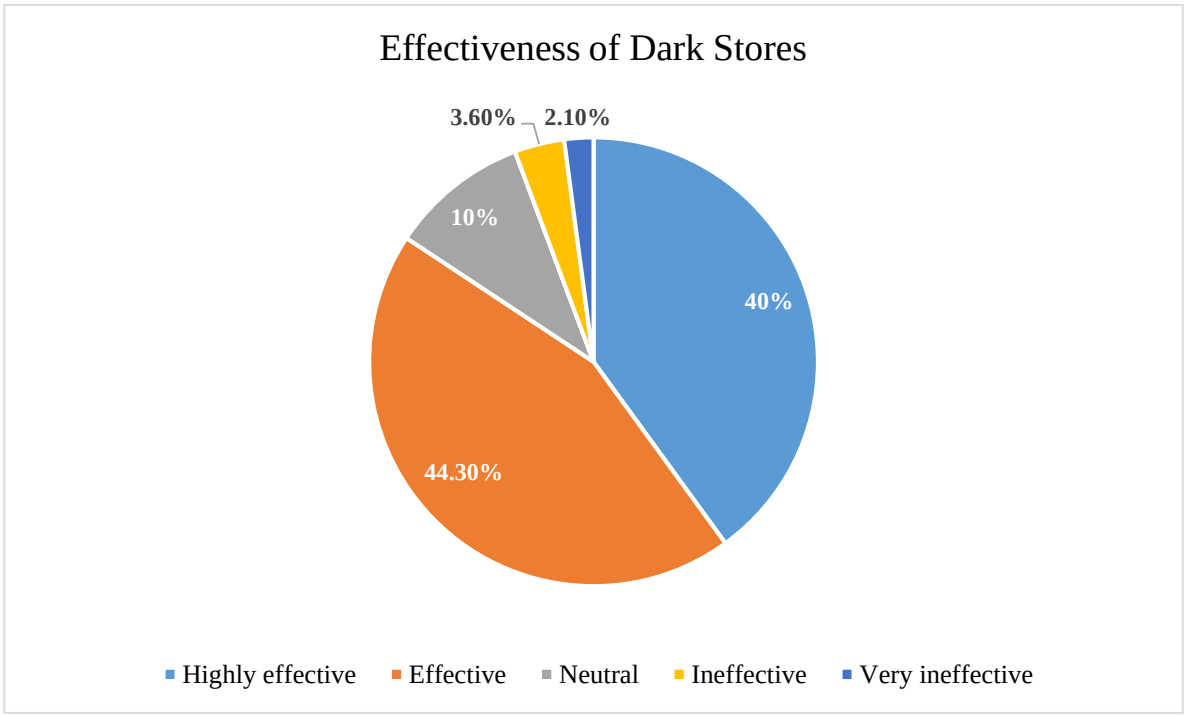
Dark stores are also referred to as shadow stores or micro-fulfillment centers. Assessing the effectiveness helps in speed and reliability of delivery, enhances accuracy and optimization.

Table 9.7: Effectiveness of Dark Stores

Particulars	Frequency	Percentage
Very effective	56	40
Effective	62	44.3
Neutral	14	10
Ineffective	5	3.6
Very ineffective	3	2.1
Total	140	100

Source 9.7: Compiled from Primary Data

Figure 9.7: Effectiveness of Dark Stores



Source 9.7: Compiled from Primary Data

Table 9.7 and figure 9.7 indicates that 44.3% respondents feel dark stores are effective, 40% respondents are of the point of view that dark stores are highly effective followed by 10%

respondents staying neutral regarding dark stores and 3.6% and 2.1% respondents feel dark stores are ineffective and very ineffective respectively.

Thus, it can be interpreted that majority respondents find dark stores effective concept for the quick commerce industry which shows a positive perception in the minds of the respondents.

9.8 Benefits of using Dark stores or Micro fulfillment centers.

By assessing the competitiveness, saving of costs and revenue growth, the scalability of companies is studied.

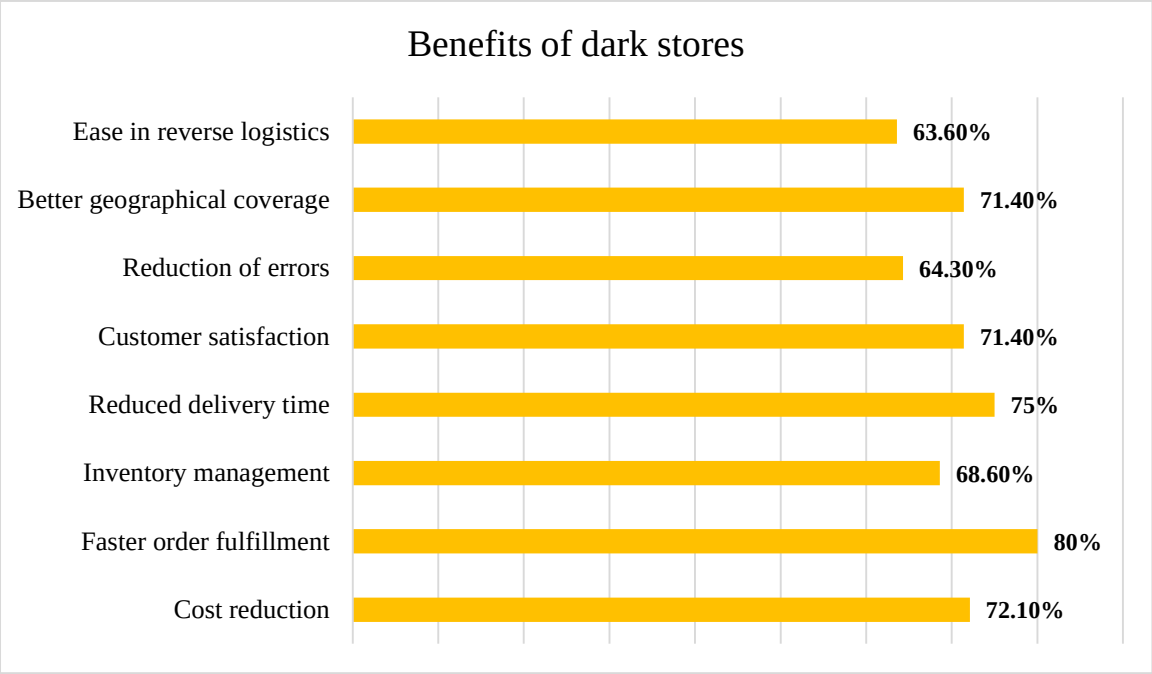
Table 9.8: Benefits of Dark stores

Particulars	Frequency	Percentage
Cost reduction	101	72.1
Faster order fulfillment	112	80
Inventory Management	96	68.6
Reduced delivery time	105	75
Customer Satisfaction	100	71.4
Reduction of errors	90	64.3
Better geographical coverage	100	71.4
Ease in reverse logistics	89	63.6

Multiple options allowed

Source 9.8: Compiled from Primary Data

Figure 9.8: Benefits of Dark stores



Source 9.8: Compiled from Primary Data

Table 9.8 and figure 9.8 indicates that 80 per cent respondents feel that dark stores give the biggest benefit of faster order fulfilment. 75 per cent respondents go for reduced time delivery. 72.1 per cent respondents focused on cost reduction factor. 71.4 per cent respondents feel dark stores gives better geographical coverage and customer satisfaction. 68.6 per cent, 64.3 per cent and 63.6 per cent respondents went for inventory management, reduction of errors and ease in reverse logistics respectively.

Thus, it can be interpreted that maximum respondents feel dark stores offers the highest benefit of faster order fulfillment followed by reduced time delivery which helps in the overall growth of quick commerce.

9.9 Level of importance for Sustainability

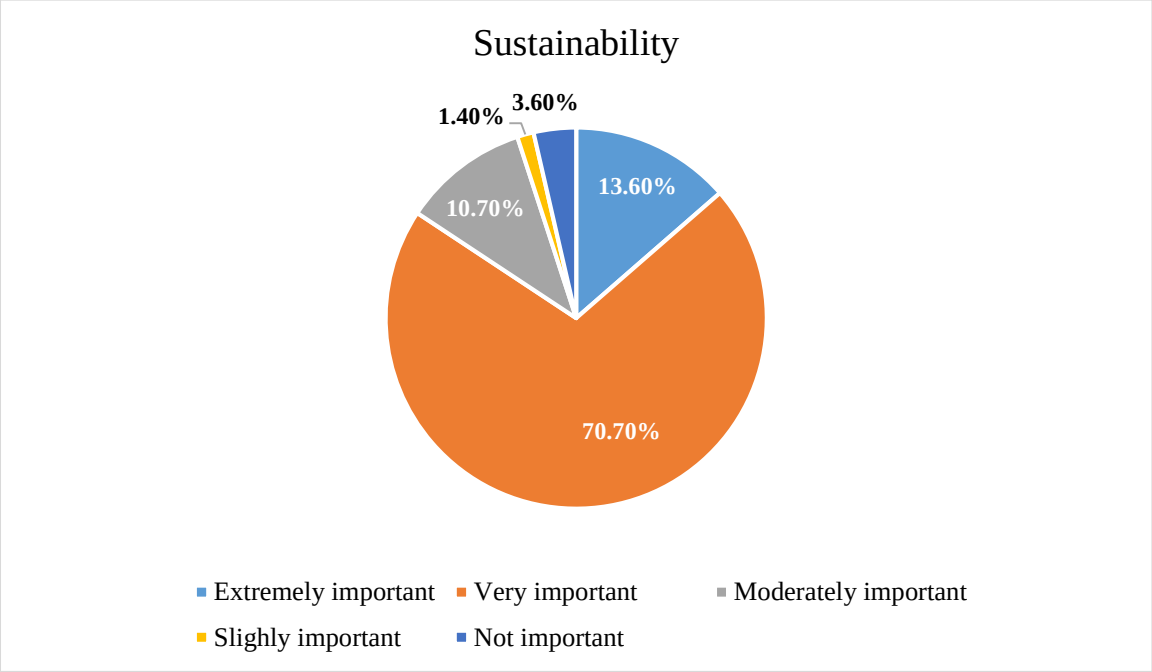
Sustainability in supply chains is a matter of concern in climate change scenario.

Table 9.9: Importance of Sustainability

Particulars	Frequency	Percentage
Extremely important	19	13.6
Very important	99	70.7
Moderately important	15	10.7
Slightly important	2	1.4
Not important	5	3.6
Total	140	100

Source 9.9: Compiled from Primary Data

Figure 9.9: Importance of Sustainability



Source 9.9: Compiled from Primary Data

Table 9.9 and figure 9.9 indicates that 70.7 per cent respondents think sustainability is very important. 13. 6 per cent respondents were of the point that sustainability is extremely important. 10.7 per cent, 3.6 per cent and 1.4 per cent respondents went for moderately important, not important and slightly important respectively.

Thus, it can be interpreted that maximum respondents think sustainability in supply chain mechanism of quick commerce is important.

9.10 Sustainability practices currently implemented in supply chain mechanism

Integrating sustainability practices in supply chain mechanism of quick commerce is crucial for a better world to live in.

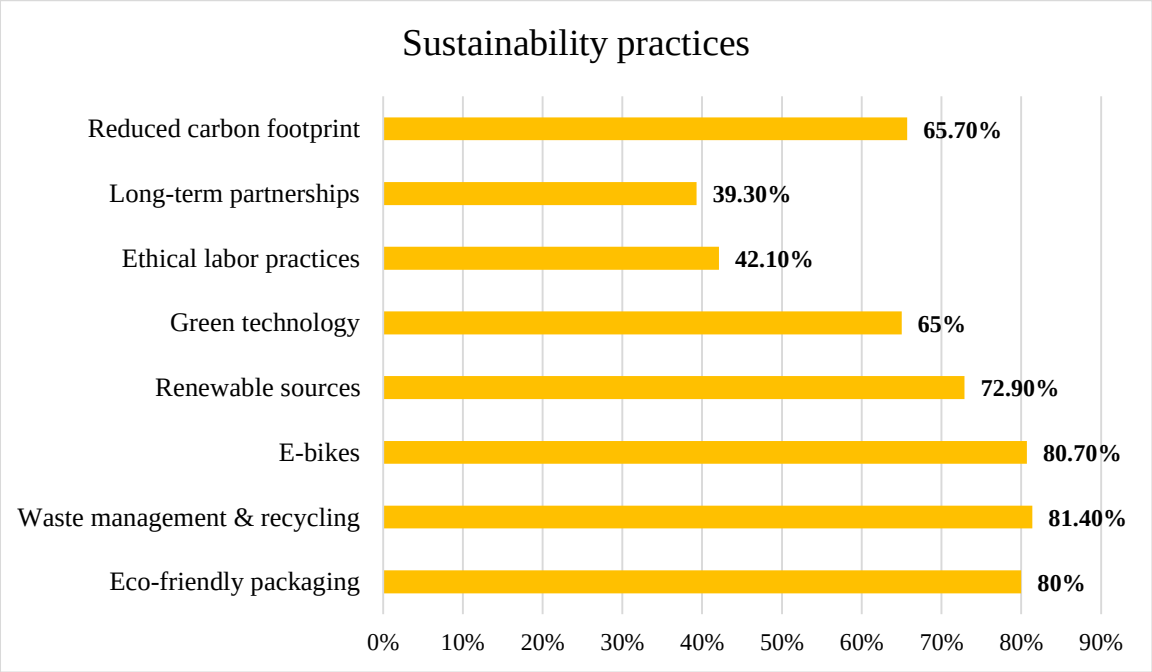
Table 9.10: Practices of Sustainability

Particulars	Frequency	Percentage
Eco- friendly packaging	112	80
Waste management and recycling	114	81.4
E-bikes	113	80.7
Use of renewable energy sources	102	72.9
Use of green energy	91	65
Ethical labor practices	59	42.1
Long-term partnerships	55	39.3
Reduced carbon footprint	92	65.7

Multiple options allowed

Source 9.10: Compiled from Primary Data

Figure 9.10: Practices of Sustainability



Source 9.10: Compiled from Primary Data

Table 9.10 and figure 9.10 indicates that 81.4 per cent respondents think that waste management and recycling as a practice of sustainability is used frequently. 80.7 per cent and 80 per cent respondents went for E-bikes and eco-friendly packaging respectively. 72.9 per cent respondents went for use of renewable energy sources. 65.7 per cent, 65 per cent, 42.1 per cent and 39.3 per cent respondents went for reduced carbon footprint, use of green technology, ethical labor practices and long-term partnerships respectively.

Thus, it can be interpreted that integrating sustainability factors into businesses helps companies to thrive in a competitive fierce world.

9.11 Current level of Technological Integration in Supply Chain Mechanism of Quick Commerce

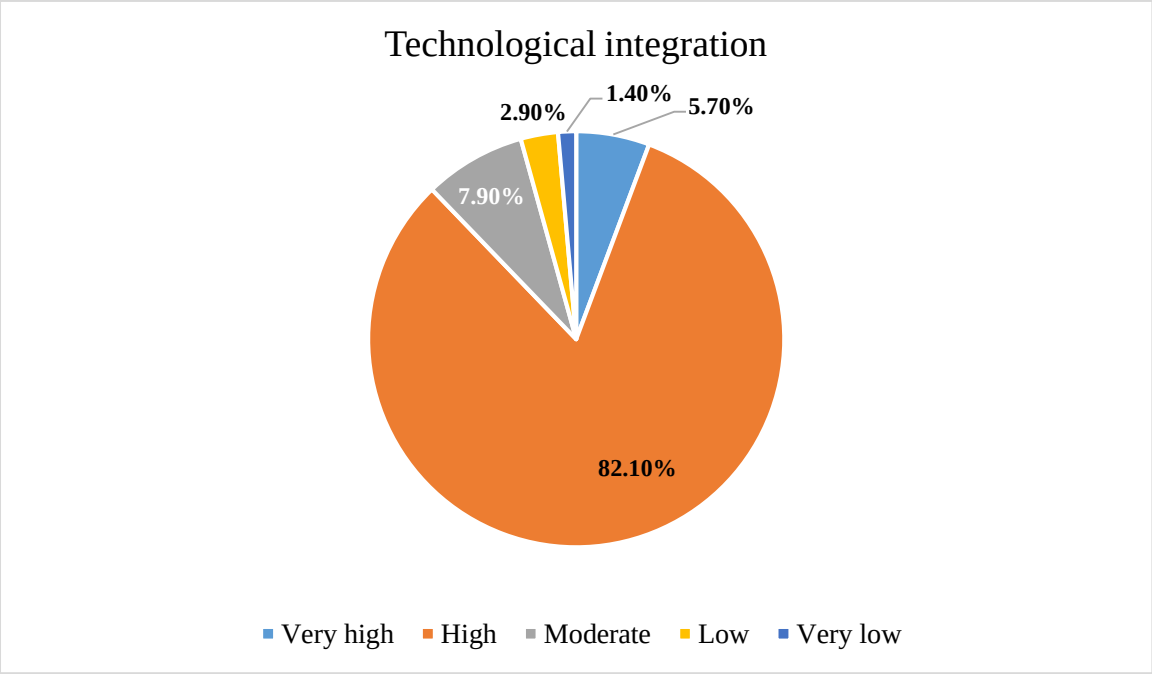
To survive in this highly competitive business scenario it's imperative for companies to go for technological integration.

Table 9.11: Technological Integration

Particulars	Frequency	Percentage
Very high	8	5.7
High	115	82.1
Moderate	11	7.9
Low	4	2.9
Very low	2	1.4
Total	140	100

Source 9.11: Compiled from Primary Data

Figure 9.11: Technological Integration



Source 9.11: Compiled from Primary Data

Table 9.11 and figure 9.11 indicates that that 82.1 per cent respondents find technological integration high. 7.9 per cent respondents were of the point that technological integration was moderate. 5.7 per cent, 2.9 per cent and 1.4 per cent respondents went for very high, low and very low level of technological integration respectively.

Thus, it can be interpreted that the maximum respondents feel that currently the level of technological integration in supply chain mechanism of quick commerce is indeed high.

9.12 Various types of technologies currently used in supply chain mechanism of quick commerce.

Learning technologies and constantly upgrading requires a whole new level of technical expertise which the quick commerce companies are leveraging in their supply chains.

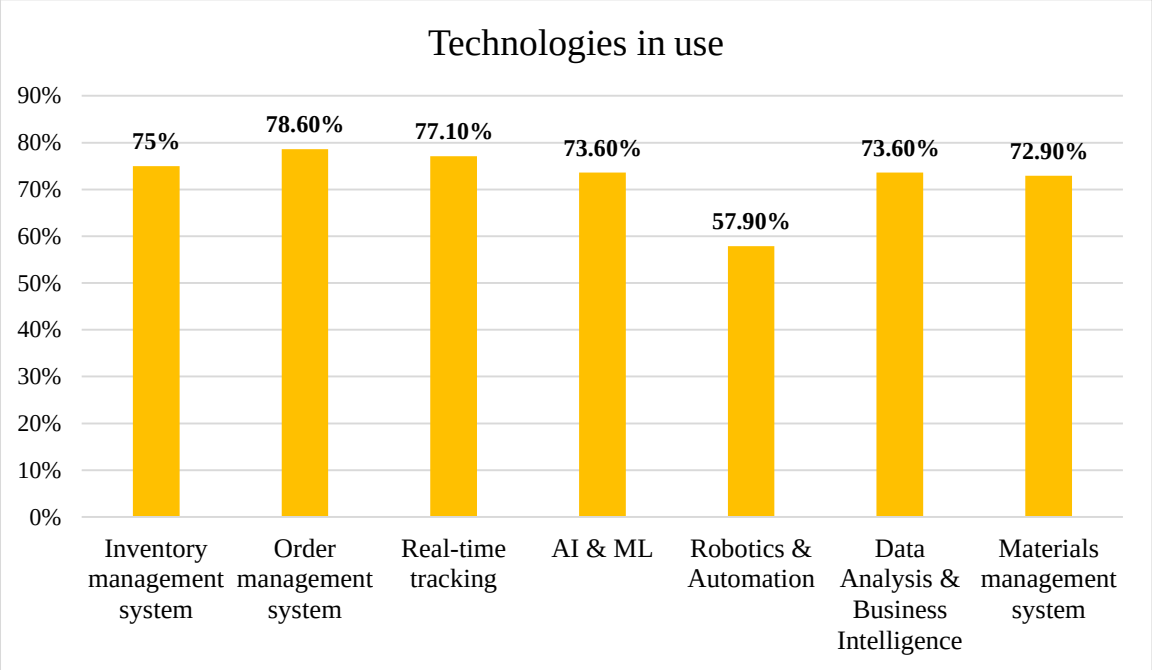
Table 9.12: Current use of technologies

Particulars	Frequency	Percentage
Inventory management system	105	75
Order management system	110	78.6
Real-time tracking	108	77.1
Artificial intelligence and machine learning	103	73.6
Robotics and automation	81	57.9
Data analysis and business intelligence	103	73.6
Materials management system	102	72.9

Multiple options allowed

Source 9.12: Compiled from Primary Data

Figure 9.12: Current use of technologies



Source 9.12: Compiled from Primary Data

Table 9.12 and figure 9.12 indicates that 78.6 per cent respondents went for order management system as the current technology in use. 77.1 per cent respondents chose real-time tracking technology. 75 per cent respondents went for inventory management system. 73.6 per cent respondents went for artificial intelligence and machine learning and data analysis and business intelligence. 72.9 per cent and 57.9 per cent respondents chose materials management system and robotics and automation respectively.

Thus, it can be interpreted that maximum respondents went for order management system as the current technology in use by quick commerce in supply chain mechanisms.

9.13 Challenges faced in technological integration for supply chain mechanism of quick commerce.

Technological integration has its own demerits, and the quick commerce segment has been continuously going through lot of changes in their supply chain mechanism.

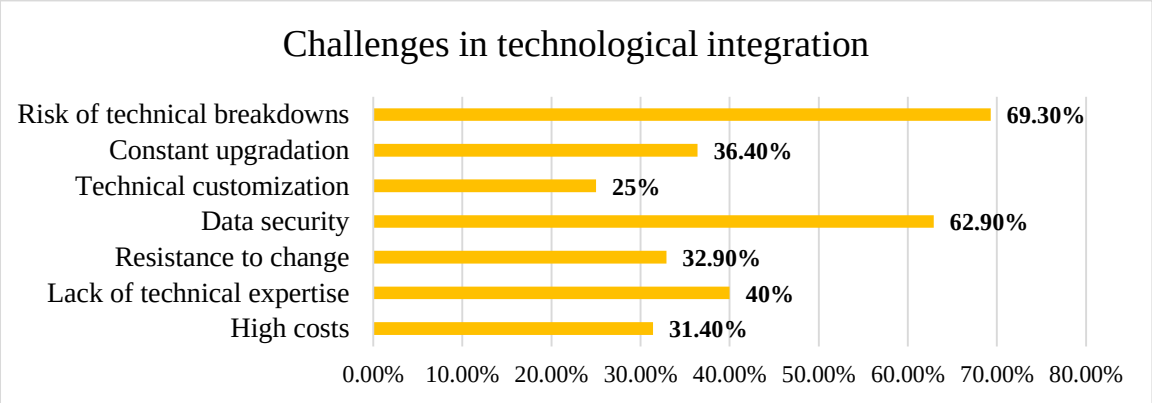
Table 9.13: Challenges in technological integration

Particulars	Frequency	Percentage
High costs	44	31.4
Lack of technical expertise	56	40
Resistance to change	46	32.9
Data security	88	62.9
Technical customization	35	25
Constant upgradation	51	36.4
Risk of technical breakdowns	97	69.3

Multiple options allowed

Source 9.13: Compiled from Primary Data

Figure 9.13: Challenges in technological integration



Source 9.13: Compiled from Primary Data

Table 9.13 and figure 9.13 indicates that 69.3 per cent respondents face the challenge of risk of technical breakdowns. 62.9 per cent respondents faced the challenge of data security.

40 per cent respondents lack technical expertise. 36.4 per cent, 32.9 per cent, 31.4 per cent and 25 per cent respondents faced the challenges of constant upgradation, resistance to change, high costs and technical customization respectively.

Thus, it can be interpreted that the maximum respondents go through the challenge of risk of technical breakdowns in supply chains of quick commerce. Investing in technologies, employing expertise and robust measures of cybersecurity can lessen the above challenges.

9.14: Key elements enabling the supply chain mechanism to continue being resilient in quick commerce.

Resilience refers to the ability to recover from certain disruptions due to internal and external factors and minimizing the risk exposed on costs, revenues and even customers.

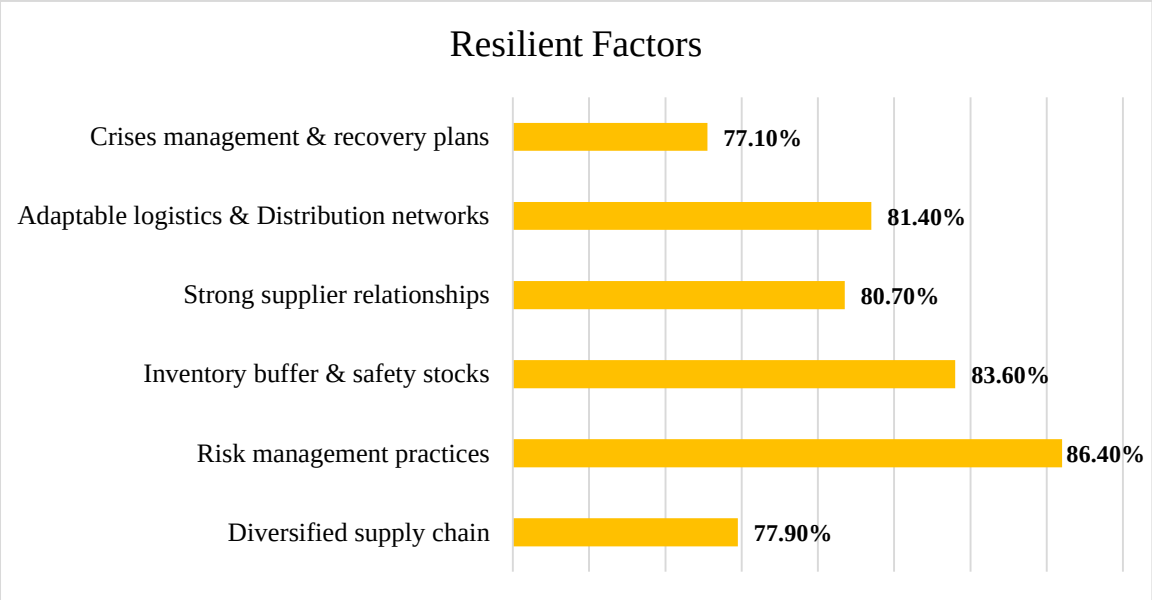
Table 9.14: Resilient factors

Particulars	Frequency	Percentage
Diversified supply chain	109	77.9
Risk management practices	121	86.4
Inventory buffer and safety stocks	117	83.6
Strong supplier relationships	113	80.7
Adaptable logistics and distribution networks	114	81.4
Crises management and recovery plans	108	77.1

Multiple options allowed

Source 9.14: Compiled from Primary Data

Figure 9.14: Resilient factors



Source 9.14: Compiled from Primary Data

Table 9.14 and figure 9.14 indicates that 86.4 per cent respondents chose risk management practices as the factor for enabling resilience. 83.6 per cent respondents feel inventory buffer and safety stock enabled resilience. 81.4 per cent respondents chose adaptable logistics and distribution networks as an element of resilience. 80.7 per cent, 77.9 per cent and 77.1 per cent respondents chose strong supplier relationships, diversified supply chain and crises management and recovery plans as elements enabling resilience respectively.

Thus, it can be interpreted that maximum respondents feel risk management practices helps in enabling resilience in supply chain mechanism of quick commerce. Resilient factors help the quick commerce companies quickly respond to changes, gain competitive advantage and balance the overall flexibility, efficiency and effectiveness.

9.15: Key elements enabling the supply chain mechanism to continue being agile in quick commerce.

Agility refers to the ability of quick commerce companies to respond quickly to the changes in demand and supply in a quick manner.

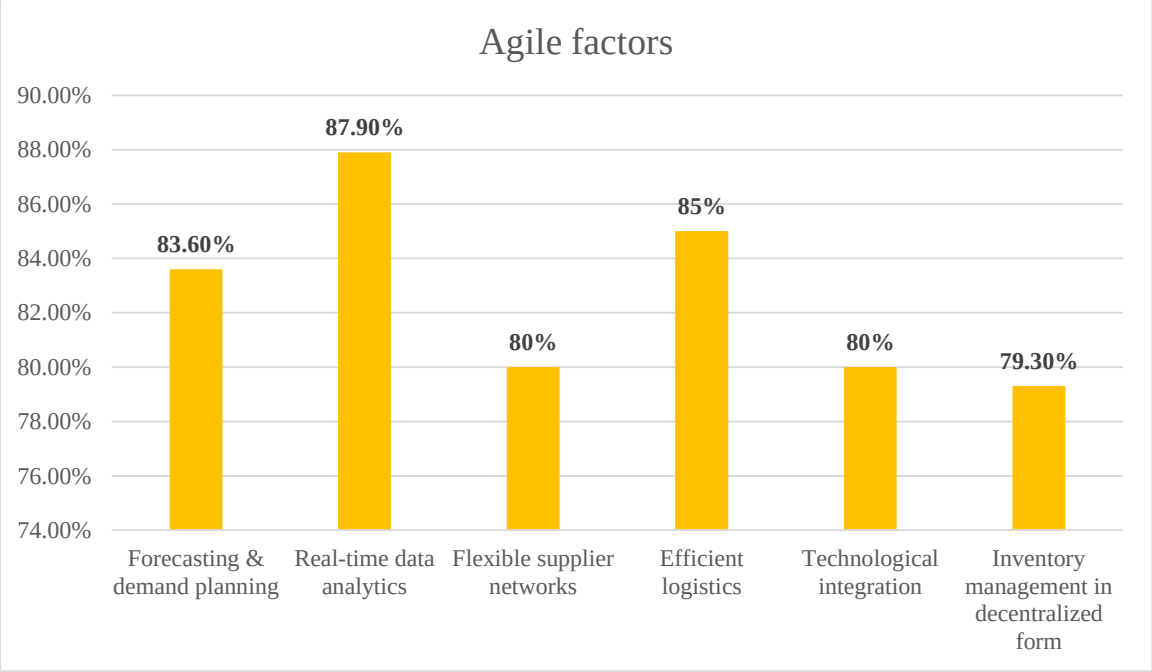
Table 9.15: Agile factors

Particulars	Frequency	Percentage
Forecasting and demand planning	117	83.6
Real-time data analytics	123	87.9
Flexible supplier networks	112	80
Efficient logistics	119	85
Technological integration	112	80
Inventory management in decentralized form	111	79.3

Multiple options allowed

Source 9.15: Compiled from Primary Data

Figure 9.15: Agile factors



Source 9.15: Compiled from Primary Data

Table 9.15 and figure 9.15 indicates that 87.9 per cent respondents think real-time data analytics contributes to agility of supply chains. 85 per cent respondents chose efficient logistics as an element of agility. 83.6 per cent respondents think forecasting and demand planning helps in contributing to agility. 80 per cent respondents chose flexible supplier networks and technological integration as elements of agility. Finally, 79.3 per cent respondents feel inventory management in decentralized form helps in agility of supply chain mechanism of quick commerce.

Thus, it can be interpreted that the maximum respondents focus on real-time data analytics in heavily contributing to the agility of supply chain mechanisms of quick commerce. Agility elements in quick commerce helps companies to be flexible, have efficient processes, quick access to latest industry information and lastly visibility into supply chains.

11. Suggestions

Following are the suggestions for the supply chain mechanism of quick commerce companies to excel in the areas.

1. Optimization of dark stores

Automate inventory management by implementing artificial intelligence and machine learning to predict demand and optimize inventory in dark businesses. As a result, there will be less waste and better stock availability. Use energy efficient micro-fulfillment stores to lessen their carbon footprint and increase sustainability, dark stores should incorporate solar energy, intelligent lighting, and cooling systems. Modular designs can be used to increase productivity and cut expenses.

2. Sustainability

Green packaging solutions to cut down on plastic waste, can collaborate with suppliers of eco-friendly packaging. Focus on carbon-neutral delivery which may help in reducing emissions, consider investing in electric vehicles (EVs) and bike delivery systems for last-mile logistics. Reducing waste via demand forecasting where AI-driven demand forecasts will be used to prevent over-ordering, minimizing food and product loss.

3. Resilience

Resilience in supply chain is very crucial. Decentralized dark store networks can be used to prevent being unduly dependent on a small number of important locations, creating a decentralized network of micro fulfillment centers or dark shops. Supplier diversification can be done to lessen reliance on a single source.

4. Agility

Real-time data analytics can be used to track consumer preferences, delivery schedules, and inventory levels with real-time data analytics solutions. Agile warehousing can be done to

relieve strain on central dark shops and cut costs and lead times, temporarily or pop-up warehouses can be erected during times of high demand (holidays, festivals, etc.).

5. Leveraging Technology

Using artificial intelligence, automation and robotics to choose, pack, and arrange goods in dark retail establishments. This can expedite delivery timelines, significantly lower human error, and raise productivity levels all around. Use of blockchain technology for transparency and fraud detection that enhances guarantee to traceability in supply chain mechanisms. This supports the integrity of the product as well as company and greatly enhances customer confidence. Drones can be used for last-mile delivery by examine hyperlocal delivery options, particularly in crowded cities. Drones are ecologically and environmentally friendly and can speed up deliveries thus reducing costs.

6. Scalability

Using cloud-based platforms and supply chain management systems that are scalable and responsive to fluctuations in volume and client demand. Additionally, these platforms provide smooth communication between delivery services, warehouses, and suppliers. Focusing on collaborative as well as elastic logistics by sharing delivery and warehousing resources by forming partnerships with other retailers or logistics companies. During off-peak hours, this strategy increases fulfillment speed while lowering operating expenses.

The future of quick commerce will be greatly influenced by innovations like blockchain transparency, carbon-neutral shipping, and AI-driven hidden storefronts. Businesses engaged in quick commerce can meet changing customer expectations while upholding operational efficiency and environmental responsibility by adopting the above suggestions and techniques.

12. Conclusion

To conclude the research project focused on the supply chain mechanism of quick commerce companies. Within this quickly expanding industry, research on the quick commerce supply chain mechanism aimed to investigate how dark stores concept worked, the current sustainable practices, and technological integrations already in place. A standardized questionnaire was used to gather data for this study from delivery agents, suppliers, employees, and vendors from different quick commerce organizations. This study set out to examine the

ways in which these elements supported the agility, robustness, and efficiency of the fast commerce supply chain. The theory argued that the quick commerce supply chain is naturally resilient and agile, capable of adapting swiftly to dynamic market demands and operational issues.

The results verified that dark stores, by maximizing order fulfillment speed and accuracy, played a pivotal role in the supply chain mechanism of quick commerce supply companies. The research also showed that quick commerce companies implemented sustainability policies, albeit in different ways. Numerous suppliers and delivery drivers reported that businesses were starting to use eco-friendly packaging and electric cars as part of their green logistics strategies. Artificial intelligence (AI), machine learning, and real-time tracking technologies were cited by staff members and delivery agents as being crucial for controlling inventory, estimating demand, and optimizing routes.

Therefore, in conclusion the supply chain mechanism of quick commerce is resilient and agile supported by the objectives of concept of dark stores, the sustainability factors and technological integration in quick commerce companies. However, the study also underlined the need for constant innovation and investment in technology, sustainability, and operational efficiency to maintain the long-term survival of the quick commerce companies. A thorough grasp of the supply chain's existing condition as well as potential avenues for future expansion and improvement have been made possible by the insights acquired from suppliers, vendors, workers, and delivery agents.

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Annexure 1 - Questionnaire

1. Name ?

2. Age ?

(a) Below 21 (b) 21-40 (c) 41-60 (d) Above 60

3. Gender ?

(a) Male (b) Female (c) Prefer not to say

4. Mobile Number ?

5. For which Quick commerce company do you work? (One option)

(a) Swiggy Instamart

(b) Zepto

(c) Blinkit

(d) Big Basket

(e) Others (Please Specify)

6. How effective do you think the current supply chain process is?

(a) Very effective

(b) Effective

(c) Neutral

(d) Ineffective

(e) Highly Ineffective

7. What are the challenges faced in supply chain mechanism? (Multiple options)

(a) Inventory Management

(b) Technological Integration

(c) Speed of delivery

(d) Order fulfillment

(e) Coordination with suppliers or vendors

(f) Working Capital

(g) Legalities

8. How frequently there are disruptions in supply chain mechanism?

(a) Very frequently

(b) Frequently

(c) Occasionally

(d) Rarely

(e) Never

9. What do you think regarding the effectiveness of dark stores or micro-fulfillment centers?

(a) Very effective

(b) Effective

(c) Neutral

(d) Ineffective

(e) Highly Ineffective

10. What are the benefits of using dark stores or micro fulfillment centers? (Multiple options)

(a) Cost reduction

(b) Faster order fulfillment

(c) Inventory management

(d) Reduced delivery time

(e) Customer satisfaction

(f) Reduction of errors

(g) Better geographical coverage

(h) Ease in reverse logistics

11. How important is sustainability according to you?

(a) Extremely important

(b) Very important

(c) Moderately important

(d) Slightly important

(e) Not important

12. Which practices of sustainability are implemented in supply chain mechanism? (Multiple options)

(a) Eco-friendly packaging

(b) Waste management and recycling

(c) E-bikes

(d) Use of renewable energy sources

(e) Use of green technology

(f) Ethical labor practices

(g) Long - term partnerships

(h) Reduced carbon footprint

13. What is the current level of technological integration in supply chain mechanism?

(a) Very high

(b) High

(c) Moderate

(d) Low

(e) Very low

14. Which types of technologies are currently used in supply chain mechanism? (Multiple options)

(a) Inventory management system

(b) Order management system

(c) Real-time tracking

(d) Artificial intelligence & Machine Learning

(e) Robotics & Automation

(f) Data analysis & Business intelligence

(g) Materials management system

15. What are the challenges faced in technological integration for supply chain mechanism? (Multiple options)

(a) High costs

(b) Lack of technical expertise

(c) Resistance to change

(d) Data security

(e) Technical customization

(f) Constant upgradation

(g) Risk of technical breakdowns

16. What are the key elements that enable the supply chain to continue being resilient in quick commerce? (Multiple options)

(a) Diversified supply chain

(b) Risk management practices

(c) Inventory buffer & safety stocks

(d) Strong supplier relationships

(e) Adaptable logistics & distribution networks

(f) Crises management & recovery plans

17. What are the key elements that enable the supply chain to continue being agile in quick commerce? (Multiple options)

(a) Forecasting & demand planning

(b) Real-time data & analytics

(c) Flexible supplier networks

(d) Efficient logistics

(e) Technological integration

(f) Inventory management in decentralized form

Evaluating the Impact of Robo-Advisors on Investment Planning: A Study on Adoption, Efficiency, and Investor Perception in Mumbai

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Abstract

Robo-advisors seem to provide a new shape to the investment industry powered by artificial intelligence, algorithmic trading and various other technological advancements. This research looks at their relevance to investment planning bearing in mind their affordability, ease of engagement and their advice. We investigate the reasons why investors do opt to go with these managed portfolios offered by robo-advisors or even the potential robo advisors impact on the traditional advisory services. As addressing the benefits such as, lower fees, enhanced efficiency, data-driven decisions, we as well cover the downsides of it all, namely, lack of human contact and distributing the weight of the decision to algorithms. This research seeks to examine what the future holds for investment advice, looking at ways in which human advisors and AI powered systems may work together and the role of the advisors in the digital era. By focusing on both the merits and demerits of the investment decision either done by human or by an algorithm, we try to present what might be the best possible strategy while planning for future investment.

Keywords: Robo-advisor, Investment Planning, Algorithmic Trading, Artificial Intelligence, Financial Technology, Financial Literacy, Human Advisor.

Introduction

A Robo-advisor is a digital platform that provides automated, algorithm-driven financial planning and investment services with little to no human supervision. A typical Robo-advisor asks questions about your financial state and future goals through an online survey. It then uses the data to offer guidance and automatically invest for you. Other common terms for Robo-advisors include "automated investment advisor," "automated investment management," and "digital advice platforms." The best Robo-advisors offer easy account setup, robust goal planning, account services, and portfolio management. Additionally, they offer security features, comprehensive education, and low fees.

Objective of The Study

1) To understand the functionality of Robo-advisors
2) To evaluate the user experience and perception regarding Robo-advisors.
3) To analyse the impact of Robo-advisors on traditional advisors
4) To analyse the user demographics and preferences

Research Methodology

Primary Data Collection

In regards to the primary data of this study, it was collected through the use of a structured complete questionnaire survey concerning the research problems under study. As such, the questionnaire was designed in a sequence manner to target the respondents on certain views and opinions within the research topic while still understanding the area to be studied. In order to facilitate quantitative evaluation, several multiple-choice questions were also included. 80 people responded to the survey and this number was enough to give primary and relevant data. The questionnaire was distributed in an electronic manner implying that the respondents pool is reasonable.

Secondary Data

The primary or main data was supplemented with secondary data through an internet search specifically to cover all aspects of the study. These included search of literature, online articles, sites, online data bases among many others. The secondary data were useful in providing context and supporting evidence to the primary data as well as the literature on the focal problems. The secondary data was also used to cover any missing gaps in the literature, primary data, aiming to achieve a full comprehension of the research topic. All the secondary sources of data were scrutinised in terms of credibility, relevance, accuracy and timeliness.

Limitations of The Study

Small Sample Size: The study is not a perfect representation of every participant, as it is based on 80 respondents which is not the ideal optimal sampling size.

Limited Scope of Respondents: The respondents may have been underrepresented from a wide spectrum of investors as the sample taken for the survey may have been biased towards a particular group of people. This can impact the generalisability of the findings to all investors.

Limited Understanding of Robo-Advisor Technology: If the respondents are not acquainted with the concept or functioning of robo-advisors, their responses may not accurately reflect their true opinions or potential behaviours regarding investment planning.

Dynamic Nature of Financial Markets: The study was conducted with a focus on the existing market conditions and digital environment. As the research ecosystem changes and robo-advisors enhance in their capabilities the conclusions reached in the study may start to become more and more obsolete with the passage of time.

SWOT- Analysis of Robo Advisors

Robo-advisors have undoubtedly changed the face of investment by providing the investors with Automated Portfolio Management Services based on systems and algorithms. Let’s delve deeper into their strengths, weaknesses, opportunities and threats through a SWOT analysis:

Strengths

a) Automated Feasibility Studies: Robo-advisors can automate the pre-determined investment decision criteria and perform countless feasibility studies in the blink of an eye.

b) Low Costs: Robo-advisors typically charge significantly lower fees compared to traditional human financial advisors.

c) Affordability: They enable a greater number of people to invest with the inclusion of people who invest smaller amounts.

d) Algorithm: Over indeed, most of the investment choices and management are made by algorithms. This feature right here makes the choices and management over investments free from human biases and decision-making emotions.

e) Efficiency: The amount of workload that is involved with both the advisor and the client for 'investment management'' is reduced through automated processes which make the investment process much more streamlined and efficient.

f) Transparency: Robo-advisors provide clear and transparent information about investment strategies, fees, and performance.

Weaknesses

a) Lack of personal touch: As opposed to the lack of human interaction and contact that some clients appreciate or yearning for, Robo-advisors tend to provide more of a mechanical approach.

b) **Limited Complexity:** Customization, particularly among clients who have complicated financial needs, may not be possible.

c) Technological Reliance: Depending on technology requires exposing customers to potential cyber-attacks and system crashes.

d) Emotional Intelligence Gap: Robo-advisors are unable to understand the emotions in a financial plan and resolve the related concerns.

Opportunities

a) Expanding Market: Integrating more technology and online services expands the available market space for robo-advisors considerably.

b) Integration with Traditional Advice: There are gaps that new technology applied with human interaction will not cover.

c) AI and Machine Learning: New approaches in AI and machine learning will allow robo-advisors to use more complex investment strategies.

d) Global Expansion: There is room for growth across markets for robo-advisors as they can be deployed through digital means.

Threats

a) Regulatory Uncertainty: Changes in policy may threaten some operations or even the whole business model of robo-advisors.

b) Competition: Both newly emerging and already existing operators can outcompete robo-advisors in the market.

c) Market Volatility: During a recession or any economic calamity, the performance of a robo-advisor's portfolio is likely to be hit.

d) Security Risks: Cyber-attacks and data breaches can damage the reputation of robo-advisors and wear away client trust.

By understanding the strengths, weaknesses, opportunities, and threats linked with robo-advisors, investors can make knowledgeable decisions about whether to consume these services. A balanced approach, combining the efficacy of technology with the human touch of traditional advice, may offer the best solution for many investors.

Robo Advisors Vs Traditional Advisors

Feature	**Robo-Advisors**	**Traditional Advisors**
Management	Automated, algorithm-based	Human-managed
Fees	Typically lower (0.25% -0.5%)	Higher (1%-2%)
Accessibility	Often require a smaller minimum investment	May require a higher minimum investment
Objectivity	Objective, based on data and algorithms	Can be influenced by personal algorithms
Personalization	Limited, based on pre-set criteria	More personalized, tailored to individual needs
Complexity	Suitable for simple investment	Can handle more complex financial situations
Availability	Online, accessible 24/7	In-person or online, often with limited office hours

Emotional support	Limited	Can provide emotional support during market downturns
Tax optimization	May offer basic tax optimization	Can provide more advanced tax planning
Estate planning	Limited	Can provide comprehensive estate planning

How Robo Advisors Are Paid

Payment Structure	Explanation
Asset Under Management (AUM) Fee	A percentage of the total value of invested assets
Transaction fees	A Fixed amount of a fixed percentage of the transaction value
Other fees	Account maintenance fees, fees for specific services

Notable Robo-Advisors in India

Kuvera

Founded in 2016, Kuvera is an online wealth management platform offering financial services such as direct mutual funds, tax planning, and family accounts. It emphasizes user-friendly interfaces and goal-based investing. In February 2024, Kuvera was acquired by Cred to enhance its wealth management offerings.

Scripbox

Being one of the early players in the Indian robo-advisory space, Scripbox focuses on simplifying mutual fund investments through curated fund ranges and goal-based planning. It is recognized for its user-friendly interface and importance on achieving financial goals.

FundsIndia

Proven as one of India's largest robo-advisory firms, FundsIndia offers a comprehensive platform for mutual fund investments, along with other financial products and services. It provides research-backed recommendations and simplifies end-to-end transactions

Angel One's ARQ

Angel One has developed ARQ, a proprietary robo-advisory engine that provides personalized investment recommendations based on advanced algorithms and machine learning. It aims to assist retail investors in making well-versed decisions in the stock market.

ArthaYantra

Claiming to be one of India's first online financial advisory platforms, ArthaYantra facilitates automated personal finance planning services, assisting users in making informed investment decisions.

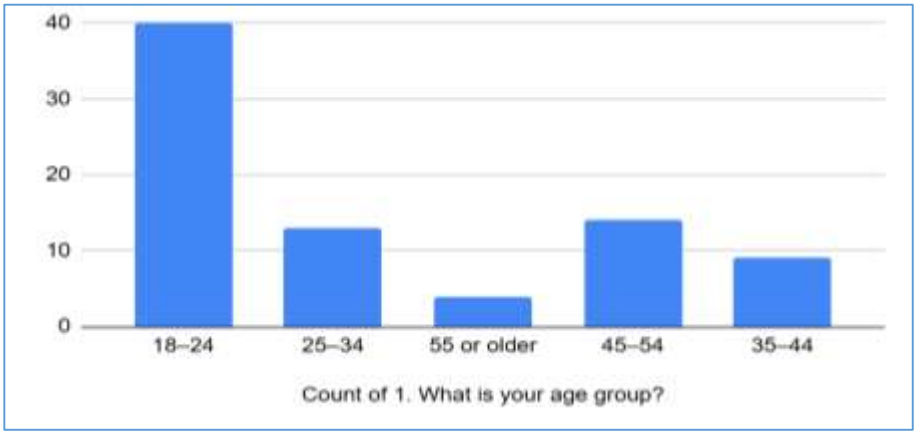
Genius

ET Money offers a premium subscription service called "Genius Membership," providing personalized investment recommendations and exhaustive portfolio analysis.

Data Analysis & Interpretations

User Demographics And Preferences

Analysis of Age Group Distribution



The provided graph shows the distribution of respondents across different age groups

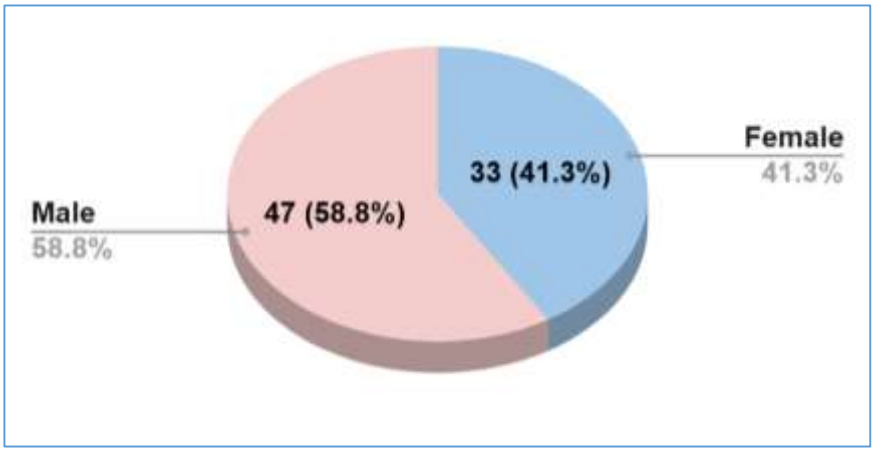
Key Observations:

18-24 Age Group Dominance: The majority of respondents belong to the 18-24 age group, with a significant count of 40 individuals.

Decreasing Trend: As we move to older age groups, the number of respondents gradually decreases.

Moderate Representation: The 25-34, 35-44, and 45-54 age groups have moderate representation, with counts ranging from 10 to 15.

Lowest Representation: The 55 or older age group has the lowest representation, with only 6 respondents Gender-wise Analysis

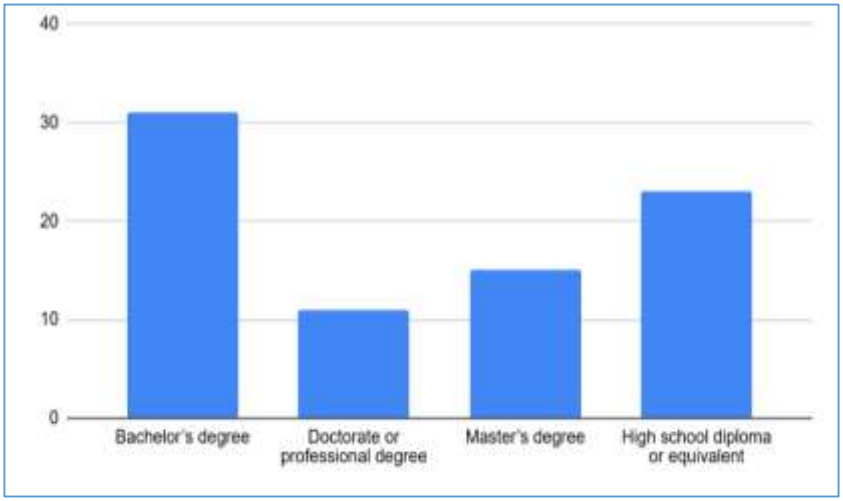


Key Observations:

Male Dominance: Males account for a larger proportion of respondents (58.8%) compared to females (41.3%).

Gender Imbalance: The survey appears to have a slight bias towards male respondents, with nearly 20% more men participating.

Educational background of Respondents



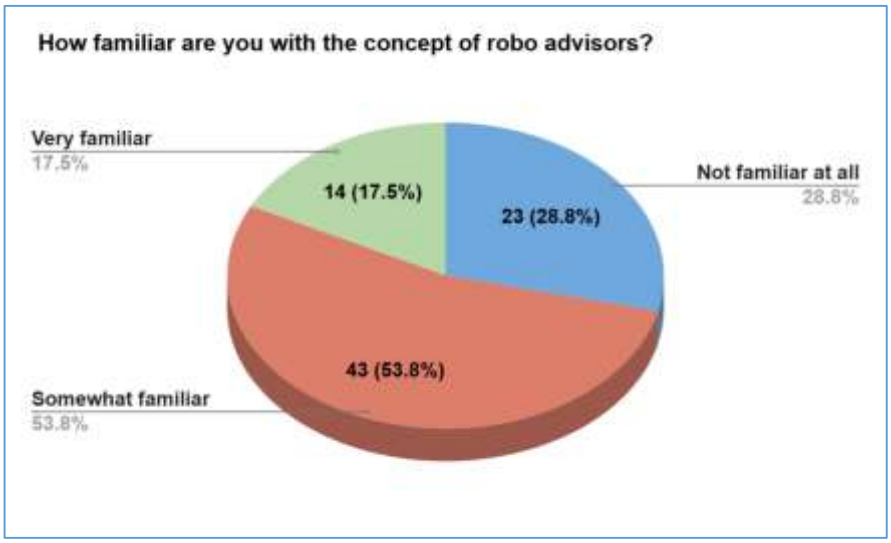
Key Observations:

Bachelor's Degree Dominance: The majority of respondents hold a Bachelor's degree, with a count of 35.

Moderate Representation: Master's degrees and High school diplomas/equivalent have moderate representation, with counts around 20.

Lowest Representation: Doctorate or professional degrees have the lowest representation, with only 10 respondents.

Understanding Robo Advisor Functionality



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Analysis of Familiarity with Robo-Advisors

Key Observations:

Moderate Familiarity: The majority of respondents (53.8%) are somewhat familiar with the concept of robo-advisors.

Lower Levels of Familiarity: A significant portion (28.8%) are not familiar at all, while only 17.5% are very familiar.

Possible Interpretations:

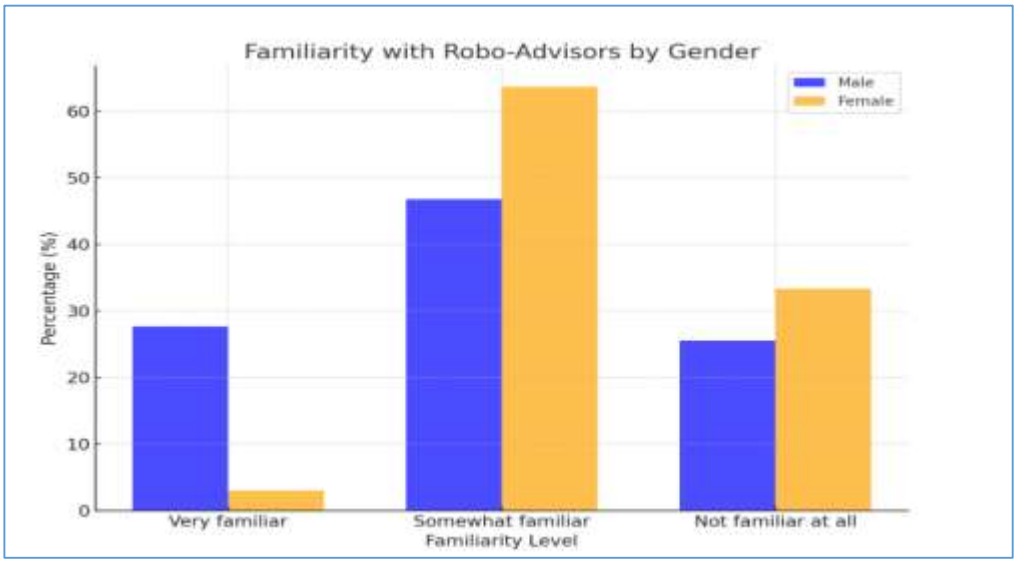
Emerging Technology: Robo-advisors are a relatively new technology, and this data suggests that they are still gaining mainstream awareness.

Financial Literacy: The level of familiarity might be linked to financial literacy and interest in investment technologies.

Marketing and Awareness: There may be opportunities to improve marketing and awareness campaigns about robo-advisors to reach a wider audience.

Further Gender wise analysis is as follow

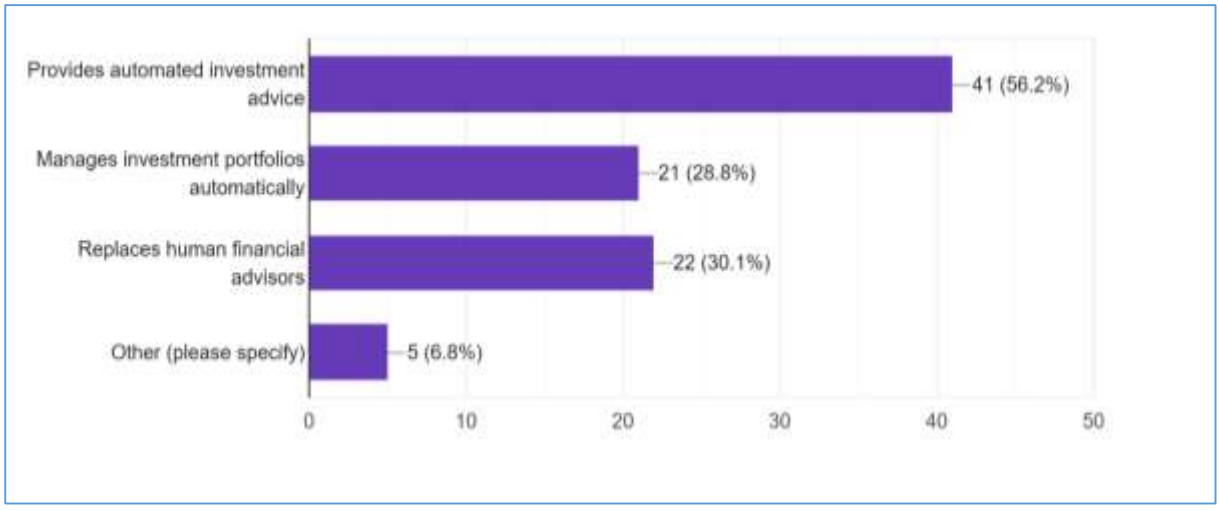
Here is a bar chart showing the percentage distribution of familiarity with robo-advisors across genders:



Key Observations:

- Males are more likely to be "Very familiar" with robo-advisors compared to females.
- The "Somewhat familiar" category dominates for both genders, with females having a higher proportion (63.64%).
- A slightly higher percentage of females fall under the "Not familiar at all" category compared to males.

Perception of Respondents with respect to Robo-advisor



Analysis of Perceptions of Robo-Advisors

Key Observations:

Automated Investment Advice: This was the most common perception, with 56.2% of respondents believing that robo-advisors provide automated investment advice.

Portfolio Management: A significant number of respondents (28.8%) understood that robo-advisors manage investment portfolios automatically.

Replacing Human Advisors: While a smaller proportion (30.1%) thought robo-advisors replace human financial advisors, it still indicates a level of awareness about their potential to disrupt traditional financial services.

Other Perceptions: A small percentage (6.8%) had other perceptions, which could be explored further to understand alternative viewpoints.

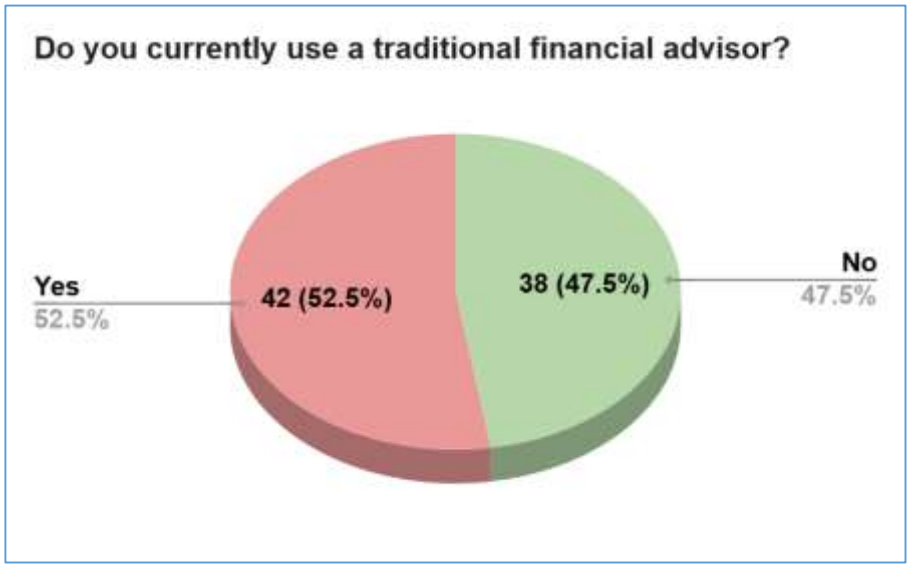
Possible Interpretations:

Core Functionality: The high percentage of respondents who identified automated investment advice and portfolio management suggests that these are the primary perceived functions of robo-advisors.

Technology Adoption: The growing awareness of robo-advisors indicates that they are becoming more widely accepted as a legitimate investment option.

Misconceptions: The perception of robo-advisors replacing human advisors may be due to a lack of understanding of the hybrid models offered by many robo-advisors, which often combine automated algorithms with human oversight.

Impact On Traditional Advisors



Analysis of Traditional Financial Advisor Usage

Key Observations:

Near-Equal Split: The chart shows a fairly even split between individuals who currently use a traditional financial advisor (52.5%) and those who do not (47.5%).

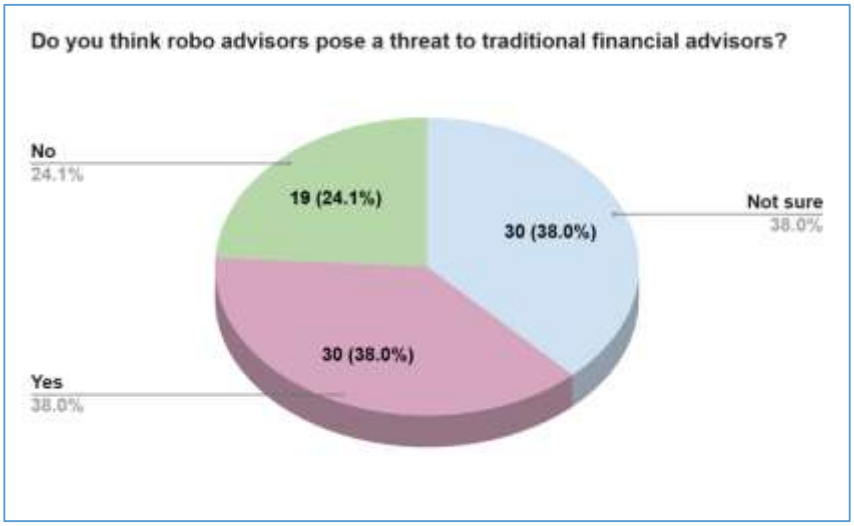
Possible Interpretations:

Shifting Landscape: The near-equal split suggests that there is a growing trend of individuals seeking alternative investment options, potentially due to increasing financial literacy, technological advancements, and the rise of digital investment platforms.

Diverse Needs: The data indicates that there is a segment of the population that still values the personalized advice and services offered by traditional financial advisors.

Cost and Accessibility: Some individuals may find traditional financial advisors too expensive or inaccessible, leading them to seek alternative options.

Analysis of Perception of Robo-Advisors as a Threat to Traditional Advisors



Key Observations:

Mixed Opinions: The responses are evenly split between "Yes" (38%) and "No" (38%), indicating a divided opinion on whether robo-advisors pose a threat to traditional financial advisors.

Uncertainty: A significant portion of respondents (24.1%) are "Not sure," suggesting a lack of clarity or understanding of the potential impact of robo-advisors on the industry.

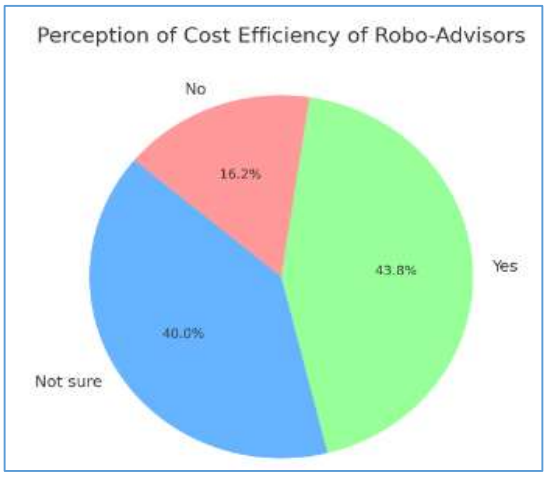
Possible Interpretations:

Emerging Technology: Robo-advisors are a relatively new technology, and there is still uncertainty about their long-term impact on the financial advisory industry.

Hybrid Model: Some respondents may recognize the potential of robo-advisors to complement traditional advisors, rather than replace them entirely.

Consumer Preferences: The diversity of opinions reflects the varied needs and preferences of different consumer segments. Some may prefer the personalized advice of a human advisor, while others may be comfortable with automated solutions.

Cost Efficiency factor



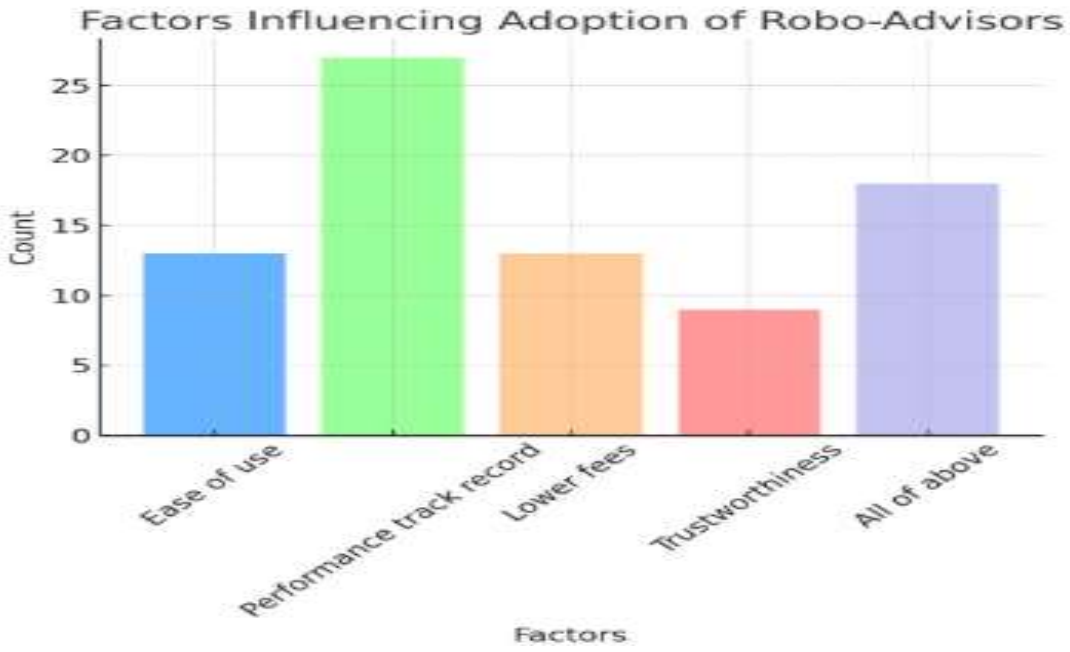
Key Observations:

The high percentage of "Not sure" responses indicates a lack of awareness or understanding about robo-advisors' cost efficiency among respondents.

Despite this, **43.8%** of respondents perceive robo-advisors as cost-efficient, suggesting a positive sentiment overall.

Only **16.2%** reject the idea of cost efficiency, implying that negative perceptions are limited.

Factors influencing adoption of Robo-advisors



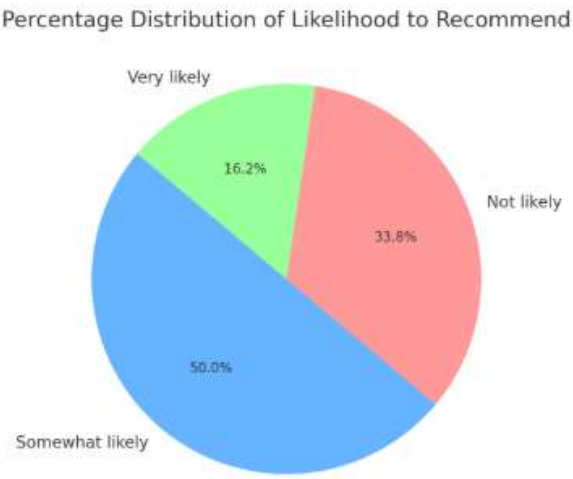
Key Observations:

The dominance of Performance track record indicates that users prioritize proven results and historical performance when considering robo-advisors.

The response All of the above (22.5%) shows that many respondents consider a combination of factors, signaling the multifaceted nature of adoption decisions.

Ease of use and Lower fees remain critical, while Trustworthiness has a relatively lower influence.

Likelihood to recommend a robo-advisor to a friend or family member



Key Observations:

Moderate sentiment dictates: Half of the respondents are somewhat likely to recommend robo-advisors. This suggests a cautious or neutral stance regarding their performance or value.

High skepticism: Approximately one-third (33.8%) of respondents are not likely to recommend robo-advisors, indicating hesitation or dissatisfaction.

Low strong advocacy: Only 16.2% are very likely to recommend robo-advisors, signaling limited strong confidence or loyalty.

Conclusion

We can draw the following conclusions about where robo-advisors stand today and how they're shaking things up in the financial world:

- Growing Awareness and Adoption: It is evident that, lots of people still don't really know what robo-advisors are, but the buzz is definitely growing. More people are starting to check out these digital investment platforms and seeing what they can do.
- Positive User Experience: For those who've jumped on board, the feedback is mostly good. Generally speaking, users are pretty happy with what they're getting, especially when it comes to automated investing and managing their portfolios.
- Mixed Perception of Threat to Traditional Advisors: It's a bit of a mixed bag when it comes to opinions about whether robo-advisors are a threat to traditional financial advisors. Some think they can actually work alongside traditional services, while others worry they might shake things up a bit too much.

Suggestions

Enhanced Education and Awareness: It would be great if robo-advisor companies could keep educating people about what they offer—the pros and the cons. It's really important to keep the communication clear and simple. It is is essential to dispel misconceptions and build trust.

Personalised Experience: By investing in tech and data analytics, robo-advisors could really step up their game in offering personalized advice tailored to individual needs and risk tolerance.

Strong Customer Support: Strong customer support is key. Whether it's live chat, email, or phone support, being there for clients and addressing their concerns can go a long way in building solid relationships.

Hybrid Model: Maybe Consider offering hybrid models that blend human expertise with the automation. That way, They can cater to a wider variety of client needs and preferences.
Transparent Fee Structures: It's important to be clear about fees and what kind of value clients are getting for their money. That helps justify costs and build trust.

Ethical Considerations: Prioritize ethical practices, focus on data security and confidentiality to build trust with clients.

Regulatory Compliance: Finally, staying on top of regulatory changes and making sure everything's compliant with the law and regulations is a mandatory.
By following these suggestions, robo-advisor providers can continue to revolutionize, improve user experience, and strengthen their position in the financial services industry.

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Efficient Utilisation of Librarians as Human Resource in Higher Education Institutions: A Study

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Abstract:

The Librarians in academic intuitions are playing a crucial role, contributing significantly to the academic, innovation and research environment. It is observed that these librarians had always worked beyond their stipulated role as an integrated part of the academic institution in supporting academic curricula. This paper examines the kind of roles played by the academic librarians in their institutions, as well as their knowledge related to the latest technology applications.

Keywords: Librarians, Librarians as human resource, higher education institutions, technological knowledge of librarians, ICT applications in libraries.

Introduction:

Librarians as an integral part to the academic fabric of HE institutions, play the major role of ensuring that both the students and the faculty have access to the resources required for their academic as well as co-academic activities. Their role is not limited to one department, but they are required to reach themselves to all the departments and activities in the institution. From supporting the academic curriculum to research work, from innovations to publications, from helping start-ups to networking for start-ups, from manual to ITC enable activities, they are expertly playing their role without any anticipation. It is essential to know the kind of roles played by the academic librarians within their institutions and understand their credibility in the academic sphere. Librarians are essential in creating an inclusive academic environment that supports the success and well-being of all students.

The librarians in the academic institutions are highly qualified. Many of them are multifaceted and multitasking personalities. The librarians as an academician are involved in various statutory and non-statutory committees. They are involved in research, publications, innovations, syllabus creation, short term courses, long- term courses. Being in the field of information science, they are not only handling the printed material, but also handling the digital and ICT material efficiently. They always keep searching for new developments in ICT and their applications in the libraries.

Literature review:

Christen Cardina and Donald Wicks assessed the changed roles of academic reference librarians during the period 1991 to 2001 in United States. It gives overview of traditional and newly developed duties of reference librarians in academic institutions. They found the changes occurred in the most frequent jobs and also the amount spent on some particular jobs. The number of reference tools used by librarians also increased (Cardina and Wicks, 2004). The study is exclusively related to role of reference librarians in the libraries.

Sheila Corrall (Corrall, 2010) explored about hybrid librarian as information specialist in the academic libraries, in view of curriculum development for professional education for librarianship. This research provides insights on trends and developments in information services in view of technological advances and changes in education sector. The author emphasised on the specialist role of librarians as information literacy educator and digital library manager to meeting the then demands of educational institutions and the stake holders. This paper gives a conceptual framework for emerging professional roles and the challenges faced by the educators of librarianship profession.

Youngok Choi and Edie Rasmussen studied digital library professionals in United States academic libraries. They had conducted a survey to trace the digital library professionals' activities, skills and training gaps, in view of digital library education to meet their workplace needs. Participants were asked about their job responsibilities, which were individually analysed and grouped into six categories: Management, Technology, Processing, Digital Library, Collection and Resources, and Other (Choi &. Rasmussen, 2024). To determine the Skills and Knowledge Needed participants rated the important skills and knowledge for technical areas, library related and other skills on a 5-point Likert scale.to find

the training gaps. Based on the results of the survey digital library syllabi were evaluated.

Sambhu Nath Halder studied the new roles of library professionals especially as advocate, sifter, consultant, researcher, content manager, consortia manager, web designer, guide/teacher, intermediary, knowledge manager, facilitator, etc. (Halder, 2009). His emphasis was on digital libraries, digitization of libraries, automation, personalised services, collaborations with other libraries. He stated that LIS professionals have done a commendable job in seizing new technology, but they will need to become much more aggressive and proactive in the future as they face increased competition from a variety of groups who think they can do a better job in providing information to the user (Halder, 2009).

Steven J. Bell and John Shank started his research paper with a very strong statement by Stephen J. Bell, Director of the Paul J. Gutman Library at Philadelphia University. "The future of the library is that there is no library; the functions that the library performs have been blown up and are scattered throughout the universe." (Bell & Shank, 2004). This shows that at the beginning of information era, where Internet had just started to be used by people individually, the future predicted for libraries was the libraries are going to be vanished and there was ambiguity about the professional role of librarians. Though in 2024, the libraries are not yet vanished, but have undergone lot of changes and the librarians are expected to adopt the changes due to ICT faster than many other professions. With the exponential increase in digital information upto the use of artificial intelligence, the job responsibilities of librarians have expanded significantly and they were expected to be blended librarians, i.e. to balance technology with humanism and focus on student-centered services in academic libraries.

Need of the present study:

There are many studies on the role of librarians – expected and performed – in the libraries, performance of academic librarians, relevancy of academic librarians in the institutions, their professional development, perceptions on job satisfaction of librarians, etc. There is no study on the various roles played by academic librarians in the sphere of the academic institutions, beyond the libraries. The roles of librarians are always valued for the libraries setting, but not tapped upon for their role in the entire academic settings. Hence, this paper tries to search the roles played by academic librarians beyond the library settings and within the academic institutions settings.

Objectives of the study:

1. To investigate the role of academic librarians played beyond their libraries and within their institutions.
2. To explore the awareness and knowledge of utilization of latest technology by the academic librarians.

Methodology:

Area of study: The colleges affiliated to University of Mumbai were considered for this research.

Method used for primary data collection: A survey was conducted using online poll on a WhatsApp group of 281 Librarians using the Convenience sampling. Only two questions were asked in the poll with several options for multiple selection possibility.

Limitations: All the librarians in the group did not reply the poll. Hence, only the number of Librarians replied are taken into consideration for data analysis and drawing interpretations.

Duration of survey – The survey was recently conducted in the second week of December 2024.

Total population – 281

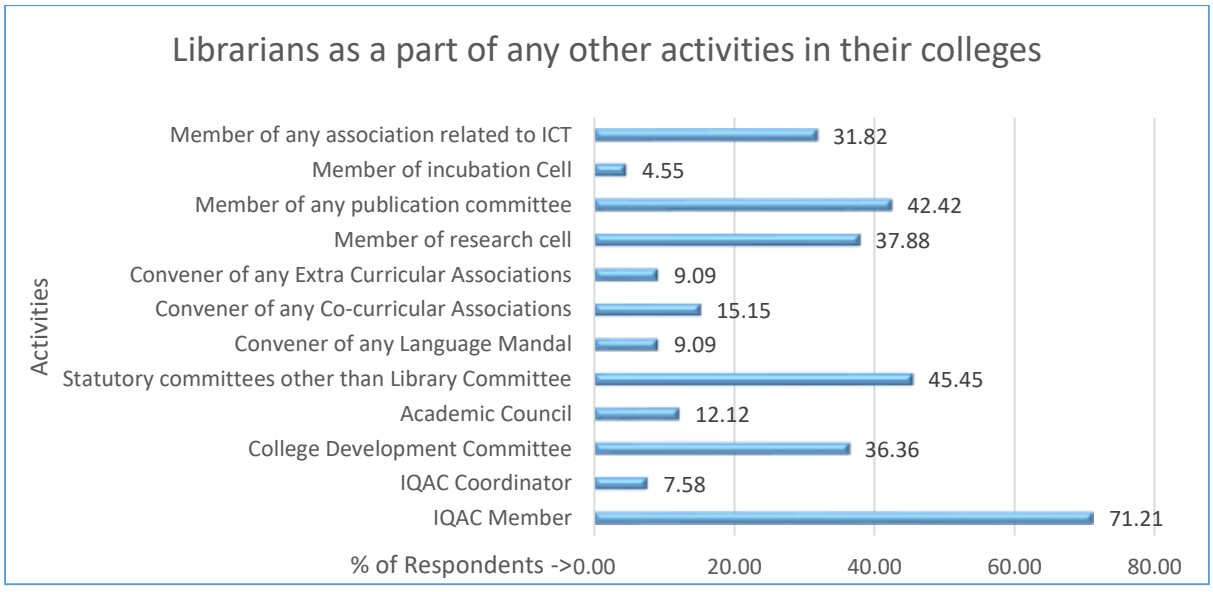
Replies received from – 66 (23.48% of the population) for the first poll question and 22 (7.82%) For the second poll question. The rest of the librarians in the group did not attend the poll.

Data Analysis and interpretation:

I. Are you part of any other activities in your college?

Replies received from – 66 (23.48% of the population)

Sr. No.	Activities	No. of respondents	% of respondents out of the replies received from
1	IQAC Member	47	71.21
2	IQAC Coordinator	5	7.58
3	College Development Committee	24	36.36
4	Academic Council	8	12.12
5	Statutory committees other than Library Committee	30	45.45
6	Convener of any Language Mandal	6	9.09
7	Convener of any Co-curricular Associations	10	15.15
8	Convener of any Extra Curricular Associations	6	9.09
9	Member of research cell	25	37.88
10	Member of any publication committee	28	42.42
11	Member of incubation Cell	3	4.55
12	Member of any association related to ICT	21	31.82



The above chart shows that many librarians (71.21%) are part of their college's internal IQAC Cell. Member and 7.58% librarians are even IQAC Coordinator. This indicates their strong leadership qualities, analytical skills and data management skills.

Nearly 42.42% librarians are member of any publication committee in their institution. This indicates their abilities in handling publications, editing and presentation skills.

About 45.45 % librarians are part of the statutory committees other than Library Committee. This shows the librarians expertise knowledge in related committee's purpose, their decision- making abilities and their abilities of team-working.

As a member of research cell 37.88 % libraries are indicating their abilities in the activities related to research and guidance in the respective subjects related to their colleges. The 36.36% Librarians are denoting their dedication to their colleges through their participation in college development committee and their thorough knowledge about the requirements of their college's academic and other activities.

As a part of association related to ICT, 31.82 % librarians are showing their interest and abilities in ICT. Also, being the part of ICT association indicates their increasing knowledge in ICT field. This implies that librarians are ready to acquire and use the latest knowledge and ready to adopt the related changes due to ICT.

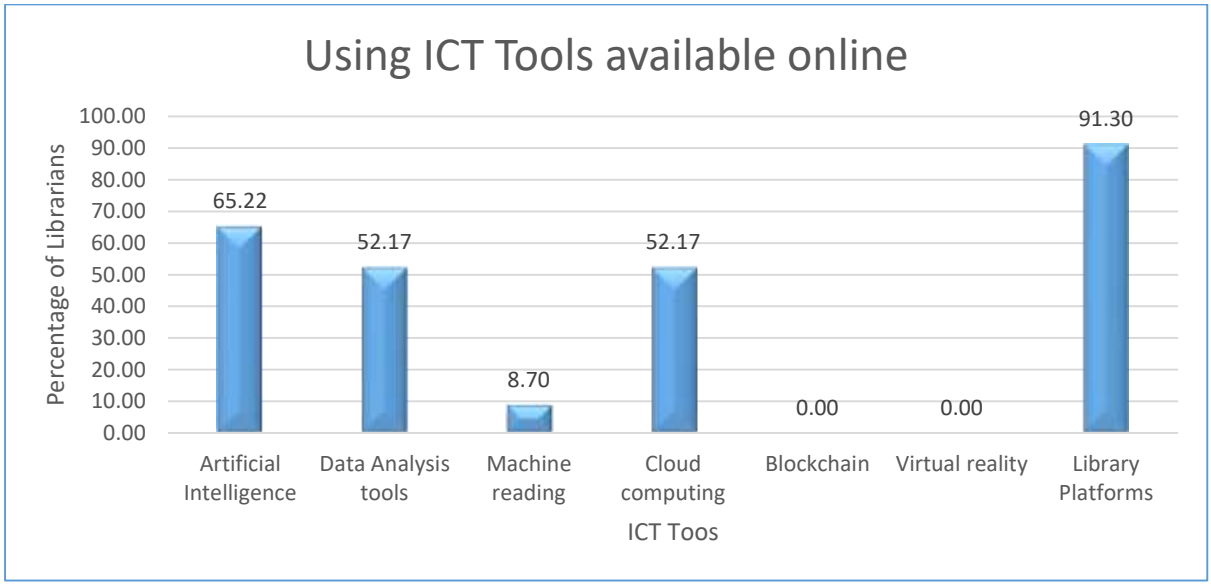
Many librarians are part of co-curricular, extra-curricular and languages related activities in the colleges. Nearly 15.15% librarians are being a Convener of any Co-Curricular Associations, 9.09% librarians are Convener of any Extra Curricular Associations and 0.09% librarians are Convener of the Language Mandals. This shows the varied interest of librarians and denotes their extra abilities beyond their field of stipulated job responsibilities. It is interesting to find the librarians multifaceted personalities indicated by these activities.

Apart from this 4.55% librarians are member of incubation cell in their college. This is an indicator of strong entrepreneurial abilities of the librarians, which is the requirement of the latest developments in the country.

II. Are you using any of the following tools available online

Replies received from22 participants out of 281 (7.82%)

Sr. No.	ICT Tools available online	No. of respondents	% of respondents out of the replies received from
1	Artificial Intelligence	15	65.22
2	Data Analysis tools	12	52.17
3	Machine reading	2	8.70
4	Cloud computing	12	52.17
5	Blockchain	0	0.00
6	Virtual reality	0	0.00
7	Library Platforms	21	91.30



The total 23 replies out of 281 itself indicates the requirement of training to librarians for adopting new technologies. For survival, it is extremely important for librarians to be adoptable to new technologies for the benefit of the library users. Or else somebody else will do the job and librarians will be side-lined.

Most of the librarians are acquainted with library platforms (91.30%) and artificial intelligence (65.22%). The librarians are also familiar with Data analysis tools available online (52.17) and cloud computing (52.17%). Very few librarians are familiar with machine reading (8.70%). The librarians do not accustom to Blockchain and virtual reading.

Conclusion:

Besides their qualities related to their job requirements in academic libraries, many librarians are expressing and utilising their various abilities by being the part of various activities in the colleges beyond libraries. The above study also indicates that the academic librarians are multi-tasking successfully, with their multifaceted personalities. They are playing a crucial role in managing various tasks, and in development of their colleges.

However, the study also indicated that librarians need good training continuously on the application and for adoption of newly emerging technologies in libraries for fulfilling the five laws of library science by Dr. Ranganathan – the base of librarianship.

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Unlocking Excellence: The Transformative Power of Technology in Business Optimization Dynamics

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Abstract:

Advanced technology integration has become essential for streamlining organisational procedures, increasing productivity, and spurring innovation in a variety of industries. This study investigates how advanced analytics, data-driven technologies, and automation may enhance strategic decision-making and streamline operations. Technology gives businesses the ability to concentrate on high-value tasks by minimising manual interventions and providing real-time information, which promotes agility and competitiveness in ever-changing markets. Customer engagement, workforce management, and financial operations are among the key areas of effect, where technological solutions improve performance tracking, personalisation, and collaboration. Segmentation and customised interactions are made possible by data-driven technologies, which increase client retention and pleasure. In a same vein, workforce management is revolutionised by automation and self-service platforms, which streamline hiring, onboarding, and performance reviews while promoting employee engagement.

This paper underscores the transformative potential of technology as a catalyst for operational excellence and long-term growth. By leveraging these advancements, organizations can enhance adaptability, uncover opportunities, and maintain a competitive edge in an increasingly digital world.

Introduction:

The quick development of technology has transformed organisations, allowing for strategic growth and improved productivity through the application of new tools and processes. Artificial intelligence, automation, data analytics, and self-service platforms streamline

processes, provide real-time insights, and replace human workflows. Businesses can overcome challenges, maximise their resources, and maintain their competitiveness in dynamic marketplaces thanks to this technology.

Technology has a significant impact on customer interaction, employee management, and financial operations. Advanced technologies enable personalised customer interactions, enhanced employee experiences, and decision-making supported by predictive data. By automating repetitive tasks and promoting teamwork, businesses reduce inefficiencies and boost shareholder value.

This paper investigates how technology is changing organisational procedures. It emphasises how these developments foster operational excellence, improve flexibility, and open doors for long-term expansion in a world that is becoming more interconnected by the day.

Scope of Research:

This study examines how cutting-edge technology might improve organisational procedures in several crucial operational domains, including as financial operations, workforce management, and customer interaction. In order to comprehend how these technologies, improve productivity, optimise workflows, and facilitate data-driven decision-making, the study will look at how automation, artificial intelligence, data analytics, and self-service platforms are integrated. In addition to assessing how automation might reduce inefficiencies, the study will investigate how technology can enhance consumer experiences, workforce productivity, and resource allocation.

Assessing the wider effects of technology on organisational competitiveness and flexibility in a quickly evolving digital environment is another aspect of the scope. This paper will demonstrate how technology supports long-term growth and operational excellence through case studies and data-driven analysis. The intention is to offer practical advice to companies wishing to use technology to boost performance, encourage innovation, and secure long-term success in a global marketplace that is becoming more interconnected by the day.

Aim of Research:

The aim of this research is to investigate how sophisticated technology can revolutionise organisational procedures and strategic development. The study specifically aims to comprehend how important operational domains including personnel management, financial operations, and customer engagement are optimised through the integration of automation, artificial intelligence, data analytics, and self-service platforms. The study intends to offer important insights into how businesses may use technology to attain operational excellence, adaptability, and sustainable growth by looking at how these tools improve productivity, simplify processes, and facilitate data-driven decision-making.

It is divided into two parts:

a) how technological optimization has streamlined and automated different departments of a corporate organization
b) a brief case study on how AI has affected strategic planning of two different sectors

Methodology Used:

The methodology for this research combines qualitative and exploratory approaches to analyse the impact of advanced technologies on organizational processes. It begins with a comprehensive literature review of existing studies and industry reports to establish a theoretical foundation. Case studies from various industries will illustrate real-world examples of technology integration, highlighting both benefits and challenges. Secondary data analysis will assess trends in technological adoption and its effects on business performance. Interviews with industry experts and business leaders will provide practical insights into technology applications and future trends. Finally, the findings will be synthesized to offer recommendations for businesses aiming to optimize operations and achieve sustainable growth through technological integration.

Sales:

The technical systems that managers and businesses employ to handle external interactions with customers are referred to as CRM (customer relationship management) technologies. This automation shows how technology affects company by allowing sales teams

to change their emphasis and spend more time on strategic planning and building stronger customer relationships. All stages of the customer life cycle—discovery, education, purchase, and post-purchase—benefit from it. Additionally, the automation results in more individualised customer service since CRM data analytics give organisations insights into the preferences and behaviours of their customers, enabling them to customise interactions to meet the demands of each individual.

"With an estimated global revenue of over $89 billion in 2024, CRM technology is widely cited as the fastest-growing enterprise software category, which largely encompasses the broader software-as-a-service (SaaS) market" (See Investopedia, CRM). Major players include Salesforce, HubSpot, Ascendix, Microsoft Dynamics and Monday.com.

Customer Data Collection and Management

- Customer data is gathered via CRM software from a variety of touchpoints, such as website visits, social media engagements, email correspondence, and in-person transactions.
- After that, the data is arranged in a central database that the marketing, sales, and customer support departments may access and examine.
- Automation solutions facilitate the automatic collection of data from sources including online forms, transaction logs, and chatbot interactions with customers.

Customer Segmentation

- CRM systems classify customers into segments (e.g., by demographics, buying behaviour, or location) by analysing the obtained customer data.
- Targeted marketing, individualised communications, and tailored product suggestions are made possible by segmentation.(Rogers, M., and Peppers, D. (2011))

Customer Communication and Engagement

- CRM solutions facilitate multi-channel communication, such as live chat, social media interaction, phone calls, and email marketing.
- Based on past contacts and customer interests, tailored emails, newsletters, and promotions are sent.

- Social media CRM technologies facilitate real-time consumer inquiry response and conversation tracking.

Sales Management

- Until make sure no opportunity is missed, sales teams follow leads using CRM solutions from the first point of contact until the sale.
- CRM software facilitates the automation of processes like issuing estimates, setting up meetings, and sending follow-up reminders.
- CRM analytics solutions are used for sales forecasting and performance tracking in order to evaluate the efficacy of the sales process and make necessary strategy adjustments.

Customer Service and Support

- Support tickets are managed within CRM software, with automated workflows to ensure timely responses.
- Self-service portals, FAQs, and chatbots integrated into CRM systems allow customers to find solutions to common issues independently.

Marketing Campaigns and Campaign Management

- CRM technologies facilitate the creation and automation of marketing programs for paid advertising, social media, SMS, and email.
- Based on consumer behaviour and segmentation, campaigns are frequently tailored (e.g., offering promotions to new leads or discounts to regular customers).
- Analytics tools monitor consumer reactions and campaign performance, enabling marketing teams to modify their strategies as necessary.

Customer Retention and Loyalty Programs

- CRM systems use surveys and evaluations of service quality to track customer satisfaction.
- CRM platforms incorporate loyalty programs, which allow customers to accrue points, discounts, or rewards for their purchases or interactions with the business. (F. Buttle, 2009).

- To preserve relationships and improve retention, follow-up emails, birthday discounts, and special offers are employed on a regular basis.(Shah, D., and Kumar, V. (2004))

Customer Feedback and Analysis

- CRM platforms that incorporate sentiment analysis tools aid in evaluating customer happiness and sentiment.
- Product offers, marketing strategies, and customer service are all improved with the help of feedback.

Reporting and Analytics

- CRM platforms include reporting dashboards for monitoring important data like sales conversion rates, client lifetime value, and customer acquisition costs.
- Analytics support strategic decision-making by pointing out patterns in advertising success, sales performance, and consumer behaviour. (J. Harrison & L. Fogg, 2016)
- Decision-makers can evaluate the efficacy of CRM tactics by using automated reports that are created for management.

HR solutions

Recruiting

"Research indicates that more than 80% of companies use social media to meet their hiring needs." (HRTech Singapore. (n.d.)**)** From posting jobs to reviewing resumes to scheduling interviews, applicant tracking systems (ATS) assist human resources managers in overseeing the complete hiring process. In order to save time and guarantee a better fit, AI-powered systems may even evaluate applications and match applicants to job requirements. ATS can cut the time-to-fill by up to one-fifth, according to data. Indeed, more than 86% of users reported that their hiring process has improved after using an applicant tracking system.

Onboarding and Employee Management

An important part of their onboarding process is technology. By improving onboarding procedures, an organisation can increase employee retention by up to 82%. Before their first day on the job, new hires can communicate with their teammates, undertake paperwork, and access training materials through digital onboarding tools.

HR employees can concentrate on more strategic duties by using HR chatbots to assist new hires with the onboarding process and provide answers to frequently asked queries.

Compared to those who have been onboarded without any such procedure, 30% of employees who have been onboarded utilising AI-powered onboarding processes say they would rather stay with the company for the first year. (HRTech Singapore. (n.d.)**)**

Employee Data Management.

Employee self-service portals enable staff members to handle their own HR requirements by providing them with access to their personal data, time-off requests, and benefits enrolment.

In addition to saving HR professionals time, this raises employee engagement and satisfaction. An outline of how self-service technologies can increase HR effectiveness can be found here.

(HRTech Singapore. (n.d.)):

HR Process:	**Manual:**	**Self-Service:**
Benefits Enrolment	2-4 weeks	2-3 days
Time-Off Requests	1-2 days	1-2 hours
Employee Information Updates	1-2 weeks	1-2 days

Performance Management and Employee Engagement

Software such as 15Five, Lattice, and BambooHR enable managers and staff to set objectives, give feedback, and monitor progress in real-time for ongoing performance tracking and feedback. This approach encourages better communication, alignment, and progress among employees.

HR managers can assess staff morale and pinpoint areas for development with the use of pulse surveys and employee sentiment analysis tools. Businesses can increase employee

engagement and retention by routinely gathering feedback and acting upon it.

Compensation And Benefits Administration

The most recent advancements in benefits administration and payroll technologies have greatly simplified the process.

Payroll processing that is automated, for example, guarantees timely and correct payments. Benefits administration software, on the other hand, makes it easier to enrol in and manage retirement plans, health insurance, and other employee benefits.

A comprehensive perspective of an employee's pay and benefits package is also provided by a number of total rewards management software programs, which aid businesses in making data-driven decisions and informing staff members of the worth of their benefits.

Research and Development

Technology has greatly streamlined research and development (R&D) across a range of businesses by offering cutting-edge instruments, methods, and platforms that enhance productivity, teamwork, and creativity.

The following are some significant ways that technology has improved R&D:

Collaboration and Cloud Computing

- Cloud Storage: Cloud computing makes it simple for researchers to store and exchange large volumes of data, allowing for real-time access and cross-border collaboration. This speeds up the dissemination of research findings and removes barriers related to physical data storage.
- Collaboration Tools: Researchers from various places can collaborate easily using online platforms and communication tools (like Slack, Microsoft Teams, and virtual laboratories), which promotes cross-disciplinary cooperation and speeds up the R&D cycle.

Big Data and Data Analytics

- Data mining: By examining vast datasets, or "big data," researchers might find previously undetectable insights that result in quicker discoveries and more accurate forecasts. This is particularly helpful in fields like genomics, where enormous volumes of biological data can be analysed to find patterns and progress medicine.
- Real-Time Data Collection: R&D can be informed by real-time data collected by sensors and Internet of Things (IoT) devices. These technologies, for example, assist in real-time process monitoring and optimisation in the industrial and energy sectors, lowering waste and enhancing product quality.

Advanced Manufacturing and 3D Printing

- Quick Prototyping: 3D printing, also known as additive manufacturing, makes it possible to create prototypes quickly, which speeds up design revisions and iterations without requiring conventional production techniques. This is very helpful when designing and developing new products.
- Custom printing: In industries like medicine, where individualised therapies are being explored, additive printing also enables more specialised solutions catered to particular research objectives.

Improved Access to Information

- Digital Libraries and Databases: Researchers can quickly access a multitude of material through online repositories like PubMed, Google Scholar, and industry-specific databases, which helps them avoid duplication of effort and save time on literature reviews.
- Open-Source Platforms: By democratising access to research tools and discoveries, open-source software and data-sharing platforms enable even independent researchers or smaller organisations to participate in and gain from extensive R&D projects.

Faster Innovation Cycles

- Agile Methodologies: More flexible R&D procedures are now possible thanks to technologies like software development platforms, version control, and project management tools. The innovation cycle is accelerated by teams' ability to swiftly iterate and modify their strategy in response to feedback or fresh information.

- Continuous Integration (CI) and Continuous Deployment (CD): These methods have facilitated the quick testing and deployment of new software or products in tech-driven companies, ensuring that innovations reach the market more quickly.

Finance and Accounting

Automation of Routine Tasks

- Automation of Accounts Payable and Receivable: Intelligent software tools and robotic process automation (RPA) have made operations like data entry, invoice processing, and payments easier. As a result, financial transactions are processed more quickly, with less physical labour and human mistake.
- Reconciliation: By rapidly comparing transaction data with bank statements, automated reconciliation technologies provide improved accuracy and save time compared to human reconciliation. Real-time report generation and discrepancy flagging are capabilities of these systems.

Tax Compliance and Automation

- Tax Automation Software: By automating tax calculations, monitoring evolving tax regulations, and producing precise tax reports, technology has made tax preparation and compliance easier. Software programs lower the possibility of mistakes in tax returns while guaranteeing adherence to national and international tax laws.
- Real-Time Tax Monitoring: To make sure the company is in compliance with tax rules and transactions, AI and machine learning algorithms can continuously monitor them. This allows the finance staff to be informed of any problems before they become expensive.

Faster and More Accurate Financial Close Process

- Streamlined Closing Procedures: The financial closing process, which often takes days or weeks, is made more efficient by automation and linked technologies. Financial closure operations including journal entries, reconciliations, and consolidation are made faster and more precise with the aid of technology.
- Reduced Errors: By automating repetitive processes and enabling real-time cross-checking of financial data, human error is decreased and the accuracy of financial

statements is guaranteed, reducing the need for corrections and restatements.

Improved Cash Flow Management

- Cash Flow Forecasting solutions: Using past data, ongoing transactions, and anticipated payments, cloud-based solutions are able to forecast cash flow. This assists the finance team in making well-informed decisions about financing and investments while ensuring there are sufficient cash to meet operational needs.
- Automatic Billing and Payment Systems: Technology enables automatic payment processing, reminders for past-due payments, and billing. This helps to enhance cash flow by ensuring that invoices are sent out on time and that collections are handled more effectively.

Financial Planning and Analysis (FP&A)

- Scenario Analysis: Finance teams assess various financial situations and their effects on the company with the aid of financial modelling and scenario analysis tools. Better long-term planning is made possible by these tools, which also offer insights into possible dangers and possibilities.
- Budgeting Automation: Businesses can maintain financial discipline and make necessary projection adjustments thanks to technology, which makes it possible to create and track budgets automatically. When expenditure departs from the authorised budget, automated systems notify teams so that corrective action can be taken more quickly.

Strategic Planning using AI: Case Study on two different industries

Even though AI's integration into fundamental business operations is still in its infancy, several early adopters are already seeing notable improvements in both operational and financial results. To comprehend the strategy enrichment AI provides, let's look at a few examples from a variety of industries.

Financial Services Leader Banks on AI

Risk management is essential to financial institutions' ability to preserve client trust and generate healthy profits. These businesses usually work with intricate financial products that are exposed to a range of credit and market risks and are closely regulated. Financial behemoths

like JPMorgan Chase & Co. are increasingly using artificial intelligence (AI) approaches to change risk management from a subjective to a more scientific and objective process. These organisations can spot trends, abnormalities, and risk connections that human analysts might miss by utilising machine learning algorithms that are based on enormous volumes of historical and current data.

With the use of AI-based technologies, portfolio risks may be monitored in real time, enabling prompt mitigation measures that can stop minor problems like account breaches or loan defaults from turning into more serious financial disasters. For instance, financial organisations can take prompt action and lower the danger of large losses by using machine learning algorithms to identify early warning indicators of possible defaults. According to specialists in the field, this technology integration has improved the total coverage of risks while reducing loss rates by about 20–30%. (For more, see The Strategy Institute, n.d.)

Furthermore, a more thorough, integrated perspective of possible risks is provided by AI-driven cognitive risk and compliance consultants. These sophisticated technologies reduce the possibility of being caught off guard by unanticipated hazards by enabling financial decision-makers to make quicker and more informed decisions.

Media Giant Wins through AI Content Strategy

Traditional media behemoths are stepping up their efforts to undergo digital transformation in order to compete with streaming disruptors such as Netflix and Prime. Their hegemony in cable distribution has been challenged by shifting consumer tastes, as more people choose video-on-demand services that are available on several platforms. Media giants like Disney, Fox, and WarnerMedia are using artificial intelligence (AI) to improve their digital content strategy and give viewers more individualised watching experiences in order to remain competitive.

In the background, AI algorithms examine enormous volumes of metadata, such as actors, titles, categories, and user usage information. Machine learning algorithms can forecast possible content achievements by identifying patterns in this data, providing production companies with insightful information to approve digital material that appeals to a wide range

of consumer demographics. This improves engagement across demographics by ensuring that material is more in line with customer interests.

Additionally, AI is used in marketing initiatives, where campaign ideas are improved by sentiment analysis and interaction data. Viewership rises as a result of improved content discoverability and more efficient streaming suggestions. AI offers evidence-based personalisation and targeting, which improves monetisation potential compared to depending solely on expert judgement, especially as traditional ad revenues fall. Media organisations may maintain growth and relevance in the face of digital disruption by integrating AI into their operations and generating new income streams from premium online content.

Conclusion:

In conclusion, the incorporation of cutting-edge technologies has fundamentally changed how businesses function, promoting productivity, creativity, and strategic expansion in a number of fields. In addition to streamlining internal procedures, the implementation of automation, AI, data analytics, and self-service platforms has improved financial operations, workforce management, and customer engagement. These technologies have given businesses the ability to streamline processes, increase productivity, and provide individualised experiences by decreasing manual activities and facilitating real-time decision-making. Businesses that want to remain competitive in an increasingly digital environment must make the transition to technology-driven operations; it is no longer an option.

The study also emphasises how technology helps businesses quickly address new issues and adjust to changing market conditions. The capacity to automate repetitive operations, use data analytics for decision-making, and offer customised client solutions has been crucial in enhancing operational effectiveness. Businesses gain important insights from technologies like artificial intelligence (AI) and machine learning, which aid in trend prediction, resource allocation optimisation, and risk mitigation. In addition to providing short-term benefits, this continuous optimisation lays the groundwork for long-term, sustainable growth.

In the end, the results imply that promoting organisational resilience, adaptation, and creativity requires technology optimisation. Technology will continue to be a key facilitator of operational excellence as companies embrace digital transformation. Organisations may

improve communication, expedite procedures, and maintain their agility in a cutthroat global marketplace by carefully integrating these tools. Leveraging technology as a strategic asset that promotes value creation and long-term success, rather than merely as an efficiency tool, is the way forward.

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Bankruptcy Prediction - A Case of Indian Firms

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Abstract

Predicting corporate bankruptcy holds profound implications for businesses, investors, and the broader economic ecosystem, especially in the dynamic Indian landscape. This research endeavours to develop a robust bankruptcy prediction model tailored for Indian firms, addressing the nuances of the regulatory environment and cultural intricacies. Through a comprehensive analysis of critical financial ratios, market variables, and macroeconomic factors, the study employs advanced machine learning techniques, including ensemble methods and deep learning models. The research encompasses three key objectives: identifying determinants of financial distress, developing tailored bankruptcy prediction models, and evaluating the performance of statistical and machine learning approaches. The findings underscore the superior predictive capabilities of ensemble methods like Random Forest and XGBoost, coupled with the promising potential of Long Short-Term Memory (LSTM) models in capturing temporal dependencies within financial data. The study contributes to the field by bridging the gap in long-term, context-specific bankruptcy prediction frameworks for Indian firms, incorporating qualitative factors, and leveraging diverse datasets. The results pave the way for enhanced resilience and stability within the Indian corporate ecosystem while informing decision-making processes for businesses, investors, and regulatory bodies.

Keywords: Bankruptcy Prediction, Logit Model, Machine Learning, KNN, Ensemble Methods, Random Forest, XGBoost, LSTM, Market returns, Macroeconomic Factors.

I. Introduction

In the ever-changing and complex world of India's business sector, companies are constantly confronted with the looming threat of financial crises that can disrupt their stability and resilience. These crises bring with them an increased risk of bankruptcy, diminished competitiveness, and financial instability, all of which are influenced by the distinctive dynamics of the Indian economic environment. It is crucial, therefore, to understand and predict these crises to not only ensure the survival of individual companies but also to safeguard the broader economic ecosystem.

Rationale of the research

The ability to predict bankruptcy holds great significance for Indian companies as it provides them with a proactive defence against financial turbulence. By enabling businesses to anticipate, manage, and mitigate risks associated with economic uncertainties, bankruptcy prediction offers a strategic advantage. This is particularly relevant in the context of India, where cultural nuances, regulatory intricacies, and economic fluctuations add layers of complexity to the financial landscape.

Problem Statement

In light of these challenges, our research aims to address a critical gap by undertaking the development of a robust bankruptcy prediction model explicitly tailored for Indian companies. The unique challenges faced by these enterprises, coupled with the intricacies of the regulatory framework, notably the Insolvency and Bankruptcy Code (IBC), underscore the need for a model seamlessly aligned with the specific nuances of the Indian business context. This research study had a comprehensive framework with three key objectives. Firstly, it aimed to identify and analyse the critical factors that contribute to financial distress and subsequent bankruptcy of companies. Secondly, the study focused on developing robust bankruptcy prediction models using advanced machine learning techniques, specifically tailored for Indian companies. The third objective was to evaluate and compare the performance of both statistical and machine learning models in the context of bankruptcy prediction for Indian firms. These objectives collectively formed the foundation for a study

designed to not only advance academic understanding of bankruptcy prediction but also offer practical insights and tools.

As we navigate through the complexities of bankruptcy prediction for Indian companies, our research endeavours to provide insights that go beyond theoretical frameworks. By developing a model that is attuned to the unique challenges of the Indian economic landscape, we aim to empower businesses, investors, and regulatory bodies with a tool that goes beyond generic predictions. Ultimately, our objective is to contribute to the resilience and stability of Indian firms in the face of potential financial crises.

II. Literature review

The prediction of corporate bankruptcy has garnered significant attention from researchers and practitioners alike, prompted by the profound implications it holds for businesses, investors, and the broader economic landscape. The seminal work of Edward I. Altman (1968) laid the foundation for this field, introducing the application of multiple discriminant analysis (MDA) on financial ratios to forecast bankruptcy. Altman's Z-score model, derived from a meticulous analysis of liquidity, profitability, leverage, solvency, and activity ratios, exhibited remarkable accuracy in predicting bankruptcy up to two years prior to its occurrence. This pioneering study underscored the utility of quantitative models in assessing financial distress and catalysed subsequent explorations into statistical techniques.

As research progressed, scholars embraced alternative methodologies, such as logistic regression (Aziz & Dar, 2006; Bandyopadhyay, 2006) and hazard models (Nam et al., 2008). Logistic regression models facilitated the estimation of bankruptcy probabilities, while hazard models incorporated temporal and macroeconomic dependencies, enriching the predictive framework with dynamic considerations.

The advent of machine learning (ML) techniques ushered in a transformative phase in bankruptcy prediction. Studies by Atiya (2001), Nagaraj and Sridhar (2015), and Jabeur et al. (2023) demonstrated the superior performance of neural networks, support vector machines, and ensemble methods like XGBoost in capturing intricate patterns and nonlinearities within financial data. The integration of these advanced algorithms often outperformed traditional statistical approaches, underscoring the potential of ML in enhancing predictive accuracy.

Recognizing the complementary strengths of statistical and machine learning methodologies, researchers have proposed hybrid models that synergistically integrate both paradigms. The work of Altman et al. (2020) exemplifies this approach, harnessing the collective power of machine learning and statistical techniques to augment predictive capabilities. However, a notable limitation pervades the existing literature – the predominant focus on short-term predictions within a 2 to 3 year time horizon. Long-horizon bankruptcy forecasting, spanning extended periods, remains an understudied and challenging frontier Altman et al. (2020).

In the Indian context, the landscape of bankruptcy prediction is relatively nascent, with a paucity of studies tailored to the unique dynamics and regulatory environment of the Indian business ecosystem. While some researchers have applied generic models to Indian firms Bapat & Nagale (2014), others have underscored the imperative need for frameworks that explicitly account for the nuances of the Indian economic landscape Sehgal et al. (2021) Narvekar & Guha (2021).

A significant research gap persists in the development of robust long-term bankruptcy prediction models specifically designed for Indian firms. Integrating advanced machine learning techniques with expert knowledge of the Indian business ecosystem presents a promising avenue for enhancing predictive accuracy and relevance. Addressing data quality issues, incorporating relevant macroeconomic factors, and aligning methodologies with the intricacies of India's Insolvency and Bankruptcy Code are critical areas that warrant further exploration.

Furthermore, the existing literature has predominantly focused on quantitative variables, primarily financial ratios, and market indicators. While these variables hold undeniable value, the potential predictive power of qualitative factors, such as management quality, corporate governance practices, and industry-specific dynamics, remains largely unexplored. Developing hybrid models that seamlessly integrate both quantitative and qualitative variables could contribute to a more comprehensive understanding of bankruptcy risk, transcending the limitations of purely numerical approaches.

The review of the literature also reveals an opportunity to broaden the scope of datasets employed in bankruptcy prediction studies. Many existing works have concentrated on listed

companies or specific sectors, potentially limiting the generalizability of their findings. Expanding the dataset to encompass a diverse range of companies, including small and medium-sized enterprises (SMEs) and private entities across various industries, could enhance the applicability and robustness of the predictive models developed.

In conclusion, while the field of corporate bankruptcy prediction has witnessed remarkable advancements, facilitated by the integration of advanced statistical and machine learning techniques, several critical gaps persist. Addressing these gaps through the development of long-term, context-specific models tailored to the Indian business landscape, incorporating qualitative factors, and leveraging diverse datasets, presents a fertile ground for future research endeavours. By bridging these gaps, researchers can contribute to the establishment of more accurate, adaptable, and comprehensive bankruptcy prediction frameworks, ultimately enhancing the resilience and stability of the Indian corporate ecosystem.

III. Data and Methodology

3.1 *Data*

The data utilized in this research on bankruptcy prediction among Indian firms was meticulously sourced from multiple reliable sources. The list of bankrupt firms was acquired from the Insolvency and Bankruptcy Board of India (IBBI), focusing on listed companies to ensure data accessibility to the public. Conversely, the roster of non-bankrupt firms was extracted from the National Stock Exchange (NSE) Nifty 500 index, representing a diverse set of stable companies. Financial and market data pertaining to both bankrupt and nonbankrupt firms was procured from ProwessIQ by the Centre for Monitoring Indian Economy (CMIE), encompassing comprehensive information on financial statements and market variables. Additionally, macroeconomic indicators crucial for the analysis were sourced from Macrotrends.com, enriching the dataset with external economic context.

To facilitate effective prediction modelling, data for all firms—both bankrupt and non-bankrupt—was collected for a period of three years preceding their last published financial reports. This timeframe was chosen based on established literature suggesting that a three year window provides a robust foundation for predictive analytics in bankruptcy prediction models

Altman et al. (2020). The data collection spanned from 2002 to 2022, aligning with the IBBI's available list of bankrupt firms up to 2022.

The selection of predictive factors was informed by a comprehensive approach, categorizing 63 pertinent variables into four distinct categories: accounting ratios, financial metrics, market variables, and macroeconomic factors. This meticulous categorization ensured a holistic assessment of firm performance and environmental influences, contributing to the robustness and comprehensiveness of the predictive model. For a detailed overview of the selected predictive factors, refer to Table 01.

Table 01: Overview of Factors

Factors	Description	Data Type
Bankruptcy	1 if Bankrupt 0 if Non-Bankrupt	Integer
Profitability	ROA (EBITDA)	Float
	ROA (EBIT)	Float
	ROA (PAT)	Float
	Gross Profit Margin	Float
	EBITA/Capital Employed	Float
	Net Profit/Capital Employed	Float
	Total income/Total expense	Float
	Net Income to Total Assets	Float
Liquidity	Current Ratio	Float
	Quick Ratio	Float
	Cash/Current Liability	Float
	Current Liability to Assets	Float
Coverage	Interest Expense Ratio	Float
	Interest cover (times)	Float
	DSCR	Float
Solvency	Contingent Liability/Net worth	Float
	Total Debt/Total Net Worth	Float
	Debt/Equity Ratio	Float
Efficiency	Reinvestment rate	Float

	Employees utilisation ratio(times)	Float
	Fixed Assets turnover frequency	Float
	Accounts Receivable turnover	Float
	Creditor turnover frequency	Float
	Working Capital to Total Assets	Float
	Current Asset Turnover Rate: Current Assets to revenue	Float
Cash Flow	Cash Turnover Rate: Cash to Revenue	Float
	Cash Flow to Revenue	Float
	Cash Flow to Total Assets	Float
	Cash Flow to Liability	Float
	CFO to Assets	Float
	Cash Flow to Equity	Float
Asset	Equity/Total Assets	Float
Management	Current Assets/Total Assets	Float
	Cash/Total Assets	Float
	Total expense/Assets	Float
	Retained Earnings to Total Assets	Float
	Fixed Assets to Assets	Float
Risk	Current Liabilities/Liability	Float
Management	Working Capital/Equity	Float
	Current Liability to Liability	Float
	Current Liability to Equity	Float
	Equity to Long-term Liability	Float
	Liability to Equity	Float
Financial	Pre-Tax Interest Rate (%)	Float
Factors	Tax rate	Float
	After-Tax Interest Rate (%)	Float
	R&D Expense	Integer
	CSR expense to be incurred or incurred	Integer
	Liability-Assets Flag: 1 if Total Liability exceeds Total Assets, 0 otherwise	Integer
	Degree of Financial Leverage (DFL)	Float

	Net Income Flag: 1 if Net Income is Negative, 0 otherwise	Integer
Market	Cash Flow per share	Float
Return	Revenue per share	Float
	EBITDA per share	Float
	EBT per share	Float
	EPS	Float
	Net Income to Stockholder's Equity (Return on Equity)	Float
Macro	GDP Growth Rate	Float
Factors	Inflation Rate	Float
	Unemployment Rate (%)	Float
	FDI as % of GDP	Float
	Market Return	Float
	Volatility	Float

3.2 *Data Processing*

In the data processing phase of the research, the original dataset comprising 817 companies— 317 bankrupt and 500 non-bankrupts, underwent meticulous refinement to ensure data integrity and suitability for predictive modelling. Due to missing information across various factors, the dataset was streamlined to include 75 bankrupt firms and 450 non-bankrupt firms, ensuring a more robust and complete dataset for analysis.

Accounting ratios, deemed pivotal for bankruptcy prediction, were meticulously derived from the financial statements available within the ProwessIQ database. Additionally, dummy variables were strategically constructed based on financial metrics to encapsulate nuanced variations in firm performance and characteristics. Macro-economic variables, crucial for contextualizing firm performance within broader economic trends, were harmonized to align with the temporal scope of the dataset for each company. This ensured that macroeconomic factors accurately reflected the economic conditions pertinent to each firm during the analysed period.

Prior to analysis, the dataset underwent thorough scrutiny to identify and rectify any missing values. Fortunately, no missing values were detected, affirming the completeness and

reliability of the dataset. To standardize the data and mitigate potential biases arising from varying scales and magnitudes across different variables, a scaling process was implemented using the scikit-learn library. Scaling ensures that each feature contributes uniformly to the analysis, preventing dominance by variables with larger magnitudes and enhancing the efficacy of the predictive model. This approach facilitates robust and unbiased analysis by ensuring that each variable's influence is appropriately weighted within the predictive framework.

3.3 *Fitting the Data into Models*

In the process of fitting the dataset into the model, several steps were undertaken to ensure robustness and accuracy in predictive modelling. Initially, a correlation matrix was constructed to assess the interrelationships among the 63 predictive factors. To mitigate multicollinearity, factors exhibiting mutual correlations exceeding an absolute value of 0.5 were systematically removed from the dataset, resulting in a refined set of 28 factors. Figure 01 shown below displays the correlation matrix for the refined set of factors. This step ensured that redundant or highly correlated variables did not unduly influence the model, enhancing the reliability of subsequent analyses.

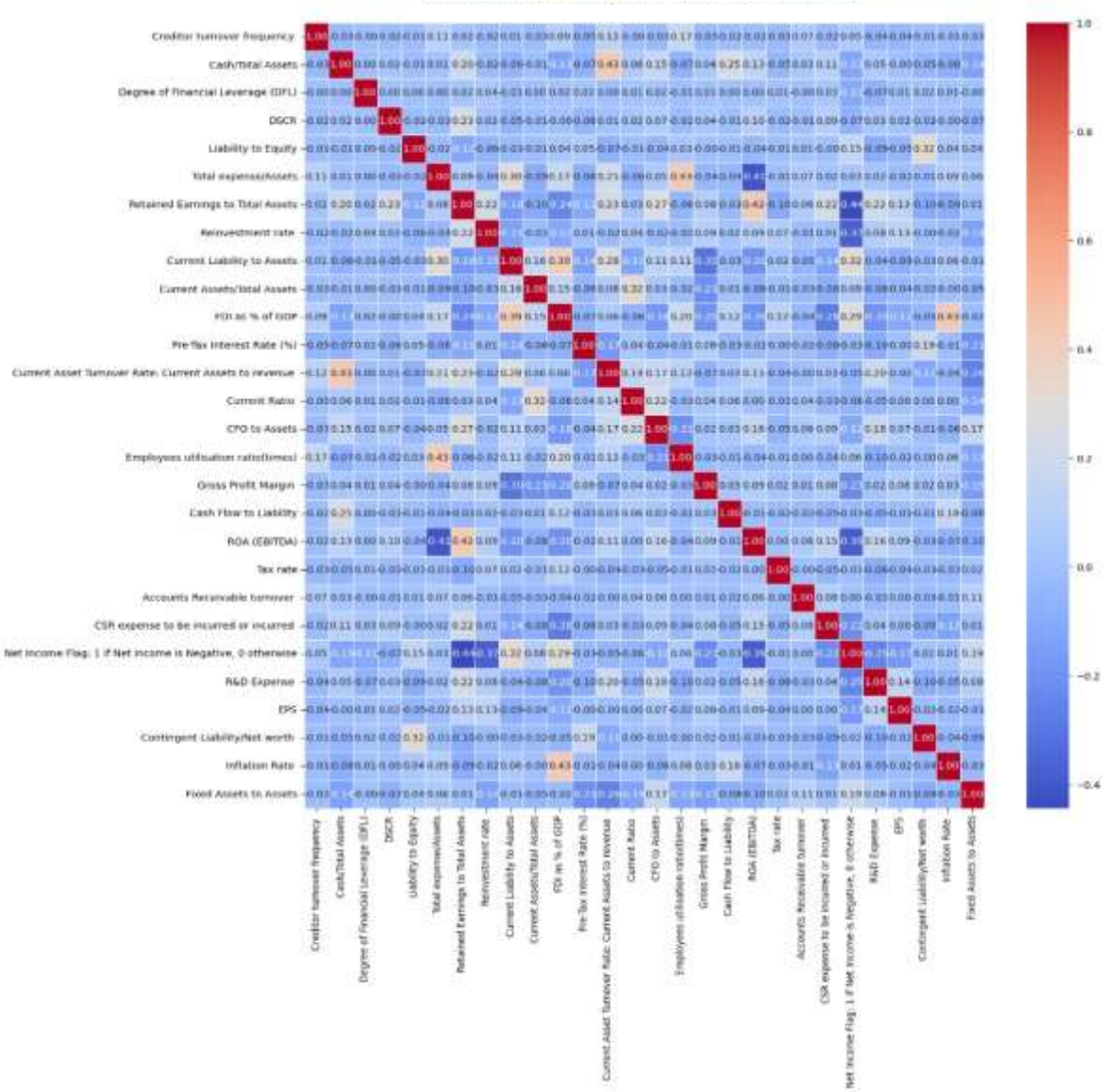

Figure 01: Correlation matrix for heatmap for selected factors

Subsequently, the dataset was partitioned into training and test sets, with 70% of the samples allocated to the training set and the remaining 30% to the test set. This partitioning strategy allowed for rigorous evaluation of model performance on unseen data, thereby providing insights into the generalization capabilities of the predictive models. Such evaluation is critical for assessing the practical utility of machine learning algorithms in real-world scenarios.

For the logistic regression model, which serves as the baseline model, the refined dataset of 28 variables was utilized. Meanwhile, for more complex machine learning models—Random Forest, KNN, and XGBoost—the entire dataset of 63 variables was employed. These

models were selected based on their demonstrated efficacy in providing highly accurate results in previous studies, making them well-suited for the task of bankruptcy prediction. Random Forest, KNN, and XGBoost algorithms are renowned for their ability to handle complex relationships within data and exhibit robust performance across diverse datasets, thereby justifying their inclusion in the analysis.

To further enhance computational efficiency and interpretability, dimensionality reduction was performed on the dataset using Principal Component Analysis (PCA). This technique enabled the extraction of essential information while reducing the dimensionality of the dataset, thereby streamlining computational complexity without sacrificing predictive accuracy. Figure 02 illustrates the proportion of variance explained by each principal component, demonstrating the effectiveness of PCA in retaining the most relevant information. Subsequently, the three machine learning models - Random Forest, KNN, and XGBoost were re-run using the reduced dataset to evaluate the impact of dimensionality reduction on model performance.

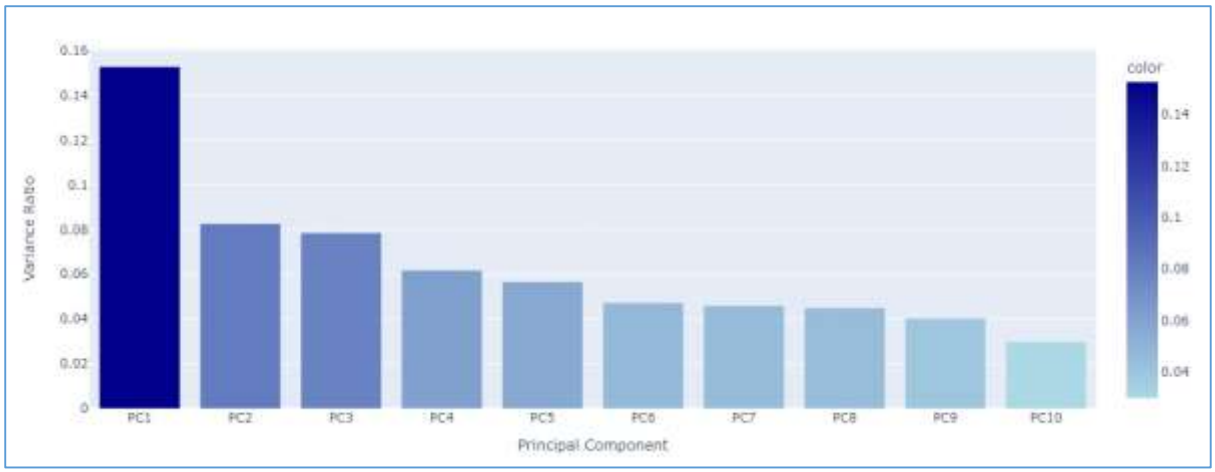

Figure 02: Proportion of Variance in Principal components

Lastly, in recognition of the temporal dynamics inherent in financial data, a Long Short-Term Memory (LSTM) model was developed. LSTM models, a type of recurrent neural network (RNN), are well-suited for capturing sequential dependencies in time-series data, making them particularly apt for modelling financial time series. The LSTM model was trained and tested using the entire dataset of 63 variables, leveraging its ability to capture temporal patterns and dependencies for enhanced predictive performance. By incorporating

an LSTM model, the analysis aimed to harness the power of deep learning techniques to augment the predictive capabilities of the overall model ensemble.

3.4 *Performance Evaluation*

In evaluating the performance of the Logit model, model fit was assessed using the log likelihood value and pseudo R-squared statistic, which provide insights into the goodness of fit of the model to the data. Furthermore, accuracy scores were computed for both the training and test sets to gauge the overall predictive performance of the model.

In comparing the performance of ML models, accuracy score, Receiver Operating Characteristic (ROC) curve, and Area Under ROC Curve (AUC) were utilized as evaluation metrics. The accuracy score provided a measure of overall classification accuracy, while the ROC curve and AUC facilitated a more nuanced assessment of model performance by capturing the trade-off between true positive rate (TPR) and false positive rate (FPR). Additionally, the F1 score, which considers both precision and recall, was computed to provide a holistic assessment of model performance.

These evaluation metrics were computed for all three ML models—Random Forest, KNN, and XGBoost—both before and after PCA dimensionality reduction to discern any potential impact on model performance. Cross-validation techniques were employed to optimize model hyperparameters and identify the best-performing model based on the chosen evaluation metrics.

Additionally, the LSTM model underwent similar evaluation using the specified metrics to ascertain its predictive capabilities in the context of bankruptcy prediction. By systematically evaluating model performance across multiple metrics, this analysis aimed to provide a comprehensive understanding of the relative strengths and weaknesses of each model, thereby informing decision-making and model selection in practical applications.

IV. Results and Analysis

Building upon the methodology and evaluation outlined previously, this section presents the findings of our bankruptcy prediction study, employing a range of models

including logistic regression, machine learning algorithms, and a LSTM model. Through detailed analysis, we explore the predictive performance of each model and draw comparisons with previous research to provide insights into their effectiveness in assessing bankruptcy risk.

4.1 *Statistical Model*

The logistic regression model served as the statistical backbone in our analysis. Table 02 presents a comprehensive overview of the model coefficients and the corresponding levels of statistical significance for each predictor variable.

Table 02: Logistic Regression Model Results

Accuracy: 91.77 Pseudo Rsquare: 0.8244 LogLikelihood: -37.799				
	coef	std err	z	P>|z|
const	-7.59	2.66	-2.86	0.00
Inflation Rate	31.63	24.19	1.31	0.19
Fixed Assets to Assets	-0.76	2.08	-0.37	0.71
Reinvestment rate	-0.08	0.40	-0.19	0.85
Gross Profit Margin	-3.16	1.77	-1.79	0.07
ROA (EBITDA)	-9.40	5.79	-1.62	0.10
Total expense/Assets	-1.20	0.68	-1.77	0.08
DSCR	0.00	0.01	-0.46	0.64
Current Asset Turnover Rate: Current Assets to revenue	0.06	1.79	0.03	0.98
CFO to Assets	-2.10	2.45	-0.86	0.39
Contingent Liability/Net worth	-0.03	0.13	-0.24	0.81
Cash/Total Assets	-7.98	5.73	-1.39	0.16
Current Liability to Assets	2.26	1.48	1.53	0.13
EPS	0.00	0.00	0.03	0.98
Degree of Financial Leverage (DFL)	0.02	0.07	0.26	0.80
Accounts Receivable turnover	-0.12	0.07	-1.66	0.10
Tax rate	2.10	1.10	1.90	0.06

R&D Expense	0.02	0.83	0.02	0.98
Employees utilisation ratio(times)	0.01	0.01	2.02	0.04
Liability to Equity	-0.01	0.02	-0.53	0.60
FDI as % of GDP	426.39	82.73	5.15	0.00
Retained Earnings to Total Assets	0.07	0.14	0.53	0.60
Pre-Tax Interest Rate (%)	0.00	0.04	0.13	0.90
CSR expense to be incurred or incurred	-1.98	1.26	-1.57	0.12
Current Assets/Total Assets	0.04	0.06	0.64	0.52
Creditor turnover frequency	0.10	0.07	1.48	0.14
Cash Flow to Liability	0.00	0.00	0.00	1.00
Net Income Flag: 1 if Net Income is Negative, 0 otherwise	0.70	1.21	0.58	0.57
Current Ratio	-0.35	0.48	-0.72	0.47

Compared to previous studies, the accuracy of our logistic regression model (91.77%) is higher than the findings reported by Bapat and Nagale (2014) for Indian firms, where logistic regression achieved an accuracy of 75.00%. However, it is lower than the 97.2% accuracy reported by Nagaraj and Sridhar (2015) using logistic regression. Bandyopadhyay's study (2007) on Indian corporate bonds also achieved a higher accuracy of 87% with a ROC of 0.9383 using a logit model.

The discrepancy in accuracy can be attributed to several factors, including variable selection, sample size, and the specific characteristics of the dataset used in each study. Our model incorporates a comprehensive set of financial ratios and macroeconomic variables, which may have contributed to its relatively high accuracy compared to some previous studies. However, the variable selection process and the underlying relationships between these variables and bankruptcy risk can vary across different datasets and industries, potentially influencing the model's performance.

It is worth noting that while our logistic regression model demonstrates a high level of accuracy, certain variables, such as "FDI as % of GDP" and "Employees utilisation ratio(times)," exhibit statistical significance, suggesting their potential relevance in predicting bankruptcy. Conversely, variables like "Inflation Rate," "Reinvestment rate," and "EPS" do

not appear to be statistically significant in our model, which may warrant further investigation into their predictive power or the need for alternative variable transformations.

4.2 *Machine Learning Models*

4.2.1 Before Dimensionality Reduction

In exploring the performance of machine learning models before dimensionality reduction, we examined the accuracy, ROC AUC, F1-score, and cross-validation results. Table 03 provides a concise summary of these metrics for each model.

Table 03: Machine Learning Model Results (Before Dimensionality Reduction)

Model	Accuracy	ROC AUC	F1-Score	Cross validation
KNN	93.67%	0.9395	0.76	0.8414
Random Forest	97.47%	0.9939	0.91	0.9568
XGBoost	98.10%	0.9784	0.93	0.9375

The results demonstrate the superior performance of ensemble methods like Random Forest and XGBoost compared to the KNN algorithm. This aligns with findings from previous studies, such as Barboza et al. (2017), which reported a Random Forest ROC AUC of 92.92%, and Nagaraj and Sridhar (2015), who achieved 98.6% accuracy using a neural network.

The high accuracy and ROC AUC scores of Random Forest and XGBoost can be attributed to their ability to capture complex non-linear relationships and handle high-dimensional data effectively. Additionally, ensemble methods often exhibit better generalization performance and robustness to overfitting compared to single models like KNN.

4.2.2 After Dimensionality Reduction

Following dimensionality reduction, we evaluated the performance of machine learning models and compared them against their pre-reduction counterparts. Table 04

presents a succinct overview of the accuracy, ROC AUC, F1-score, and cross-validation results for each model.

Table 04: Machine Learning Model Results (After Dimensionality Reduction)

Model	Accuracy	ROC AUC	F1-Score	Cross validation
KNN	96.84%	0.9957	0.89	0.8879
Random Forest	97.47%	0.9847	0.81	0.8751
XGBoost	98.1%	0.9826	0.83	0.8655

Dimensionality reduction using PCA can improve model performance by mitigating the curse of dimensionality and reducing noise in the data. However, in our case, the results after dimensionality reduction are mixed. While KNN exhibited an improvement in accuracy, ROC AUC, and F1-score, the performance of Random Forest and XGBoost slightly declined compared to their pre-dimensionality reduction results.

This discrepancy may be attributed to the potential loss of informative features during the dimensionality reduction process. While PCA aims to capture the maximum variance in the data, some relevant information for bankruptcy prediction could have been inadvertently discarded, leading to a slight performance degradation for ensemble methods like Random Forest and XGBoost, which are known to be more robust to high-dimensional data.

Nonetheless, the cross-validation scores indicate that Random Forest remains the most consistent and robust model, with the highest cross-validation score of 0.9568 before dimensionality reduction and 0.8751 after dimensionality reduction. Cross-validation is a crucial technique for evaluating model performance and generalization ability, as it provides an estimate of how the model will perform on unseen data.

4.3 *LSTM Model*

Incorporating the Long Short-Term Memory (LSTM) model into our analysis, we scrutinized its performance in predicting bankruptcy risk. Table 05 encapsulates the key metrics, including accuracy, ROC AUC, and F1-score, delineating the effectiveness of the LSTM model in our study.

Table 05: LSTM Model Results

Model	Accuracy	ROC AUC	F1-Score
LSTM	96.2%	0.98	0.88

Compared to our machine learning models, the LSTM model's performance is competitive, with an accuracy and ROC AUC score comparable to the top-performing models like Random Forest and XGBoost. However, its F1-score is slightly lower, which may indicate a trade-off between precision and recall.

As a novel approach in bankruptcy prediction, LSTM models are not widely reported in the literature, making direct comparisons with previous studies challenging. Nonetheless, the results suggest that LSTM models can effectively capture temporal dependencies and patterns in financial data, which are critical for bankruptcy prediction.

When compared to traditional neural networks, as reported by Atiya (2001), our LSTM model outperforms the reported accuracy of 85.50% for testing. This aligns with the general trend of deep learning models, such as LSTMs, exhibiting superior performance in various domains due to their ability to learn hierarchical representations and handle sequential data effectively.

It is important to note that the performance of LSTM models can be influenced by factors such as the choice of hyperparameters, the quality and quantity of training data, and the specific architectural design. Further exploration and fine-tuning of these factors may lead to improved performance in bankruptcy prediction tasks.

V. Conclusion

The results demonstrate the effectiveness of machine learning models, particularly ensemble methods like Random Forest and XGBoost, in predicting bankruptcy with high accuracy. The novel application of an LSTM model also showcased promising performance, highlighting the potential of deep learning techniques in this domain. However, a major challenge faced was data scarcity, as the study primarily utilized publicly available data due to difficulties in accessing information from private companies. While dimensionality

reduction improved certain models' performance, careful consideration of feature selection and the trade-off between model complexity and interpretability is crucial.

Looking ahead, future advancements could involve integrating qualitative factors, such as management quality and corporate governance practices, to enhance the comprehensiveness of the models. Employing semi-supervised learning techniques and transfer learning approaches could help mitigate data limitations. Ensembling diverse models and developing interpretable AI systems to explain bankruptcy risk drivers are also promising avenues. Leveraging AI capabilities like natural language processing and advanced neural networks will be crucial in these endeavours. Additionally, the discrepancies observed between our results and previous studies underscore the importance of dataset-specific characteristics, variable selection techniques, and the dynamic nature of financial conditions, necessitating periodic model updates and refinements to maintain relevance and accuracy over time.

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Janani Suraksha Yojna: Awareness and Impact Assessment

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Abstract

Despite advancements in medical science and public health initiatives, women's healthcare in India faces critical challenges. This study examines the hypothesis that government policies, particularly those centred around birth control and family planning, have not effectively improved women's overall health outcomes. Instead, these policies may have contributed to a shift in the primary causes of mortality among women—from pregnancy-related complications to stress-induced illnesses. This shift is rooted in the sociocultural dynamics of family pressures, particularly the role of in-laws, which exacerbate the psychological and emotional burden on women.

Literature Review

The study by Somdeep Chatterjee and Prashant Poddar investigates the unintended positive effects of India's Janani Suraksha Yojana (JSY), a program designed to enhance maternal health through conditional cash transfers that encourage institutional deliveries. The authors find that the program improves maternal health and provides significant educational benefits for older children in beneficiary households, particularly girls, as mothers can invest more in their education due to increased financial resources and altered fertility preferences. The findings underscore the inter-generational impacts of maternal health initiatives, advocating for sustained investment in such programs despite their high costs. (Poddar)

The article analyzes the effects of India's Mission Parivar Vikas (MPV) program, initiated in November 2016, which targets high fertility rates in 146 districts by enhancing access to contraceptives, offering monetary incentives for adoption, and spreading family planning information. Utilizing data from the National Family Health Survey (NFHS) and a

difference-in-differences methodology, the study finds a notable decline in the Total Fertility Rate (TFR) in MPV districts, with a 5% reduction in births. Additionally, the program has contributed to lower fertility preferences among both genders, an 8.9 percentage point increase in contraceptive use, and improved exposure to family planning information, indicating its effectiveness in influencing fertility decisions and promoting family planning practices in India.(htt)

(Shukla) Nandita Bhan and Prajakta Pradip Shukla examine the increasing prevalence of non-communicable diseases (NCDs) among women in India and the impact of the Pradhan Mantri Jan Arogya Yojana (PMJAY) on healthcare access. They note that NCDs, including cardiovascular diseases, chronic respiratory conditions, and cancers, are responsible for over half of female deaths in the country. Despite the PMJAY's goal of enhancing health coverage, significant gender disparities in healthcare access remain, with men more likely to benefit from public-funded programs. The authors stress the importance of understanding the barriers women face in accessing healthcare and advocate for patient-centred approaches, as well as initiatives aimed at empowering women and promoting self-care to improve health outcome
(Das) provide a comprehensive analysis of the progress and challenges in women's healthcare in India, focusing on maternal mortality as a key indicator. The paper emphasizes that while government initiatives have significantly reduced maternal deaths through improved institutional delivery systems and antenatal care, these policies often neglect the broader spectrum of women's health needs. The authors argue that the exclusive focus on reproductive health outcomes has overshadowed critical areas such as mental health and non-communicable diseases, which are increasingly affecting women. They advocate for a more inclusive healthcare model that integrates cognitive, emotional, and social health dimensions to ensure sustainable improvements in women's overall well-being.

The objective of the research is to evaluate the impact of government initiatives, including Janani Suraksha Yojana, on maternal and neonatal outcomes in India. The hypothesis recognized in the research is that "Government programs reduce maternal and neonatal mortality rates".

The method of study is the literature review of 32 studies, employing qualitative and quantitative methods. Finally, Conditional cash transfers under programs like Janani Suraksha

Yojana significantly improved institutional delivery rates, thus reducing maternal and infant mortality. (Ohio)

(htt1) **Objective:** To evaluate the effectiveness of India's maternal healthcare programs post-implementation of major initiatives like cash incentives and non-cash services. **Hypothesis:** Government interventions positively influence the utilization of maternal health services.

Methodology: Data analysis from NFHS-3, NFHS-4, and NFHS-5, employing a composite index to measure utilization levels across states, with correlation tests and Gini coefficients for inequality analysis.

Conclusion: Significant improvements were noted in institutional deliveries and antenatal care, but disparities persist across regions, necessitating targeted interventions.

(BMJ) **Objective:** To identify drivers behind India's faster-than-expected reduction in maternal and neonatal mortality rates.

Hypothesis: Comprehensive policy changes and health interventions significantly reduce mortality rates.

Methodology: Mixed-methods study integrating quantitative analysis and qualitative insights, examining four national policy periods (1992–2020) and their impacts. **Conclusion:** Reductions were linked to improved health financing, infrastructure, and effective national programs like RMNCH+A. Cross-country comparisons highlighted India's exemplary progress.

Methodology:

1. The primary survey constituted 58 women eligible for JSY predominantly from Nehru Nagar, Mumbai
2. The secondary data has been collected from government verified websites

Objective:

1. To study the awareness of government programs like Janani Suraksha Yojana (JSY)
2. To study the relationship between age of women and the no. of children of have.

Hypothesis:

Hypothesis 1

(H_0): There is no awareness of the Janani Suraksha Yojana (JSY) among women.

(H_1): There is awareness of the Janani Suraksha Yojana (JSY) among women

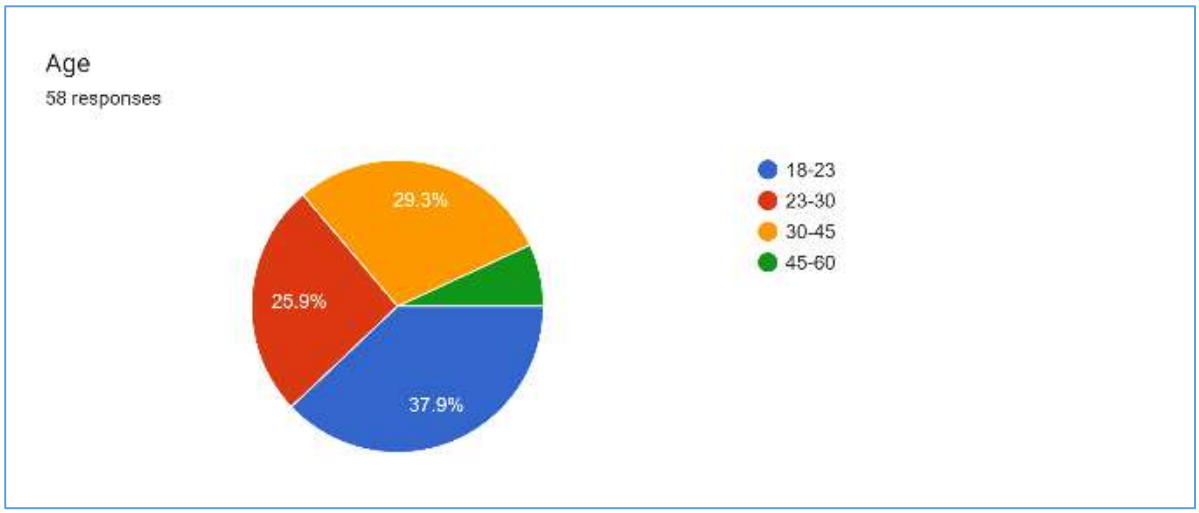
Hypothesis 2

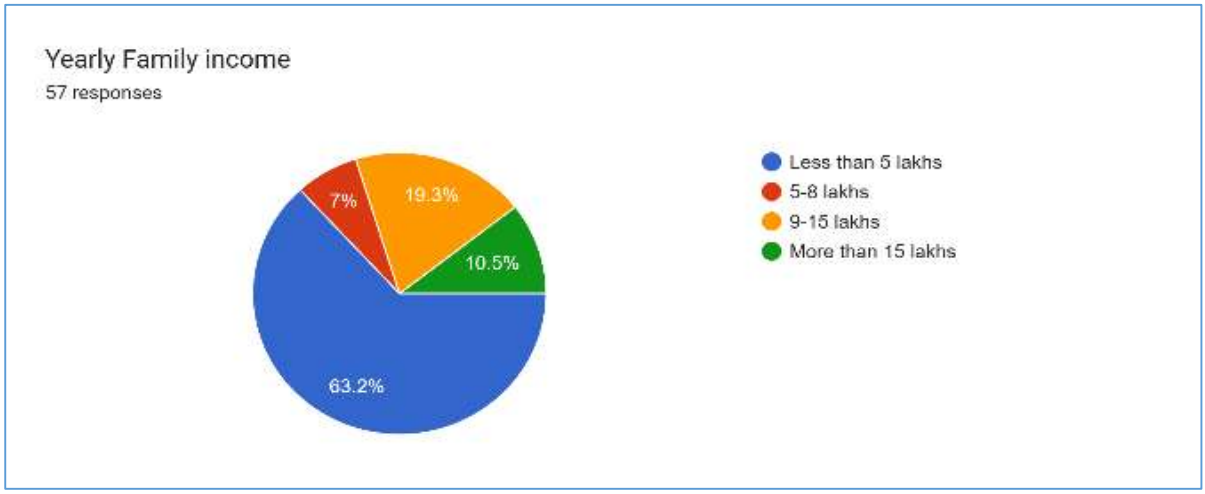
(H_0): There is no significant association between the age of women and the number of children they have.

(H_1): There is a significant association between the age of women and the number of children they have.

Analysis:

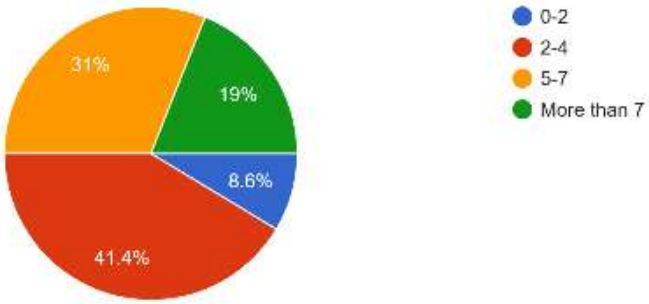
The analysis of the observed values provides us with age group of women and the no. of children in the family. the form also recorded if they were familiar with Janani Suraksha Yojana or provided with any government aid during of after pregnancy. Causes of death and illness also constitute our analysis.





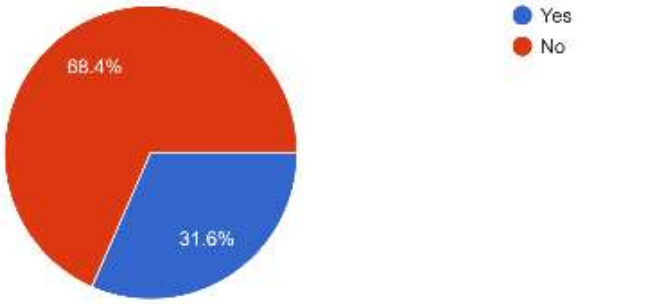
Number of members in the family

58 responses



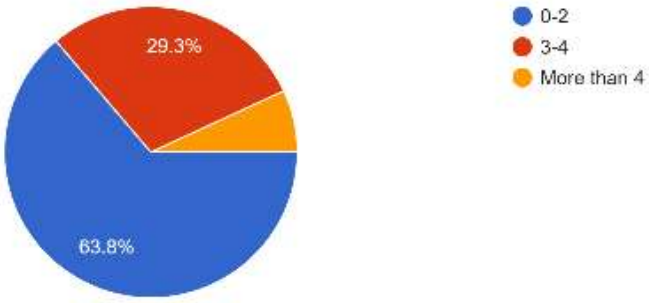
He you ever benefitted by any government policy

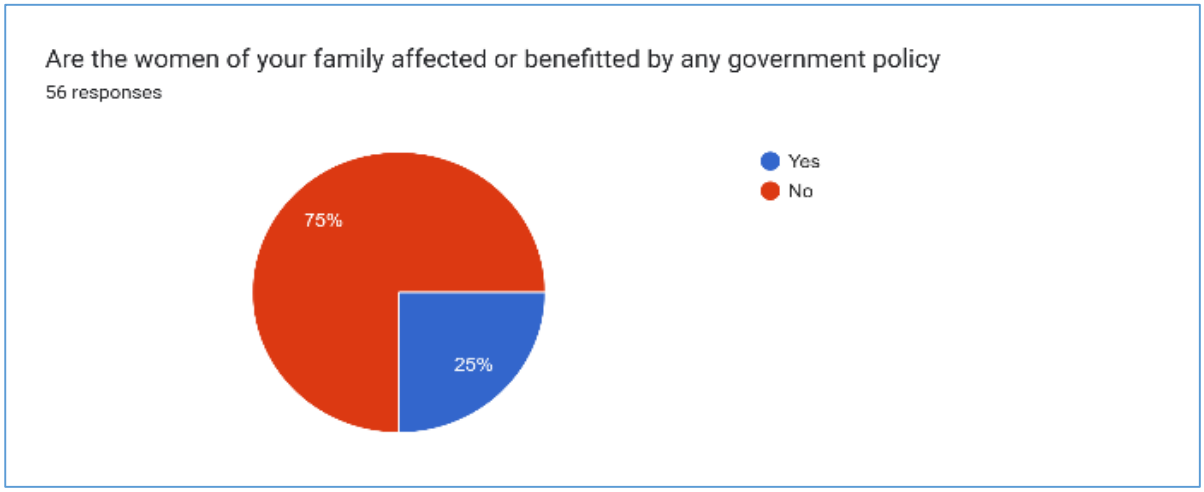
57 responses

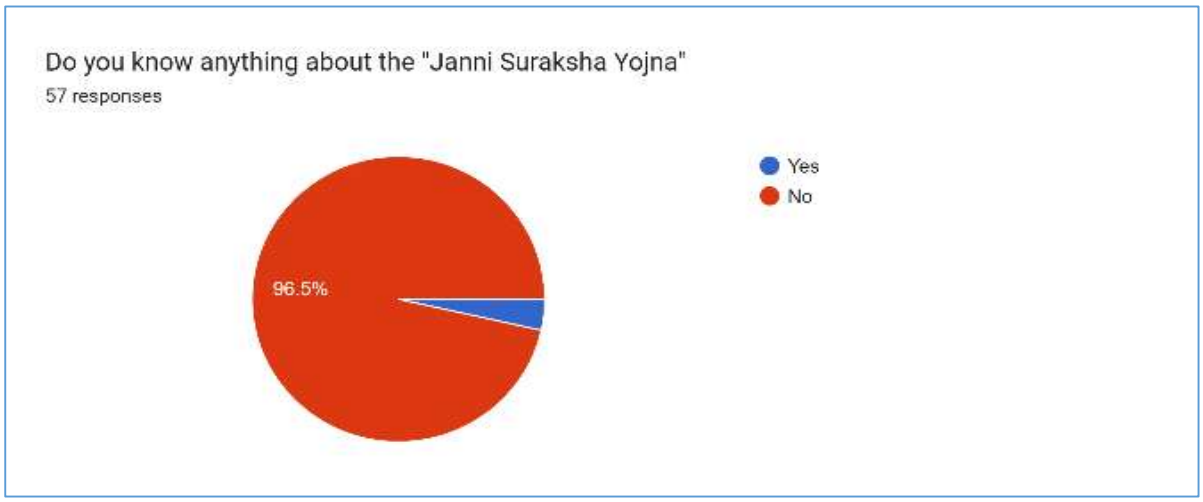


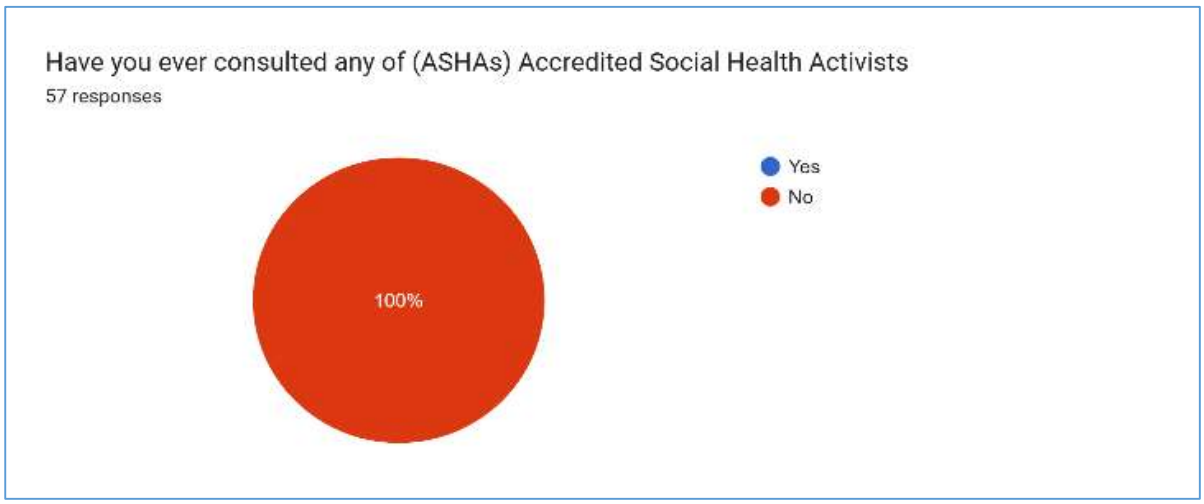
Number of children in the family

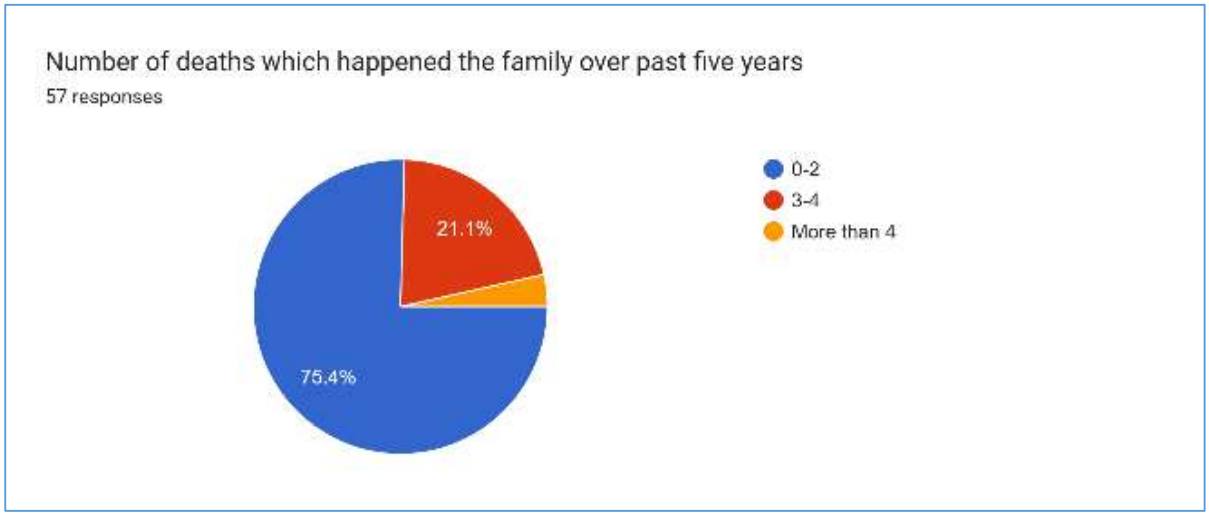
58 responses

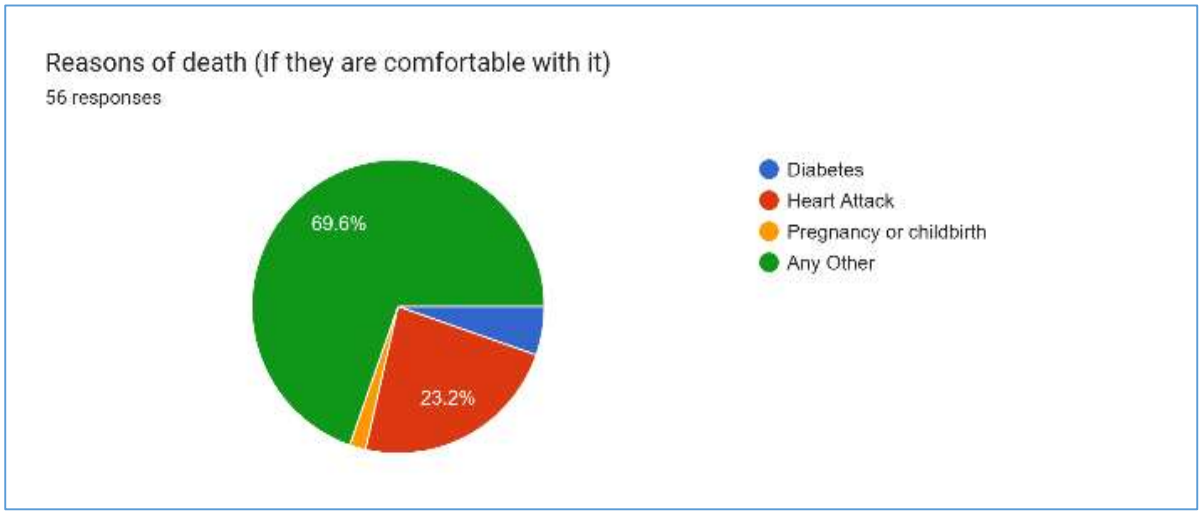



Are the women of your family affected or benefitted by any government policy
56 responses
75%
25%
Yes
No


Do you know anything about the "Janni Suraksha Yojna"
57 responses
96.5%
Yes
No


Have you ever consulted any of (ASHAs) Accredited Social Health Activists
57 responses
100%
Yes
No





Findings:

1. The survey emphasizes on low to almost no knowledge and awareness about Janani Suraksha Yojana, among the 58 women who we included in the survey only 2 have shown any awareness about the policy.
2. There is a statistically significant relationship between the age of women and the number of children they have. This implies that the number of children women have varies significantly across different age groups in the observed data.

Recommendation:

1. Improvement in the Public Healthcare Sector for Maternal Health

- **Strengthen Infrastructure**: Upgrade healthcare facilities in rural and underserved areas to ensure better maternal care, including access to prenatal and postnatal services.
- **Training for Medical Staff**: Conduct regular training programs for healthcare workers, midwives, and auxiliary nurses to improve the quality of maternal health services.
- **Accessibility of Healthcare**: Increase the availability of mobile healthcare units and telemedicine facilities for remote regions to ensure timely care for pregnant women.
- **Monitoring and Evaluation**: Implement a robust system to monitor maternal health programs, track outcomes, and ensure accountability at every level of healthcare delivery.

2. Inclusion of Policies in the Curriculum to Spread Awareness

- **Educational Curriculum**: Integrate topics related to maternal health, government welfare schemes, and gender equity into school and college syllabi to create early awareness.
- **Community Education Programs**: Organize workshops and seminars at the community level to educate families, especially women, about maternal health rights and government benefits.
- **Youth Engagement**: Engage youth groups and NGOs to run campaigns, using innovative methods like street plays, short films, and social media to spread awareness about maternal health policies.
- **Teacher Training**: Equip educators with the necessary tools and knowledge to effectively teach and create awareness about health policies and welfare schemes like JSY.

3. Utilization of Bank Transfers for Monetary Benefits

- **Direct Benefit Transfers (DBT)**: Ensure that all monetary benefits under schemes like Janani Suraksha Yojana are transferred directly to beneficiaries' bank accounts to reduce leakages and corruption.
- **Financial Inclusion**: Facilitate the opening of bank accounts for women in rural areas by collaborating with banks and financial institutions.

- **Awareness of DBT Process**: Conduct workshops and training sessions to educate women on how to access and utilize their benefits through bank accounts.
- **Grievance Redressal System**: Establish an efficient grievance redressal mechanism for beneficiaries to report and resolve issues related to financial disbursements.
- **Technology Integration**: Use digital platforms to track and manage fund transfers, ensuring transparency and timely delivery of benefits.

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A Study on Evaluating the Impact of Mergers on the Financial and Stock Performance of the Selected Acquirer Banks

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Abstract:

This study examines the financial and stock performance of six major Indian acquirer banks—State Bank of India, Bank of Baroda, Canara Bank, Union Bank of India, Punjab National Bank, and Indian Bank—after their mergers. To evaluate the financial impact, the EAGLE approach was applied. Over a 5-year period before and after the mergers, various financial metrics were calculated and compared. A paired t-test was used to determine whether the changes observed after the mergers were statistically significant. A total of 10 different metrics, covering 5 key financial areas, were analysed to assess how the mergers affected the financial performance of the selected banks.

Union Bank of India was found to undergo significant changes in the 5/10 metrics, the highest among the banks that have been analysed, followed by Bank of Baroda with significant changes seen in 4/10 metrics. The impact of the merger was the least on Indian Bank where significant changes were seen only in 3/10 considered metrics. Among the considered banks, Union Bank of India alone showed a significant increase in Return on Assets (ROA) whereas Canara Bank was the only bank that showed a significant decrease in its gross NPAs. Major changes were seen in the aspects of net NPAs, Capital adequacy ratio, and Interest income to total income of the considered banks.

The impact of mergers on the stock performance of the acquirer banks was understood using the average daily return, average annual return, beta, and volatility measures. It was found that the mergers had a positive impact on the stock performance of these considered banks and also the risk associated with the investment in these banking stocks has slightly decreased after the mergers. Overall, while financial performance indicators showed mixed

effects, the mergers improved stock performance. This analysis offers valuable insights into the impact of mergers on the major acquirer banks, particularly regarding stock performance and financial stability.

Key Words: EAGLE Approach, Mergers, Net Interest Margin, NPA, Capital Adequacy Ratio, Return on Assets, Beta, Volatility, Returns, Post-Merger Analysis.

Attainment of SDGs in urban slums

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Abstract:

The research aims to study and analyse the slums of Juhu, Mumbai, laying emphasis on living conditions of the urban slum dwellers and the extent of attainment of Sustainable Development Goals (SDGs) in these slums. It seeks to identify the root problem areas and provide suggestions for government intervention. A case study-based methodology was employed, which involved face-to face interviews with a questionnaire assessing living standards, health, education, economic standards and government intervention in these slums. The key findings included the existence of deep gender and economic disparity in the slums. While many residents lack access to healthcare, sanitation, usage firewood as the main source of cooking. Majority of the population is engaged in informal jobs. Poor air quality to be poor, lack of ventilation and open dumping of household waste, lead to several preventable diseases. In addition, masses consider their surroundings to be unsafe. It was also noted that women are less educated that men, resulting in poor mental health and them lacking equal economic opportunities. The research highlights the importance of addressing gender disparity, improving sanitation, waste management and education. Creation of job opportunities and enhancing the local security is also to be kept in mind. The study underscores the urgency of implementing stricter policies and programs to ensure sustainable development in the Juhu slums, as the current situation is far from meeting the SDGs.

Policies in The Health Sector

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This paper deals with the various healthcare policies such as Ayushman Bharat, Mahatma Jyotirao Phule Jan Arogya Yojana, etc. which the government launches and analyse whether the impact of such policies have actually reached the true beneficiaries.

A survey of 57 people was conducted by visiting slums, talking to delivery persons and speaking to potential interviewees. They were asked very basic questions like

1. Do they have a health insurance?
2. How often they consult a doctor?
3. Their awareness about the health policies
4. If not, then what stopped the information to reach them.

Through this survey I found that maximum population was unaware about the policies itself let alone the benefits that these bring to them or did not know how to access these policies of the government. Of those surveyed, 56.1% said they go to the doctor when they become sick, while 43.9% said they don't get medical attention. By visiting a doctor while ill, a small majority of the sample's members appear to value their health, according to the data. Nonetheless, a sizeable fraction of participants does not see a physician, possibly because of things like limited resources, inability to obtain healthcare, cultural restrictions, access constraints.

According to the data, 22 respondents (38.6%) indicated that they were familiar with the Ayushmaan Bharat Yojana, making it the most well-known initiative. This is probably because of its wide appeal and widespread use as a health insurance program meant to give millions of people access to reasonably priced healthcare.

From respondent input, several important issues about the existing affairs of the healthcare system, mainly concerning deprived sections of society has come to light. Their suggestions focus mainly on awareness-building, making application processes streamlined, more accessibility of health facilities, and also extending services to these deprived sections that consist of women, geriatric groups, and slum dwellers. Systemic corruption needs to be fought along with greater efforts to enhance transparency.

Making healthcare programs accessible and well-implemented would help bridge the gap that exists between what is provided by the government and the needs of the poor communities. This will enable them to fully benefit from the policies because of the emphasis on awareness, shortened procedures, and targeted healthcare initiatives. Ultimately, these changes will help create a more equitable healthcare system in which everyone has equal access to the benefits and treatment they are entitled to.

A Research Review On Precision Farming Using Machine Learning Approach

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Abstract

Agriculture is known to be the backbone of the Indian economy and also known as a principal source of income. Currently agro industry is dealing with difficulties such as water shortages, demand supply imbalance and weather discrimination, etc. which gives rise to problems such as unpredictable climatic variations, inadequate irrigation systems, deterioration of soil fertility, etc. Conventional farming approaches exacerbate the challenges already present. To deal with such uncertainties, farmers must be furnished with smart farming techniques. Machine learning, deep learning, artificial neural networks, big data analytics, and other approaches can all be used together to improve crop yield prediction. To forecast crop yield, many machine learning approaches such as prediction, classification, regression, and clustering can be used. A number of researchers have presented prediction models based on remote sensing, big data analytics and machine learning techniques. This study looks at a range of precision farming technologies for estimating agricultural production.

Keywords: Agriculture, Big data analytics, Crop prediction, Machine Learning, precision farming

1. Introduction

“Precision farming is the science of using the latest technology sensors and analysis tools to improve agricultural yields and help in management decisions”. It is used to improve the production yield of crops and to effectively use available agricultural resources such as

fertilizers, irrigation, etc.

Weather, soil type and quality, seed quality, fertilizer availability, and fertilizer and pesticide application efficiency are all elements that influence agricultural yield production.

It is a major problem for all farmers to manage these issues, and this is where precision farming comes in. Precision farming collects environmental data using a variety of ICT, remote sensing, IoT, Big data, and cloud computing technologies.

Prediction models based on IoT, remote sensing, data mining, big data analytics, artificial intelligence and machine learning techniques have been proposed by a number of researchers. Based on the results, these models can be effectively employed to boost total crop yield.

The Internet of Things employs a variety of wireless remote sensing techniques to collect real-time data, which may then be utilized to train prediction models for increased efficiency. The acquired data can then be stored using cloud computing techniques, and a big data strategy can be used to make such massive data appropriate for decision-making.

“Linear regression, logistic regression, Naive Bayes, KNN, Random Forest, and other machine learning algorithms can be used to discover which conditions generate the best yield for a specific crop”. “Machine Learning is a technology that allows systems to learn and improve automatically over time by continuous training. It consists of a series of well-defined models that gather certain data and use precise algorithms to obtain the desired outcomes.” “In order to improve the productivity and quality of the crops cultivated, machine learning techniques have been used in the agriculture area” [1].

This paper primarily focuses on reviewing the many strategies that can be used to improve the accuracy of crop yield prediction models.

2. Review of Literature

Many researchers have proposed various models which will be beneficial to farmers for precision farming.

Khaoula Abrouguia et al. examined the performance of ANN and MLR with diverse input data for predicting potato yield. The best model was obtained using ANN [2], which demonstrated that "crop production can be predicted by evaluating soil resistance to penetration, soil microbial biomass, and soil organic matter in the tilled layer, as well as estimating the tillage technique utilized".

M Chandraprabha et al., in this paper, the performance of several algorithms is estimated and evaluated. The entire technique works well with various factors, but when error rates are used as a performance indicator, the recurrent neural network (RNN) outperforms other algorithms [3].

R. Kingsy Grace et al. used Clustering algorithms on datasets of rice, wheat, and maize crops. E-DBSCAN's results are superior to DBSCAN, CLARA, and K-means, according to the results. The results show that DBSCAN performs exceptionally well in clustering. Furthermore, multiple linear regression prediction is less prone to errors. Wheat has the highest accuracy, and Ariyalur has the largest productivity among the districts evaluated in Tamil Nadu.

Mehdi Hussain et al. showed a self-contained robotic device capable of precise farming. "It includes a four-wheel PID-controlled robot that can generate a field map using odometry and a pH sensor, as well as a CNC mechanism for precision herbicide spraying and drip irrigation" [4].

Jaimahaprabhu A. et al. proposed a system where farmers are given a variety of crop and fertilizer alternatives. The sensor data is retrieved and visualized using the Android application, which is connected to the IBM data platform. The application communicates with Cloudant to obtain results, which are then processed and stored in the database.

Rehna Baby Joseph et al. used the "latest trends in agricultural UAVs to direct us to precision farming" [5]. To address the difficulties and limits faced by automated brilliant cultivating frameworks, a circulation of robotic framework strategy is applied.

S.Nagini et al., in this paper, exploratory data analysis has been performed, and multiple predictive models have been developed. Furthermore, in the states of Andhra Pradesh and

Telangana, several regression models such as linear, multiple linear, and non-linear models are tried for the successful prediction or forecast of agriculture production for diverse crops[6].

Monali Paul et al. proposed a system in order to predict crop production using available dataset, data mining techniques are used to classify soil into low, medium, and high categories [7].

Vaishali Pandith et al. based on the results of the experiment, it is stated that "machine learning techniques can be used to accurately anticipate mustard crop yields". However, in this study, "KNN and ANN were proven to be the most reliable strategies for predicting mustard crop output". "Farmers will be able to anticipate yield in advance using these effective machine learning approaches based on soil data" [1].

G Sai Pravallika et al. In this study, Sensors are employed in IoT-based applications to collect information such as moisture, pH value, temperature, and humidity, which helps anticipate the best crop to farm during the season. This basic experimental setup gives farmers the information they need in a timely and reliable manner.

S. Kanaga Suba Raja et al. proposed a system by estimating crop yield and price that a farmer can acquire from his land and analyzing patterns in prior data, the system aims to advise the best crop choices for a farmer to adjust to the need of the current socio-economic problem facing many farmers today. They employed a sliding window non-linear regression technique to predict crop yields based on several parameters impacting agricultural productivity, such as rainfall, temperature, market prices, land area, and previous crop yields. The analysis is carried out for a number of districts in the Indian state of Tamilnadu [8].

S. Rajeswari et al. proposed a model which can be used to analyze Big Data for the optimum crop sequence, the next crop to be planted for better production, total crop production in the area of interest, total fertilizer requirements, and other data. This model also makes it easier to predict overall productivity and total fertilizer requirements per crop region [9].

V.Roopa et al. suggested an agricultural business system that enhances crop productivity by gathering real-time crop status. The displayed patterns aid farmers in re-modeling, which is the overall goal of the suggested system, after additional investigation on automation and intelligent predictive systems of agriculture [10].

Shivi Sharma et al. in this study soil and environmental characteristics such as “average temperature, average humidity, total rainfall, and production yield are employed to predict two classes: good yield and bad yield”. The suggested approach is separated into three phases: “pre-processing, feature selection, and SVM GWO i.e grey wolf optimizer combined with Support Vector machine (SVM) classification is utilized to improve the accuracy, precision, recall, and F-measure”. In comparison to traditional SVM classification algorithms, the SVM GWO technique performs better [11].

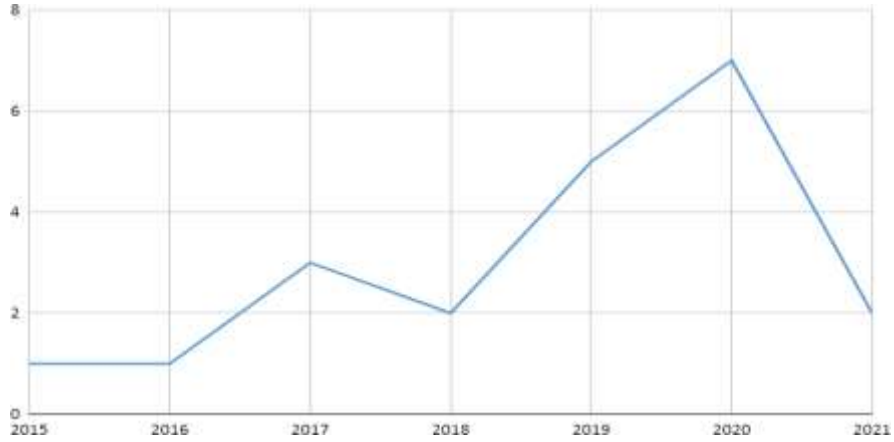
Ankita H. Tidake et al. have proposed a technique to prevent unintentional measures by combining continuous live research and weather forecasting so that farmers may acquire information about their crops on a regular basis. The system also ensures that farmers are alerted about changing weather conditions and preventive actions [12].

Rabin Thapa et al. said that for area and production forecasting, the ARIMA of order (0,2,1) was the best fit model, while for productivity forecasting, (0,2,0) was the best fit model.

3. Results and findings

The research papers employed in this study were chosen from a pool of thousands based on a keyword search and includes research study since 2015. This study has accessed Springer, Elsivier, IEEE and Web of Science sources. "Big Data," "machine learning," "agricultural," and "precision farming" were the search terms used across all data sources. Figure 1 shows the yearly distribution of the included papers.

Figure 1. Yearly distribution of the included articles



This research attempted to examine the many strategies that can be utilized to develop precision

farming predictive models. Table 1 shows a summary of the research papers used and the various techniques used in predictive models.

Table 1. Techniques used and brief description of predictive models used in agriculture

Sr. No	**Reviewed Literature**	**Techniques used and Brief description**
1	Khaoula Abrouguia (2019)	**Techniques used:** ANN and MLR **Brief description:** "With diverse input data, the performance of ANN and MLR for forecasting potato production was examined. With an RMSE of 0077 and a correlation coefficient of 0.975, the best response was produced using ANN" [2].
2	M Chandraprabha (2020)	**Techniques used:** "support vector machines (SVM), recurrent neural networks (RNN), K nearest neighbour regression (KNN-R), Naïve Bayes, BayesNet, support vector regression (SVR)" **Brief description:** "Several algorithms' performance is estimated and compared. The overall technique works well with a variety of factors, but the recurrent neural network (RNN) beats other techniques when error rates are employed as a performance metric" [3].
3	R. Kingsy Grace (2021)	**Techniques used:** DBSCAN; K-means; Multiple linear regression **Brief description: "**On datasets of rice, wheat, and maize crops, clustering methods were utilised. According to the findings, E-DBSCAN outperforms DBSCAN, CLARA, and K-means. DBSCAN performs remarkably well in clustering, according to the results. Furthermore, the prediction of multiple linear regressions is less prone to errors. Among the districts studied in Tamil Nadu, wheat has the best accuracy, and Ariyalur has the highest production" [13].
4	Mehdi Hussain (2020)	**Techniques used:** a four-wheel PID controlled robot, Machine Learningmodule **Brief description: "**A self-contained robotic device capable of precise farming was demonstrated. It has a four-wheel PID-controlled robot that uses odometry and a pH sensor to build a field map, as well as a CNC mechanism for precision herbicide spraying and drip irrigation" [4].

5	Jaimahaprabhu A (2019)	**Techniques used:** predictive algorithm model and IBM Watson Analytics **Brief description: "**This paper presented a system in which farmers could choose from a number of crop and fertiliser options. The Android application, which is connected to the IBM data platform, is used to retrieve and visualise sensor data. To obtain results, the application talks with Cloudant, which are subsequently processed and stored in the database" [14].
6	Rehna Baby Joseph (2020)	**Techniques used:** UAV, MAV **Brief description: "**Precision farming was guided by the current advances in agricultural UAVs. A robotic framework circulation approach is used to solve the difficulties and limitations confronted by automated brilliant developing frameworks" [5].
7	S.Nagini (2016)	**Techniques used:** general linear model (lm), generalized linear model (glm) **Brief description: "** Exploratory data analysis was undertaken in this work, and different prediction model were built. Furthermore, numerous regression models, including linear, multiple linear, and non- linear models, are being tested in the states of Andhra Pradesh and Telangana for the successful prediction or forecast of agriculture production for a variety of crops" [6].
8	Monali Paul (2015)	**Techniques used:** classification algorithms K-Nearest Neighbor (KNN) and Naive Bayes (NB), RapidMiner 5.3 **Brief description: "**Data mining techniques are used to classify soil into low, medium, and high categories in order to predict crop production using available datasets" [7].
9	Vaishali Pandith (2020)	**Techniques used:** ANN, KNN, Naive Bayes (NB), Multinomial Logistic Regression (LR), Random Forest (RF) **Brief description: "**Machine learning algorithms can be used to accurately predict mustard crop yields, according to the results of the experiment. KNN and ANN, on the other hand, were shown to be the most reliable techniques for predicting mustard crop output in this study. Using these powerful machine learning algorithms based on soil

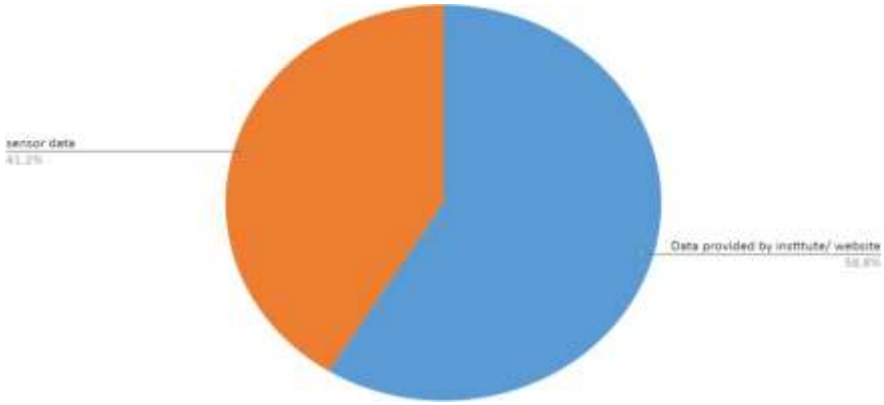
		data, farmers will be able to predict yield in advance" [1].
10	G Sai Pravallika (2020)	**Techniques used:** pH sensor, Temperature and Humidity sensor along with Arduino UNO **Brief description: "**Sensors are used in IoT-based applications in this study to collect data like moisture, pH value, temperature, and humidity, which aids in predicting the best crop to farm during the season. Farmers may get the information they need in a timely and accurate manner with this basic experimental setup" [15].
11	S. Kanaga Suba Raja (2017)	**Techniques used:** classification techniques, Text translation **Brief description: "**This paper proposed a method that estimates the crop yield and price that a farmer may obtain from his property and analyses trends in earlier data to advise the best crop selections for a farmer to respond to the current socioeconomic situation that many farmers are facing today. They used a sliding window non-linear regression technique to forecast crop yields based on rainfall, temperature, market prices, land area, and prior crop yields, among other factors that influence agricultural productivity. The analysis is carried out for a number of districts in Tamilnadu, India" [8].
12	S. Rajeshwari (2017)	**Techniques used:** IoT, C5.0 algorithm using MapReduce, cloud database **Brief description: "**This study provided a model for analyzing Big Data to find the best crop sequence, the next crop to plant for greater yields, total crop production in the area of interest, total fertilizer requirements, and other information" [9].
13	V.Roopa (2019)	**Techniques used:** IoT, Raspberry Pi, Zero Rule Algorithm, Image processing using libraries of OpenCV, K-means clustering **Brief description: "**It presented an agricultural business system that gathers real-time crop status to improve crop productivity. After more research into agriculture automation and intelligent predictive systems, the presented patterns enable farmers in re-modeling, which is the

		overall purpose of the suggested method" [10].
14	Shivi Sharma (2018)	**Techniques used:** Grey wolf optimization, support vector machine **Brief description: "**Soil and environmental parameters such as average temperature, average humidity, total rainfall, and production yield are used in this study to forecast two classes of yield: good yield and bad yield. To increase the accuracy, precision, recall, and F-measure, the suggested approach is divided into three phases: pre-processing, feature selection, and SVM GWO (grey wolf optimizer) paired with Support Vector Machine (SVM) classification. The SVM GWO approach performs better than typical SVM classification algorithms" [11].
15	P.Surya (2018)	**Techniques used:** regression techniques, Linear Regression, Logistic Regression, Polynomial Regression, Ridge Regression **Brief description: "**The predictor formula is said to be quite useful in agriculture crop production in tonnage crop prediction. In Tamil Nadu, particularly in the North Western zone, sugarcane and tapioca have the greatest yield production rates. In comparison to the other crops, banana, maize, ragi, turmeric, coconut, cotton, and jowar have the next greatest yield of production rate, according to the results of the predictor model".
16	Ankita H. Tidake (2019)	**Techniques used:** classification techniques (Random Forest algorithm) **Brief description: "**They have presented a method for preventing accidental measures by integrating continuous live research and weather forecasts so that farmers can get regular updates on their crops. Farmers are also warned to changing weather conditions and preventive actions using the system" [12].
17	Rabin Thapa (2021)	**Techniques used:** non-parametric Mann-Kendall (MK) test, ARIMA model **Brief description: "** According to the researchers, the ARIMA of

		order(0,2,1) was the best fit model for area and production forecasting, whereas (0,2,0) was the best fit model for productivity forecasting" [16].

According to the studies reviewed, the training datasets for prediction models are primarily obtained from institutes/websites or from field sensors. Figure 2 shows the percentage of different datasets used in the study.

Figure 2. Source of datasets used in predictive models



In the experiments, a wide range of crops are used. These crop varieties are mostly used to anticipate the best crop for a certain set of circumstances, such as meteorological conditions, soil kinds and behavior, and so on. It's also utilized for crop monitoring, crop productivity increases, and so on. Figure 3 depicted an attempt to map the numerous crops employed in various research studies.

Figure 3. Widely used crops in the crop yield prediction research

Figure 5 shows that maize is the most frequently applied research study crop in prediction models, followed by rice, peanuts, and wheat.

In summary, we can deduce that big data and machine learning approaches are implemented to address important issues in the agriculture area. Increased production and

Figure 4. Major problems addressed in the reviewed articles

quality, crop selection, soil behavior, climate forecast and control, crop monitoring, and other issues are discussed. Figure 4 gives a quick overview of the primary difficulties to be solved in relation to the various strategies utilized in the reviewed articles.

ANN, predictive algorithms, classification algorithms, machine learning algorithms, and other methodologies are employed in precision farming. Figure 5 shows how significant research articles examined here used predictive algorithms such as linear regression, logistic regression, and Naive Bayes to create the best working prediction models. The study articles have done their best to compare the efficiency, accuracy, and overall time taken to predict the results of various algorithms.

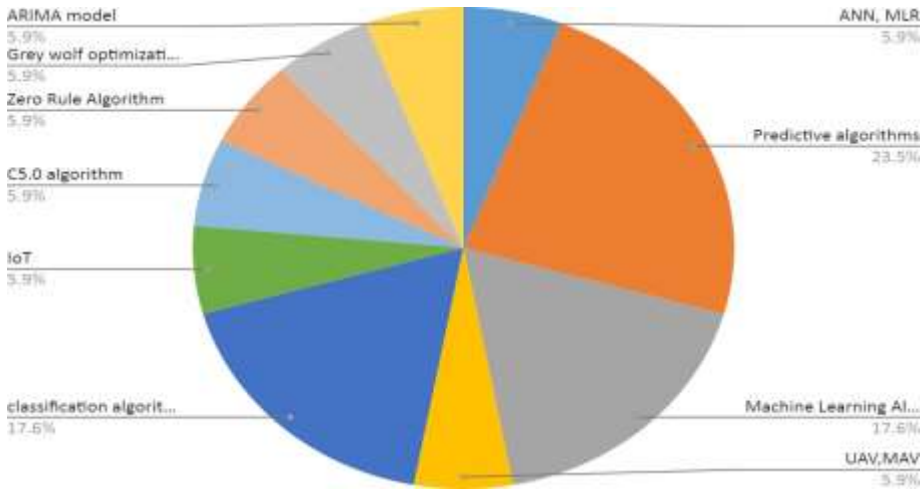


Figure 5. Number of technologies used in included articles

4. Future scope

Jaimahaprabhu A et al. stated that “the system can be improved with more datasets, farm irrigation facilities, and deep learning ideas, and the model can be integrated with cameras for crop disease diagnosis utilizing image processing”.

As described in the paper by Monali Paul et al., “other data mining classification techniques, such as support vector machine and principal component analysis, can be employed to develop more efficient models”.

“Crop yield prediction with a large soil data set can be implemented in a Big Data context, according to Vaishali Pandith et al. Fertilizer suggestions can be adopted based on yield prediction data to assist soil analysts and farmers in making informed decisions in the event of low crop production predictions”.

According to S Rajeshwari et al., “interfacing different soil nutrient sensors with any IoT tools, collecting data with the sensor tools, and storing the data in a cloud database, then analyzing and predicting with data mining algorithms suitable for agricultural Big Data analysis to get the desired result”.

According to V. Roopa et al. “the system can be adjusted to meet unique needs, and the overall yield can be visualized using Artificial Intelligence”.

“Other machine learning techniques such as artificial neural networks, random forests, and optimization algorithms with hybrid approaches to select the best feature can be integrated in the future”, as described by Shivi Sharma et al.

“Terrain-friendly robots with multiple sensors and live video streaming capabilities can also be employed to collect live data, increasing the predictive model's efficiency” as Mehdi Hussain et al.

P .S. Vijaybaskar et al. stated that “a graph can be created that displays information on the crops that other farmers in a certain location are currently planting”.

As discussed in the paper by Mohamed Torky et al., “precision agriculture systems can be

designed using reliable IoT networks that can withstand a variety of network security threats".

In the article written by Venkata Rama Rao Kolipaka employed that "to create machine learning models that can aid in the holistic feature selection-based analysis of data and help with more precise precision farming settings".

5. Conclusion

It is evident from the studied literature that precision farming techniques are evolving over time, producing more efficient and accurate results. In the context of embracing big data analytics solutions, the significance of machine learning models in the predictive analytic process for precision farming is becoming incredibly valuable. Although these technologies can analyze a significant number of heterogeneous data at a tolerable speed, using machine learning algorithms remains a hurdle. Agriculture's Big Data development and usage of machine learning has a great potential in precision farming. Cloud computing, on the other hand, will become more popular as network speeds improve intangibly. Machine learning approaches can also be enhanced by including deep learning features, which will eventually alleviate data volume issues.

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The Current Scenario of Grocery Retailing in India: An Overview

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Abstract:

The grocery retailing sector in India is undergoing a profound transformation, shaped by evolving consumer preferences, rapid urbanization, technological advancements, and policy changes. Historically dominated by traditional, family-owned grocery stores, the sector is now experiencing a rise in modern retail formats, including supermarkets, hypermarkets, and e-commerce platforms. India’s grocery retail market is among the largest in the world, contributing nearly 70% to the country’s total retail revenue. The sector is projected to grow further, with e-grocery emerging as the fastest-growing segment, fueled by advancements in digital technology, mobile connectivity, and changing consumer lifestyles. Despite the dominance of traditional grocery stores, modern retail chains like Reliance Fresh, D-Mart, and Big Bazaar are reshaping consumer shopping experiences with organized and efficient service offerings. This paper explores the changing landscape of India's grocery retail sector, specifically focusing on consumer preferences, market structure, and the growth of modern retail and e-commerce platforms. The study analyzes the impacts of urbanization, digital transformation, and evolving consumer behavior on the grocery sector. It also discusses the

role of government policies, including foreign direct investment (FDI) regulations and the Goods and Services Tax (GST), in shaping the sector's growth. The paper concludes with an outlook on the future of grocery retailing in India, emphasizing the importance of digital innovation, sustainability, and rural market expansion in driving long-term growth.

Keywords: Grocery Retailing in India, Grocery shops, Modern Store retailing, Consumer Preferences, Retailing in India, E-commerce and Digital Transformation

1.1 Introduction:

The grocery retailing sector in India is undergoing a significant transformation, driven by shifts in consumer behavior, technological advancements, and policy reforms. Traditionally dominated by small, family-owned grocery (mom-and-pop) stores, the sector is now witnessing the rise of modern retail formats, such as supermarkets, hypermarkets, and e-commerce platforms. This duality in the retail landscape has created a unique blend of traditional and contemporary shopping experiences for consumers. India’s grocery retail market is one of the largest in the world, contributing significantly to the country’s economy and employment. The unorganized sector, comprising small grocery stores, continues to account for a substantial share of the market, especially in rural and semi-urban areas. However, the rapid expansion of organized retail, supported by increased foreign direct investment (FDI) and growing consumer preference for convenience, quality, and variety, is gradually reshaping the sector.

The grocery business in India forms the backbone of its retail industry, contributing nearly 70% of the total retail revenue, with an estimated market size of $600 billion as of 2023. India’s grocery market can be categorized into traditional grocery shops (grocery shops), modern retail formats (supermarkets and hypermarkets), and e-grocery platforms. Traditional grocery stores dominate the sector with more than 80% market share due to their vast network, convenience, and personal relationships with customers. Modern retail, though smaller, is growing steadily, driven by urbanization and middle-class aspirations. Supermarkets and hypermarkets like Reliance Fresh, D-Mart, and Big Bazaar have made grocery shopping more organized and efficient by offering a wide range of products under one roof. Their focus on competitive pricing, quality assurance, and customer experience has earned them a strong foothold in urban and semi-urban areas. E-grocery platforms are the most dynamic segment, with players like BigBasket, Blinkit, and JioMart reshaping how Indian consumers shop for

groceries. The grocery business in India also reflects the diversity of the nation's consumption patterns, influenced by regional preferences, cultural nuances, and income levels. Staples such as rice, wheat, and pulses dominate consumption, while fresh produce, dairy, and packaged goods are gaining prominence. Health-conscious consumers are also fueling demand for organic, gluten-free, and other niche products.

1.2 Objectives of the Study:

1) To investigate the market share distribution and growth trends in India's grocery retail sector.
2) To evaluate the role of government policies and foreign investments in shaping the competitive dynamics of India's grocery retail market.

1.3 Global Position of India in Grocery Retail:

The global grocery market grew at 3.1% CAGR (compound annual growth rate) between 2020 and 2022, according to a 2021 forecast by The Institute of Grocery Distribution, U.K. (IGD).

Table 1.1: Global market size of grocery retail – Top 10 countries

Rank	Country	Market size in 2022 ($ billion)	CAGR (2020-2022)
1	USA	1655	0.2%
2	China	1627	5.8%
3	**India**	**656**	**7.2%**
4	Japan	408	0.3%
5	Germany	301	0.4%
6	Brazil	297	3.0%
7	France	287	0.4%
8	Russia	280	4.3%
9	U.K.	277	2.3%
10	Mexico	214	2.8%

Source: Global grocery retail will generate an additional $440 billion in sales by 2022 (The Institute of Grocery Distribution, U.K.).

The global forecasted scenario in Table No. 1.1 depicts India as the third largest grocery retail market. The U.S. is poised to retain the top rank with the largest market size but has the lowest CAGR (2020-2022) of 0.2%. China has a robust CAGR of 5.8% (2020-2022), and the online grocery segment is likely to see a major boost in China and the U.K. If the current CAGR continues, India will be the second largest grocery market of the world by the year 2036.

1.4 Market Structure and Composition:

The Indian grocery retail sector can be broadly classified into three categories:

1) Grocery Shops:

Comprising Grocery stores, local vendors, and street markets, these outlets dominate rural and semi-urban areas. They are characterized by personal relationships with customers, credit facilities, and flexible purchase options Traditional grocery shops, commonly known as grocery shops, along with local vendors and wet markets, form the backbone of the Indian grocery retail sector, accounting for over 80% of the market share. Their widespread presence, from bustling cities to remote villages, ensures accessibility for diverse consumers. These stores are deeply embedded in the social and cultural fabric of Indian communities, offering a personalized shopping experience that modern formats struggle to replicate. One of the key strengths of grocery shops is their adaptability. They operate with low overhead costs and can customize their inventory to meet the specific needs of local consumers. Many shops offer credit facilities, enabling customers, especially in rural and semi-urban areas, to make purchases and pay later. This personalized approach fosters trust and loyalty, making them indispensable in their localities. Another significant factor is the proximity of these stores to consumers' homes, making them convenient for quick and frequent purchases. Despite their dominance, traditional shops face challenges from modern store markets and e-grocery platforms.

2) Modern Store Retail:

Modern retail, including supermarkets and hypermarkets, is a growing segment in India, particularly in urban and semi-urban areas. Chains like Reliance Fresh, D-Mart, Big Bazaar and local Bazars have revolutionized grocery shopping by offering a one-stop solution

for a wide variety of products, including food, personal care, and home essentials , better hygiene, and self-service. These stores are known for their competitive pricing strategies, promotions, and discounts, attracting middle- and upper-middle-class consumers. D-Mart, for instance, has successfully captured market share with its low-cost operating model and emphasis on value-for-money products. Modern retail formats also prioritize hygiene, quality, and a pleasant shopping environment, which are increasingly valued by urban customers.

However, the segment is relatively small, accounting for about 10-12% of the grocery market. Expanding into Tier-II and Tier-III cities offers significant growth potential, as disposable incomes rise and consumer preferences evolve. Challenges include high operational costs, competition from traditional stores, and navigating India's regulatory landscape.

3) E-commerce and Online Grocery Retail:

E-grocery is the fastest-growing segment in India's grocery market, driven by increased digital adoption and changing consumer behavior. Platforms like BigBasket, Grofers (now Blinkit), and the grocery sections of e-commerce giants like Amazon and Flipkart have gained prominence, especially after the COVID-19 pandemic. These platforms offer doorstep delivery, cashless payments, and subscription-based services and Amazon Pantry offer consumer's unparalleled convenience, wide product variety, and the advantage of doorstep delivery. E-grocery platforms cater to diverse consumer needs, from daily essentials and fresh produce to premium organic products. They leverage technology to provide personalized recommendations, discounts, and subscription-based delivery services. Quick commerce, a subcategory offering delivery within 10-30 minutes, is also gaining traction with players like Zepto entering the market. Despite its rapid growth, the e-grocery segment faces challenges such as high delivery costs, complex logistics, and maintaining the quality of perishables. To address these issues, many companies are investing in efficient supply chains, dark stores, and cold storage facilities. Collaborations with local grocery stores also help them extend their reach while supporting traditional retailers. The segment holds immense potential, with projections indicating a compound annual growth rate (CAGR) of over 20% in the next five years. As consumer trust in online platforms increases, e-grocery is expected to become a significant contributor to India's grocery retail landscape.

1.5 Key Trends in Grocery Retailing:

i) Urbanization and Demographic Shifts:

India is witnessing rapid urbanization, with its urban population projected to reach 600 million by 2030, accounting for nearly 40% of the total population. This urban shift is driven by economic growth, job opportunities, and better living standards in cities. Urbanization is accompanied by changing demographics, including a growing middle class, nuclear families, and young, tech-savvy consumers, all of which significantly influence the grocery retail sector. Rising disposable incomes in urban areas have led to a shift in consumption patterns. Urban consumers increasingly prioritize convenience, quality, and variety, driving demand for modern retail formats and online grocery platforms. Supermarkets, hypermarkets, and e-grocery services cater to these preferences by offering a one-stop solution for groceries, home essentials, and specialty products.

Urban lifestyles also contribute to the growth of niche segments such as organic foods, ready-to-eat meals, and international brands. Health-conscious urbanites are willing to pay a premium for these products, creating opportunities for retailers to diversify their offerings. Furthermore, urban dwellers value time-saving solutions, prompting the rise of quick-commerce platforms delivering groceries within minutes. This demographic transition is also affecting rural-urban connectivity. Migrants from rural areas often retain ties with their hometowns, creating demand for region-specific products in urban stores. Retailers that adapt to these evolving needs and preferences stand to benefit significantly in the coming years.

ii) Digital Transformation:

India’s digital revolution has been a key driver of growth in the grocery retail sector. Smartphone penetration and affordable internet services have enabled millions of Indians to access e-commerce platforms, transforming how groceries are purchased. By 2024, the online grocery market is expected to grow at a compound annual growth rate (CAGR) of over 20%, underscoring the sector's immense potential.

Digital transformation encompasses various aspects, from e-commerce platforms to digital payments and logistics infrastructure. Platforms like BigBasket and Amazon Pantry

leverage advanced technologies such as artificial intelligence (AI) and machine learning (ML) to offer personalized shopping experiences. Real-time inventory tracking, dynamic pricing, and automated customer support enhance operational efficiency and customer satisfaction. Moreover, the government's push for digital literacy, through initiatives like Digital India, has created a favorable environment for e-commerce growth. Digital payments, enabled by platforms like UPI and Paytm, have made transactions seamless, even in smaller towns and rural areas. Logistics innovations, such as hyper local delivery networks and cold chains, further support the e-grocery segment by ensuring timely and quality delivery.

iii) Changing Consumer Preferences

The evolving preferences of Indian consumers have become a significant growth driver for the grocery sector. Traditional shopping habits are gradually giving way to organized retail and online platforms, influenced by changing lifestyles, higher disposable incomes, and increasing exposure to global trends. One key trend is the rising preference for quality and hygiene, particularly in urban areas. Consumers are drawn to supermarkets and e-grocery platforms that offer clean, organized shopping environments and a curated selection of products. This shift is especially notable in the wake of the COVID-19 pandemic, which heightened awareness of health and safety.

Additionally, there is growing demand for health-focused products like organic foods, plant-based alternatives, and gluten-free items. Consumers are also increasingly interested in sustainable and eco-friendly products, prompting retailers to adopt green practices such as plastic-free packaging and locally sourced goods. Convenience is another crucial factor shaping consumer behavior. Busy schedules and dual-income households have increased the demand for quick and hassle-free shopping solutions, driving the popularity of quick-commerce platforms and subscription-based services. Retailers that adapt to these preferences by offering personalized experiences and innovative product categories are better positioned to capture market share.

iv) Government Initiatives:

The Indian government has played an instrumental role in shaping the growth trajectory of the grocery sector through various policies and initiatives. One of the most notable measures

is the allowance of 100% Foreign Direct Investment (FDI) in food retail, which has encouraged global giants like Amazon and Walmart to invest heavily in the Indian market. These investments have helped modernize the sector by introducing global best practices, advanced technologies, and robust supply chains. Subsidies and incentives for agri-tech startups have also fueled growth by addressing critical challenges in agriculture and grocery retail. Technologies like blockchain, AI, and IoT are being increasingly adopted to improve supply chain efficiency, reduce food wastage, and ensure product traceability. For instance, cold storage facilities and food processing units have received financial support under government schemes, benefiting both farmers and retailers.

1.6 Challenges in Grocery Retailing:

i) Supply Chain Inefficiencies:

Supply chain inefficiencies remain a significant challenge for India's grocery retail sector. The supply chain is fragmented and involves multiple intermediaries, leading to higher costs, delays, and wastage of perishable goods like fruits and vegetables. Poor infrastructure, such as inadequate cold storage facilities and inefficient logistics networks, exacerbates this problem. Retailers, particularly e-commerce platforms, struggle to ensure timely delivery, especially during peak demand periods. Addressing these inefficiencies requires investment in modern warehousing, cold storage solutions, and last-mile delivery mechanisms. By improving the supply chain, grocery retailers can reduce wastage, lower costs, and increase profitability.

ii) High Competition:

The Indian grocery retail sector faces intense competition from traditional Grocery stores, organized retail chains, and e-commerce platforms. Each format has its unique strengths. Grocery stores are deeply entrenched in the community, offering personalized service and credit facilities, while organized retail offers hygiene, variety, and modern shopping experiences. E-commerce platforms provide the convenience of doorstep delivery. This intense competition forces retailers to innovate and offer unique value propositions to retain customers. Price wars, promotional offers, and loyalty programs have become common strategies, but they erode profit margins, making it difficult for smaller players to sustain themselves

iii) Consumer Trust and Loyalty:

Building consumer trust and loyalty is essential for the success of e-commerce platforms and modern retail chains. Unlike Grocery stores, which have long-standing relationships with customers, online platforms must establish trust from scratch. Issues such as product quality, delays in delivery, and refund processes affect customer satisfaction. Negative customer experiences can lead to high churn rates, making it difficult to retain customers. Retailers are now focusing on enhancing transparency, ensuring timely delivery, and improving customer service to build loyalty. User reviews, ratings, and customer feedback mechanisms have become essential tools for gaining consumer trust.

iv) Logistics and Last-Mile Delivery:

Last-mile delivery is one of the most critical and challenging aspects of grocery retailing, especially for e-commerce platforms. Ensuring timely delivery in crowded urban areas and remote rural locations requires efficient logistics systems. The unpredictability of traffic, weather conditions, and delivery agent availability adds complexity to the process. Retailers are adopting route optimization technologies, GPS tracking, and predictive analytics to improve delivery efficiency. However, the high cost of last-mile delivery impacts the profitability of e-commerce platforms. Retailers are experimenting with innovative models such as dark stores, local fulfillment centers, and partnerships with third-party logistics providers to overcome this challenge.

1.7 Government Policies and Regulations:

Indian government has introduced several policies that impact the grocery retail sector, such as:

i) Foreign Direct Investment (FDI) Regulations:

The Indian government has permitted 100% foreign direct investment (FDI) in single-brand retail and 51% in multi-brand retail. This policy encourages global retail giants to enter India, boosting competition and benefiting consumers. It allows foreign companies to set up

their retail operations in the country, giving them access to a vast consumer base. The entry of international players like Walmart, Amazon, and Carrefour has significantly impacted the competitive landscape. These players bring advanced technologies, efficient supply chain management, and innovative marketing strategies, thereby increasing operational efficiency in the sector. However, this policy has also faced criticism from small retailers and Grocery stores, who fear losing their market share to large multinational corporations. To address these concerns, the government has mandated that foreign retailers source a certain percentage of their products from local suppliers.

ii) E-commerce Policy:

The Indian government's e-commerce policy aims to regulate and promote fair competition in the digital retail space while protecting the interests of consumers and small businesses. The policy mandates that e-commerce platforms operate as neutral marketplaces, preventing them from favoring specific sellers or offering exclusive deals. This ensures a level playing field for small retailers and prevents large e-commerce giants from dominating the market. One of the key provisions of the e-commerce policy is the restriction on "inventory-based" e-commerce models for foreign companies. Under this rule, foreign e-commerce firms cannot own or control inventory sold on their platforms. Instead, they must operate as facilitators between independent sellers and customers. This provision is intended to protect small and medium-sized businesses from being overshadowed by multinational giants.

iii) GST Implementation:

The introduction of the Goods and Services Tax (GST) has had a profound impact on India's grocery retail sector. GST has simplified the indirect tax system by consolidating multiple state and central taxes into a single, unified tax structure. This change has reduced the overall tax burden on retailers and improved the ease of doing business. For grocery retailers, GST has streamlined supply chain operations, reduced logistics costs, and eliminated the need for multiple checkpoints during the movement of goods across states. One of the key benefits of GST implementation is the reduction of cascading taxes. Previously, retailers had to pay taxes on taxes at each stage of the supply chain, leading to inflated product prices. GST has eliminated this issue, resulting in more transparent pricing and cost savings for consumers.

Additionally, the introduction of input tax credit allows retailers to claim tax credits for inputs purchased, thereby reducing their tax liability.

1.8. Role of Rural Grocery Retailing:

Rural grocery retailing plays a vital role in India's economy, serving the needs of a large rural population that relies on Grocery stores and local vendors for essential goods. These retail outlets operate in remote areas where access to modern supermarkets or e-commerce platforms is limited. They provide convenience, credit facilities, and customized service, fostering strong customer relationships. Rural retailing also contributes significantly to rural employment, supporting livelihoods for shop owners, distributors, and local suppliers. Additionally, it drives the rural economy by facilitating the distribution of agricultural produce and locally made products. As digital payment adoption rises in rural areas, Grocery stores are integrating with payment apps, enabling smoother transactions. The rise of mobile connectivity and government initiatives like Digital India further boost rural retailing. Retail giants are also eyeing rural markets, launching affordable products and expanding rural supply chains. However, rural retailers face challenges such as limited inventory, supply chain issues, and competition from larger players. Addressing these challenges will be crucial for sustaining rural grocery retailing's growth and ensuring equitable access to essential goods for India's rural population.

1.9 Future Outlook of Grocery Retailing:

The future of grocery retailing in India is expected to be shaped by the following factors:

i) Digital Transformation:

Digital transformation is expected to revolutionize the grocery retail sector in India. Retailers are increasingly leveraging technologies such as artificial intelligence (AI), machine learning (ML), and predictive analytics to improve inventory management, enhance supply chain efficiency, and personalize customer experiences. AI-driven recommendation engines enable personalized product suggestions, while predictive analytics can forecast demand, reducing wastage and optimizing stock levels. Automated checkout systems and cashier-less stores may also become more widespread, providing seamless shopping experiences. Retailers investing in digital transformation will be better positioned to compete in the future.

ii) Rural Expansion:

Rural areas present a significant growth opportunity for grocery retail in India. With over 65% of India's population residing in rural areas, retailers are focusing on expanding their footprint in these untapped regions. Improved internet connectivity and smartphone penetration have facilitated the entry of e-commerce platforms in rural areas. Retailers are using localized supply chain models and partnering with local Grocery stores to facilitate last-mile delivery. Rural expansion will enable retailers to tap into a vast consumer base, thereby driving growth. Success in rural markets will require retailers to offer affordable products, flexible payment options, and customized service models.

iii) Sustainability and Green Retailing:

Sustainability is becoming a key consideration for retailers and consumers alike. The growing emphasis on environmental sustainability is driving demand for eco-friendly products, sustainable packaging, and waste reduction practices. Retailers are increasingly adopting green initiatives such as using biodegradable packaging, promoting reusable bags, and reducing food waste. Sustainable sourcing of raw materials and promoting local products are also gaining importance. Consumers, particularly in urban areas, are willing to pay a premium for sustainable products. Retailers who adopt sustainable practices are likely to gain a competitive edge and appeal to environmentally conscious consumers.

iv) Hybrid Retail Models:

Hybrid retail models, which blend online and offline shopping experiences, are set to become the future of grocery retailing in India. Retailers are adopting Omni channel strategies that allow consumers to shop seamlessly across physical stores, websites, and mobile apps. Services like "click-and-collect" enable customers to order online and pick up their groceries in-store. Hybrid models enhance customer convenience and provide greater flexibility. Retailers who integrate these models effectively can increase customer loyalty and reduce operational costs. Advanced technologies such as IoT and real-time inventory tracking play a crucial role in supporting hybrid retail models, enhancing efficiency and customer satisfaction.

1.10 Conclusion:

The grocery retail sector in India is experiencing a transformative shift, driven by rapid urbanization, technological advancements, changing consumer preferences, and evolving market dynamics. Traditional grocery stores, which have long been the backbone of grocery retailing, continue to dominate rural and semi-urban areas due to their deep-rooted presence and personalized service. However, modern retail formats and e-grocery platforms are gaining significant traction, particularly in urban regions, where consumers seek convenience, variety, and quality. The rise of digital technology and e-commerce platforms has accelerated the growth of online grocery shopping, offering consumers the convenience of home delivery, diverse product ranges, and competitive pricing. Moreover, the increasing adoption of smartphones, digital payments, and government initiatives such as Digital India has paved the way for e-grocery platforms to penetrate deeper into rural markets. This shift reflects broader changes in consumer behavior, with younger, tech-savvy, and urban consumers driving demand for modern retail formats. Despite the promising growth prospects, challenges such as supply chain inefficiencies, logistical constraints in rural areas, and intense competition between traditional and modern retail formats persist. Retailers must navigate these challenges by investing in technology, improving last-mile delivery solutions, and collaborating with local grocery stores to enhance reach and service quality. Additionally, the regulatory environment, including FDI policies and GST implementation, plays a crucial role in shaping the competitive landscape and growth potential of the sector.

In conclusion, the future of grocery retail in India lies in the successful integration of traditional and modern retail models, with an emphasis on digital innovation, sustainability, and rural market expansion. Retailers who can adapt to these changes and address the challenges will be well-positioned to capitalize on the sector's growth, contributing to the overall economic development of the country. This research highlights the importance of understanding consumer behavior, market trends, and technological advancements in shaping the future of grocery retail in India.

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Strengthening Cybersecurity: Legal And Ethical Challenges In Risk Management For The Digital Age

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Abstract

The rapid expansion of digital technologies has not only brought outstanding connectivity and convenience but also vulnerabilities to cyber threats in a connected world. This paper explores the legal and ethical challenges to cybersecurity in a digitalized world. The paper begins with the growing significance of cybersecurity highlighting the need for a robust-defenses in a hyper-connected world. Through a detailed analysis of the rise of ransomware, phishing and other AI-enabled cyberattacks including case studies the paper demonstrates the greater risks faced by individuals, businesses and government. The paper dives into the gaps in existing legal frameworks and the jurisdictional challenges in implementing them at the global level, and the enforcement of data protection laws like GDPR, CCPA, HIPAA. Ethical considerations surrounding the privacy technologies, data collection of individuals and the responsibility that falls upon organizations and government in protecting consumer data has also been addressed in the paper. The paper concludes with recommending strong legal frameworks for addressing and tackling cybercrime at the global level by cooperation between the countries, by establishing unified global framework, cross-border agreements, comprehensive international bodies, stringent legal measures for non-compliance, partnership between private and public sector, education and awareness among common man and the need for companies, organizations and governments to handle fairness, transparency and privacy of individuals when implementing laws. By providing legal, ethical and technological efforts this research paper aims at establishing a roadmap for safeguarding the digital ecosystem in the face of increasing cyber threats

Introduction

In today's hyper-connected world, where nearly every aspect of life relies on digital technologies, cybersecurity has become more crucial than ever. The rapid expansion of the internet and smart devices has made data exchange faster and more complex, but also more vulnerable to cyberattacks. From ransomware to data breaches, cyber threats pose significant risks to businesses, individuals, and national security. As our dependence on digital systems grows, so does the need for robust cybersecurity measures. Protecting sensitive information, maintaining trust, and ensuring system stability have become top priorities. Addressing these challenges is essential for a secure and resilient digital future. As technology advances, more devices and system become interconnected, forming what is often referred to as the "Internet of Things (IoT)" or the "Connected World". This includes smart devices, industrial systems, critical infrastructure, and more. In a connected world, the dynamic nature of cyber threats requires a comprehensive and proactive approach to cybersecurity because threat actors, including state-sponsored, and criminal enterprises are becoming more sophisticated by searching for vulnerabilities to exploit machine learning, and AI tools. Organizations need to adapt and evolve their cybersecurity strategies to address emerging challenges and safeguard their interconnected systems and data (*Connected World Cybersecurity*, n.d.). The primary focus of cybersecurity is to ensure confidentiality, integrity, and availability of data. This means that only authorized users should have access to specific data, that the data should remain accurate and unchanged unless authorized, and that the data should be available to authorized users whenever needed (*The Importance of Cybersecurity in Today's Digital World*, n.d.).

Major Cybersecurity Threats in the Digital Age

The number of connected Internet of Things (IoT) devices is expected to reach an astounding 14 billion by the end of this year and over 27 billion by 2025 (*IoT 2022*, n.d.). These so called "smart" devices are everywhere, from homes to businesses of all kinds to the infrastructure, transportation, and health care systems that underpin our "smart" cities. The benefits of being connected is clear. The proliferation of intelligent devices makes our lives easier and our businesses more efficient and productive. However, progress as usual comes with a cost. Being connected also means being more vulnerable to cyberattacks (*Cybersecurity in a Connected World*, n.d.). The well-known computer security and antivirus software company "Kaspersky" claims that during the first half of 2021, IoT cyberattacks more than

doubled annually.

According to Kaspersky, there were approximately 1.51 billion IoT device breaches between January 2021 and June 2021, up from 639 million in 2020. More than 872 million of IoT cyberattacks were found and many with the intent of cryptocurrency mining, distributed denial-of-service (DDoS) shutdowns or pilfering confidential data. The findings from studies have confirmed that the pandemic has exaggerated IoT vulnerabilities by expanding the use of device within the household settings. Many of these devices whether intended for enterprise for or personal use lack adequate security protocols (*IoT Cyberattacks Escalate in 2021, According to Kaspersky*, n.d.). According to the "National Security alliance", "ransomware" has become one of the world's biggest cybersecurity threats today. Ransomware assaults often encrypt sensitive information using any executable, then hold the files hostage until a ransom is paid. When any target refuses to pay the ransom, then attackers threaten to delete the data or even make it public. No matter how threat actors gain access to an organization's sensitive data, ransomware attacks often results in heavy financial loss and irreparable damage to their reputation (*Rise-of-Ransomware.Pdf*, n.d.). Companies have traditionally been a desirable target for ransomware because of their sensitive data as well as their financial resources. Although ransomware can appear in any industry, it is more common in those like finance, healthcare, and utilities that depend significantly on data for their operations. That said, the impact on business operations differs from industry to industry, for instance, in healthcare, if a patient's health record or protected health information is released or locked by an intruder, then it can bring the medical operations of a given hospital or a clinic to a standstill, thus jeopardizing patient well-being (*Rise-of-Ransomware.Pdf*, n.d.). One case was of the 'WannaCry Ransomware Attack' in May 2017. This case had a devastating impact on the UK's "National Health Service (NHS)", disrupting critical healthcare operations and highlighting severe vulnerabilities in cybersecurity infrastructure. The ransomware infected NHS systems, encrypting vital data and demanding payment in exchange for decryption keys. As a result, hospital staff were locked out of patient records, surgeries were canceled, and communication systems, including telephones, became inoperable. An estimated one-third of NHS trusts in England were affected, causing widespread privacy concerns as sensitive medical data was compromised. This case underscored the urgent need for robust cybersecurity measures in critical infrastructure sectors like healthcare, where cyberattacks can directly endanger lives. By contrast, a ransomware attack on a technology company could impact not only the targeted company but also many companies that use their technology, thus effecting a massive halt of

services and damage to the company's brand (*Rise-of-Ransomware.Pdf*, n.d.).

For instance, the case of "Chemonics International Data Breach". This case was first detected on December 15, 2023, exposed sensitive consumer data and highlighted vulnerabilities in the organization's network security. The breach investigation revealed that unauthorized access to the Chemonics network occurred between May 30, 2023, and January 9, 2024, allowing the intruder to access confidential information. Chemonics responded by notifying law authorities, securing its network, changing all passwords, and deactivating impacted accounts. In order to determine whether data was hacked and who was affected, the organization thoroughly examined the compromised files; this procedure was finished on October 31, 2024. On December 3, 2024, Chemonics sent notification letters to affected individuals, detailing the compromised information. This case underscores the importance of timely detection, robust security measures, and transparent communication during a data breach (*Chemonics International Announces Data Breach Following Unauthorized Access to IT Network | Console and Associates, P.C. - JDSupra*, n.d.). Attackers now target governments in addition to corporations due to the current geopolitical environment. Recent ransomware attacks targeting the government include:

A. In 2021, a ransomware attack known as PayOrGrief targeted a local U.S. County government system. The incident disrupted server access and affected essential services, including COVID-19 vaccination scheduling. Additionally, the attackers extracted more than two gigabytes of sensitive data (*220330.Pdf*, n.d.)
B. In 2021, ransomware incidents impacted 14 out of the 16 critical infrastructure sectors in the United States. Likewise, ransomware attacks were reported by the Cyber Security Centers in both Australia and the United Kingdom, affecting their infrastructure

Another kind of hack is called "phishing," which involves deceiving people into sharing important information via fraudulent emails, texts, calls, or websites, leading them to download malware or otherwise expose themselves to crimes. Phishing assaults, which are typically a type of social engineering attack, involve pressure techniques, false narratives, and human error to trick victims into inadvertently hurting themselves or their companies. Cybercriminals like it and use it successfully. The hacker usually assumes the identity of a trusted person, such as a supervisor, coworker, authority figure, or representative of a well-known company, in attempt to gain the victim's trust. According to IBM, phishing accounts for 15% of all data breaches, making it the most prevalent vector. Breaches caused by phishing cost organizations an average

of USD 4.88 million (*What Is Phishing?*, 2024). Between the period of 2013 and 2015, “Facebook” and “Google” were deceived out of $100 million through a prolonged phishing campaign. The fact that both businesses collaborated with "Quanta, a Taiwan-based vendor" was taken advantage of by the attacker. The attacker duped "Facebook" and "Google" into paying by delivering a string of fake invoices that looked like they were from Quanta. After the scam, was eventually uncovered, Google and Facebook filed lawsuits in the US. After being detained in Lithuania, the assailant was subsequently extradited. As a result of the legal proceedings, Facebook and Google managed to recover $49.7 million of the $100 million that was stolen (*The Top 5 Phishing Scams of All Time*, n.d.). In 2016, FACC, an Australian manufacturer of aerospace parts, lost a significant amount of money to a BEC scam where the phisher posed as the company’s CEO and instructed an employee in the accounting department to send $61 Million to an attacker-controlled bank account (*The Top 5 Phishing Scams of All Time*, n.d.). Current phishing patterns show that con artists are always coming up with new ways to evade detection. For example, "AI Phishing" creates phishing communications using generative AI technologies. These systems are able to produce customized emails and texts that are free of grammatical errors, spelling mistakes, and other typical warning signs of phishing attempts. Scammers can expand their activities with the aid of generative AI. IBM claims that a scammer needs 16 hours to manually create a phishing email. In just five minutes, scammers may use AI to craft ever more convincing communications. In order to give their scams more legitimacy, scammers also employ voice synthesizers and image producers. For instance, in 2019, attackers used AI to clone the voice of an energy company CEO and scam a bank manager out of USD 243,000 (*What Is Phishing?*, 2024). Another type of cybercrime include is that of an malicious insider threat. It is know that sometimes the biggest threats come from within an organization, Insider threats can take any form but one of them is that of a malicious insider threat which refers to an individual, employee, contractor or any other person within the company who misuses companies sensitive data for malicious purposes intentionally (*The Importance of Cybersecurity in Today’s Digital World*, n.d.). In September 2017, a former employee of one of Coca-Cola's subsidiaries stole an external hard drive that included the personal information of 8,000 employees, posing a serious insider threat to the company. Law enforcement initially requested the company delay disclosure while investigating the breach. Once notified, Coca-Cola reassured affected employees that there was no evidence of the stolen information being used for identity theft. To address concerns, the company partnered with Kroll to offer one year of free identity monitoring and urged employees to stay vigilant by reviewing their account statements and credit reports. Insider threats, as highlighted by PwC's

Global State of Information Security Survey 2018, remain a leading cause of security incidents, with such breaches often resulting in financial costs to enterprises. While Coca-Cola's stock had already seen a decline of 3.91% over three months and 7.56% over six months before the breach became public, the long-term impact on its finances remains unclear (Zurkus, 2018).

Legal Challenges in Cybersecurity and Risk Management

Existing legal frameworks often fail to keep up with the rapidly evolving nature of cybercrime, leaving significant loopholes for criminals to exploit. The lack of coordination and outdated regulations makes it challenging to effectively investigate and prosecute cyber threats both nationally and internationally. Following are some of the frameworks:

1. The “IT Act 2000's” ambiguities have become major legal issues in India's quickly expanding digital era. Although the Act played a significant role in establishing the groundwork for digital governance and e-commerce, it is unable to handle the complexity of contemporary technology. For example, while “Section 43A of the IT Act” concerns carelessness in handling sensitive data, it does not provide a thorough framework for data privacy. Indian users are consequently exposed to illegal data gathering and data breaches. The Act does not sufficiently address new risks including phishing, internet stalking, and cyberbullying. The prosecution process is made more difficult by the fact that many of these crimes are not clearly defined. Additionally, the problem is made worse by the lack of strict legal procedures to punish violations (Team, 2024).
2. There are no particular clauses pertaining to the safeguarding of vital infrastructure in the “Budapest Convention”. It should be noted that the Budapest Convention combines its legal measures over multiple sections and concentrates more on basic cybercrimes such unauthorized access, data interference, and system interference. Without branching out into more general cyber-enabled crimes, this structure indicates a more focused approach to crimes that directly involve computer systems and data (*Comparative Analysis*, 2024).
3. The “UN Convention” against Cybercrime does not include offences related to copyright infringement (*Comparative Analysis*, 2024). The Convention’s lack of adequate safeguards and its potential for abuse by authoritarian regimes make it a dangerous precedent for international cooperation (Jahangir, 2024). Numerous human rights organizations declared in February 2022 that the treaty's wording was excessively

expansive and might be detrimental to journalists and researchers. Some warn that member states could use the treaty to limit free expression or justify state surveillance (Jimenez, 2024).

The enforcement and compliance of data protection laws, such as GDPR, CCPA, and HIPAA, present significant challenges for organizations across various industries. These laws are designed to safeguard personal data, but businesses often face difficulties in fully meeting the requirements. At the same time, regulatory bodies struggle with ensuring consistent enforcement and addressing violations effectively.

1. While freedom of speech and privacy are both considered essential rights in Europe, in the United States, freedom of expression typically takes precedence over privacy when the two principles clash. The creators of the GDPR are worried that the regulations may be overturned by American-style freedom of speech arguments. For example, the ruling in "IMS Health" by the "U.S. Supreme Court" implied that the sale of medical prescription data for direct marketing purposes was protected under the constitution. Many protections would be eliminated by such a broad expansion of constitutional rights to commercial operations (Hoofnagle et al., 2019).
2. As long as there is a way to opt out, the CCPA generally does not require a prior legal jurisdiction to gather personal data and does not specify when or how businesses can use it. However, the law does include some exceptions that override the CCPA, includes, obeying federal, state or local laws, cooperating with law enforcement or regulators, doing internal research for product development, conducting public interest research (maksim, n.d.).
3. The HIPAA Privacy Rule requires appropriate safeguards to protect the privacy of protected health information and sets limits and conditions on the uses and disclosures that may be made of such information without an individual's authorization (Rights (OCR), 2008).

Due to the international nature of the internet, where criminal activity can occur across borders and legal systems, jurisdictional issues in cybercrime prosecutions arise. Because different governments may have conflicting rules, differing degrees of cooperation, or difficulties implementing cross-border legal processes, these hurdles make it more difficult to prosecute cybercriminals. The following are a few jurisdictional issues that arise in cybercrime cases:

1. Cybercrimes that impact victims across many jurisdictions can be perpetrated from a single country. Because cybercriminals can readily operate from places with lax or ineffective laws and law enforcement, determining which nation has jurisdiction over a cybercrime occurrence can be difficult.
2. Cybercriminals frequently employ methods like proxy servers, anonymizing services, and hacking through compromised networks to hide their identities and whereabouts. This complicates the process of identifying and apprehending the criminals by making it impossible to pinpoint the jurisdiction from where the crime originated.
3. Only certain jurisdictions may have the technical know-how and specialized knowledge needed for cybercrime investigations. Law enforcement agencies may find it more difficult to properly investigate and prosecute cybercrimes if they lack the necessary financial and technological resources.

   Conflicts may emerge and present diplomatic and legal difficulties when several nations assert jurisdiction over a cybercrime occurrence. Identifying the proper jurisdiction and settling disputes necessitate close coordination and collaboration between the participating nations (*(PDF) Cybercrime and Its Legal Implications*, 2024)

Ethical Considerations in Cybersecurity Practices

The idea of privacy has been defined in a variety of ways by philosophers, legal experts, scientists, and the government, emphasizing how context-dependent privacy is like ethics. For example, the emphasis on control over personal information is one definition of privacy. A great deal of study on privacy policies has been conducted as a result of increased public and governmental awareness, and as a result, privacy laws such as the “EU General Data Protection Regulation”, the “Personal Information Protection and Electronic Documents Act”, and the “California Consumer Privacy Act”. However, in contrast to security, there is a lack of technical maturity and standardization particular to the industry, which leads to complexities and misunderstandings. In order to avoid penalties imposed by rules, organizations endeavor to achieve check-box compliance. For example, highlighting the "Accept All Cookies" button and greying out a "Reject All Cookies", which is confusing and detrimental to privacy but nevertheless passes a privacy audit. When considered as an ethical notion, privacy can assist organizations in addressing technical system design holistically, resolving privacy issues, pushing them to come up with innovative solutions, and fostering a culture of respect for individual privacy. Organizations are encouraged to actively operationalize privacy in their

culture and transform it into creative solutions because it is an ethical idea. It holds everyone in an organization responsible for defending people's right to privacy, not simply security, privacy, or compliance staff. This would also entail developing technologies that gather, process, and distribute information while honouring people's choices, as well as giving everyone the appropriate channels to report privacy concerns. For businesses to profit from a reliable relationship with their customers, privacy due diligence and care should be represented in technological innovation and privacy engineering. (*Privacy: An Organization's Responsibility for Building Trustworthy Systems | IAPP*, n.d.). Governmental organizations have been hesitant to implement appropriate procedures pertaining to consumer data until lately. However, it is believed that we are now moving in the right way, with awareness at an all-time high and the emergence of new blockchain technologies that support digital identification. The "General Data Protection Regulation" has established the gold standard for handling customer data in Europe. Many nations are adhering to the European Union's principles for data privacy, with states like California, Australia, and Canada enacting their own laws (*With Great Power Comes Great Responsibility: Protecting Consumer Data*, n.d.).

Conclusion and Recommendations for a Secure Digital Future

The strategies presented are aimed at providing strong legal frameworks for tackling cybercrime at the global level by cooperation between countries in the digital environment for safeguarding the rights and security of individuals and organizations.

Following are a few recommendations for a secure digital future

- A unified, global legal framework for all that will help laws, policies, rules and guidelines for tackling cyber threats, ensuring that nations work in collaboration
- Establishment of cross-border agreements, cyber laws through bilateral and multilateral agreements, introduction of comprehensive legislations in areas such as artificial intelligence, data protection, cryptocurrency
- Establishment of comprehensive international bodies to monitor, investigate and stringent legal measures to penalize cybercrime to promote accountability
- Encourage collaborations between private and public sectors with various organization at the global level in taking an initiative towards combating cyber threats and create a more secure and cyber resilient environment for all

- Establishment of awareness campaigns to educate citizens about cyber risks and best practices such as recognizing phishing attacks to secure personal data

Last but not the least, ethical cybersecurity practices in risk management is important in the digital age. Both nationally and internationally, organization must adopt responsible and accountable ways to handle fairness, transparency and privacy of individuals when implementing measures. Protecting sensitive data of the user and prioritizing right to privacy is essential in ethical risk management to keep individual data secured that aligns with ethical principles. Companies and government must act with integrity when dealing with sensitive individual data to foster trust among investors, stakeholders and employees.

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Market Dynamics and Analysis of Mumbai Metro and Local

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Our field project, "Market Dynamics and Analysis of Mumbai Metro and Local," explores the relationship between two crucial transportation systems in Mumbai: the Local Trains and the Metro. These systems, essential for the city's daily commute, serve millions of people but also faces unique challenges and growth opportunities.

Our report delves into many aspects, including fare structures, service standards, economic contributions, and employment impacts. The Local Trains, running since the mid-19th century, are known for their cheap and wide reach but faces various issues like overcrowding and outdated infrastructure. In contrast, the Mumbai Metro, a more new addition to daily commute, prioritises comfort and efficiency, though it comes with higher fares and limited network resulting is less coverage. Our study highlights a segmented market where commuter preferences vary due to cost involved and their convenience.

We have used a combination of primary surveys and secondary research to analyze both transportation systems. Data collection involved surveying over 150 people through offline surveys and online forms, focusing on factors such as fare sensitivity, preference in mode of transport and demand trends. Secondary research from official reports and reliable sources supported this analysis.

The findings tells that midday travel accounts for a significant share of demand, alongside the traditional peak hours. While Local Trains cater primarily to lower-income travelers with their affordability and also caters to those travelers which there is no reach of metro, whereas the

Metro attracts middle-class and premium users. Gaps in service availability during non-peak and late-night hours were also identified.

The economic importance of these transportation networks, notably their role in fostering urbanization and employment creation, is emphasized in the paper. In order to satisfy the growing expectations of commuters and improve overall operational performance, it makes proposals such network expansion, increased service frequency, and the use of integrated ticketing systems. This analysis provides a solid foundation for tackling Mumbai's transportation issues.

A study on the effect of Remote Working practices in the post covid era with special reference to the IT sector in Mumbai City

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Abstract

In the wake of the COVID-19 pandemic, businesses globally, including the Information Technology (IT) sector, have undergone profound transformations necessitating significant shifts in Human Resource Management (here after referred to as HRM) practices. Amidst the pandemic, companies swiftly adapted to remote work, digitalized hiring processes, and revamped onboarding methods to sustain operations. This study looks at the changing face of HRM post-COVID in the Indian IT sector, recognizing its pivotal role in organizational success and job creation. Strong HRM practices are very much needed in the IT sector because of the indispensable contribution to economic growth and job creation. Therefore, to ensure organizational resilience and employee satisfaction, the effects of these changing HRM practices need to be evaluated.

The literature review highlights the diversified influence of COVID-19 on HRM, thus highlighting remote work, digitalization, and the combination of HRM with technological advancements. Information drawn from various authors like Elayan M. B., Nteboheng Patricia Mefi, Xiaoyan Liang, Annisha, Reza Nurul Ichsan, and Sasmita Misra help provide an all-rounded perspective on the pandemic's challenges and opportunities. Based on this context, the project objectives outline the study of HRM practices after COVID, determining their impact on employee job satisfaction, and their effect on productivity. The abstract captures the urgency and relevance

of understanding the changing nature of HRM practices in the IT sector post-COVID while underlining the need for proactive measures to ensure organizational resilience and employee well-being. By addressing these objectives, the study aims to contribute valuable insights to HRM discourse and inform strategies for navigating the post-pandemic landscape effectively. We tested through the two-hypothesis using Chi Square test which concluded that there is significant relation between remote working and job satisfaction and remote working and employee productivity.

Introduction

The role of information technology (IT) in shaping India's economy is multifaceted and profound. IT functions as a foundational support system for diverse industries such as Travel, Healthcare, Hospitality, Education, Legal, Entertainment, Banking/Finance, Retail, among others. Its integral role in rendering these sectors accessible to end customers is undeniable, and the profound impact of IT on these businesses is unequivocal.

Mr. Singh reviews several interrelated aspects of the role of information technology in the evolution of India’s economy. It considers the unexpected success of India’s software export sector and the spillovers of this success into various IT enabled services, attempts to make IT and its benefits available to India’s rural masses, e-commerce for the country’s growing middle class, the use and impacts of IT in India’s manufacturing sector, and various forms of e-governance, including internal systems as well as citizen interfaces. (Singh, 2016)

In the contemporary era, the Information Technology (IT) sector stands out as a burgeoning industry characterized by a relatively youthful workforce. Recognized as indispensable for fostering exponential economic growth and creating myriad employment opportunities, the IT industry assumes a pivotal role in contemporary socioeconomic landscapes.

Human Resource Management (HRM) Functions are a vital part to work out the whole organization. The HRM practices that deal with people, performance, information, and work because they create an "Environment" and “Infrastructure” that affects employees, customers, stakeholder's effectiveness, and the overall performance of an organization. (Shil, Barman, Zayed, & Shahiduzzaman, 2020)

Given the irreplaceable and pervasive nature of the IT sector, there arises a heightened imperative to institute robust Human Resource Management (HRM) practices. Such practices are crucial in ensuring that employees are satisfied to their fullest potential, which leads to the continued effectiveness and vibrancy of this essential industry.

The contemporary workplace environment has undergone tremendous changes, particularly since the outbreak of the global pandemic. The COVID-19 pandemic revealed the critical role of employee mental health and well-being in determining organizational performance and productivity. In this study, Mr. Olele Afam Chukwudi explores the influence of HRM practices on employee mental health, stress management, and overall well-being in post-pandemic work environments in Nigeria. The adoption of evidence-based HRM practices, with an emphasis on employee mental health and positive work environment, is recommended. Moreover, recommendations on post-pandemic HRM strategies were presented, which included hybrid work models, the establishment of mental health support networks, regular mental health assessments, and strengthening EAPs. (Chukwudi & Eusebius, 2023)

The COVID-19 pandemic has dramatically transformed Human Resource Management (HRM) practices, with remote working becoming a prominent trend. While remote working was a growing but not ubiquitous aspect of workplace culture before the pandemic, the need to keep business operations running during lockdowns and social distancing mandates sped up the adoption of remote work across various industries.

Post-COVID, remote working has become a cornerstone of HRM practices. Companies have recognized the benefits of remote work, such as increased employee productivity, reduced overhead costs, and access to a broader talent pool unconstrained by geographic location. As a result, many organizations have adopted hybrid work models, combining remote and in-office work to offer flexibility and maintain a balance between work and personal life for employees. In this paper, some aspects of human resource management are investigated to see the impact of working from home on HRM especially in a pandemic situation. The absence and non-adoption of ICT in different organizations explain why some organizations are away from performing their regular human resource management activities during the outbreak of the COVID-19 pandemic. (Rahman, Md Habibur , & Mahbubur, 2023)

The COVID-19 pandemic has brought mental health to the forefront of Human Resource Management (HRM) practices, highlighting its critical importance in maintaining a productive and engaged workforce. The unprecedented challenges and disruptions caused by the pandemic have exacerbated stress, anxiety, and other mental health issues among employees, prompting organizations to adopt comprehensive mental health strategies as an integral part of their HRM practices.

Mr. Zafir Khan Mohamed Makhbul summarizes and discusses the literature addressing mental health concerns linked to the COVID-19 pandemic. The issue here is how the situation at the workplace, post-COVID-19 is different from the previous situation. Thus, the psychological preparation of every member in the organization is crucial to face the challenges coming their way. The available literature showed consensus that the COVID-19 pandemic not only affects physical health, but also stress and well-being. In conclusion, emotional well-being must be emphasized through training and human resource development strategy to prepare and empower the mentality of the organizational members to address this stress. (Makhbul & Rawshdeh, 2021)

Scope

The scope of this study encompasses a comprehensive examination of the shifting landscape of Human Resource Management (HRM) practices within the Information Technology (IT) sector in India, in response to the COVID-19 pandemic. Specifically, the study aims to investigate the adoption and adaptation of HRM practices namely remote working arrangements by IT companies post-COVID, with a focus on addressing key challenges and opportunities.

The study will trace the history of these changes, examining the emergence of the COVID-19 pandemic and its transformative impact on the work environment.
One of the main goals of the study is to identify and analyze the challenges that employees face in adapting to these changing HRM practices. It will examine employee awareness and perception regarding the changes in HRM, with the aim of throwing light on potential gaps and areas for improvement. Additionally, the study will examine the effectiveness of HRM initiatives in ensuring maximum employee satisfaction and productivity.

Ultimately, the scope of this study extends to providing valuable insights and recommendations for IT companies to navigate the post-pandemic landscape effectively. By examining the impact of HRM practices on employee satisfaction and productivity, the study aims to contribute to the enhancement of organizational resilience and success within the IT sector in India.

Review of Literature:

The COVID-19 pandemic has brought about unprecedented challenges and transformations across various industries. Among these, the Human Resource Management (HRM) practices have undergone significant changes, with the Information Technology (IT) sector being no exception. In this literature review, we aim to explore the evolving HRM practices in the post-COVID era, particularly within the context of Mumbai's IT sector. We will examine the key drivers of change and their implications for HRM, including remote work, employee well-being, and digital transformation.

Human resource management (HRM) is going through a transformation phase due to the pandemic. The COVID-19 crisis compelled the employees to work virtually. To mitigate the effects of COVID-19, several organizations heavily invested in artificial intelligence (AI) in the realm of HRM. In this study, Ms. Akansha Mer investigates and proposes a conceptual framework for the paradigm shift in HRM practices post-COVID-19 pandemic and the significance of AI. Furthermore, the study investigates the outcomes of the use of AI in HRM for organizations and employees. (Mer & Virdi, 2023)

HR managers in India are rethinking their traditional practices to adjust to the new normal. The themes point to a shift towards a virtual organizational structure, with emphasis given to developing virtual empathy and virtual team building. There is more willingness to hire gig workers and freelancers now given the increased risk of overstaffing in the post-pandemic market. The study by Ms. Sasmita Misra provides practitioners with a lot of validity about the way forward in a new world of work-from-home and virtual employment contracts. (Misra, Ponnam, & Banerj, 2023)

In the modern business environment, HRM plays a critical function in ensuring that all employees operations and stakeholders are implemented and effective. HRM plays an active

role in determining the approach to be followed in the return to work for all employees, flexible working strategies and promoting the health and well-being of their employees. This would assist in imparting the employees with the required skills for harnessing an effective organization operation. To maximize fully on technology, it would be possible to adopt technology to facilitate effective remote working and online platforms.

A study was formulated by Nteboheng Patricia Mefi to tap into the future of HRM given the disruptions arising from the Covid-19 pandemic as well as the progression of the global technological environment to the fourth industrial revolution. The study established seven emerging themes to inform HRM practices for the competitiveness of organizations in future following the Covid-19 disturbances. These themes are: primacy of HRM, increased cyber influences, digitalization, remote HRM, human-machine interface skills, human-organization strategic links as well as human-technology interface competencies. (Asoba & Mefi, 2021)

In the contemporary business landscape, Human Resource Management (HRM) serves a pivotal role in ensuring the effective implementation of employee operations and stakeholder engagement. This extends to guiding the approach for the return-to-work strategy, devising flexible working solutions, and prioritizing employee health and well-being. Furthermore, HRM plays a central role in equipping employees with the necessary skills for optimal organizational functioning. Embracing technology is a key aspect, enabling the seamless integration of remote work and online platforms to maximize operational efficiency.

Since the COVID-19 pandemic, the use of digital and ICTs has surged, leading to more remote working. The remote work arrangements extensively implemented during the pandemic, especially under lockdown orders, offer a distorted view of this work form's true functioning, highlighting its potentials and problems.

Mr. Haque Shamoel in this paper explores the profound effects of remote work on HR functions, addressing both challenges and opportunities in this new paradigm. The shift to remote work has increased flexibility for the workforce and opened access to a global talent pool. This study offers valuable guidance to HR leaders and practitioners in effectively navigating challenges and optimizing remote work arrangements. Embracing remote work

provides clear advantages for organizations that enhance resilience and attract top talent. (Haque S. , 2023)

Since the COVID-19 pandemic outbreak, there has been a wealth of studies and reports published on the impacts of remote working due to pandemic lockdown measures. The primary aim of this article is to synthesize this work and conduct an exploratory scoping review of both scholarly and grey literature on the impacts of the pandemic on people, productivity, and the planet, with a focus on remote working and the post-pandemic workplace. Mr. Ruth McPhail revealed that most of the scholarly research and industry reports published since the pandemic outbreak are data-driven and some anecdotal rather than theory-driven. (McPhail, Chan, May , & Wilkinson, 2023)

In this paper Arosha S. Adikaram aims to explore how Human Resource Management (HRM) practices were adopted to implement and manage remote working during the COVID-19 pandemic and identify whether and how remote working would/should continue in the future, in a developing and a unique cultural set up in the Asian context. (Adikaram & Naotunna, 2023)

Changes brought on by the novel coronavirus COVID-19 have had far-reaching consequences for businesses all around the world, and had a significant impact on human resource management. HRM had to cope with the layoffs and staff reductions brought on by the pandemic lockdown. Mr. Martin Selvakumar Mohanan through this study aimed to conduct a thorough examination of HRM in IT firms in Tamil Nadu under a work-from-home scenario in the event of a COVID pandemic. Here, the analysis is conducted on the basis of nine categories such as “employee wellbeing, flexible workplace, remote work, job loss, human capital, human resource development, leadership, performance, and communication”. (Rajarathinam, Mohanan , Selvakumar , & Rajarathinam, 2023)

Shamoel Haque offers valuable guidance to HR leaders and practitioners in effectively navigating challenges and optimizing remote work arrangements. Embracing remote work provides clear advantages for organizations that enhance resilience and attract top talent. In this regard, HR professionals must proactively adopt technology and acquire new skill sets to optimize remote work environments. As organizations navigate the challenges of remote work, the HR function plays a fundamental role in shaping work's future and nurturing a thriving

workforce. This study offers valuable insights, empowering HR practitioners to position their organizations for success amid this evolving landscape. (Haque, 2023)

Remote work has lately become the norm in most countries during COVID-19. Since it was an unexpected movement forced by government rules and regulations to control the situation, followed by most organizations to maintain sustainability and ensure continuity, organizations have found it complicated to establish and develop a telecommuting policy to monitor the new work environment norms. Ahmed Saleh Ahmed Saif Al-Shameri, critically evaluate the impact of remote work policies on employee job performance, particularly during the COVID-19 pandemic, and investigate the challenges and opportunities presented by remote work in the Malaysian context, assessing how organizations have adapted to this unexpected shift in work dynamics. (Al-Shameri , Omar , Alzoraiki , & Abkar, 2023)

Organizations have revised their HR policies to address remote work arrangements, including guidelines for remote work eligibility, communication protocols, and cybersecurity measures. However, these changes have enabled companies to maintain productivity, attract talent from a wider geographic pool, and reduce operational costs. However, remote work has also introduced challenges, such as feelings of isolation and difficulties in work-life balance, necessitating a robust HR response.

COVID 19 outbreak created a huge change in our socioeconomic structure. The orientation toward life of common people changed significantly because of growing health-related and economic concern arising out of pandemic situation. The pandemic is also causing great level of stress and anxiety because of a number of factors such as fear of infection, loss of livelihood, and prevailing uncertainty. Mr. Debraj Datta investigates the impact psychological disturbance could have on the productivity, quality of work, interpersonal communication, relationship, motivation, and self-esteem among the professionals during pandemic period. The findings revealed that professionals suffered from stress and anxiety because of pandemic situation. It also explored the level of anxiety and workplace factors for different profiles. (Datta, 2023)

Ms. Kay Lisa Maddox-Daines examines how human resources (HR) professionals in the UK have supported employee wellbeing during the coronavirus disease (COVID) pandemic. It considers the extent to which HR professionals were prepared for the crisis and

their readiness in supporting the wellbeing of their people. This study finds that business continuity plans turned out to be useless during the pandemic because they focused on data, not people. It highlights the tension between home-working and burn-out as online presenteeism increased due to staff changing their behavior in response to self-surveillance. The paper emphasizes the importance of soft skills and authentic leadership and the tensions in respect of equity. (Maddox-Daines, 2023)

This study Mr. Arshad and Mr. Zakaria explores and tests a model that extends the wellbeing research across organizational settings and targets the crucial factors that lead to job performance improvement even in the post pandemic COVID-19 situation. To improve both in-role performance and extra-role performance behaviors in the Pakistan banking sector, organizational virtue (also known as organizational virtuousness) and internal virtue (also known as emotional intelligence) are examined. Research findings also determined that conceptualizing subjective wellbeing in the context of work is more meaningful in understanding its relationship with the workplace variables than the general or global subjective wellbeing. (Arshad , Zakaria, & Arshad, 2023)

With the COVID-19 pandemic, organizations suddenly have to navigate the unprecedented and thereby find new solutions to challenges arising across many areas of their operations. In this article, Mr. Carnevale and Ms. Hatak discusses some of these challenges, focusing on the implications COVID-19 has for human resource management (HRM) as organizations help their workforce cope with and adjust to their newly altered work environment. In addition, they propose several avenues for future research and advocate for an integrated research agenda for tackling the challenges discussed. (Carnevale & Hatak , 2020)

Research Gap and Research Problem

Based on the extensive literature review on the evolving landscape of Human Resource Management (HRM) practices post-COVID-19, several key themes and emerging trends have emerged. However, amidst these discussions, certain gaps in research remain apparent, paving the way for further investigation. One notable gap revolves around the intersection of technological innovation, remote work dynamics, and their implications for employee well-being and organizational resilience, particularly within the context of the IT sector in Mumbai, India.

Furthermore, few studies discuss the applications of AI in HRM and most of the research is focused on the adoption of AI applications by IT firms in Mumbai post-COVID-19. Hence, the extent to which AI has been integrated into the HRM practices, how this affects organizational efficiency, and its implications for employee experience must be known to inform future strategies.

Besides, although there is tremendous debate on the issues due to remote work and emphasis on employee well-being, a gap in the extant research remains on the effectiveness of HR initiatives to mitigate issues due to remote work and their relevance in the case of Mumbai IT sector.

Therefore, the research question arising from this literature review is:

Despite the very extensive discourse in the recent past on the post-COVID HRM practices, there is an immense deficiency in the detailed implications of technological innovations, remote work dynamics, and AI adoption within the Mumbai IT sector. Hence, this paper is designed to examine the role of HR in mitigating the challenges in remote working and improving well-being while also evaluating how such activities affect organizational resilience and performance. Through a comprehensive analysis, this study seeks to provide actionable insights for HR professionals and organizational leaders navigating the evolving landscape of HRM in the post-pandemic era.

This study will help both employees and employers to identify practices potentially facilitating growth in employee productivity and job satisfaction. Further, employers can look forward to reinforcing such positive practices in organizations and do away with practices that hamper productivity and job satisfaction. Moreover, practices implemented and having a positive effect can also be considered for implantation in the non-IT sectors ensuring a more productive and satisfied workforce.

Objectives of the research:

(1) To examine the effect of remote working arrangements implemented by organizations on employees' job satisfaction.
(2) To examine the effect of remote working arrangements implemented by organizations on employees' productivity.

Disclaimer: Employee productivity has been measured based on employees' interpretation of his/ her productivity post implementation of the above HRM practices. Employers' interpretation of employee productivity doesn't fall in the purview of the objectives of our research.

Research Methodology

The population under study encompasses individuals working in Mumbai.

The sample size for our research is 102 responses.

While our initial plan aimed for a stratified random sampling and convenience sampling approach to ensure representativeness, practical constraints necessitated a shift towards convenience and random sampling methods. Nonetheless, measures were taken to ensure the inclusion of diverse perspectives within the sampled population.

A well-planned pre tested interview was conducted with Mr. Karan Mehta from TCS and Ms. Shruti Shah from TCS. Based on the inputs from the above interaction a questionnaire was designed and circulated among employees for whom the responses have been acquired.

The responses were collected from the employees working in the IT sector in Mumbai city.

Hypothesis of the study

H0: There is no relation between remote working arrangements implemented by organizations and employees job satisfaction.
H1: There is significant relation between remote working arrangements implemented by organizations and employees job satisfaction.

H0: There is no relation between remote working arrangements implemented by organizations and employee's productivity.
H1: There is significant relation between remote working arrangements implemented by organizations and employee's productivity.

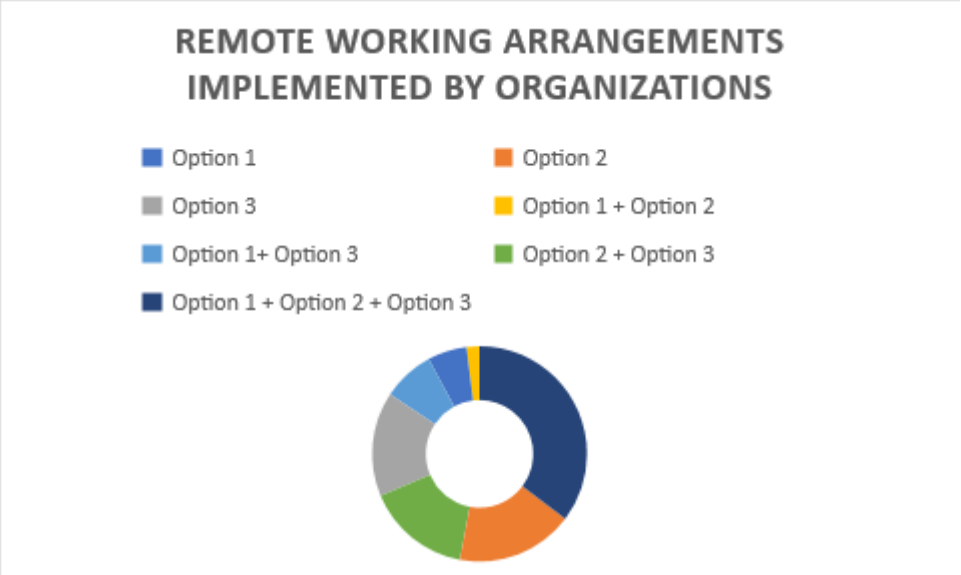
Data analysis, interpretation and findings

What are the Remote working arrangements implemented by organizations?

Table 1

Below table captures the Remote working arrangements implemented by organizations

Options	Particulars	Number of Respondents
Option 1	Providing of an option to work from current office location or from any location where an office of the organization is located	6
Option 2	Providing of option to work a few days from office and the other days out of office	18
Option 3	Providing of setup (desktop/ laptop/ internet connectivity etc) to work out of office	16
Option 1 + Option 2	Providing of option to work a few days from office and the other days out of office;Providing of an option to work from current office location or from any location where an office of the organization is located	2
Option 1+ Option 3	Providing of setup (desktop/ laptop/ internet connectivity etc) to work out of office;Providing of an option to work from current office location or from any location where an office of the organization is located	8
Option 2 + Option 3	Providing of setup (desktop/ laptop/ internet connectivity etc) to work out of office;Providing of option to work a few days from office and the other days out of office	16
Option 1 + Option 2 + Option 3	Providing of setup (desktop/ laptop/ internet connectivity etc) to work out of office;Providing of option to work a few days from office and the other days out of office;Providing of an option to work from current office location or from any location where an office of the organization is located	36



The data presented highlights a significant shift in HRM practices, particularly in the realm of remote working arrangements, within organizations post-COVID, with a specific focus on the IT sector in Mumbai city. A considerable proportion (36 respondents) reported that their organizations provided setup (desktop/ laptop/ internet connectivity etc) to work out of office, provided an option to work a few days from office and the other days out of office and provided an option to work from current office location or from any location where an office of the organization is located. 2 respondents reported providing of option to work a few days from office and the other days out of office and Providing of an option to work from current office location or from any location where an office of the organization is located. This multi-faced approach by the organizations acknowledges the need for a multi prong attack to ensure a smooth transition for employees post covid. Overall, these observations underscore a fundamental transformation in HRM practices post-COVID, characterized by an increased emphasis on remote work arrangements and flexibility in work locations. Such adaptations are particularly pertinent in the context of the IT sector in Mumbai City, where technological infrastructure and digital connectivity play pivotal roles in facilitating remote work. By embracing these changes, organizations not only demonstrate resilience in the face of challenges but also prioritize employee well-being and productivity in the evolving landscape of work.

Data Interpretation

Hypothesis Testing

Hypothesis 1

H0: There is no relation between remote working arrangements implemented by organizations and employees job satisfaction.

H1: There is significant relation between remote working arrangements implemented by organizations and employees job satisfaction.

Observed Value Table

Count of How would you rate your job satisfaction on account of the remote working arrangements implemented by your organization?	**Column Labels (Job Satisfaction)**					
Row Labels	1	**2**	**3**	**4**	**5**	**Grand Total**
Option 1	0	0	2	4	0	6
Option 2	0	2	6	6	4	18
Option 3	2	2	2	6	4	16
Option 1 + Option 2	0	0	0	2	0	2
Option 1+ Option 3	0	0	4	4	0	8
Option 2 + Option 3	0	2	2	4	8	16
Option 1 + Option 2 + Option 3	0	0	12	18	6	36
Grand Total	2	6	28	44	22	102

Expected Value Table

Expected Value Table = (row total*column total)/grand total

Count of How would you rate your job satisfaction on account of the remote working arrangements implemented by your organization?	**Column Labels (Job Satisfaction)**					
Row Labels	1	**2**	**3**	**4**	**5**	**Grand Total**
Option 1	0.118	0.353	1.647	2.588	1.294	6
Option 2	0.353	1.059	4.941	7.765	3.882	18
Option 3	0.314	0.941	4.392	6.902	3.451	16
Option 1 + Option 2	0.039	0.118	0.549	0.863	0.431	2
Option 1+ Option 3	0.157	0.471	2.196	3.451	1.725	8
Option 2 + Option 3	0.314	0.941	4.392	6.902	3.451	16
Option 1 + Option 2 + Option 3	0.706	2.118	9.882	15.529	7.765	36
Grand Total	2	6	28	44	22	102

Chi-Square Table = (Observed value- Expected value)^2/Expected value

Count of How would you rate your job satisfaction on account of the remote working arrangements implemented by your organization?	**Column Labels (Job Satisfaction)**					
Row Labels	1	**2**	**3**	**4**	**5**	**Grand Total**
Option 1	0.118	0.353	0.076	0.770	1.294	2.610
Option 2	0.353	0.837	0.227	0.401	0.004	1.821
Option 3	9.064	1.191	1.303	0.118	0.087	11.763

Option 1 + Option 2	0.039	0.118	0.549	1.499	0.431	2.636
Option 1+ Option 3	0.157	0.471	1.482	0.087	1.725	3.922
Option 2 + Option 3	0.314	1.191	1.303	1.220	5.996	10.024
Option 1 + Option 2 + Option 3	0.706	2.118	0.454	0.393	0.401	4.071
Grand Total	10.750	6.278	5.393	4.489	9.939	36.849

Degrees of freedom= (Column-1) (Row-1) (5-1)(7-1)	24	Significance level	0.01
Test value	36.849	Critical value/ Tabular	42.98

Test Value > Critical Value

Hence Null hypothesis is REJECTED

Hence, there is significant relation between remote working arrangements implemented by organizations and employees job satisfaction.

Hypothesis 2

H0: There is no relation between remote working arrangements implemented by organizations and employee's productivity.

H1: There is significant relation between remote working arrangements implemented by organizations and employee's productivity.

Observed Value Table

Count of How would you rate your productivity on account of the remote working arrangements implemented by your organization?	**Column Labels (Productivity)**				
Row Labels	**2**	**3**	**4**	**5**	**Grand Total**
Option 1			6		6
Option 2		4	8	6	18
Option 3		6	2	8	16

Option 1 + Option 2			4	4	8
Option 1+ Option 3			2		2
Option 2 + Option 3	2		6	8	16
Option 1 + Option 2 + Option 3		8	14	14	36
Grand Total	2	18	42	40	102

Expected Value Table

Expected Value Table = (row total*column total)/grand total

Count of How would you rate your job satisfaction on account of the remote working arrangements implemented by your organization?	**Column Labels (Productivity)**				
Row Labels	**2**	**3**	**4**	**5**	**Grand Total**
Option 1	0.118	1.059	2.471	2.353	6
Option 2	0.353	3.176	7.412	7.059	18
Option 3	0.314	2.824	6.588	6.275	16
Option 1 + Option 2	0.157	1.412	3.294	3.137	8
Option 1+ Option 3	0.039	0.353	0.824	0.784	2
Option 2 + Option 3	0.314	2.824	6.588	6.275	16
Option 1 + Option 2 + Option 3	0.706	6.353	14.824	14.118	36
Grand Total	2	18	42	40	102

Chi-Square Table = (Observed value- Expected value)^2/Expected value

Count of How would you rate your productivity on account of the remote working arrangements implemented by your organization?	**Column Labels (Productivity)**				
Row Labels	**2**	**3**	**4**	**5**	**Grand Total**
Option 1	0.118	1.059	5.042	2.353	8.571
Option 2	0.353	0.214	0.047	0.159	0.772
Option 3	0.314	3.574	3.195	0.475	7.557
Option 1 + Option 2	0.157	1.412	0.151	0.237	1.957
Option 1+ Option 3	0.039	0.353	1.681	0.784	2.857
Option 2 + Option 3	9.064	2.824	0.053	0.475	12.414
Option 1 + Option 2 + Option 3	0.706	0.427	0.046	0.001	1.180
Grand Total	10.750	9.861	10.214	4.483	35.309

Degrees of freedom= (Column-1) (Row-1) (4-1)(7-1)	18	Significance level	0.05
Test value	35.309	Critical value/ Tabular	28.869

Test Value > Critical Value
Hence Null hypothesis is REJECTED

Hence, there is significant relation between remote working arrangements implemented by organizations and employee's productivity

Conclusion

The post-COVID era has drastically changed the HRM scenario in the IT sector with a new trend of increased working from home and a higher emphasis on initiatives to build mental

health and well-being. Such practices have become very common and have proved to be effective in raising employee job satisfaction and productivity levels.

Remote working is one of the most striking features that has emerged in the IT sector, providing flexibility and work-life balance for its employees. Through the digital collaboration tool and technology adopted, the team can effectively collaborate across the physical geography. Flexibility has relieved commuters from stressful journeys and has helped employees create an environment where they like to work to enhance their overall job satisfaction.

Organizations have recently realized the need to ensure that HRM practices have prioritized mental health and well-being. The pandemic threw into sharp relief the pitfalls of remote work, namely social isolation and the confusion of lines between work life and personal life. Organizations have taken several steps since then, including virtual wellness programs, access to mental health resources, and regular checks with employees to ensure well-being. By addressing these concerns proactively, organizations not only demonstrate their commitment to employee welfare but also foster a supportive culture conducive to productivity.

It can be said that the effects of these new practices on employee satisfaction and productivity are very positive. Employees are likely to be engaged and motivated in their work if they feel supported and valued by their organizations. Remote work, along with mental health initiatives, provides an enabling environment where employees can professionally and personally grow. This then leads to a higher level of productivity as employees become more focused, energized, and committed to organizational goals.

The employee-friendly practices in the HR will be of utmost importance in maintaining and improving employee satisfaction and productivity in the IT sector. Organizations will have a resilient and high-performing workforce that can work with the system if they continually update these practices to fit evolving employee needs and expectations.

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