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A One - Day Multi – Disciplinary

Hybrid International Conference

on

"Interface of Human Intelligence & Artificial Intelligence - Possibilities and Challenges"

14th February, 2026

Organised by

Parle Tilak Vidyalaya Association's

M. L. DAHANUKAR COLLEGE OF COMMERCE

(Autonomous)

Internal Quality Assurance Cell (IQAC)

In association with

Western India Regional Council (WIRC),

The Institute of Chartered Accountants of India (ICAI)

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President's Message

Dear Readers,

It gives me great pleasure that PTVA's M. L. Dahanukar College of Commerce hosted a dialogue among academics, industry professionals and students from across the world on a topic of such contemporary relevance, namely Artificial Intelligence (AI). The enthusiastic and wholehearted participation of scholars, practitioners and young learners ensured that the conference emerged as a platform of meaningful exchange and intellectual engagement.

Needless to say, Artificial Intelligence has made significant inroads into almost every arena of our existence. From the ways in which we work and communicate to the methods through which knowledge is created and disseminated, AI has begun to reshape the rhythms of everyday life as well as the structures of institutions. In such a context, conferences devoted to Artificial Intelligence assume particular importance. They function as intellectual forums where scholars, industry experts, policymakers and young learners can come together to deliberate upon the technological possibilities and the broader social implications of this evolving field.

Within the domain of higher education, the influence of Artificial Intelligence is especially visible. Educational institutions across the world are exploring how AI can enhance teaching and learning. Intelligent learning systems, data-driven insights and digital platforms are enabling more personalized forms of education and expanding access to knowledge. AI has become a vital instrument in contemporary research, accelerating discovery and enabling scholars to analyze complex patterns once beyond the reach of conventional methods. Collaboration between academia and industry has opened new pathways for innovation and knowledge production, across medicine, environmental science, engineering, commerce, social sciences and digital humanities.

Yet the promise of Artificial Intelligence must also be accompanied by thoughtful reflection. The questions before educators, policymakers and technologists are not merely technical but deeply ethical. Concerns regarding algorithmic bias, the protection of personal data and the implications of automation for employment demand careful consideration. Universities therefore carry a special responsibility: they must prepare students not only to use emerging technologies, but also to examine them critically and guide their development with wisdom and integrity.

In responding to these challenges, educational institutions must pursue certain key priorities. The first is education and capacity-building. It is essential to prepare students not merely as consumers of technology but as thoughtful creators and responsible users of it. This requires curricula that combine technical competence with ethical awareness and interdisciplinary inquiry.

The second priority is collaboration. The most pressing challenges—whether technological, social, or environmental—cannot be addressed by isolated institutions. Partnerships among universities, industries and governments are vital for sharing knowledge, developing standards and ensuring that innovation benefits society at large.

Equally important is the principle of inclusivity. Ensuring wider access to education, resources and digital infrastructure is essential if the benefits of AI are to reach diverse communities and contribute to more equitable forms of development.

Conferences such as these therefore represent far more than academic events. By bringing together academicians, professionals and students from diverse backgrounds, such forums contribute to shaping Artificial Intelligence not only as a technological achievement but also as a force that advances knowledge, responsibility and human well-being. Thus, we see Artificial Intelligence is making steady strides into every facet of human life. The stalwarts in the field are invoking and celebrating its expansion, but at the same time issuing a caveat that, in the wake of massive change ushered in by AI, human beings must stay relevant and not succumb to this deluge of change. A significant way to do so is to be more human, as in working on self-awareness and being emotionally intelligent should be the guiding light to manoeuvre AI deftly. Working alongside AI, with these boons of self-awareness and emotional intelligence, could only assure a comprehensive growth of humans.

CA Shri. Anil B. Ganu
President, PTVA

Principal's Message

The academic year 2025-26 has been yet another year of remarkable glory for PTVA's M. L. Dahanukar College of Commerce (Autonomous) as other than various academic accomplishments, it also achieved numerous accolades in co-curricular arena.

In fact, our distinction lies in the pursuit of high academic co-curricular attainment through sustained encouragement, praise and motivation. These achievements reach its summit, as every year, we ensure organising intellectual exchanges and confluence of international and national standards in form of Conferences, FDPs and Workshops.

In line with the currents of time and demands of the present day, the last year's Conference on "Viksit Bharat" saw its natural amalgamation in this year's conference on "Artificial Intelligence" titled, "Interface of Artificial Intelligence and Human Intelligence: Possibilities and Challenges".

As AI is entering all walks of human activity and bringing forth unprecedented changes in all walks of lives, the need is extremely urgent to reflect and brainstorm on the various facets of AI. So, the topic is floated with an intent of larger discourse which eventually garnered a huge response with time across the globe.

The purpose was to bring in line of thinking that is articulate, incisive well-researched. In a world increasingly mired in cut-throat competition, enhanced with the influence of AI, humans are confronted with a threat to honour, dignity and rectitude. The contribution to the conference from eminent Resource Persons, research scholars and participants turned out to be extremely fulfilling as they stepped up to the purpose for which the conference was designed.

As we believe in the significance of collaborative efforts, our association with WIRC (ICAI) made the attempt innately enriching.

The outcome of the congregation was that it offered cohesive techniques clubbed with the knowledge of the technology of AI to ensure holistic and constant growth. A learning that pledges dynamic interaction and refuses to rest on the laurels of the past can only

bring about the moral and intellectual vigour to encounter the threat of this massive change.

If with systematic awareness and equipped with constant update of this new knowledge system of AI, then it will open up to the ocean of opportunities that are in front of us all. It is also said that today's knowledge is tomorrow's ignorance. India has witnessed a series of reforms in economic and social sectors since over a decade. The winds of reforms have changed the fundamentals of economy. The Government appeared to be keen on bringing forward the social reforms. Government has taken note of the fact that, world is rapidly growing into a global village and globalization is inevitable. In this increasingly shrunken global scenario, Artificial Intelligence is becoming a core functionary and a determinant of human growth, the knowledge of which can bring assured success, and also prevent it from outsmarting humans. The One-day Conference has offered an opportunity to the participants express their views on major reforms that have transformed the nation in the last few years.

PTVA's M. L. Dahanukar College of Commerce seeks and maintains high standards of higher education. I am glad that the Conference provided the right platform to the researchers, academicians, corporate experts and students through deliberations, discussions, presentations and academic exchanges.

It gives me immense pleasure and pride to acknowledge contribution of all the committee members, viz, teaching, non-teaching staff and student volunteers whose concerted efforts made the conference a great success. Together we plan to reach richer and higher landmarks in future.

On this occasion, I once again convey my best wishes to all!

Prof. (Dr.) Vinay G. Bhole
Principal

IQAC Co-ordinator's Message

Dear Readers, on behalf of the *Internal Quality Assurance Cell (IQAC)*, I feel extremely glad to share my thoughts on the development of the journey of One-Day Multi-Disciplinary Hybrid International Conference titled, "*Interface of Human Intelligence & Artificial Intelligence – Possibilities and Challenges*."

The *Internal Quality Assurance Cell* (IQAC) plays a pivotal role in fostering a culture of quality, innovation, and continuous improvement in higher education. Conferences such as this are integral to IQAC's vision of promoting research orientation, interdisciplinary learning, and meaningful engagement with contemporary global concerns.

We have a culture of setting the theme with deliberations and due diligence, and we have arrived on this theme of Artificial Intelligence noting the contemporary relevance of the topic. It goes without saying that Artificial Intelligence is no longer a futuristic concept; it is an integral part of our present reality. As educators and learners, it becomes our responsibility to examine not only its technical capabilities but also its social, ethical, and intellectual implications. This conference seeks to encourage critical inquiry into how human intelligence can meaningfully coexist with, guide, and complement artificial intelligence.

In discussions about the future of technology, renowned environmental activist, Vandana Shiva advocates arguing that true judgment and soul cannot come from an AI model. "You are not Atlas carrying the world on your shoulder. It is good to remember that the planet is carrying you". Many such words of caution make us ponder about the complex future of humanity and our precarious existence which require right reflections from researchers and policy makers. Conferences such as this work as a sustainable platform to address and redress these growing concerns.

The hybrid mode of this international conference further reflects our commitment to inclusivity, accessibility, and global academic collaboration. The enthusiastic participation from scholars across disciplines and regions is truly a indicator towards the success of this objective.

I extend my heartfelt thanks to our ever-supportive PTVA management, our source of motivation, our Principal, the Convenor, our partner institution WIRC–ICAI, and all the faculty members and student volunteers of the organising committee for their whole hearted efforts towards the success of the Conference. I also thank all participants for trusting us and associating us always which adds to our enthusiasm to deliver better and the academic vibrancy of this event.

I am certain that the scholastic deliberations in the volume will spark further ideas and stored insights in the Research articles will add value to our collective understanding and inspire future research initiatives.

Thank you, and look forward to your association in future as well !

Dr. Chandana Chakraborti
Vice Principal

Convenor's Message

Dear Contributors, it gives me immense pleasure to extend my gratitude at the outset for associating and reposing in your faith in us. Your being part of our Conference is the fulcrum of our zeal and enterprise to keep coming up with such Conclave wherein both budding scholars and the erudition of luminaries confluence with an intent of broadening the intellectual horizon and giving a part of the think tank that usher transformation. Our esteemed Management Parle Tilak Vidyalaya Association (PTVA) and the lighthouse of our multifarious activities, our Principal Prof. (Dr.) Vinay G. Bhole, our sustained mentor, Vice Principal and IQAC Coordinator, Dr. Chandana Chakraborti led us to formulate and engineer yet another successful conference, the testimony of which is evident in the presence of 320 participants from across the country and beyond.

One-Day Multi-Disciplinary Hybrid International Conference on "Interface of Human Intelligence & Artificial Intelligence – Possibilities and Challenges", got a further impetus as Internal Quality Assurance Cell of M. L. Dahanukar College of Commerce (Autonomous), got an opportunity to collaborate with the Western India Regional Council of the Institute of Chartered Accountants of India.

As we speak of our Conference on the theme of Artificial Intelligence, humanity at large has gathered at a moment when technology is quietly and persistently rewriting the grammar of our lives. Artificial Intelligence has emerged as a transformative presence across education, commerce, governance, healthcare, and almost every sphere of human activity. It promises extraordinary possibilities—enhancing efficiency, extending human capability, and reshaping the ways we think and work—yet it also urges us to pause and reflect on meaning and responsibility. Rabindranath Tagore reminds us that "the highest education is that which does not merely give us information but makes our life in harmony with all existence." As we engage more deeply with intelligent machines, this reminder becomes especially urgent.

At the same time, literature has long celebrated and interrogated the uniqueness of human intelligence. Shakespeare's words in Hamlet—"What a piece of work is a man… in apprehension how like a god!"—capture both wonder and vulnerability. As machines increasingly imitate human cognition, we are compelled to ask not merely how intelligent our technologies can become, but how wisely we choose to use them.

As T. S. Eliot cautions us, "Where is the wisdom we have lost in knowledge? Where is the knowledge we have lost in information?" This question resonates strongly in an age of data abundance and machine learning. While AI opens new horizons of innovation, it also raises profound questions about ethics, creativity, agency, employment, and moral judgment. The concern is not only what machines can do, but how far human intelligence is willing—or prepared—to delegate judgment, imagination, and accountability.

The multidisciplinary nature of this conference reflects our conviction that such complex questions cannot be addressed through a single disciplinary lens. Scholars from commerce, management, technology, humanities, social sciences, and professional bodies such as ICAI bring diverse ways of knowing that enrich this collective inquiry. In this convergence of disciplines, we move closer to a holistic vision of knowledge—one that balances innovation with ethics, and intelligence with wisdom.

I take this opportunity to express my sincere gratitude to our collaborating institution, WIRC–ICAI, for their valuable support, and to all our distinguished speakers, paper presenters, and participants for their enthusiastic response. I also deeply appreciate the tireless efforts of the organising committee, faculty members, and student volunteers whose dedication has made this academic gathering possible.

I am confident that the deliberations today will inspire thoughtful engagement, foster ethical reflection, and reaffirm the centrality of human intelligence in shaping the future of artificial intelligence.

Heartfelt gratitude to everyone for your contribution !

Mr. Somnath R. Deshmukhya
Head, Dept. of English

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A STUDY ON THE ROLE OF AI IN ENHANCING ENVIRONMENTAL SUSTAINABILITY AND GENERATING ENVIRONMENTALLY RESPONSIBLE BEHAVIOUR

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Abstract
The earth is facing numerous environmental challenges like climate change, rise in pollution levels, biodiversity loss, deforestation etc. The fragile balance of Earth's ecosystems has been negatively impacted by human activity, with global repercussions. Given the scope of these issues, creative and revolutionary solutions are required to guarantee a sustainable future for future generations. Artificial Intelligence (AI) has in current times emerged as a dominant tool for undertaking preservation and conservation tool for sustainable development. AI, for enhancing environmental sensitivity and generating environmentally responsible behaviour needs interdisciplinary efforts from various stakeholders like governments, industrialists, planners, citizens and educationists. This paper explores the role of AI in enhancing environmental sustainability through its application in environmental management and also shares numerous success stories wherein AI has successfully been used for mitigating environmental hazards. AI by far is a powerful tool that can be used for dealing with numerous environmental issues but needs to be used with caution and ethics. An environmentally responsible behaviour in the use of AI technologies is a must to at the best mitigate and combat the environmental catastrophe the earth is going through.

Keywords: Artificial Intelligence, Climate Change, Sustainable Development, Conservation, Environmentally Responsible Behaviour, Environmental Management, Ethics.

► *Corresponding Author: Dr. Chandana Chakraborti*

Introduction

Unparalleled environmental catastrophes, including pollution, deforestation, biodiversity loss, and climate change, are all-pervading in the modern era. The fragile balance of Earth's ecosystems has been negatively impacted by human activity, with global repercussions. Given the scope of these issues, creative and revolutionary solutions are required to guarantee a sustainable future for future generations.

Artificial Intelligence revolution has emerged as a solution that holds a tremendous potential for giving a solution to environmental conservation endeavours. The biggest advantage of AI is its unique ability to process voluminous data, synthesise the data in a logical sequence and identify patterns and accordingly give a wide plethora of options for environment protection and management and thereby transforming the scope of sustainable development. AI helps protect

nature, improves monitoring, and informs sustainable decision-making, along with its benefits and challenges.

Use of AI in Environmental Protection

1. Real-Time Environmental Monitoring & Data Analysis: AI can rapidly collect and process massive environmental data from satellites, drones, sensors, and IoT devices to detect changes in ecosystems and environmental conditions.

- **Air, water, soil quality:** AI analyses sensor data to identify pollution levels and sources.
- **Wildlife tracking and Biodiversity monitoring:** AI models detect and classify species in camera-trap videos or sensor feeds, helping assess biodiversity in real time. Through AI powered remote sensing tools it is possible to have real time monitoring and analysis of changes in forest cover and detection of illegal logging, poaching, encroachment and unsustainable agricultural practices.
- **Early warning systems:** AI helps spot environmental hazards (e.g., forest fires, harmful algal blooms) earlier than traditional methods This enables faster responses to environmental threats and helps policymakers act before damage becomes irreversible. Deforestation, habitat loss, and land degradation may be detected with previously unheard-of accuracy thanks to AI techniques like Convolutional Neural Networks (CNNs), which are excellent at extracting information from satellite imageries.

2. Enhanced Predictive Modelling & Climate and Weather Forecasting: AI excels at recognizing complex patterns in large datasets. This capability makes it useful for predicting environmental trends such as AI models can be used for forecasting extreme weather occurrences and modelling the climate. One of the most urgent issues facing the world today is climate change, which has an effect on human communities, ecosystems, and economic activity. climatic models driven by AI have shown promise in improving our comprehension of intricate climatic processes and increasing the precision of long-term climate projections. AI-driven algorithms also make it possible to spot trends and patterns in past climate data, which makes it easier to anticipate future scenarios and alerts decision-makers to possible dangers and weaknesses.

Decision-makers can create focused strategies for mitigating and adapting to climate change because to AI's analytical capabilities. AI-guided solutions are essential for creating climate resilience at both local and global levels, from optimizing energy use and reducing carbon emissions to creating robust infrastructure. These predictions support adaptation and mitigation planning. Example: AI systems now help forecast cyclone paths and strength days earlier, giving disaster managers more lead time.

3. Planning for Urban Development and Smart Cities:

- **Urban sustainability and waste management applications**: Urban regions' negative environmental effects are lessened by the widespread use of AI-driven waste management systems. By streamlining waste collection routes and sorting procedures, AI-powered recycling and rubbish collection algorithms increase productivity and cut expenses. By taking into account elements like green areas, public facilities, and infrastructure optimization, AI-driven urban planning models make it possible to create resilient and sustainable communities.
- **AI-powered methods for transportation and energy optimization:** The idea of smart cities is gaining traction as more people want to live in metropolitan areas. Through the optimization of energy consumption, traffic flow, and public transportation systems, artificial intelligence (AI) technologies significantly contribute to the transformation of urban living. AI-enabled smart grids

reduce waste and encourage the integration of renewable energy sources by enabling real-time monitoring and management of energy distribution.

4. Sustainable Resource Use & Optimization:

- **AI's contribution to increasing renewable energy systems' efficiency**:

In order to reduce greenhouse gas emissions and fight climate change, the switch to renewable energy sources is essential. The development of more effective solar panels, wind turbines, and energy storage technologies has been accelerated by AI's capacity to evaluate complicated energy data and optimize renewable energy systems. These developments speed up the world's shift to sustainable energy by making renewable energy more accessible and economically viable.

- **Uses for waste reduction and resource allocation optimizatio**:

Degradation of the environment is largely caused by ineffective resource management. Organizations may optimize resource allocation and cut waste by using AI algorithms to examine data on supply chains, consumption trends, and resource usage.

- AI can make grids more efficient, balance renewable energy use, and cut emissions.
- Smarter routing and inventory planning in supply chains, lowers the carbon footprint of logistics. This enhances sustainability without compromising economic productivity.

5. Developing Sustainable Food Production and Precision Agriculture:

It is a difficult task to feed the world's expanding population while reducing agriculture's environmental impact. Traditional agriculture is resource-intensive, relying heavily on fertilizers, pesticides, and water. AI-powered **precision agriculture** aims to optimize these inputs, minimizing environmental impact while maximizing yield. By integrating data from sensors, satellites, and drones to produce a detailed picture of soil conditions, crop health, and water usage, AI-driven precision agriculture provides a solution. Precision nutrient application, intelligent irrigation, and pest control are made possible by AI-powered insights, which support effective and sustainable farming methods as well as reduces waste and environmental runoff.

6. AI's contribution to lowering food waste and guaranteeing food security:

Global food security and the ecology are severely impacted by food waste. Real-time supply chain monitoring is made possible by AI's predictive capabilities, which enable prompt actions to stop food loss and spoiling. AI algorithms can also reduce food waste at the retail and consumer levels by optimizing inventory management and analysing patterns of customer behaviour.

7. Conservation & Human-Wildlife Conflict Mitigation:

AI tools support habitat monitoring and reduce conflicts between humans and wildlife by:

- Recognizing animal movement patterns with camera/trap data
- Triggering alerts when wildlife approaches human settlements
- Helping manage protected areas more effectively

Such technologies are being deployed in India and elsewhere to protect both people and wildlife.

8. Increasing Public Awareness & Policy Support:

AI especially chatbots and information systems can improve **environmental communication**:

- Simplifying access to pollution rules and guidelines
- Helping citizens understand environmental norms
- Supporting transparent compliance and reporting

For example, AI-powered assistants like *GreenMind AI* help citizens and regulators navigate environmental information more easily.

Role of AI in Generating Environmentally Responsible Behaviour

Artificial intelligence (AI) is playing an increasingly important role in encouraging environmentally responsible behaviour by helping individuals, businesses, and governments make better educated and sustainable decisions. By analysing enormous amounts of data and offering practical solutions, AI encourages environmental conservation in several significant ways.

1. Promoting Education and Awareness: AI-powered apps, chatbots, and learning platforms may teach people about environmental issues including pollution, waste management, and climate change.

2. Reducing Energy Consumption: AI is frequently used in smart homes and buildings to efficiently control electricity, heating, and cooling. For example, by learning user patterns and reducing energy use when rooms are empty, smart thermostats promote responsible energy use without sacrificing comfort.

3. Encouraging Eco-Friendly Transportation: Artificial intelligence helps reduce carbon emissions by improving traffic control, suggesting fuel-efficient routes, and supporting electric vehicles. Ride-sharing businesses utilize AI to reduce the number of cars on the road and enhance routes.

4. Improving Waste Management and Recycling Processes: AI algorithms can identify recyclable products, sort garbage more precisely, and use fewer landfills. In order to reduce pollution and save fuel, AI can also be used to monitor waste levels and improve collection routes.

5. Promoting Ethical Business Conduct: AI systems are able to recognize recyclables, sort trash more accurately and utilize fewer landfills. Some communities use AI to monitor waste levels and enhance pickup routes in an effort to reduce pollution and conserve gasoline.

6. Backup to Legislators and Governments: AI aids governments forecast environmental hazards including deforestation, droughts, and floods. Policymakers can enact effective environmental legislation and advance sustainable development with improved data and projections.

Challenges & Ethical Considerations in Seamless Use of AI

AI holds numerous potentials for achieving sustainable development goals; however, it has to be used with caution. Here are some of the major concerns related to indiscriminate use of AI.

1. Energy consumption & Carbon Footprint: AI models use highly sophisticated technologies, using deep learning algorithms which are all energy intensive. Data centres that run these models involve considerable computational resources, leading to high electricity consumption especially if powered by non-renewable energy.

2. Greenhouse gas (GHG) emissions: The large quantity of energy required for powering AI systems often leads to extensive GHG emissions, especially if the energy is sourced from non-renewable power plants.

3. Water consumption: Large data in sophisticated AI systems require cooling schemes that needs enormous amounts of water to avert overheating and sustain performance. This usage can aggravate water scarcity especially in regions already subject to water stress.

4. E-Waste and Hardware Used for AI: The production and disposal of AI hardware involve significant resource extraction, manufacturing emissions and e-waste generation. High-performance computing hardware, such as GPUs and TPUs, have a comparatively short lifecycle due to the swift progression of technology and on becoming outmoded the AI hardware often ends up in landfills, where it is a cause of environmental pollution.

Green AI Movement

Green AI is all about building smart sustainable technology that also cares for the environment. It involves designing models that are not only powerful but also energy efficient and environmentally conscious. It focuses on reducing the energy and resources needed to run AI systems, while still delivering strong performance.

Global AI Case Studies in Environmental Protection

1. **Predictive Air Quality and Pollution Management:**

- **SAFAR in Delhi:** Machine learning models forecast air pollution up to **72 hours in advance**, enabling authorities and citizens to take preventive actions (e.g., traffic regulation, alerts).
- **IBM's Green Horizons (Beijing):** AI integrates weather, emissions and traffic data to predict air quality, leading to **20% reductions in particulate pollution** during trial phases through targeted interventions.

2. **AI-Driven Environmental Monitoring & Mapping:**

- **Global Forest Watch:** Uses AI + satellite imagery to detect deforestation in near real-time, triggering alerts when illegal logging or forest loss occurs, empowering faster enforcement and conservation responses.
- **Space Intelligence:** AI helps map forest change and carbon stocks across millions of hectares globally, improving deforestation tracking and climate data insights.

3. **Wildlife Conflict Reduction:**

- **AI Wild Netra Cameras, Maharashtra:** Solar-powered AI cameras detect leopards near villages and trigger alarms to alert residents, reducing human–animal conflicts.
- **AI Cameras in Chhattisgarh Tiger Reserve:** Detect elephants, leopards & other wildlife and send alerts (sirens, SMS) to villagers and forest staff to prevent conflict and casualties.

4. **AI for Environmental Monitoring & Pollution Control:**

- **AI for Waste Sorting & Circular Economy:** AI-powered vision systems in waste recycling facilities (e.g., North America & Europe) automatically sort plastics and materials — increasing recycling rates and reducing landfill emissions.
- **Marine Plastic Hotspot Mapping – Vembanad Lake:** Drones + AI (YOLO object detection) identified **17 plastic pollution hotspots** in Kerala's Vembanad Lake, helping target cleanup and policy action.
- **AI + IoT Water Purity Monitoring Device:** Developed by IIIT-Prayagraj and SHUATS, this device analyzes water quality in seconds using AI processing sensor data — useful for clean-water access efforts.

5. **AI for Regulatory Governance & Public Engagement:**

- **GreenMind AI – MPCB, Mumbai:** An AI assistant that helps citizens and regulators access environmental norms, compliance information, and regulatory guidance easily — improving transparency and environmental governance.
- **AI in Agriculture & Land Management: Crop Disease Detection System (IIIT-Allahabad):** AI + IoT model detects crop diseases in real time on farms, conserving resources (water, fertilizers) and reducing ecological strain from overuse of inputs.
- **Satellite + AI Forest Monitoring (ISRO/NRSC):** AI-based forest monitoring detects small-scale deforestation with greater frequency and precision vs traditional annual surveys, aiding forest conservation.

Conclusion

To conclude we can say that AI has tremendous potential for environmental conservation, as seen by its numerous applications ranging from biodiversity protection to climate change predictions. AI provides unmatched opportunities to address to pressing environmental challenges despite the environmental concerns and the ethical aspects related to data accessibility and procurements. AI is a powerful tool for generating environmentally responsible behaviour by incorporating AI technologies into conservation measures. AI, when used ethically and sensibly, may be able to create a more sustainable future that will balance human growth and at the same time also protect the environment and build a more sustainable future.

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INTERFACE OF HUMAN INTELLIGENCE & ARTIFICIAL INTELLIGENCE: POSSIBILITIES AND CHALLENGES IN AVIATION'S SYMBIOTIC ERA

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Abstract
Putting Artificial Intelligence (AI) and Machine Learning (ML) into crucial areas like commercial and military aviation is causing a big change moving from old-style automation to truly smart, independent systems. This means we need a fresh look at how humans and machines work together (the Human-Machine Interface, or HMI). The goal is to build a truly symbiotic relationship a close, beneficial partnership between Human Intelligence (HI) and AI systems. This article looks at the great opportunities and tricky problems in aviation's move into this collaborative time. On one side, the chances for better safety and efficiency are huge. This includes predicting maintenance problems, saving fuel, and giving smart, real-time advice to air traffic control and pilots. However, relying too much on highly reliable automation brings up serious human challenges. The most famous one is the "Ironies of Automation "where stronger machine capability accidentally weakens human skills and awareness, often causing huge failures when the system runs into trouble. It is essential to manage human trust: operators must trust the AI's results, but they must not trust it blindly. To fix the risks of the AI making hidden, non-obvious decisions (the "black box" problem) and to meet legal rules, we look at the vital role of Explainable AI (XAI). We examine specific tools like LIME and SHAP, which are essential for showing why the AI made a certain decision. This transparency is needed for humans to accept the system and for safety checks. The article also summarizes the quickly changing global rules, focusing on EASA's goal of 'AI trustworthiness' and new regulations that demand proof of reliability. We argue that AI will only succeed in aviation if we focus not on letting the machine do everything, but on building genuinely collaborative human-AI teams. This requires strong rules for explainability, focusing on human needs in the design, and solid management that directly tackles the HI-AI partnership.
Keywords: Artificial Intelligence, Human-AI Teaming, Ironies of Automation, Explainable AI (XAI), Trustworthiness, Aviation Safety, EASA Regulation, LIME, SHAP.

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1. Introduction

Aviation is standing at the **start of its next big technology change**. After the times of mechanical flight and simple automation, using Artificial Intelligence (AI) and Machine Learning (ML) is a shift toward a **symbiotic era**. Here, the aim is not just to do tasks automatically, but to create smart, collaborative systems that make humans better at their jobs. This progress promises huge gains in speed, saving fuel, and spotting problems early.

However, since flying is so safety-critical, we must bring in AI with great care. The history of how humans and machines interact is full of problems, mainly about who is in charge and how to make sure the human operator stays skilled. The hidden **"black box" nature** of complex ML models—where we don't know why they decide what they do clashes directly with the industry's absolute need for proven safety and decisions that can be checked.

This article looks closely at the connection between Human Intelligence (HI) and AI in today's aviation world. First, it highlights the good things that can come from this partnership. Second, it uses the key human challenge, the "Ironies of Automation," to understand modern AI use. Third, it explains why Explainable AI (XAI) is the technology needed to make this work, describing tools like LIME and SHAP. Finally, it looks at the new rules coming from EASA and the FAA, concluding that safe and effective AI use depends on building strong, clear, and well-governed human-AI teams.

2. The New Automation: What Could Go Wrong

2.1. Possibilities in the Symbiotic Era

AI can be used in **all parts of flying**. In **Air Traffic Management (ATM)**, AI can guess complex traffic flows and suggest better routes to cut down on delays and pollution. In the **cockpit**, AI acts like a smart digital co-pilot, predicting weather and dangers in real-time, helping the crew when they are busy, and diagnosing system problems.

The area where AI is already doing well is **predictive maintenance**. By looking at massive amounts of data from sensors on engines and other parts, ML models can predict exactly when a component is about to fail. This changes maintenance from a fixed schedule or fixing things after they break to a precise, condition-based plan, which makes fleets much more reliable and safer. These opportunities rely on AI systems becoming active helpers rather than just simple automated tools.

2.2. The Ironies of Automation

When systems become more reliable, they create the most serious problem for humans, first explained by Lisanne Bainbridge in her important 1983 paper. The irony is simple: the better the automation is at stopping human mistakes, the more necessary, yet less ready, the human operator is when the automation breaks down.

The success of the automated system means humans don't have to intervene often, leading to **getting bored and losing focus** (vigilance decrement) and their **manual flying skills getting rusty**. When a rare but serious problem happens the exact moment when human diagnosis and skill is needed the operator might not be trained enough, won't know what's going on (poor situational awareness), and won't fully understand how the system works. The same systems meant to boost safety can sometimes make the human the least reliable part during a crisis. This problem shows that HI cannot just be taken out of the loop; instead, its role must be actively supported and improved.

3. Designing the Human-AI Symbiotic Interface

The collaborative era needs interfaces designed to manage human trust and make things clear, turning the AI "black box" into a trusted partner.

3.1. Balancing Trust and the Black Box Problem

For a pilot or air traffic controller, trusting an automated system is non-negotiable. But this trust must be **balanced**: high enough to use the system's benefits, but low enough to allow for proper

checking and the ability to step in. Unbalanced trust either relying too much on (over-trust) or doubting too much (under-trust) can lead to mistakes.

The main problem stopping balanced trust is the **"black box" issue**. Here, complex ML models (like deep learning) give very accurate answers but don't explain *how* they reached that answer. While this is okay for less critical apps, in aviation, a system giving advice must explain *why* it suggests a specific action or *why* it warns about an engine part. Without a clear reason, the human-AI partnership fails because the human operator cannot safely take responsibility for a command they don't understand or believe in.

3.2. Explainable AI (XAI) as the Technical Bridge

Explainable AI (XAI) is the field focused on making AI systems clear, checkable, and easy for humans to understand. XAI methods generally explain either the model's *overall* behavior or the reasons for a *single* specific decision.

Two of the most well-known XAI techniques that **work for any type of AI model** are **LIME** and **SHAP**.

Local Interpretable Model-agnostic Explanations (LIME) works by looking at how the complex model behaves for a single prediction. It builds a simple, easy-to-understand model (like a basic math formula) using slightly altered data points around that specific case. In aviation, LIME could show why an AI spotted an object on the ground: it might show that the decision was based locally on the object's darkness, speed, and size details the human operator can quickly check.

Shapley Additive explanations (SHAP) values, which come from game theory, offer a standard way to measure how much each piece of data contributes to a prediction. It ensures **fairness** by calculating the value of a feature across all possible groupings of features.

In a predictive maintenance case, SHAP can help engineers understand both local and global behaviors. Locally, it can tell an engineer that a "critical fault" warning was mainly caused by a 10% change in pressure and a 15% drop in response time. Globally, it can show that fluid temperature is the most important factor for spotting failures early across all predictions. This detailed, reliable explanation is crucial for meeting official rules.

4. Critical Challenges and Human Factors in Teaming

Moving successfully into a symbiotic era requires **solving problems before they happen**, particularly the human issues that typically affect highly reliable automation.

4.1. Skill Degradation and the Vigilance Challenge

The core problem of Bainbridge's **Irony** remains the main worry. Automation already means pilots spend less time manually flying and more time watching systems. If AI makes routine tasks even smoother, the gap widens between the human's normal, easy workload and the sudden, intense demands of an unexpected failure.

Design must include ways to keep the human involved. This means **designing for active checking**, where the pilot must interact with the AI sometimes to stay aware, and **keeping up manual training** for situations where the automated system is running poorly. The AI interface must explain its reasoning and data streams even when things are running smoothly, constantly giving the human the awareness needed to take control fast.

4.2. Automation Surprise and Mode Confusion

Automation surprise happens when the system does something unexpected or acts differently from what the operator thought it would. In complex, AI-driven environments, this surprise is **made worse by Mode Confusion**, where the operator loses track of what the automated system is currently doing (e.g., is it just helping the human, or is it operating mostly on its own?).

A symbiotic design must give clear, simple, and advance warnings about the AI's planned actions and its current operational limits. XAI is vital here, not just for fixing problems, but for **proactive transparency**. The AI should explain its decision logic *before* carrying out a crucial command, letting the human partner check and anticipate the system's behavior. This keeps the human ready to be the ultimate safety layer.

4.3. Algorithmic Bias and Data Governance

AI systems are only as good and fair as the data they learn from. Aviation data, while usually complete, might accidentally include old biases or miss rare, important cases. If an AI system, trained on historically unbalanced data, provides advice that favors certain flight conditions or types of aircraft, it creates a risk far more hidden and dangerous than a simple mechanical fault.

Strong data governance is the most important thing. This involves setting up secure, private, and fair data systems, and creating records that allow regulators to trace an AI's decision back to the original training data. The regulatory rules must specifically address how good and representative the data used for official approval is, making sure AI doesn't just automate human or data biases that already exist.

5. The Regulatory and Assurance Landscape

For AI to be widely used in aviation, it needs to clear the regulatory hurdle of **getting official approval**, which is closely linked to how trustworthy and explainable it is.

5.1. EASA's Framework for AI Trustworthiness

The European Union Aviation Safety Agency (EASA) is **acting early**, creating its **AI Roadmap 2.0** and planning new rules (like Notice of Proposed Amendment 2025-07). EASA's plan focuses on creating **AI Trustworthiness**, based on four key parts that directly match the problems of the symbiotic era:

1. **Technical Resilience:** The AI must be tough, secure, and accurate.
2. **Human Factors and Performance:** The design must account for the HI-AI partnership, focusing on balanced trust, the ability for humans to step in, and good training.
3. **Ethical Requirements:** The system must be fair, and its overall goal must match safety values.
4. **Governance and Quality:** The data, the development process, and how it's used must be clear and checkable throughout the AI's entire life.

EASA's method is key because it requires more than just high accuracy (Technical Resilience). It also demands that the process and ethics can be checked (Governance and Ethics). This effectively forces the use of XAI, because without clear explanations, the requirements for Human Factors, Ethics, and Governance cannot be met.

5.2. FAA's Focus on Certification Standards

At the same time, the U.S. Federal Aviation Administration (FAA) works closely with the industry to develop shared standards that ensure AI models used in aircraft meet current official approval rules. While EASA focuses on a complete trustworthiness plan, the FAA concentrates heavily on how AI components can be proven to do their jobs reliably and safely within established performance limits, especially through industry standards like those from RTCA.

Both the FAA and EASA are focused on sorting AI systems by their **Level of Autonomy (LoA)**, from Level 1 (Human-AI Assistance) to higher levels where the machine acts independently. The complexity of the rules and the mandatory need for explainability grow with the LoA. This system ensures that for the highest risk uses, the demand for XAI and the human's ability to take over remains absolute.

6. Conclusion

Aviation's move into a truly symbiotic era, where Human Intelligence and Artificial Intelligence work together, is the industry's biggest safety and efficiency challenge since the invention of the jet engine. The chances for a better, safer, and optimized aviation system are clear, but they cannot be separated from the historical human challenge called the **Ironies of Automation**.

The way forward requires changing the design plan: shifting the focus from letting the AI do everything to **optimizing collaborative teamwork**. The technical possibility of this partnership depends on **Explainable AI (XAI)**. Tools like LIME and SHAP are not just academic ideas; they are vital safety features that provide the clarity needed for human operators to stay aware, build balanced trust, and fulfill their role as the ultimate **guarantee of safety**.

In the end, the successful use of AI in aviation relies on the maturity of the rules and management systems. EASA's focus on the four pillars of Trustworthiness sets a global example, confirming that AI must be externally checked and approved. The future safety of air travel requires designers, regulators, and operators to work together to ensure that AI is not a replacement for human intelligence, but a trustworthy, explainable, and accountable partner in the cockpit and control tower.

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HUMAN RESOURCE STRATEGIES FOR THE FUTURE: ROLE OF EMPLOYEE WELL-BEING IN ORGANIZATIONAL PERFORMANCE

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Abstract

In an era characterized by rapid technological advancement, evolving workforce expectations, and increasing emphasis on sustainability, human resource strategies for the future must prioritize employee well-being as a core strategic element. This study examines the role of employee well-being in enhancing organizational performance and positions it as a critical future-oriented human resource strategy. Innovative HR practices such as flexible work arrangements, mental health support programs, digital wellness platforms, and employee assistance initiatives contribute to higher levels of engagement, motivation, and job satisfaction. The study highlights how well-designed well-being strategies reduce employee burnout, absenteeism, and turnover while improving productivity, organizational commitment, and overall performance. By aligning employee well-being with strategic HR objectives, organizations can build a future-ready workforce capable of meeting emerging challenges. The study concludes that employee well-being is not merely a supportive HR function but a vital strategic investment that drives organizational effectiveness and competitive advantage.

Keywords: Human Resource Strategies, Employee Well-being, Organizational Performance, Future Workplace, Sustainable HR Practices, Employee Engagement.

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Introduction:

Employee well-being encompasses the holistic health of individuals in the workplace, including their physical, psychological, emotional, and social dimensions. It involves elements such as job satisfaction, balance between professional and personal life, workplace safety, financial security, supportive interpersonal relationships, and a meaningful sense of purpose in one's role.

Employee mental health is an integral aspect of overall well-being and focuses specifically on an individual's emotional and psychological condition. It reflects factors such as stress management, emotional resilience, mood stability, cognitive focus, and general mental effectiveness. Positive mental health allows employees to manage workplace demands effectively, maintain productivity, and make constructive contributions to the organisation.

Employee Well-Being A Key Priority in Modern Organisations:

Organizations that invest in employee well-being are more successful in attracting and retaining talented professionals, as today's workforce places high value on mental health and work–life balance. Employees who feel respected and psychologically supported are more attentive, motivated, and innovative, which contributes to improved organizational outcomes A strong culture of well-being helps minimize stress and burnout through initiatives such as flexible working arrangements, counselling support, and effective workload management, leading to greater employee resilience and lower turnover rates. Furthermore, attention to mental health supports compliance with occupational health and safety standards, reducing potential legal and reputational risks.

A workforce that is mentally healthy is more open to collaboration, creativity, and innovation, which is critical for maintaining competitiveness in a dynamic business environment. Additionally, employees who feel supported are more likely to interact positively with customers, resulting in higher satisfaction, stronger loyalty, and improved long-term organizational performance. This directly leads to higher productivity, as tasks are completed more efficiently with fewer errors. Improved well-being also enhances the quality of work by reducing stress and burnout, enabling employees to make sound decisions, maintain attention to detail, and consistently deliver high-quality outcomes.

Investing in well-being initiatives—such as flexible work arrangements, mental health support, and recognition programs—creates a supportive and positive work environment. This strengthens employee commitment, improves retention, and lowers turnover, thereby reducing recruitment and training costs. Overall, employee well-being contributes to the development of a motivated workforce and a performance-driven organisational culture.

Employee Well-Being as a Strategic Driver of Performance

In contemporary organisations, employee well-being has evolved from a welfare measure into a strategic driver of organisational success. Organisations that prioritise well-being benefit from sustained productivity, consistent quality of output, and long-term workforce stability. Healthy and emotionally supported employees are better equipped to manage work demands, collaborate effectively, and contribute creatively, strengthening organisational effectiveness and innovation. Furthermore, a positive well-being culture enhances the organisation's image, attracting high-quality talent and reinforcing stakeholder trust. Ultimately, a motivated and engaged workforce delivers superior customer experiences, leading to increased satisfaction, loyalty, and competitive advantage. This study therefore highlights employee well-being as a critical factor in enhancing organisational performance and overall effectiveness.

Importance of the Study:

The study of employee well-being and mental health is crucial in today's demanding work environment, where high performance pressures and blurred work–life boundaries affect employees across sectors. Well-being, including physical, mental, emotional, and social health, directly influences productivity, motivation, and quality of life. Prioritizing well-being helps organizations reduce stress, burnout, absenteeism, and turnover while strengthening workplace culture and long-term organizational success.

Objectives of the Study:

1. To evaluate the strategies designed by the organization to maintain the wellbeing of employee.

2. To examine the nature and current status of various dimensions of employee well-being in the IT sector.

Limitations of the Study:

The study is limited to employees working in the IT sector; therefore, the findings may not be generalizable to other industries or sectors. The research relies on self-reported data, which may be influenced by personal bias, perception, or reluctance to disclose mental health concerns. The sample size and geographic coverage may be limited, restricting the broader applicability of the results. The study captures employee well-being at a specific point in time and does not account for changes over time or long-term trends. External factors such as organizational culture, economic conditions, or personal life circumstances may affect employee well-being but may not be fully captured in the study. Time constraints and availability of respondents may limit the depth of data collection and analysis.

Review of Literature:

Rufeng, L., Nan, Z., & Jianqiang, Z. (2023) the authors wish to convey that employee happiness is not just an emotional outcome but a key driver of workplace performance and attitudes. Their research highlights a cause-and-effect relationship showing that happier employees tend to be more productive and develop a more positive attitude toward their work environment.

Malinen, S., Hatton, T., Naswall, K., & Kuntz, J. (2019) concluded that the strategies can strengthen organisations' adaptive capacity and increase performance in the long-term aftermath of a disaster.

Garcia, A. G. (2025) this shows that adopting sustainable and inclusive workplace practices that prioritize both physical and mental health significantly contributes to increased employee engagement, productivity, and overall satisfaction.

Dongre, A. N. (2024) the researcher profound implications of robust well-being initiatives, correlating them with heightened productivity levels, improved customer retention rates, increased talent attraction, and decreased turnover rates within organizations.

Attipoe, V., Oyeyipo, I., Ayodeji, D. C., Isibor, N. J., & Apiyo, B. (2023) this research highlight the importance of prioritising employee well-being as an organisation's strategic investment. It offers recommendations for policymakers and stakeholders interested in maximising economic returns.

BELLA, K. M. J. (2023) this study explores the dimensions of employee well-being, including physical, mental, emotional health and emphasizes the importance of work-life balance and personal fulfilment.

Monteiro, E., & Joseph, J. (2022) this study assisted in comprehending the various employee well-being initiatives introduced by IT sector companies. To assist the companies in fostering a compassionate workplace culture and putting employees first, SWOC Analysis of those initiatives is carried out.

Sampson, J. S., & Asonye, B. O. (2025) this study investigates the influence of well-being-related policies, practices, and products on employees in African nonprofits, specifically focusing on organizations in Nigeria and South Africa.

Serobyan, M. (2022) the researcher has taken the base of innovation study used Clark and Estes' (2008) gap analysis conceptual framework to understand employees' knowledge, motivation, and organizational (KMO) influences affecting their organization's implementation of well-being initiatives aimed at improving employee health, engagement, and, ultimately, performance.

Sutton, A., & Atkinson, C. (2023) the study highlights the complexity of performance effects achieved via both employee benefits and an intensification of employee experiences.
Singh, A., & Jha, S. (2022) conclude that employee well-being and organizational health have a reciprocal relationship, where each positively influences the other. A healthy organization enhances employee well-being, while improved well-being strengthens organizational effectiveness and sustainability.
Raj, A. B. (2020) the study empirically analysed the influence of internal branding initiatives on overall workplace well-being in which every stakeholder feels included, valued and respected.
Barinua, V., & Nwineewii, B. J. (2025) the researcher found that workplace wellness initiatives have a positive and significant relationship with organisational effectiveness in telecommunication firms. Their study shows that wellness programs improve employee productivity, commitment, and job satisfaction. Overall, effective wellness practices contribute to better organisational performance and sustainability.
Cook, R. (2021) concludes that until wellbeing is contextualised to the environment in which it is experienced, and responsibility for wellbeing is pushed back to management, the expected gains from wellbeing initiatives will continue not to be realised.
Huettermann, H., & Bruch, H. (2019) found that health-related HRM practices positively influence employees' collective well-being by reducing emotional exhaustion and increasing engagement. Improved collective well-being, in turn, enhances overall organizational performance. The study highlights the strategic role of HHRM in fostering both employee health and organizational effectiveness.
Odame, D. A., Laube, W., Hinson, R. E., & Dzandu, E. (2025) found that employees generally appreciated well-being initiatives introduced during the COVID-19 pandemic, which positively impacted their mental and emotional health. The effectiveness of these initiatives depended on the level of organizational support and communication. Overall, supportive well-being measures enhanced employee resilience, engagement, and trust in their organizations.

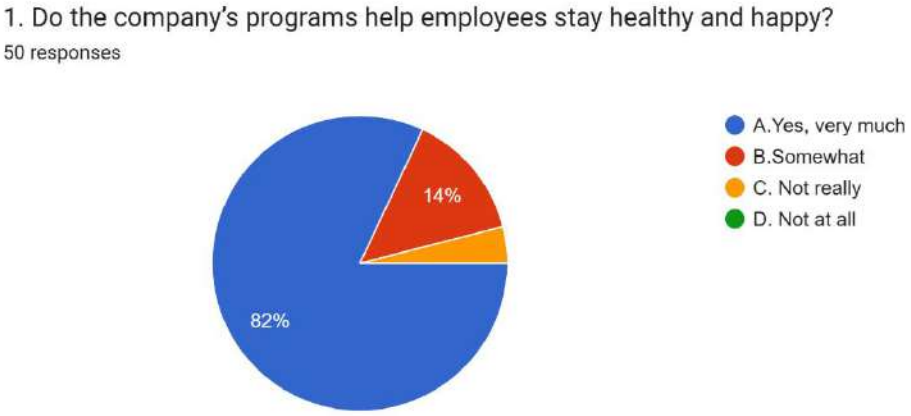
Analysis of the Study:
To Evaluate the Strategies Designed by the Organization to Maintain the Wellbeing of Employee:

Q.1) Does the Company's Programs help Employees stay Healthy and Happy?

Row Labels	No of respondents	No of respondents (%)
Yes, very much	41	82.00%
Somewhat	7	14.00%
Not really	2	4.00%
Grand Total	50	100.00%

Source: Primary Data

The above table shows that 82% of the respondents stay healthy and happy with the company's wellness programs, whereas 14% of the respondents are somewhat happy, and 4% states Not really. The graphical representation of the table is shown below

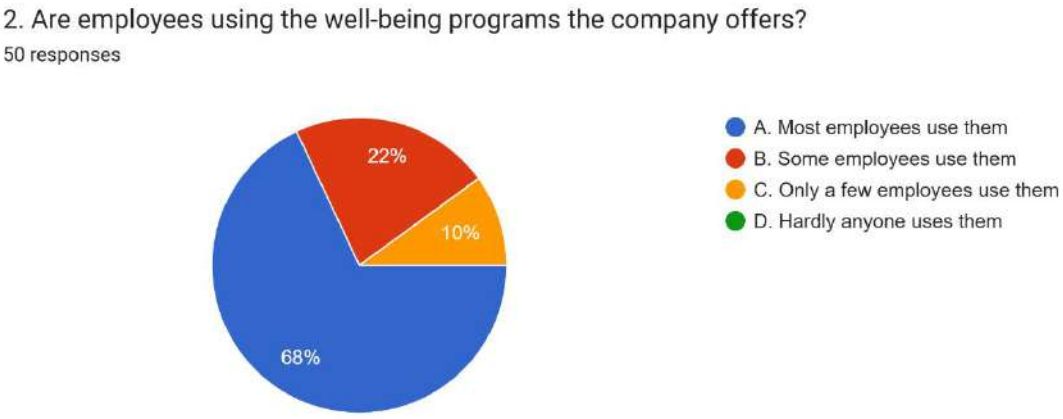


Q.2) Are employees utilizing the well-being programs offered by the company?

Row Labels	No of respondents	No of respondents (%)
A. Most employees use them	34	68.00%
B. Some employees use them	11	22.00%
C. Only a few employees use them	5	10.00%
Grand Total	50	100.00%

Source: Primary Data

The above table shows that 68% of the respondents believe most employees use the programs, 22% state that some employees use them, while 10% report that they used the well-being program very rarely The graphical representation of the table is shown below:



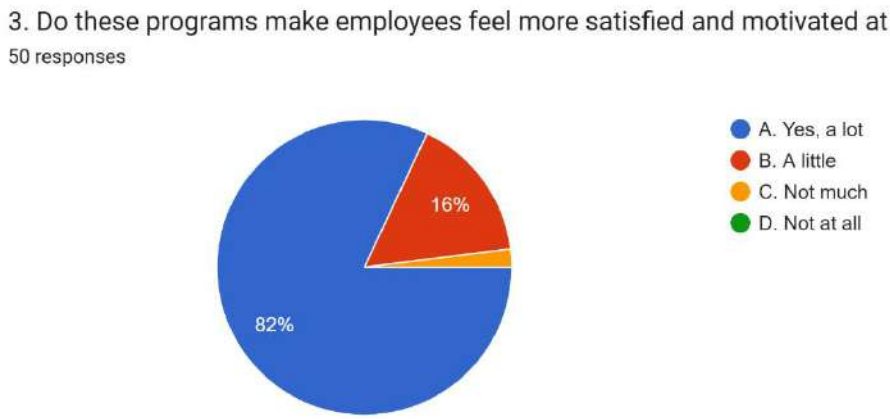
Q.3) To what extent do the well-being programs make employees feel satisfied and motivated at work?

Row Labels	No of respondents	No of respondents (%)
A. Yes, a lot	41	82.00%
B. A little	8	16.00%

C. Not much	1	2.00%
Grand Total	50	100.00%

Source: Primary Data

The above table represents that 82% of the respondents says Yes, a lot, whereas 16% states A little, 2% thinks Not much. The graphical representation of the table is shown below:

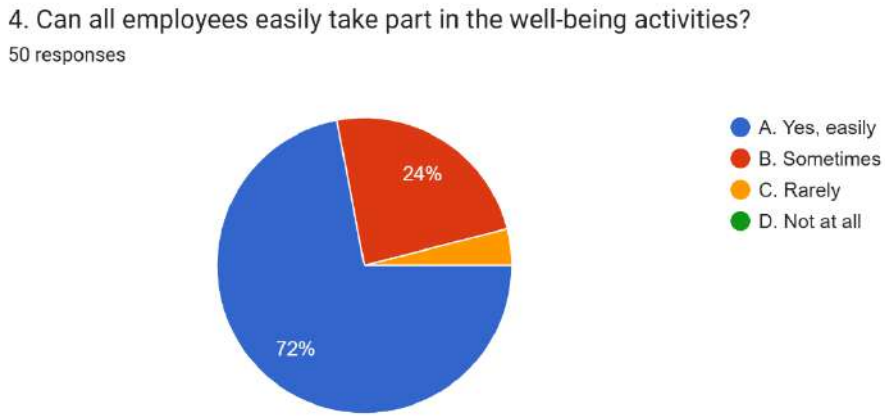


Q.4) Are employees able to easily participate in the well-being activities?

Row Labels	No of respondents	No of respondents (%)
Yes, easily	36	72.00%
Sometimes	12	24.00%
Rarely	2	4.00%
Grand Total	50	100.00%

Source: Primary Data

The above table represents 72% of the respondents feels like Yes, easily they can participate, whereas some respondents says sometimes, wherein 4% of the respondents express rarely they could participate due to work schedule. The graphical representation of the table is shown below:

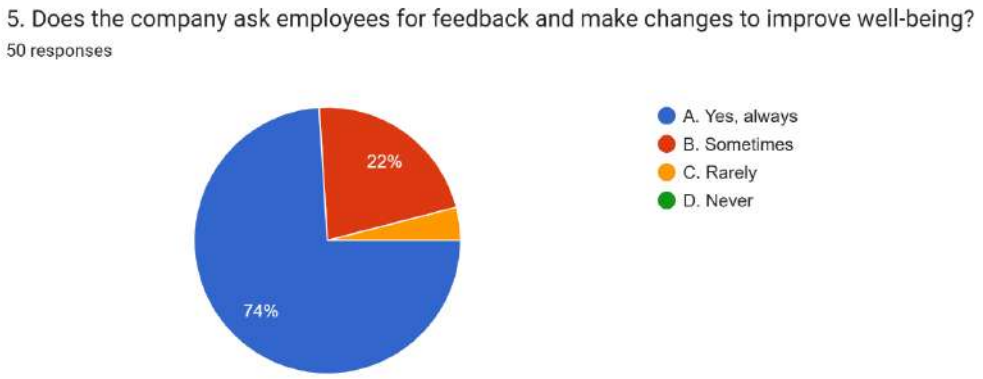


Q.5) Does the organization collect feedback from employees and take actions to improve well-being?

Row Labels	No of respondents	No of respondents (%)
Yes, always	37	74.00%
Sometimes	11	22.00%
Rarely	2	4.00%
Grand Total	50	100.00%

Source: Primary Data

The table showcase that 74% of the respondents says Yes always feedback is taken from the employees to improve well-being program, whereas 22% state that sometimes their feedback is taken, while 4% says that it is rarely done. The graphical representation of the table is shown below:



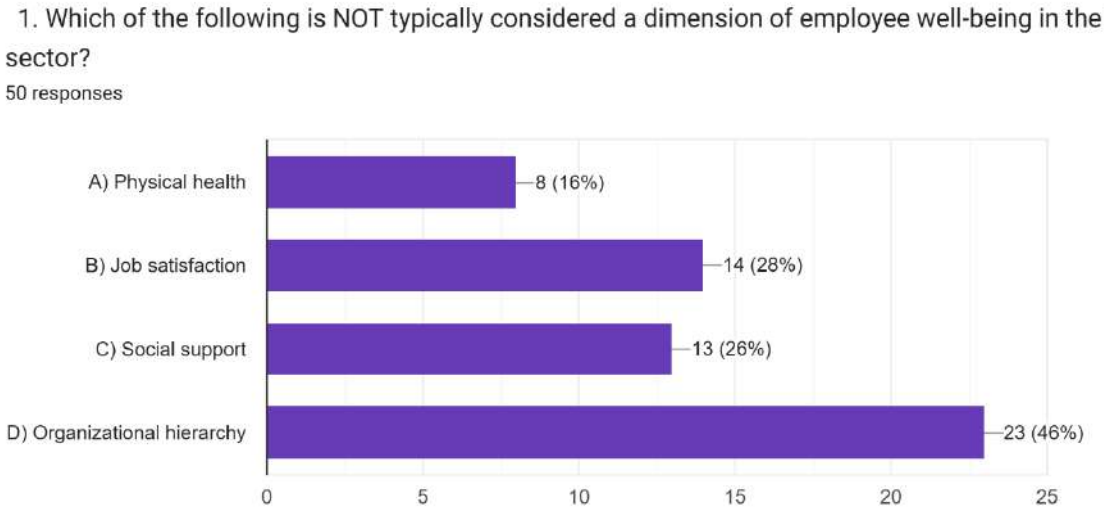
To Examine the Nature and Current Status of Various Dimensions of Employee Well-Being in the IT Sector.

Q.6) Which dimensions of employee well-being are often overlooked in the IT sector?

Row labels	No of respondents	No of respondents (%)
Physical Health	8	16%
Job Satisfaction	14	28%
Social Support	13	26%
Organisational Hierarchy	23	46%

Source: Primary Data

The above table states that 46% of the respondent's state that organisational hierarchy is the dimension often overlooked, whereas 28% feel job satisfaction is the dimension, 26% state social support and lastly 8% state that physical health of the employees. The graphical representation of the table is shown below:

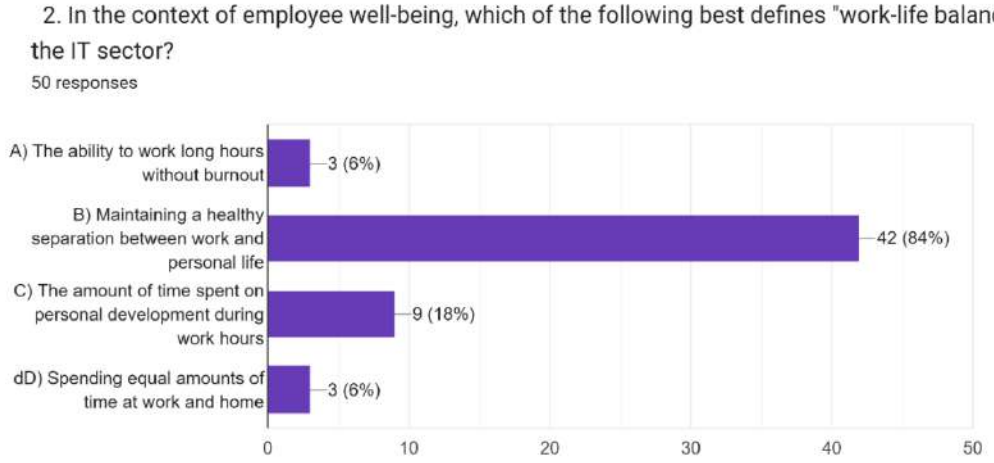


Q.7) In the Context of Employee Well-Being, Which of the Following Best Defines "Work-Life Balance" in the IT Sector?

Row Labels	No of respondents	No of respondents (%)
The ability to work long hours without burnout	3	6.52%
Maintaining a healthy separation between work and personal life	37	80.43%
The amount of time spent on personal development during work hours	5	10.87%
Spending equal amounts of time at work and home	1	2.17%

Source: Primary Data

The above table states that 80.43% of the respondents Maintains a healthy separation between work and personal life, whereas 10.87% of the respondents spend time on their personal development during work hours, while 6.52% shows the ability to work long hours without burnout, and 2.17% Spending equal amounts of time at work and home. The graphical representation of the table is shown below:

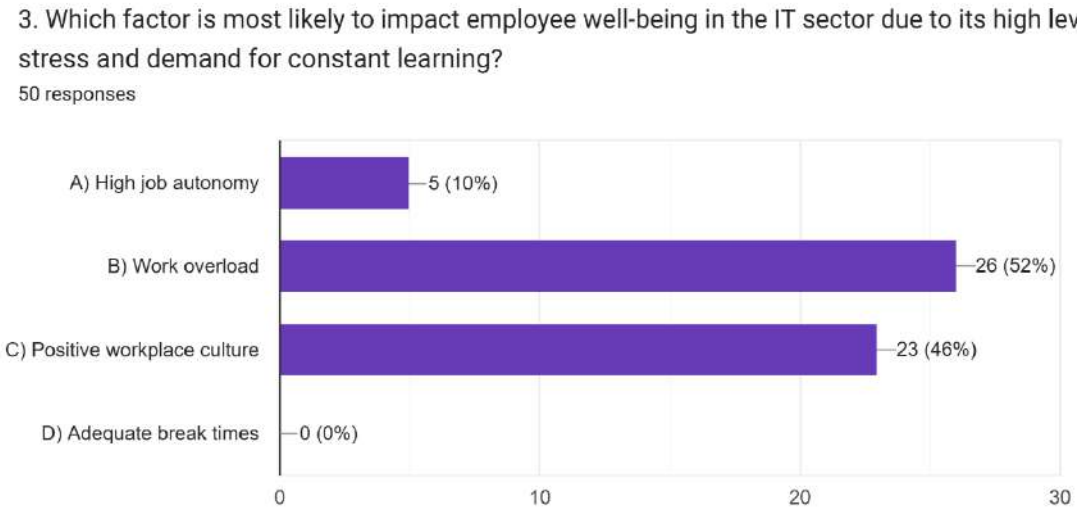


Q.8) In the IT sector, which factor has the greatest impact on employee well-being due to high stress and ongoing learning requirements?

Row Labels	No of respondents	No of respondents (%)
A) High job autonomy	5	10%
B) Work overload	26	52%
C) Positive workplace culture	23	46%%

Source: Primary Data

The above table represents that 52% of the respondent's states that workload heavily impact employee well-being 46% of the respondents says that positive workplace culture impact employee well-being 10% of the respondent's state High job autonomy impact employee well-being. The graphical representation of the table is shown below:

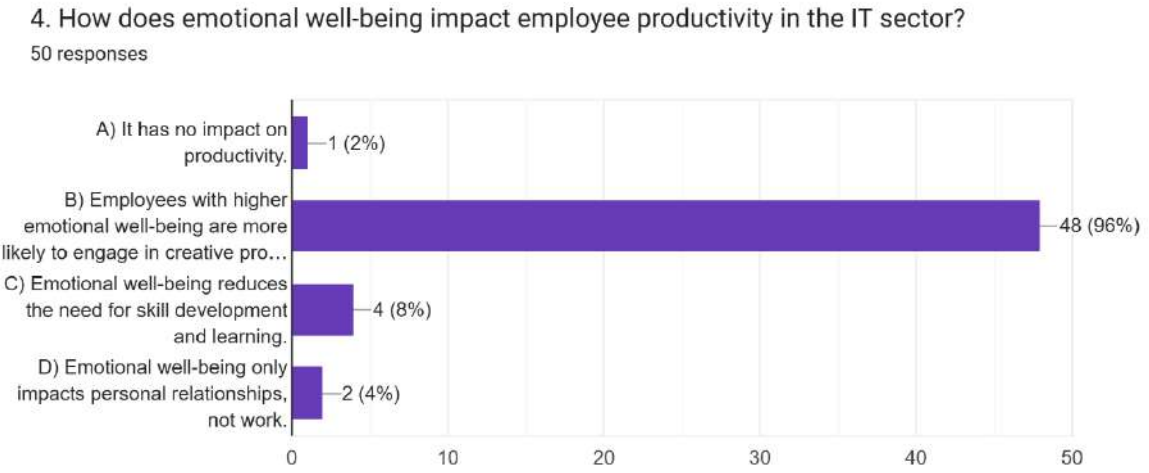


Q.9) How Emotional Well-Being Impact Employee Productivity in the IT Sector?

Row Labels	No of respondents	No of respondents (%)
A) It has no impact on productivity.	1	2%
B) Employees with higher emotional well-being are more likely to engage in creative problem-solving and exhibit better job performance.	48	96%
C) Emotional well-being reduces the need for skill development and learning.	4	8%
D) Emotional well-being only impacts personal relationships, not work.	2	4%

Source: Primary Data

The researcher found that 96% of the Employee with higher emotional well-being are more likely to engage in creative problem-solving and exhibit better job performance, whereas 8% express emotional well-being reduces the need for skill development and learning while 4% state that Emotional well-being only impacts personal relationships, not work whereas 2% ascertained that there is no impact on the productivity. The graphical representation of the table is shown below:

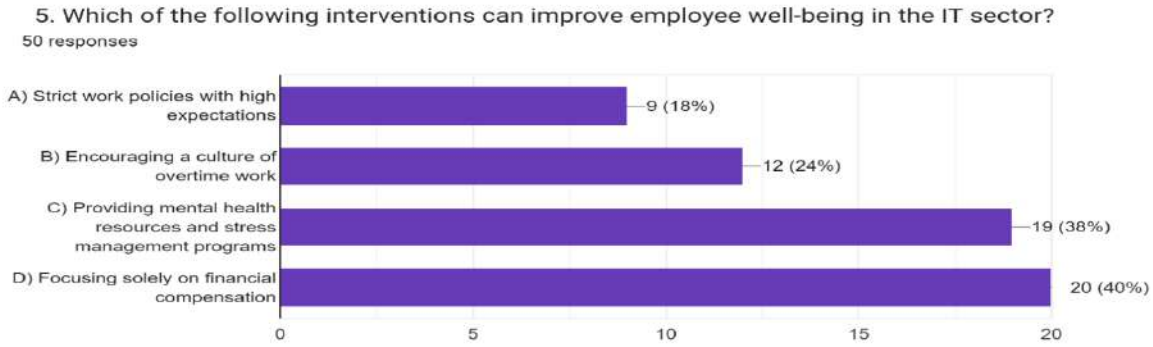


Q.10) Which of the Following Interventions can improve Employee Well-Being in the IT Sector?

Row Labels	No of respondents	No of respondents (%)
Strict work policies with high expectations,	9	18%
Reducing the Culture of overtime work	12	24%
Providing mental health resources and stress management programs	19	38%
Focusing solely on financial compensation	20	40%

Source: Primary Data

The above table shows that 40% financial compensation can help them to improve their employee wellbeing, whereas 38% states providing mental health resources and stress management programs can improve employee well-being, while 24% state intervention pertaining to culture of overtime work and last 18% intervened by strict work policies with high expectations. The graphical representation of the table is shown below:



Findings of the Study:

The researcher found that the company's well-being programs have a positive impact on employees, with the majority staying healthy and happy, using the programs regularly, and feeling more satisfied and motivated at work. Most employees can easily participate in the activities, while some do so rarely, and the company actively seeks feedback to improve these initiatives. The study

also revealed that organizational hierarchy and job satisfaction are not considered key dimensions of employee well-being in the IT sector. Maintaining a healthy work-life balance, managing heavy workloads, and fostering a positive workplace culture were identified as important factors affecting well-being. Furthermore, employees with higher emotional well-being demonstrated better job performance and creativity. Effective interventions in the IT sector include financial compensation, mental health resources, and stress management programs, all contributing to improved employee well-being.

Conclusion:

The study concludes that employee well-being programs in the IT sector significantly enhance employees' health, satisfaction, motivation, and overall productivity. Participation in well-being initiatives, combined with organizational support and feedback mechanisms, fosters a positive work environment and strengthens work-life balance. Key factors such as workload management, workplace culture, and emotional well-being play a critical role in shaping employee experiences, while targeted interventions like mental health resources, stress management programs, and financial incentives further improve well-being. Overall, prioritizing employee well-being contributes to higher engagement, performance, and organizational effectiveness.

Recommendations for Further Research:

Explore the long-term impact of well-being programs on employee retention, career growth, and organizational performance in the IT sector. Investigate sector-specific well-being challenges across different industries to identify unique factors and best practices. Study the effectiveness of digital well-being tools and remote work interventions in enhancing employee mental and emotional health. Examine the role of leadership styles and managerial support in fostering a culture of well-being. Assess the correlation between employee well-being and innovation, creativity, and team collaboration in high-pressure IT environments.

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EMOTIONAL INTELLIGENCE AS AN INNOVATIVE PRACTICE FOR ENHANCING MANAGERIAL LEADERSHIP EFFECTIVENESS

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Abstract

In the contemporary business environment marked by rapid change, complexity, and increased focus on human capital, innovative practices in management have become essential for effective leadership. This study explores the role of Emotional Intelligence (EI) as an innovative managerial practice that enhances leadership effectiveness and organizational performance. Emotional intelligence, encompassing self-awareness, self-regulation, motivation, empathy, and social skills, enables managers to lead with emotional balance, adaptability, and inclusiveness. The study emphasizes how the integration of EI into managerial leadership represents a shift from traditional, authority-driven approaches to innovative, people-centric leadership models. Emotionally intelligent managers adopt innovative practices such as empathetic communication, collaborative decision-making, constructive conflict management, and emotionally informed problem-solving. The study further highlights that emotionally intelligent leadership enhances resilience, change management capability, and sustainable organizational growth. However, the researcher tries to evaluate how emotional intelligence training and assessment significantly strengthen leadership effectiveness and drive competitive advantage in modern organizations.

Keywords: Emotional Intelligence, Innovative Management Practices, Managerial Leadership, Leadership Effectiveness, Organizational Performance, Human-Centric Management.

► *Corresponding Author: Dr. Vaishali Nadkarni*

Introduction:

Leadership is the process of influencing, guiding, and motivating individuals or groups toward achieving common goals. It involves setting a vision, making strategic decisions, inspiring others, and creating an environment where people can perform at their best. Leadership is not limited to authority; it is rooted in behaviours such as communication, integrity, empathy, and the ability to motivate and coordinate people.

Effective leaders further demonstrate strategic thinking, enabling teams to navigate complex decisions with clarity and alignment to organisational goals. Another key indicator of leadership effectiveness is its capacity to drive innovation by encouraging creativity, supporting new ideas, and creating a psychologically safe environment for experimentation. Additionally, effective leadership enhances teamwork by promoting collaboration, clarifying roles, and resolving

conflicts—an essential quality in modern organisations where cross-functional coordination is frequent. Leaders also influence organisational culture through their behaviour and values; effective leadership cultivates a positive, ethical, and high-performance culture that attracts and retains talent. Ultimately, leadership effectiveness lies in its ability to align people, processes, and resources with the organisation's mission and vision, ensuring that strategies are executed efficiently and successfully.

Key Differences and How the Shift Happened:

1. From Manual Processes to Digital Operations

- Traditional business: Relied on manual work, paperwork, and face-to-face transactions.
- Modern business: Uses digital tools, automation, software, and online platforms helps the technology to increases efficiency, reduces errors, and speeds up operations.

2. From Local Markets to Global Markets

- Traditional business: Served mainly local or regional customers.
- Modern business: Operates in global markets through e-commerce and international supply chains the globalization and the internet make worldwide reach possible.

3. From Product-Centered to Customer-Centered Approach

- Traditional business: Focused mostly on producing and selling products.
- Modern business: Focuses on customer needs, experience, and personalization. today's customer expect high-quality service, customization, and value rather than just buying a mere brand.

4. From Hierarchical to Flexible Organisational Structures

- Traditional business: Used rigid hierarchies and top-down decision-making.
- Modern business: Prefers teamwork, decentralised decision-making, and collaborative cultures. It encourages Flexibility, innovation and faster decision-making.

5. From Limited Communication to Instant Communication

- Traditional business: Communication was slow—letters, physical meetings, telephone calls.
- Modern business: Uses email, instant messaging, virtual meetings, and social media. As technology enabled real-time communication and faster response to customers.

6. From Physical Stores to Online Presence

- Traditional business: Depended on physical shops and face-to-face sales.
- Modern business: Uses websites, apps, and digital marketing to reach customers anytime. Online presence helps businesses to expands reach and lowers the operating costs.

Importance of Emotional Intelligence in Leadership:

Emotional intelligence (EI) is essential in leadership because it enables leaders to understand their own emotions, manage their reactions, and respond effectively to the feelings of others. Leaders with high EI create positive work environments, build strong relationships, and guide their teams through challenges with confidence and empathy.

Leaders with strong emotional intelligence manage conflict calmly and respectfully, using empathy to understand different viewpoints and self-regulation to avoid reactive behavior. Their clear communication and active listening reduce misunderstandings and create an environment where team members feel comfortable sharing ideas and concerns. By consistently showing empathy, honesty, and emotional awareness, these leaders build trust, encourage openness, and strengthen collaboration within the team. As a result, conflicts become opportunities for

improvement, teamwork becomes more effective, and overall team performance and unity increase.

Need for Study/Purpose:
This study explores how emotional intelligence contributes to effective managerial leadership and its overall impact on organizational functioning

Objectives of this Study:
a. To find out the importance of emotional intelligence in leadership.
b. To evaluate the impact of emotional intelligence on the development of leadership qualities.

Scope/Importance of the Study:
The scope of this study focuses on examining how emotional intelligence contributes to effective managerial leadership within organizational settings. It explores the key components of emotional intelligence—self-awareness, self-regulation, motivation, empathy, and social skills—and evaluates how these competencies influence a manager's ability to lead, communicate, make decisions, resolve conflicts, and motivate employees It also assesses the impact of emotionally intelligent leadership on team performance, employee satisfaction, workplace relationships, and overall organizational outcomes. The research is limited to selected departments or organizations and relies on employee perceptions, managerial assessments, and organizational data. The study does not focus on technical skills, personality traits unrelated to EI, or leadership styles beyond their connection to emotional intelligence. Overall, the scope defines the boundaries for understanding how EI enhances managerial effectiveness and contributes to better organizational performance.

Limitations of the Study:
This study has certain limitations that may influence the interpretation of its findings. First, emotional intelligence is a subjective concept, and the data collected through self-reported questionnaires may reflect personal biases, exaggeration, or inaccurate self-assessment by participants. The study is also limited to selected organisations, which may restrict the generalizability of the results to other industries or larger populations. Additionally, managerial effectiveness is influenced by multiple factors such as organisational culture, experience, personality traits, and external conditions, making it difficult to isolate the exact impact of emotional intelligence alone. Time constraints and limited sample size may further affect the depth of analysis. The study also does not examine long-term changes in EI or leadership behaviour, as it is based on a cross-sectional approach.

Review of Literature:
VENERA, T. A. (2019) the paper addresses aspects related to the importance of leadership based on emotional intelligence, stressing the relationship between emotion, leader, organizational culture and performance. Further it emphasis on the basic role of emotion in management is to create and generate positive resonance within the organization, allowing people to develop.
Sharma, R. (2024) explains the aspects that make it possible for leaders to traverse intricate interpersonal interactions, arrive at rational conclusions, and motivate people to work toward common goals.

Koutsioumpa, E. M. (2023) this study addressed the role of emotional intelligence in leadership and their interaction. Transformational leadership leads people with high emotional intelligence to adapt.

Sharma, R., Dhanta, R., & Solomon, D. D. (2023) reveals how EI affects decision-making, taking into account both cognitive and emotional components for better results in difficult circumstances. The importance of training, mentoring, and feedback in the development of EI in executives is stressed.

Singh, S., & Aditi, M. (2019) this research study is to understand how the employees Emotional Intelligence can be enhanced for developing effective leadership skills within them. Emotional intelligence has become increasingly popular as a measure for identifying potentially effective leaders, as a tool for developing effective leadership skills

Sheeba, M., & Rebekah, T. R. (2023) concluded that by practising Emotional Intelligence, leaders and individuals are able to reduce negative emotions, stay cool and manage stress, power to bounce back from adversity, resilient in staying proactive and not reactive and practice empathy and compassion towards other people holding close personal relationship.

Soni, P., & Dutta, M. (2019) concludes how far the Emotional Intelligence is related to leadership and how it positively impacts leadership.

DUYGU, A., VARIS, N., OZKAN, H., & ERDOGAN, A. (2023) concludes to determine what the concept of emotional intelligence means and the possible effects of emotional intelligence on job performance and leadership skills.

Nwagwu, U., & Henry, U. C. (2025) concludes that emotional intelligence is an important component of effective leadership, and that businesses should prioritize the development of emotional intelligence in their leaders.

Lambert, S. (2021) this article explores emotional leadership and argues that it is not only a key quality of effective leaders but has a particular relevance with the emotional burden created within the healthcare workforce by the recent COVID-19 pandemic.

Gómez-Leal, R., Holzer, A. A., Bradley, C., Fernández-Berrocal, P., & Patti, J. (2022) this study can help to inform the design of successful pre-service programmes for aspiring leaders and in-service programmes for school principals.

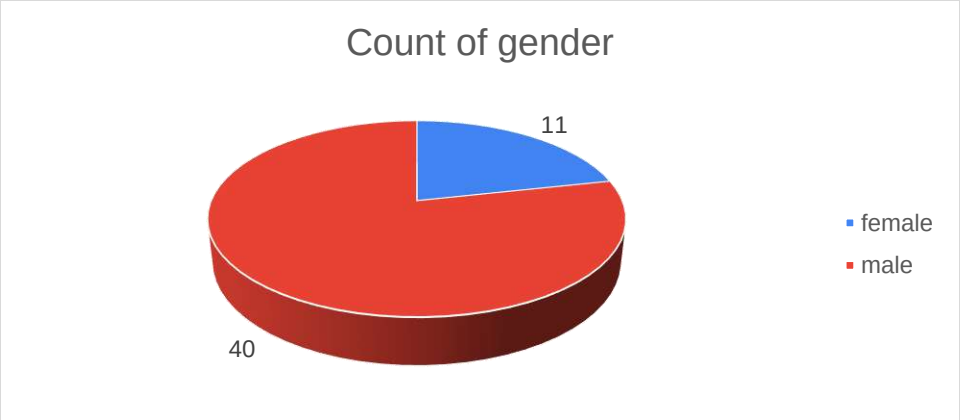
Findings of the Study:

Q.1) Gender- wise data of the respondents

Row Labels	Count of Gender	Count of Gender(%)
Female	11	21.57%
Male	40	78.43%
Grand Total	51	100.00%

Source: Primary data

The above table represents 21.57% are female respondents while 78.43% are males. The details are presented graphically as below:

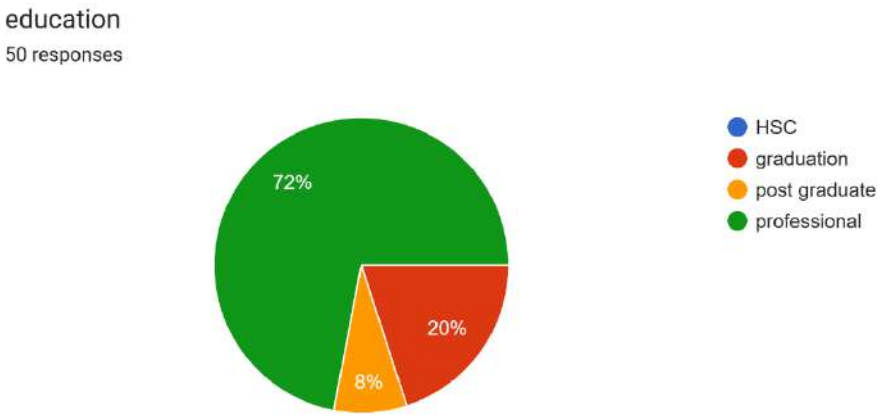


Q.2) Education- wise data of the Respondents

Row Labels	No of respondents	No of respondents (%)
Graduation	10	20.00%
Post graduate	4	8.00%
Professional	36	72.00%
Grand Total	50	100.00%

Source: Primary Data

The above table represents education of the respondents wherein graduates are 10 (20%), post graduate 4 (8%), and professional are 36 (72%) hence from the table it is concluded that maximum number of respondents are professionals. The details are presented graphically as follows:

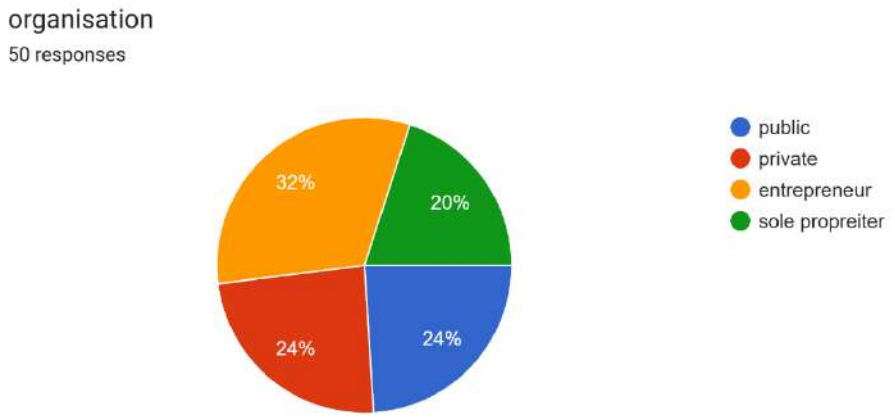


Organisation Type

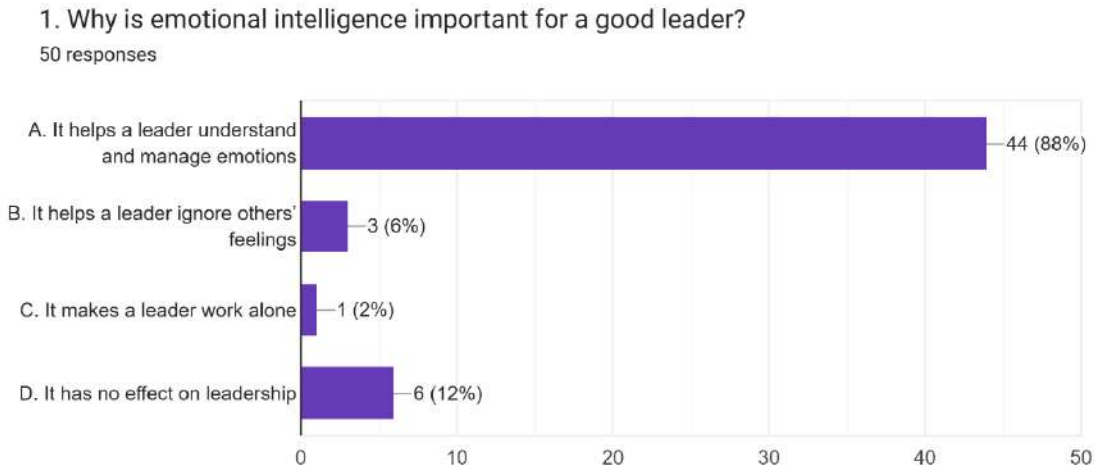
Row Labels	Count of organisation	Count of organisation (%)
Entrepreneur	16	31.37%
Private	12	23.53%
Public	12	23.53%
Sole Proprietor	11	21.57%
Grand Total	51	100.00%

Source: Primary Data

The above table represents count of the respondents working in different sectors whereas 31.37% are entrepreneurs, 23.53% are private employees, 23.53% are public employees and 21.57% are sole proprietor.

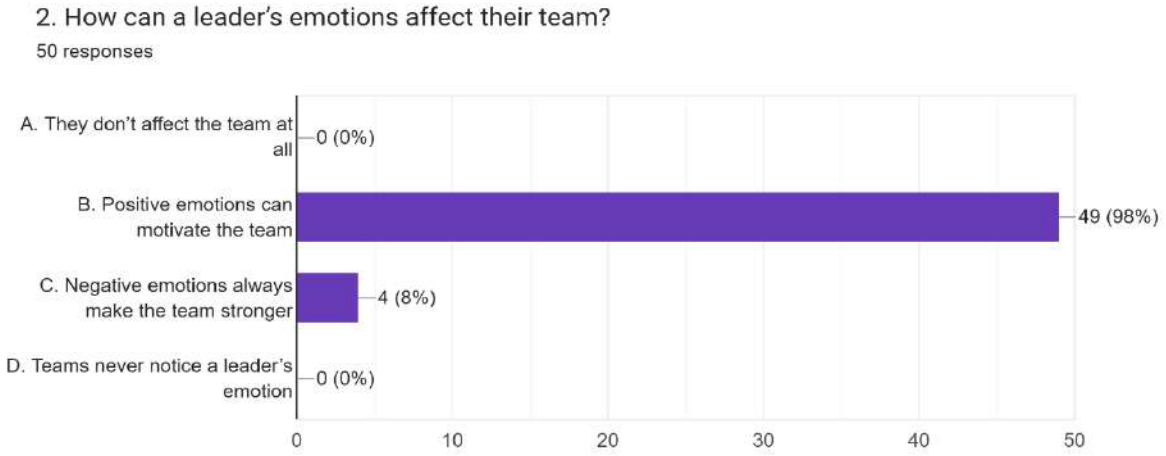


Part B: To Find Out the Importance of Emotional Intelligence in Leadership.
Q.1) Is Emotional Intelligence Important for a Good Leader



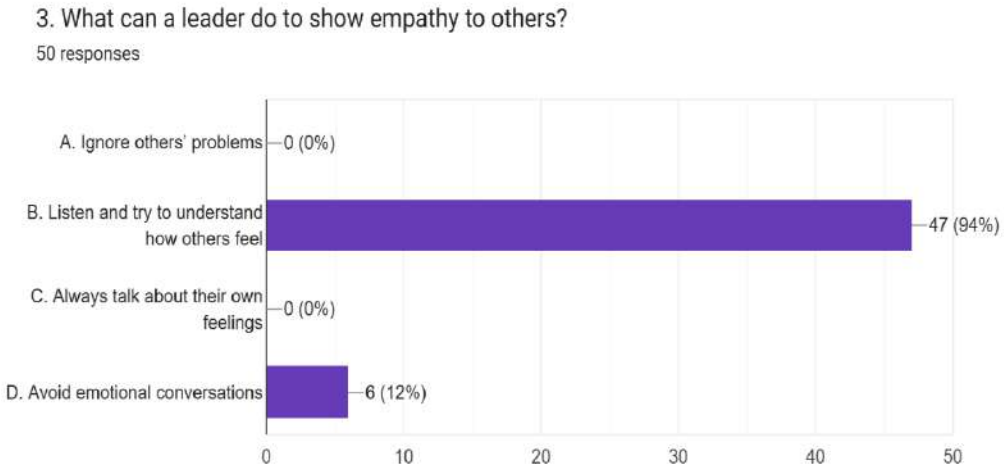
The above table indicates 88% of the respondent's emotional intelligence helps the leader to understand and manage their emotion, whereas 6% of the respondents has no effect on leadership, whereas 6% of the respondents helps a leader to ignore others' feelings whereas 2% stated it makes them to work alone. Thus, emotional intelligence is predominantly viewed as a positive and essential leadership attribute by the majority of respondents.

Q.2) How can a Leaders emotions affect a team?



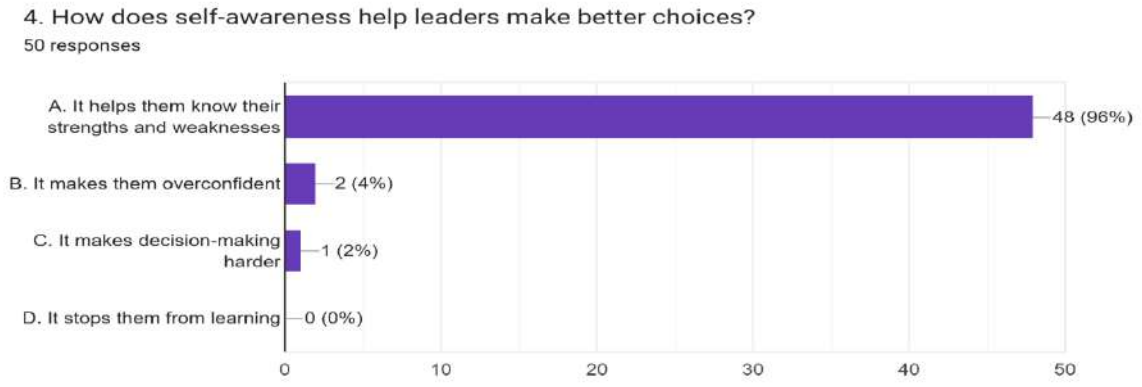
The above table indicates that 98% of the respondents are motivated by the positive emotions of the leader whereas only 8% feel that Negative emotions always make the team stronger. This clearly indicates that positive emotional expression by leaders plays a crucial role in motivating team members, while negative emotions are largely perceived as counterproductive.

Q.3) What actions can leaders take to demonstrate empathy toward others?



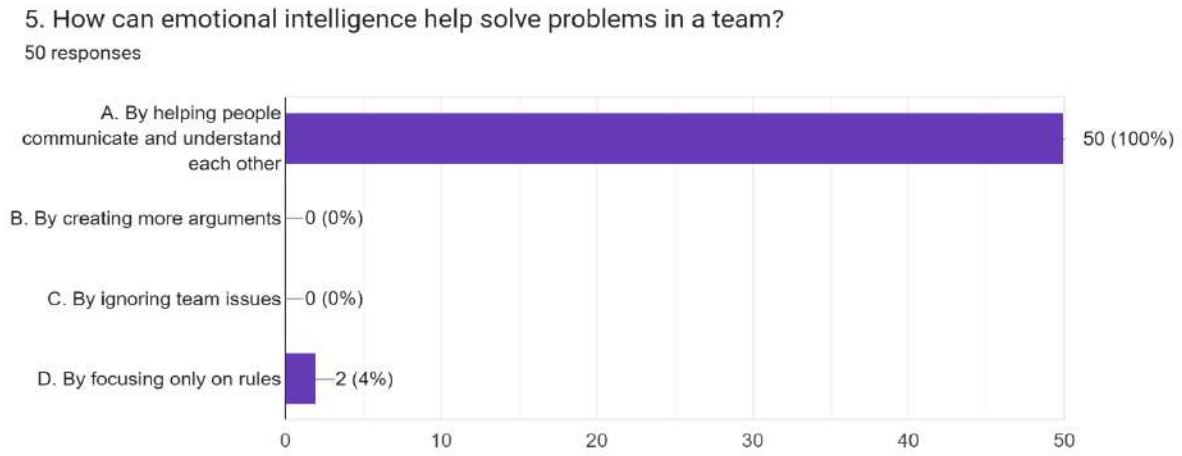
The above table represents leaders' way to show empathy towards others. 94% of the respondents express they Listen and try to understand how others feel whereas 12% state that they avoid emotional conversations in order to keep them face the challenges. This indicates that the majority of respondents demonstrate high emotional awareness and empathy, which are essential traits for effective leadership.

Q.4) How does self-awareness contribute to better decision-making among leaders?



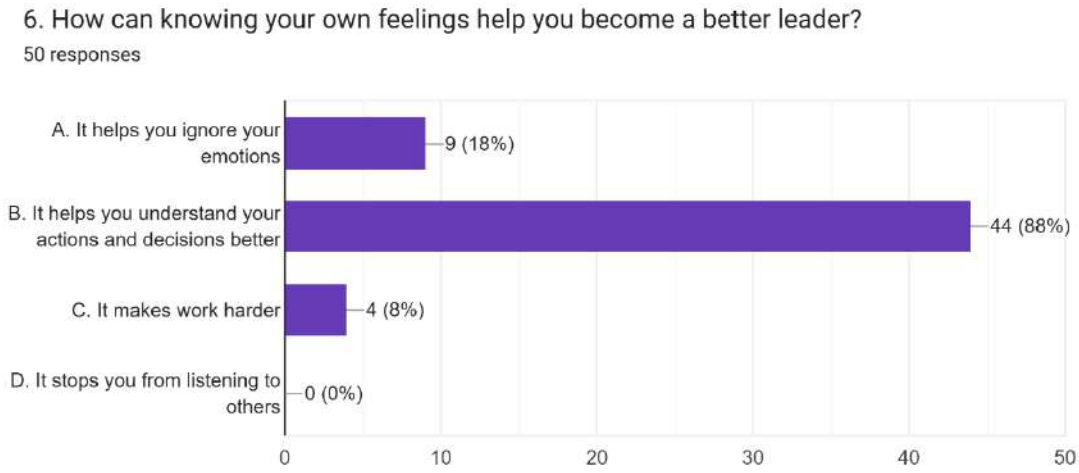
The above table shows that 96% of the respondents express It helps them know their strengths and weaknesses whereby 4% makes them overconfident and 2% makes their decision-making harder. Thus, self-awareness allows individuals to critically evaluate their leadership effectiveness.

Q.5) To what extent does emotional intelligence help in resolving team problems?



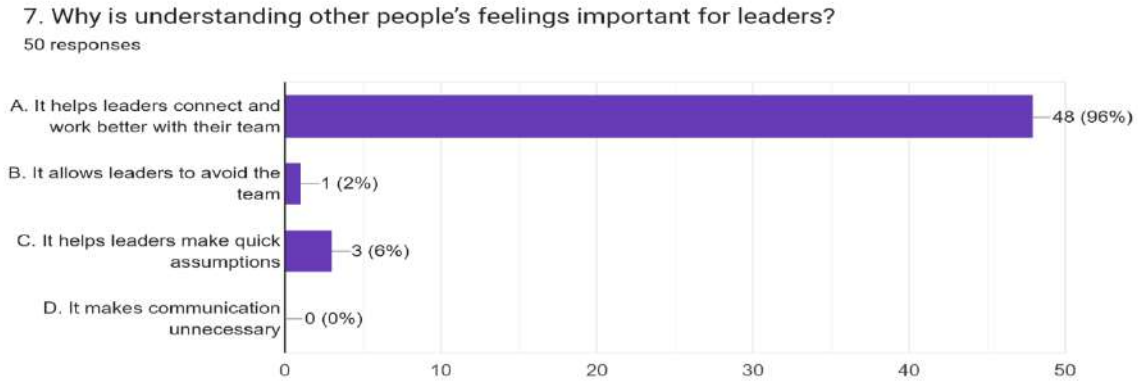
The above table shows that 100% of the respondents feels emotional intelligence help people to communicate and understand each other, whereby 4% of the respondents focus only on rules creating formal atmosphere. However, it can be concluded that two-way communication is a better tool to solve any issue in a team.

Q.6) How can understanding one's emotions contribute to becoming an effective leader?



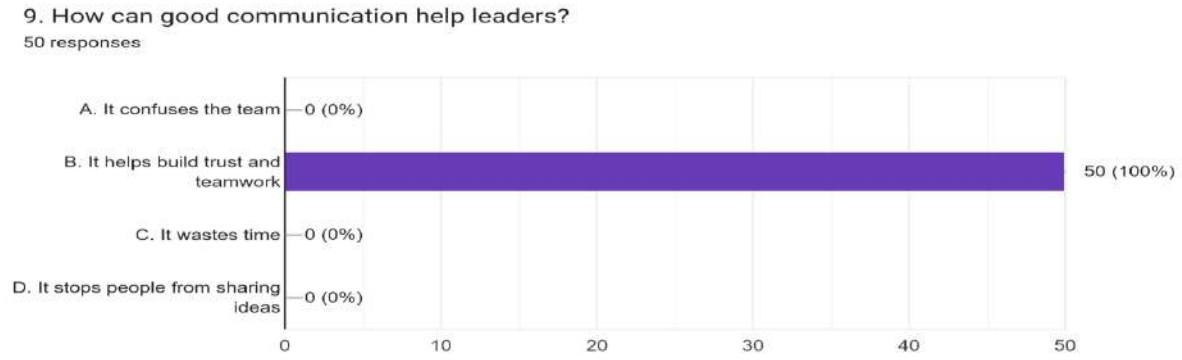
The above table conclude that 88% of the respondents states It helps them to understand their own actions and help them to take better decisions, whereas 18% thinks It helps them to ignore their emotions, wherein 4.35% express that it makes work harder. Hence it can be concluded that self-realisation always leads to a better result.

Q.7) Why is understanding others' feelings important for effective leadership?



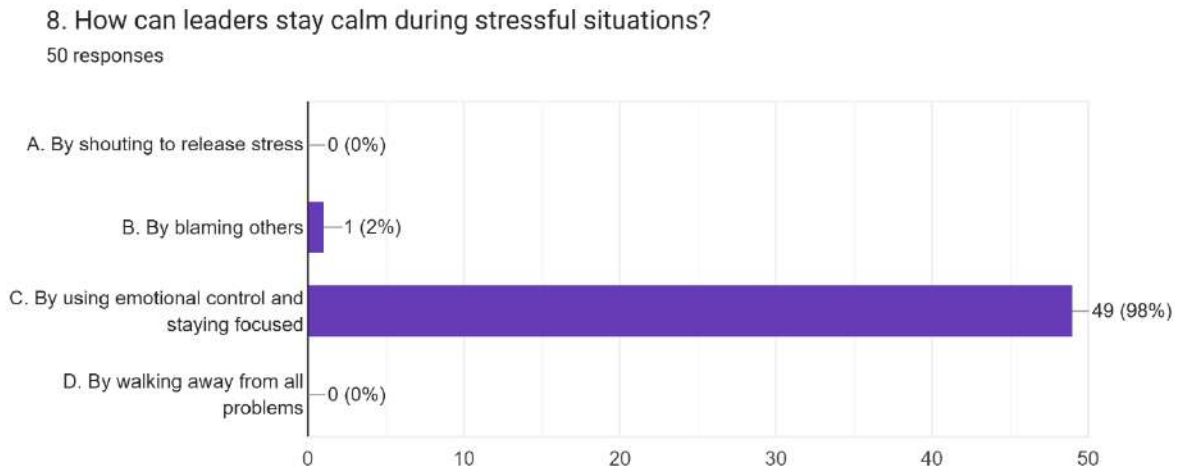
The above table express 96 % of the respondents state it helps leaders to connect and work better with their team, whereas 6% of the respondents' states that it helps them to make quick assumptions, wherein 2% states that it allows leaders to avoid the team. Thus, emotional intelligence is largely viewed as instrumental in strengthening leader–team relationships.

Q.8) How Good Communication help Leaders?



The above chart concluded that 100% of the respondent's states that good Communication helps them to build trust and teamwork within the organisation. Thus, effective communication is universally recognized as essential for trust and teamwork.

Q.9) How can leaders maintain calmness during stressful situations?



The above chart states that 98% of the respondents stated that they control their emotions and stay focused, whereas 2% out of fear or rage just blame others to come out the situation. Thus, emotional control and focus are predominant responses among respondents when facing stressful situations

Findings of the Study:

The study found that emotional intelligence plays a vital role in helping leaders understand and manage their emotions effectively. Positive emotions expressed by leaders were observed to motivate and strengthen team performance, whereas negative emotions were perceived to weaken team morale. Leaders demonstrate empathy by listening attentively and making efforts to understand others' feelings. The findings further reveal that self-awareness assists leaders in making better decisions by enabling them to recognize their strengths and weaknesses; however, overconfidence or emotional influence can occasionally hinder their decision-making. Emotional

intelligence was also found to enhance communication and facilitate problem-solving within teams. Additionally, understanding one's own actions and emotions contributes to improved decision-making. Understanding others' feelings was perceived to support better decision-making and improve leader–team relationships. Most respondents indicated that leaders generally maintain emotional control and stay focused during stressful situations, while a small proportion tend to internalize blame. The findings also highlight that good communication helps leaders build trust, encourage teamwork, and make more effective decisions.

Conclusions:

The study concludes that emotional intelligence plays a crucial role in effective leadership and organisational success. The findings reveal that leaders who understand, manage, and express emotions appropriately are better at motivating their teams, making informed decisions, and building strong workplace relationships.

Self-awareness, empathy, emotional regulation, and effective communication emerged as key factors that enhance leadership performance. While most respondents acknowledged the benefits of emotional intelligence, some highlighted challenges such as emotional overload and difficulties in decision-making when influenced by strong emotions.

Overall, the study emphasises that emotionally intelligent leaders are more capable of fostering trust, teamwork, and a positive work environment. Organisations, therefore, should invest in developing emotional intelligence skills among leaders to improve productivity, strengthen decision-making, and enhance overall organisational effectiveness.

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ROLE OF AI CHATBOTS AND VIRTUAL ASSISTANTS IN ENHANCING CUSTOMER SERVICE QUALITY: CHALLENGES AND INSIGHTS FROM AMAZON'S GLOBAL OPERATIONS

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Abstract

The growing adoption of Artificial Intelligence (AI) chatbots and virtual assistants has significantly transformed customer service operations in global organizations. These AI-driven tools enable firms to deliver faster, personalized, and consistent customer interactions, thereby enhancing the overall service quality. This study examines the role of AI chatbots and virtual assistants in improving customer service quality, with specific insights drawn from Amazon's global operations. This study explores how Amazon utilizes AI-powered conversational agents to manage high volumes of customer queries, support order tracking, handle returns, and provide personalized recommendations across multiple regions. The findings indicate that AI chatbots and virtual assistants play a critical role in enhancing operational efficiency and service consistency while supporting human agents through the automation of routine tasks. However, the study also identifies several challenges faced by Amazon in implementing AI across its global operations, including data privacy and security concerns, cultural and language differences, system integration complexities, algorithmic bias, and the need for continuous training and governance.

Keywords: Chatbots, Amazon, Virtual Assistant, Operational Efficiency, Governance.

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Introduction:

Brief Information about Amazon:

Amazon started as an online retailer/marketplace, and today, it is one of the largest e-commerce companies in the world. Amazon's business is diversified: beyond retail, it offers cloud-computing services (via Amazon Web Services — AWS), digital services (such as streaming and subscriptions), and a marketplace for many products. In recent years, AWS has become a major and high-margin business for Amazon, providing cloud infrastructure and data services and supporting many companies globally. Amazon often invests heavily in technology, such as logistics infrastructure, R&D, automation, and increasingly in AI, which helps Amazon stay at the forefront of e-commerce, cloud services, and technology.

Financial Figures and Performance Indicators

Here are some of the latest financial figures and performance indicators for Amazon (from their 2024 full-year + 2025 quarterly reports).

Period / Metric	Key Figures / Trends
Full Year 2024	Total revenue ≈ **US$ 638.0 billion**, up ~11% from 2023 (US$ 575B). About Amazon+2FirmsWorld+2
	By segment: North America revenue ~US$ 387B (+10%), International ~US$ 143B (+9%), AWS cloud business ~US$ 108B (+19%). Amazon+2About Amazon+2
	Operating income jumped to ~US$ 68.6 billion (from US$ 36.9B in 2023), raising operating margin to ~10.8%. About Amazon+2FirmsWorld+2
	Adjusted free cash flow (after accounting for leases etc.) ~US$ 36.2 billion. Amazon+1
Q1 2025 (ended March 31, 2025)	Net sales ≈ US$ 155.7 billion (≈ +9–10% YoY), AWS sales up ~17%. Amazon+1
	Operating income ~US$ 18.4 billion (vs ~15.3B previous year). Amazon+1
Q2 2025 (ended June 30, 2025)	Net sales ~US$ 167.7 billion (≈ +12–13% YoY); significant growth across North America, International, AWS segments. Amazon+2Investing.com India+2
	Operating income ~US$ 19.2 billion (vs ~14.7B last year); net income ~US$ 18.2B.
Q3 2025 (ended Sep 30, 2025)	Net sales ~US$ 180.2 billion (+13% YoY), with AWS sales up ~20%.
	Despite certain one-time charges, net income rose to ~US$ 21.2 billion
	Amazon states strong growth across business lines, especially cloud (AWS) and infrastructure expansion.

Amazon continues to grow, both in terms of revenue and profit. The increase in operating income and free cash flow shows that the company is not only selling more but also managing costs and operations efficiently. AWS (cloud business) remains a key growth driver: its revenue growth rate is higher than that of many other segments, indicating that the cloud + tech business is crucial for Amazon's stability and profitability. Amazon's diversified model (retail + cloud + technology + services) helps it survive and grow even when parts of its business face pressure or global economic uncertainties.

In today's fast-changing business world, Artificial Intelligence (AI) has become one of the most powerful tools for organizations. Almost every industry—banking, retail, healthcare, manufacturing, hospitality, and even education—is using AI to improve the way managers work and make decisions. AI cannot replace managers. Instead, it supports and enhances managerial skills. It helps managers understand trends, predict future outcomes, and choose the best possible action. Whether evaluating market trends, understanding customer behaviour, forecasting future demand, or managing employees, AI plays an important role. In many organizations, AI tools function as decision-support partners for managers. These tools can analyze patterns, identify

hidden risks, and suggest the best solutions. This reduces the chance of incorrect decisions and improves the overall performance of the business.

Challenges Faced by Amazon While Using AI in their Business Operations:

In today's competitive business world, managers cannot depend only on guesswork or personal experience; they need accurate information to handle complex situations. AI provides this accuracy by analyzing real-time data and highlighting patterns that humans may overlook. AI also helps organizations save time and costs by automating repetitive tasks and improving overall productivity. It enhances risk management by identifying problems early and suggesting preventive measures. Additionally, AI improves customer satisfaction through personalized services and a better understanding of customer needs. Owing to these benefits, AI has become an essential tool for modern managers, helping businesses grow, stay competitive, and adapt to rapid changes in the environment.

One of the main challenges is the **high cost of development and maintenance** of AI infrastructure. Amazon invests billions of dollars each year to build data centers, design algorithms, and maintain advanced computing systems that can handle massive amounts of information in real time. Another major challenge is **data privacy and security**. Since AI systems rely on collecting and analyzing customer data, ensuring that this data is protected from cyber threats and misuse is a constant concern.

Despite these challenges, the importance of AI in Amazon continues to grow because it drives innovation, enhances productivity, and strengthens decision-making capabilities. It allows Amazon's managers to predict trends, understand customer behavior, and make strategic business decisions based on real-time insights. In essence, AI has become the **backbone of Amazon's success**, enabling the company to maintain its global leadership in e-commerce, technology, and customer experience.

Need of the Study/Purpose of the Study:

There is a growing use of AI chatbots and virtual assistants in customer service, so it is important to understand how they actually improve service quality. Managers depend on AI tools for faster and more accurate decision-making, which makes it necessary to study their effectiveness. Global companies like Amazon face various challenges in adopting AI, and studying these challenges helps improve future implementation. The study is needed to identify whether AI truly reduces workload, saves time, and increases customer satisfaction.

Research Objectives:

1. To explore the contribution of AI chatbots and virtual assistants in enhancing customer service quality.
2. To identify challenges faced by Amazon in implementing AI across its global operations.

Importance of the Study:

This study is important because it helps to understand how AI chatbots and virtual assistants improve customer service by providing quick responses, reducing waiting time, and increasing overall service quality. The study is useful for companies to know what benefits AI can bring to their daily operations. At the same time, it explains the major challenges faced by global organizations like Amazon while adopting AI, such as cost, data privacy, and technical issues. The findings will help businesses plan better strategies for successful AI implementation in the future.

This study also adds valuable knowledge for researchers, students, and professionals who want to understand the role of AI in modern business management.

Limitations of the Study:

The study is based on responses from selected managers and employees, so results may not represent all industries. It focuses mainly on AI chatbots, virtual assistants, and does not cover all types of AI technologies. The information collected depends on the honesty and understanding of the respondents. The study does not include technical details of AI development or programming; Time and resource limitations may restrict the depth of analysis and sample size.

Review of Literature:

1. Hamza, P., & Karadas, G. (2025) stated that Digital leadership is not merely about technological adoption but about creating a culture of empowerment and well-being and AI is not a replacement for human capital but a tool to augment it, reducing strain and enhancing efficiency.

2. John, B. (2025) indicated that transparent, timely, and interactive communication significantly enhances technology acceptance, reduces resistance, and fosters engagement in digital initiatives.

3. David, O. (2025) explored **t**he successful implementation of digital initiatives largely depends on employees' acceptance and effective use of new technologies.

4. Rawat, M. P. (2025) claimed that **t**he anticipation of an increased workload and apprehension of being accountable for the outcomes of AI's actions are significant contributors to resistance behaviours.

5. Mariani, M. M., Machado, I., & Nambisan, S. (2023) noted the key antecedents driving firms to adopt AI include technological, social, and economic factors. Furthermore, the literature indicates that AI implementation leads to multiple innovation outcomes, such as product innovation, process innovation, business model innovation, and social innovation.

6. Rožman, M., Oreški, D., & Tominc, P. (2022) found the multidimensional talent management model with embedded aspects of artificial intelligence in the human resource processes to increase employees' engagement and performance of the enterprise.

7. Canbul Yaroğlu, A. (2024) outlined that artificial intelligence applications can change businesses' values, norms, and ways of working, they can also make it difficult to maintain a human-centered approach.

8. de Mattos, C. A., Correia, F. C., & Kissimoto, K. O. (2024) observed that practical contributions underscore the multifaceted nature of AI implementation for demand planning, emphasizing the importance of resource allocation, human capital development, collaborative relationships, organizational alignment, and relational capital and AI.

9. Chen, H., Li, L., & Chen, Y. (2021) explored the impacts of success factors on AI adoption in telecom industry by integrating the technology, organization, and environment (TOE) framework and diffusion of innovation (DOI) theory.

10. Chen, J., & Tajdini, S. (2025) concluded the uncover influence of technological, organizational, and environmental factors on the firms' AI adoption intensity. Additionally, a positive correlation is observed between AI adoption intensity and firms' performance.

11. Dabbous, A., Aoun Barakat, K., & Merhej Sayegh, M. (2022) stated that Organizational culture and habit exert a positive impact on employees' intention to use AI, whereas job insecurity has a negative impact.

12. Kumar, J., Rani, M., Rani, G., & Rani, V. (2025) the study explored the key factors and barriers influencing employees' intention to adopt AI in the banking sector using a structural equation model.
13. Islam, M. A., Aldaihani, F. M. F., & Saatchi, S. G. (2023) model developed in this study highlights how market turbulence can foster the relationship between AI adoption and organizations.
14. Park, D. H., Jiang, Q., Ko, E., Son, S. C., & Kim, K. H. (2025) stated that AI data-driven culture positively affects both perceived usefulness and perceived ease of use, while organizational agility and AI readiness positively influence only perceived ease of use but not perceived usefulness.

To Explore the Contribution of AI Chatbots and Virtual Assistants in Enhancing Customer Service Quality.

Q.1) How often do you interact with AI chat-bots or virtual assistants (like Amazon Alexa or chat support) while using Amazon services:

Q1. How often do you interact with AI chat-bots or virtual assistants (like Amazon Alexa or chat support) while using Amazon services?	NUMBER OF RESPONDENT	NUMBER OF RESPONDENT (%)
Often	21	39.62%
Rarely	12	22.64%
Very Often	20	37.74%
Grand Total	**53**	**100.00%**

Source: Primary Data

The above table represents 39.62% often interact with the AI chat-bots whereas 22.64% rarely interact with the AI chat-bots, while 37.74% (38%) very often interact with the AI chat-bots.

Q.2) How effective are AI chat-bots in resolving customer queries compared to human customer service representatives:

Q2. In your opinion, how effective are AI chat-bots in resolving customer queries compared to human customer service representatives?	NUMBER OF RESPONDENT	NUMBER OF RESPONDENT (%)
Effective	31	58.49%
Less Effective	7	13.21%
Very Effective	15	28.30%
Grand Total	**53**	**100.00%**

Source: Primary Data

The above table represents, 58.49% of the respondents state that AI Chat-bots effectively resolve customer queries, while 28.30% found AI chat-bots is very effective in resolving customer queries, and 13.21% stated that it is less effective.

Q.3) Do you feel that AI chat-bots provide faster and more accurate responses while providing customer service:

Q3. Do you feel that AI chat-bots provide faster and more accurate responses while providing customer service?	NUMBER OF RESPONDENT	NUMBER OF RESPONDENT (%)
Agree	39	73.58%
Disagree	1	1.89%
Strongly Agree	13	24.53%
Grand Total	**53**	**100.00%**

Source: Primary Data

The above table shows that 73.58% of the respondents agrees that AI provide faster and more accurate response while 24.53% strongly agree to it and only 1.89% disagree AI being offering faster and accurate response.

Q.4) How satisfied are you with the overall service quality provided by Amazon's AI-based assistants:

Q4. How satisfied are you with the overall service quality provided by Amazon's AI-based assistants?	NUMBER OF RESPONDENT	NUMBER OF RESPONDENT (%)
Neutral	18	33.96%
Satisfied	21	39.62%
Unsatisfied	2	3.77%
Very satisfied	12	22.64%
Grand Total	**53**	**100.00%**

Source: Primary Data

The above table represent satisfaction level of Amazon's AI-based assistants while providing are overall service quality to the customer. 22.64% of the respondents state they are very satisfied, 39.62% are satisfied, 33.96% are neutral about their satisfaction level, and 4% are totally unsatisfied.

Q.5) What improvements do you think can be made in AI chat-bots or virtual assistants to enhance customer satisfaction further:

Q5. What improvements do you think can be made in AI chatbots or virtual assistants to enhance customer satisfaction further?	NUMBER OF RESPONDENT	NUMBER OF RESPONDENT (%)
Improve accuracy of responses	11	20.75%
Improve understanding of complex queries	15	28.30%
Increase personalization in replies	16	30.19%
Reduce waiting/response time	11	20.75%
Grand Total	**53**	**100.00%**

Source: Primary Data

The above table depicts the improvement required for AI chat-bots or virtual assistants to enhance customer satisfaction, the table express the different responses such as 30.19% says there is a need to Increase personalization in replies, while 28.30% express Improvement in understanding the

complex queries, 20.75% states Improvement in accuracy of responses and another 20.75% states waiting/response time must be reduced.

To Identify Challenges Faced by Amazon in Implementing AI across its Global Operations

Q.6) To identify challenges faced by Amazon in implementing AI across its global operations:

1. To identify challenges faced by Amazon in implementing AI across its global operations.	NUMBER OF RESPONDENT	NUMBER OF RESPONDENT (%)
Data privacy and security concerns	21	39.62%
High implementation cost and complex technical requirements	12	22.64%
Integration issues with existing systems and global operations	4	7.55%
Resistance from employees due to fear of job loss or increased workload	16	30.19%
Grand Total	**53**	**100.00%**

Source: Primary Data

The above table represents the challenges faced by Amazon in implementing AI across its global operations. The study reveals 39.62% are concerned about Data privacy and security concerns, whereas 30.19% Resist due to fear of job loss or increased workload, 22.64% shows concerned about High implementation cost and complex technical requirements, and only 7.55% are worried about Integration issues with existing systems and global operations.

Q.7) In your opinion, does the cost of developing and maintaining AI infrastructure affect Amazon's global expansion plans:

Q3. In your opinion, does the cost of developing and maintaining AI infrastructure affect Amazon's global expansion plans?	NUMBER OF RESPONDENT	NUMBER OF RESPONDENT (%)
No, it does not affect expansion	4	7.55%
Not sure	4	7.55%
Yes, but only to some extent	37	69.81%
Yes, it significantly affects expansion	8	15.09%
Grand Total	**53**	**100.00%**

Source: Primary Data

The above table interprets, the cost of developing and maintaining AI infrastructure affecting the Amazon's global expansion plans. 69.81% agrees to Yes, but only to some extent, while 15.09% says it significantly affects expansion plan, whereas 7.55% says No, it does not affect the expansion plan at all, and remaining 7.55% are not sure.

Q.8) What other barriers (such as technical errors, ethical issues, or cultural differences) do you think Amazon faces while using AI in decision-making worldwide:

Q4. What other barriers (such as technical errors, ethical issues, or cultural differences) do you think Amazon faces while using AI in decision-making worldwide?	NUMBER OF RESPONDENT	NUMBER OF RESPONDENT (%)
All of the above	10	18.87%
Cultural and regional differences (local norms, language, regulations)	14	26.42%
Ethical concerns (bias, fairness, transparency issues)	17	32.08%
Technical barriers (system errors, algorithm failures, lack of accuracy)	12	22.64%
Grand Total	**53**	**100.00%**

Source: Primary Data

The above table represent barriers faced by (such as technical errors, ethical issues, or cultural differences) Amazon while using AI in decision-making worldwide. The table shows 32.08% express major barrier for Ethical concerns (bias, fairness, transparency issues) whereas 26.42% convey Cultural and regional differences (local norms, language, regulations) as second barrier, 22.64% state technical barriers (system errors, algorithm failures, lack of accuracy) as third barrier and 18.87% exhibit the concern for all of the above.

Q.9) Do you think employees across Amazon's global branches feel confident using AI tools for daily decision-making:

Q5. Do you think employees across Amazon's global branches feel confident using AI tools for daily decision-making?	NUMBER OF RESPONDENT	NUMBER OF RESPONDENT (%)
No, employees generally lack confidence in using AI tools	8	15.09%
Only a few employees feel confident using AI	15	28.30%
Some employees feel confident, but many still struggle	19	35.85%
Yes, most employees feel confident	11	20.75%
Grand Total	**53**	**100.00%**

Source: Primary Data

The above table represent employees across Amazon's global branches feel confident using AI tools for daily decision-making. The table reveals 35.85% of the employees are confident but still many struggles, while 28.38% are extremely confident while using AI in decision making, 20.75% most employees feel confident, 15.09% lack confidence in using AI tools.

Findings of the Study:

The study reveals that Amazon managers frequently use AI chatbots and virtual assistants to enhance customer service, with AI systems outperforming human representatives in speed and accuracy. Customer satisfaction with AI-driven assistants is generally high, though some

respondents remain neutral. Areas for improvement include personalization, handling complex queries, response accuracy, and reducing wait times. However, implementing AI globally poses challenges such as data privacy and security concerns, high costs, technical complexity, integration issues, and employee apprehensions about job security. While some view privacy risks as manageable, most consider them significant. Additionally, maintaining AI infrastructure affects expansion plans, and factors like ethical considerations, cultural differences, and technical limitations continue to influence AI adoption, despite growing confidence in AI tools across global branches.

Conclusion:

Based on the findings, it is clear that **AI plays a significant and positive role in enhancing Amazon's customer service quality**. Managers frequently use AI chatbots, and customers are generally satisfied with the faster and more accurate responses provided by AI-based assistants. However, the research also highlights important areas of concern, such as **data privacy, fear of job loss, high implementation costs, and technical or ethical challenges** in integrating AI globally.

Although employees across Amazon's global branches show **growing confidence** in using AI tools, many still struggle due to limited training and complex system requirements. Overall, the study concludes that while **AI has strong potential to improve decision-making and customer satisfaction**, Amazon must focus on improving personalization, strengthening data security, handling cultural differences, and offering better employee training to ensure smooth and successful AI adoption across its worldwide operations.

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SHIFTING CONTOURS IN INDIA'S TAX GOVERNANCE: FROM HUMANS TO ARTIFICIAL INTELLIGENCE

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Abstract
This study examines the evolving dimensions of tax administration in India transitioning from manual human oversight to artificial intelligence integration. Artificial intelligence (AI) revolutionizes tax administration through predictive analytics, automated audits and personalized services enhancing compliance rates and revenue recovery while reducing operational costs. However, challenges such as algorithmic bias, lack of transparency in decision-making, data privacy concerns and erosion of taxpayer rights demand robust mitigation strategies including human oversight and regulatory frameworks. The recent changes in the taxation law of India are focused towards faceless assessment, utilization of technology, reduction of institutional corruption and reduction of tax evasion. The taxation measures undertaken in the recent years intend to achieve reforms in the structure of all types of taxes and are designed to further escalate the basic objectives of economic growth, equity and simplicity and built in revenue raising capacity. Still, more reforms are due and the Government will have to adopt some more effective measure. This paper identifies key benefits such as reduced processing times, higher voluntary compliance and minimized discretion, alongside challenges including skill gaps, algorithmic bias, and privacy risks. This paper also examines global case studies, proposing governance models that harness AI's potential such as natural language processing for taxpayer guidance while ensuring fairness, accountability and proportionality to foster trust and innovation in tax systems.
Keywords: Artificial Intelligence, Faceless Assessment, Risk Management System.

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1. Introduction

A Tax is a mandatory fee or financial charge levied by any government on an individual or an organization for providing the best facilities and Infrastructure to its residents.

Direct taxes are those in which tax is paid by those on whom it is imposed. Examples of direct taxes are income tax, wealth tax etc. On the other hand, indirect taxes are those which can be passed on to another entity or individual. They are usually imposed on a manufacturer or supplier who then passes on the tax to the consumer.

In India, tax laws are being governed by a number of legislations. Direct taxes are governed by Income Tax Act, 1961. On the other hand, Indirect taxes in India are governed by The Central Goods and Services Tax Act, 2017 and Customs Act, 1962. In addition to this, various other taxes are being imposed by state governments and local authorities too.

In India, dimensions of taxation are changing gradually. A number of measures have been adopted to simplify the taxation law and procedure in India. The approach of the government is to make it trade and consumer friendly to promote ease of doing business in India. The recent changes in the taxation law of India are focused towards faceless assessment, utilization of technology, reduction of institutional corruption and reduction of tax evasion. The taxation measures undertaken in the recent years intend to achieve reforms in the structure of all types of taxes and are designed to further escalate the basic objectives of economic growth, equity and simplicity and built in revenue raising capacity.

Tax governance in India has undergone a structural transformation in the last decade, driven by digitisation, big data and AI. The Central Board of Direct Taxes (CBDT) and Central Board of Indirect Taxes and Customs (CBIC) now treat data as a strategic asset and increasingly rely on AI/ML to guide decision-making, enforcement and service delivery. This research paper examines the AI landscape in Indian tax governance, focusing on key systems, use-cases, benefits, risks and future directions.

Tax governance covers how the State designs, administers and enforces tax laws while balancing revenue needs with taxpayer rights and economic efficiency. AI in this context refers to algorithms and systems that can learn from data, detect patterns, make predictions and assist or automate decisions such as risk scoring, anomaly detection and case selection.

Key AI techniques used in tax:

- Machine learning models for risk scoring and anomaly detection in returns and transactions.
- Clustering and segmentation to classify taxpayers by risk, behaviour, sector and geography.
- Natural language processing (NLP) to analyse unstructured data (PAN-linked text, complaints, documents) and support chatbots or knowledge retrieval.
- Predictive analytics for revenue forecasting, refund risk, and early warning of non-compliance trends.

These tools operate within a governance framework that must address legality, proportionality, transparency and non-discrimination while leveraging efficiency gains.

2. Evolution and Development of Digitalisation in Direct Taxation in India

The rapid changes in administration of direct taxes, during the last decades, reflect the history of socio-economic thinking in India. From 1922 to the present day changes in direct tax laws have been so rapid that except in the bare outlines, the traces of the I.T. Act, 1922 can hardly be seen in the 1961 Act as it stands amended to date. It was but natural, in these circumstances that the set up of the department should not only expand but undergo structural changes as well.

Computerization in the Income-tax Department started with the setting up of the Directorate of Income tax (Systems) in 1981. Initially computerization of processing of challans was taken up. For this 3 computer centers were first set up in 1984-85 in metropolitan cities using SN-73 systems. This was later extended to 33 major cities by 1989. The computerized activities were subsequently extended to allotment of PAN under the old series, allotment of TAN, and pay roll accounting. These computer centers used batch process with dumb terminals for data entry.

In 1993 a Working Group was set up by the Government to recommend computerization of the department. Based on the report of the Working Group a comprehensive computerization plan was approved by the Government in October, 1993. In pursuance of this, Regional Computer Centers were set up in Delhi, Mumbai, and Chennai in 1994-95 with RS6000/59H Servers. PCs were first provided to officers in these cities in phases. The Plan involved networking of all users on LAN/WAN. Network with leased data circuits were accordingly set up in Delhi, Mumbai and

Chennai in Phase-I during 1995-96. A National Computer Centre was set up at Delhi in 1996-97. Integrated application software were developed and deployed during 1997-99. Thereafter, RS6000 type mid range servers were provided in the other 33 Computer Centers in various major cities in 1996-97. These were connected to the National Computer Centre through leased lines. PCs were provided to officers of different level up to ITOs in stages between 1997 and 1999. In phase II offices in 57 cities were brought on the network and linked to RCCs and NCC.

In 1982, DIT (Systems) appointed in the Directorate of Income-tax (Organisation and Management Services) to coordinate efforts in introducing electronic data processing in the IT Deptt. A microprocessor based EDP system along with data entry system was installed heralding the era of computerization. In 1983, Computerized systems for processing challans and PAN designed and developed. In 2002, Computerised processing of returns all over the country introduced and the National Website of the Income Tax Department (www.incometaxindia.gov.in) was launched to provide a vital interface between the Department and taxpayers. In 2006, A project for enabling electronic filing (e-filing) of Income Tax Returns was launched. In 2007, Sevottam Scheme was launchedto standardize service delivery to the taxpayers and the first citizen-friendly single window Aayakar Seva Kendra (ASK)was setup,for centralized receipt and registration of specified categories of documents, including income tax returns. In the same year, All India Tax Network (TAXNET) was setup connecting more than 700 offices in more than 500 cities. Consolidation of 36 (RCC) independent regional databases into a single centralized database (PDC or Primary Data Centre) was carried out and Integrated Taxpayer Data Management System (ITDMS) for drawing of 360° taxpayer profile was launched. In 2008, Cyber Forensic Labs were setup to identify relevant digital data during search and survey operations, recover hidden or password protected or deleted data and store retrieved data in a manner so that it could be used as evidence in judicial proceedings. In 2009, Centralized Processing Centre was setup in Bengaluru for bulk processing of e-filed and paper returns. The Centre operates without any interface with taxpayers in a jurisdiction – free manner. In 2011, Various IT initiatives were taken for efficient tax administration. These include e-filing and e-payment of taxes, adoption of 'Sevottam' concept by CBEC and CBDT, web based facility for tax payers to track the resolution of refunds and credit for pre-paid taxes and augmentation of processing capacity. In the same year, a new simplified form 'Sugam' was introduced to reduce the compliance burden of small tax payers falling within presumptive taxation. In 2012, TRACES (TDS Reconciliation, Accounting and Correction Enabling System) launched to serve an integrated one-stop platform for the stakeholders to facilitate the services related to TDS operations. In 2018, Launch of 'E-Proceeding' to conduct assessment proceedings electronically. In 2019, Document Identification Number (DIN) was introduced to bring transparency in the functioning of the department. e-Assessment Scheme was also introduced in the same year. In 2020, Introduction of Faceless Assessment Scheme 2020 & Faceless Appeal Scheme 2020. In 2021, Introduction of faceless proceedings before the ITAT and in 2022, Introduction of Taxation of Virtual Digital Assets.

3. Evolution and Development of Digitalisation in Indirect Taxation in India

3.1. Digitalisation of Customs in India

CBIC (Formerly CBEC) and DGFT has also introduced a variety of measures to simplify the process of Customs Law in India. Digitalization in India's Customs department, under the Central Board of Indirect Taxes and Customs (CBIC), has evolved from early EDI systems to a faceless, paperless ecosystem, enhancing trade efficiency and transparency.

Indian Customs EDI System (ICES) was rolled out from the mid-1990s, computerising assessment, examination and clearance and now covering almost all customs locations. Indian Customs EDI System (ICES) launched in 1995 automated core procedures at over 260 locations, handling 99% of trade via electronic filings.

ICEGATE (Indian Customs EDI Gateway) enabled electronic submission of Bills of Entry/Shipping Bills, online duty payment and status tracking, replacing most manual filing. ICEGATE portal enabled digital document filing and 24/7 tracking, integrating with GSTN and DGFT.

An enhanced Risk Management System (RMS) increased self-assessment-based clearances with fewer physical checks, reducing dwell time and costs.

Project Saksham (2015) modernized IT infrastructure with centralized data centers and security for seamless stakeholder services. SWIFT (Single Window Interface for Facilitating Trade) launched in 2016, allowing traders to file one integrated declaration for Customs and multiple partner government agencies (FSSAI, PQ, AQ, etc.). e-SANCHIT introduced around 2017–18 for electronic upload of supporting documents and later extended to PGA e-SANCHIT, letting partner agencies upload their own clearances and making processing largely paperless.

Faceless Assessment rolled out pan-India in October 2020 for remote evaluations, reducing physical interfaces through Faceless Assessment Groups (FAGs), delinking assessment from the port of import and enabling nationwide, anonymised scrutiny.

Turant Customs and ICEDASH dashboards monitor clearance times in real-time, while AEO e-verification simplified compliance for MSMEs. “Turant Customs” programme brought in contactless measures like e-OOC/e-Gatepass, online queries/replies and Turant Suvidha Kendras to minimise physical visits. ICETAB expanded to exports in June 2025 for digital checks, boosting logistics performance.

India’s customs digitisation has moved from basic EDI filing to a largely faceless, paperless and contactless system, with full end-to-end automation targeted by April 2026. This automation will integrate AI for faster HS code checks and end-to-end visibility.

3.2. Digitalisation of GST Administration in India

Digitalization in India's indirect taxation has evolved significantly since the introduction of the Goods and Services Tax (GST) in 2017, transforming a fragmented system into a unified, tech-driven framework. Key milestones include the rollout of the GST Network (GSTN) portal for seamless registration, returns, and payments, alongside innovations like e-way bills and e-invoicing. GST replaced multiple indirect taxes with a single system, enabling digital filing and real-time tracking from day one. E-way bills, launched in 2018, digitized goods movement documentation to curb evasion, while e-invoicing mandates since 2020 require QR-coded invoices for large businesses, ensuring automated reconciliation. Input tax credit matching occurs digitally via the GST portal, reducing discrepancies and cash flow issues for businesses. Authorities leverage business intelligence and AI for audits, detecting frauds efficiently without physical inspections.

Digital tools have boosted revenue—hitting record highs like April 2023 collections—widened the tax base, and enhanced transparency through real-time data. Compliance eased for taxpayers via user-friendly portals, though small businesses face adaptation challenges.

India's indirect tax digitalization journey centers on the GST regime, marking a shift from manual processes to a fully tech-enabled system. Key milestones reflect progressive automation for compliance, transparency, and revenue growth.

GSTR-2B auto-populated ITC statements introduced in 2020, with matching enhancements in 2022. Invoice Management System (IMS) launched in October 2024 for supplier-recipient invoice communication; Aadhaar authentication mandated for filings from January 2023.
GST 2.0 announced in September 2025 simplifies returns for small businesses and boosts auto-reconciliation. AI-driven features and full ITC hard-locking expected by mid-2025 enhance accuracy and reduce disputes.
GST fundamentally enabled digital transformation in India's indirect taxes by replacing a patchwork of state-level systems with a centralized, technology-driven framework via the GST Network (GSTN). This shift mandated electronic processes for registration, invoicing, returns, and payments, automating compliance and enabling real-time data flow.
GSTN serves as the backbone, handling over 1.4 crore registrations and processing billions of invoices digitally since 2017. Features like GSTR-1/3B for returns and auto-populated GSTR-2B for input tax credit (ITC) reconciliation eliminate manual matching, reducing errors and disputes. E-way bills (2018) digitized goods transport tracking, curbing evasion through GPS integration. E-invoicing (from 2020) requires real-time invoice reporting via Invoice Registration Portal (IRP), with QR codes for instant verification, now mandatory for businesses above ₹5 crore turnover. AI, machine learning, and data analytics on GSTN detect fraud like fake ITC claims, boosting collections to record highs (e.g., ₹2.1 lakh crore in April 2023). Integration with Aadhaar and biometrics streamlines verification, while blockchain pilots enhance supply chain transparency. This digital ecosystem widened the tax base, improved revenue buoyancy, and eased cross-border trade, though it demands robust IT infrastructure from taxpayers.

4. Need for Change in Tax Laws in India

- **Ease of doing Business**

The ease of doing business index is a ranking established by World Bank group for assessing the countries about their suitability to the business environment. India is improving its rank gradually from 77 in 2018 to 63 in 2021. For better ease of doing business index it is imperative that a suitable business environment is established in India and taxation are made trade friendly.

- **Corruption, Commercial fraud and tax evasion**

Higher tax rate is a major reason for corruption and tax evasion in India. The need of the hour is to reduce the tax rate so that the menace of corruption and tax fraud may be reduced.

- **Implementation of International conventions and agreements**

India is signatory to various International conventions and agreements related to promotion of international trade. India has also signed free trade agreements and preferential trade agreements with various countries to promote the growth of international trade in India. Therefore, there is need of change in established tax law and procedure in India.

5. Artificial Intelligence in Tax Governance in India

By the late 2010s and early 2020s, India moved to dedicated AI platforms:

- CBDT's Project Insight, implemented with technology partners, created a 360-degree taxpayer profile by integrating data from banks, registries, securities markets, TDS and third-party sources, using AI for pattern recognition and non-compliance detection.
- CBIC's ADVAIT (Advanced Analytics in Indirect Taxation) suite was designed to analyse GST, customs and other indirect tax data, providing dashboards and advanced risk engines to officers across formations.

The government has explicitly acknowledged the use of data analytics, big data and AI/ML in both direct and indirect tax departments to make administration more effective, less discretionary and more taxpayer-friendly.

5.1. AI applications in direct tax governance (CBDT)

a. Project Insight and 360-degree profiling

Project Insight is CBDT's flagship data and AI platform aimed at creating integrated taxpayer views and improving voluntary compliance.

Core features include:

- Integration of structured and semi-structured data from multiple reporting entities—banks, mutual funds, registrars, high-value property transactions—into comprehensive taxpayer profiles.
- AI models that correlate high-value transactions with income tax returns to identify non-filers, under-reporting or suspicious patterns, feeding risk-based case selection.
- Pre-filled and information statements (AIS/TIS) that show taxpayers their reported transactions, nudging them to correct discrepancies voluntarily.

This framework supports "nudge-based" compliance, emphasising soft enforcement before intrusive actions.

b. Behavioural analytics and nudging

CBDT leadership has publicly confirmed that AI tools now monitor taxpayer behaviour across digital touchpoints.

Key elements:

- Tracking portal visits, filing patterns and responsiveness to notices, combined with transaction data, to identify cases needing a "harder nudge" such as strong reminders or targeted scrutiny.
- Filtering PANs associated with high-risk claims or repeated inconsistencies, prioritising them for further examination.
- Sharing transaction data through AIS to prompt self-correction, leading to millions of updated returns and thousands of crores in additional revenue.

This approach shifts governance from pure enforcement to behaviourally informed regulation.

c. AI-enabled scrutiny, assessment and enforcement

AI improves both selection and conduct of enforcement actions:

- Risk-based selection of scrutiny cases using AI/ML scores rather than manual discretion, reducing arbitrariness and potential harassment.
- Analytics-driven search and seizure planning, focusing on networks of related entities and transaction webs rather than isolated taxpayers.
- Post-search data mining of seized digital records, where AI helps uncover layered ownership, shell structures or round-tripping patterns more quickly than manual review.

While officials emphasise that access to digital records is limited to legal contexts such as search and seizure, the capacity for deep AI-enabled analysis is growing.

5.2. AI applications in indirect tax governance (GST and customs)

a. Risk analytics and fraud detection in GST

The GST regime generates massive invoice-level data, making it a natural fit for AI applications.

Important use-cases:

- Detection of fake invoices and bogus input tax credit (ITC) claims through pattern recognition (e.g., circular trading, non-existent suppliers, mismatch between e-way bills, e-invoices and returns).
- Risk-based registration checks using AI to flag high-risk applicants based on PAN history, address clustering, sector risk and network linkages.

- AI-driven anomaly detection comparing GSTR-1, GSTR-3B, e-way bill and e-invoice data; discrepancies can trigger automated scrutiny notices.

By focusing on suspicious networks, authorities can reduce intrusive checks on compliant taxpayers.

b. Faceless and data-driven GST administration

AI underpins the emerging faceless GST environment:

- Computer-based automated allocation of scrutiny cases to officers, breaking local relationships and reducing discretion.
- AI-based anomaly detection systems supporting faceless scrutiny by pre-populating issues and risk indicators in notices such as ASMT-10/11.
- Analytics dashboards for officers showing risk scores, sectoral trends and compliance gaps, enabling more informed decisions.

Policy documents and circulars explicitly refer to AI/ML for risk profiling and data-driven compliance in GST.

c. AI in customs and border taxation

Customs uses AI primarily for risk management and trade facilitation:

- Advanced Risk Management Systems incorporate analytical models to flag high-risk consignments based on past compliance, commodity, route and partner data, allowing low-risk cargo to be cleared with minimal intervention.
- Faceless assessment in customs uses centralised electronic allocation and specialised assessment groups supported by data analytics, promoting uniformity and reducing physical interface.
- Under the "Next Generation / Customs 2.0" programmes, CBIC is exploring AI for HS code classification support, image analysis for scanning results and predictive targeting of smuggling and mis-declaration.

These initiatives align with the broader objective of contactless, paperless and data-driven border management.

5.3. Benefits and opportunities of AI in tax governance

AI in tax governance presents several significant benefits:

- **Enhanced compliance and revenue:** AI-driven risk selection improves hit-rates for audits and enforcement, increasing additional revenue with fewer intrusive actions.
- **Reduced discretion and corruption:** Algorithm-based case selection and faceless processes limit one-to-one interfaces, reducing opportunities for rent-seeking and inconsistent decisions.
- **Improved taxpayer services:** Pre-filled forms, AIS/TIS, intelligent help-desks and potential chatbots lower compliance costs and errors for honest taxpayers.
- **Better policy insights:** Aggregated analytics reveal sectoral risks, regional disparities and behavioural patterns, enabling more evidence-based tax policy and targeted reliefs.

When well-governed, AI can make India's tax system more efficient, equitable and predictable.

5.4. Challenges and risks of AI in tax governance

However, extensive AI use raises important challenges.

a. Data quality, bias and algorithmic fairness

- AI models depend on accurate, complete data; misreporting, legacy errors or skewed datasets can produce biased risk scores.
- Certain sectors, regions or profiles might be over-flagged if historic enforcement bias is encoded in training data, raising equity concerns.

- Lack of transparency about models and their features can make it difficult for taxpayers to contest AI-driven risk classifications or notices.

b. Privacy, surveillance and due process

- Integration of multiple data sources and behavioural tracking can create an impression of pervasive fiscal surveillance, even if legally constrained.
- Questions arise about proportionality, retention periods and secondary uses of tax data, especially when AI models mine broad digital footprints.
- Taxpayers may not fully understand how their data is processed, what inferences are drawn and how to challenge them, affecting procedural fairness.

c. Capacity, infrastructure and digital divide

- Effective AI governance requires specialised skills among officers, including data science literacy and the ability to interpret, not blindly trust, model outputs.
- Smaller taxpayers and intermediaries may struggle with increasingly digital, analytics-heavy interfaces, potentially widening the compliance gap without adequate support.
- Securing large tax datasets against breaches and cyberattacks is an ongoing concern given their sensitivity and scale.

5.5. Legal and policy framework

India's tax-AI ecosystem operates within a broader legal context:

- The Union government has formally disclosed in Parliament that it uses data analytics, big data and AI/ML across direct and indirect tax departments, highlighting objectives of effectiveness and reduced discretion.
- Faceless and data-driven schemes (e.g., faceless assessment, e-proceedings) are anchored in Finance Acts, Income-tax Rules, GST law and CBIC/CBDT schemes and circulars, providing statutory backing for digital and AI-supporting processes.
- The emerging data protection and digital governance frameworks are expected to influence how taxpayer data is collected, processed, shared and used for AI modelling, requiring alignment with principles of purpose limitation, consent (where relevant) and security.

Future regulation may need to address explainability and accountability specifically for AI-assisted tax decisions.

6. Conclusion and Suggestion

AI has moved from the periphery to the core of tax governance in India, supporting a shift toward data-driven, risk-based and largely faceless administration in both CBDT and CBIC. Systems like Project Insight and ADVAIT illustrate how large-scale data integration and AI analytics can simultaneously expand the tax base, improve targeting of evasion and facilitate compliant taxpayers. The challenge for policymakers and administrators is to institutionalise robust safeguards—around privacy, fairness, transparency and accountability—so that AI enhances, rather than undermines, the legitimacy and inclusiveness of India's tax system. The trajectory of AI in Indian tax governance points to deeper integration and sophistication:

- Greater use of real-time analytics, including streaming data from e-invoicing, e-way bills, payment systems and third-party platforms, is likely to support continuous compliance monitoring.
- Advanced models—graph analytics, network analysis and deep learning—can be used to detect complex evasion webs, beneficial ownership structures and cross-border avoidance schemes.
- AI-powered conversational interfaces and assistants may help taxpayers understand obligations, file returns, and respond to notices more effectively, reducing reliance on intermediaries.

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A STUDY ON THE EFFECTS OF FINANCIAL LITERACY PROGRAMS ON DEBT MANAGEMENT AMONG INDIVIDUALS

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Abstract
Financial literacy is crucial for improving one's financial security and independence since it empowers people to make informed financial decisions. People can avoid frequent financial hazards, accomplish their financial goals, and improve their overall state of financial well-being by having a solid understanding of fundamental financial concepts including budgeting, saving, investing, and debt management. The purpose of this study is to evaluate how financial literacy initiatives affect people's ability to manage their debt. This study used the Structural Equation Model with SMART PLS method. The outcome of the study indicated that there is a significant impact of financial literacy on debt management.
Keywords: Financial Literacy, Debt Management, SEM.

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1.0 Introduction:

When it comes to guiding people toward participating in the financial markets with confidence, financial literacy is like a beacon. Monetary liberalisation has sparked financial innovation, which has led to an increase in the dynamism and sophistication of financial products and services in industrialised nations (Kamiya, 2017). A highly volatile stock market, complex financial products, and dishonest financial organizations pushing Ponzi schemes have left the current financial environment full of unknowns. Thus, being able to defend oneself against financial fraud requires having a solid grasp of finance. Financial literacy programmes are crucial for enhancing people's ability to manage debt. These workshops' main objective is to give participants the information and abilities they need to make wise financial decisions, which will improve their debt management tactics. Financial literacy has been linked to the usage of debt management strategies, such as budgeting, saving money, and making on-time bill payments (Lusardi & Mitchell, 2014). Furthermore, it has been demonstrated that financial education lowers the risk of accumulating large debt and going through financial difficulties (Hastings, Madrian, & Skimmyhorn, 2013)..

1.1 Financial Literacy

Financial literacy includes understanding and being aware of financial products, having the confidence to use this knowledge, and having the attitudes and behaviours needed to make wise financial decisions. Financial literacy is the capacity to assess complicated financial services and make well-informed decisions to select those that optimise long-term financial well-being and best meet one's financial objectives, according to Mandell & Klein (2007). Additionally, financial literacy aids in “debt management, structured budget preparation, and interest, risk, and return calculations.” According to Lantara and Kartini (2016), it also helps in the selection of the best financial products among a wide range of complex options, including “shares, debentures,

insurance plans, mortgages, pension funds, and other financial derivatives like options and futures." Financial literacy is, at its core, the capacity to use information about financial market products and to recognize the risks and advantages associated with them in order to make wise decisions. It entails having the ability to make wise decisions on the procurement, administration, and control of financial resources (Ramakrishnan, 2011). Long-term gains require people to be able to assess new and complicated financial instruments and make wise decisions about how to employ them (Servon & Kaestner, 2008).

1.2 Financial Literacy Programs in India

The knowledge and abilities needed to make wise financial decisions must be provided by financial literacy programmes. Savings, budgeting, investment, and debt management are just a few of the many subjects covered in these programmes. An individual's economic health can be greatly impacted by financial literacy, which is required for financial planning (Lusardi & Mitchell, 2014). According to Atkinson and Messy (2012), Effective financial literacy initiatives have been linked to improved financial habits, such as increased savings and improved credit management. To encourage financial stability and reduce the likelihood of financial disasters, governments, nonprofit organisations, and higher education institutions frequently undertake these schemes.

In India, financial literacy initiatives are becoming more and more acknowledged as essential resources for enabling people to make wise financial decisions and enhance their financial security. A range of financial subjects, including managing debt, investing, saving, and budgeting, are the focus of these programmes. Through a number of programmes, the Reserve Bank of India (RBI), other financial institutions, and non-governmental organisations (NGOs) have been at the forefront of promoting financial literacy. By providing bank accounts for millions of previously unbanked people, the Pradhan Mantri Jan Dhan Yojana (PMJDY) has significantly improved financial inclusion and literacy. To educate account users on basic banking, savings, and the advantages of formal financial systems, the programme includes financial literacy camps (Ministry of Finance, 2020). RBI's annual Financial Literacy Week, which aims to increase public awareness and encourage financial education. This week's outreach initiatives emphasise topics like digital banking, grievance resolution, and credit discipline (RBI, 2022). In India, NGOs and businesses in the private sector also make major contributions to financial literacy. Underprivileged communities can develop financial resilience with the assistance of programmes like Swadhaar FinAccess and the Financial Literacy and Inclusion Fund (FLIF), which offer resources and training (Swadhaar FinAccess, 2021). In general, India's financial literacy initiatives are making significant strides towards closing the knowledge gap and promoting a culture of financially educated decision-making, both of which are essential for the nation's economic growth and each person's financial security.

1.3 Debt Management

The methodical process of managing one's debt to reduce outstanding amounts and enhance one's financial stability is known as debt management for individuals or organizations. Debt consolidation into a single payment, budgeting, negotiating with creditors for reduced interest rates or terms of payment, and using professional debt management services are some of the strategies used. Reducing total debt, averting default, and improving creditworthiness are the goals of effective debt management. People can reclaim financial control and prevent unfavorable outcomes from overwhelming debt, including bankruptcy, by approaching debt in a methodical manner. Personalized programs and financial education are frequently offered by professional debt management services to assist clients in understanding their financial circumstances and making wise decisions. Garman and Forgue (2011) assert that an effective debt management plan can avert

long-term financial difficulty and greatly enhance financial well-being. Additionally, Lusardi and Tufano's (2015) research emphasises the crucial role that financial literacy plays in efficient debt management, implying that those who possess a solid understanding of financial concepts are better able to manage their debt. An essential part of personal finance is managing debt, which aims to reduce financial stress and prepare the path for long-term financial stability.

2.0 Review of Literature:

2.1 Edy, Jumady., et al. (2024). This qualitative study set out to investigate the intricate relationships that exist between "financial behaviour, self-control, financial literacy, debt management, and financial well-being." The study's findings proved that effective debt management requires a strong foundation in financial literacy. Participant debt management abilities were higher among those with higher financial knowledge. Financial well-being was enhanced by proactive financial behaviours that were incentivized by strong financial self-efficacy and financial knowledge. Conversely, ineffective self-control and procrastination were discovered to be the primary obstacles. The study also emphasised the significance of material values and numeric literacy in influencing financial behaviour, highlighting that lower levels of materialism and good quantitative abilities were linked to more forward-thinking financial decisions.

2.2 Ruzita, Azmi. (2023). This study focused on financial or credit counselling as well as debt management plans (DMPs), which offer support and guidance to people in need. The results showed that "financial management, financial education, financial literacy, and one-on-one financial counselling are all included in the DMP components." These initiatives are acknowledged as voluntary debt repayment arrangements that provide bankruptcy alternatives. The survey underscored the need of Debt Management Plans (DMPs) in managing household finances and noted that money management counselling is gaining traction due to mounting concerns around substantial credit card debt issues. Additionally, it was discovered that in the current unstable economy, financial education—which includes life skills related to money management—is crucial.

2.3 Yulianah., Istiqlaliyah, Muflikhati. (2023). The study examined how young married families' debt management practices were impacted by their hedonistic lifestyle, financial literacy, and family dynamics. According to the study, participants had a medium degree of financial literacy in terms of their knowledge, attitudes, and behaviours. These respondents were classified as having minimal debt management behaviour and no general predisposition towards living a hedonistic lifestyle. The age of respondents showed a negative correlation with their debt management behaviour, suggesting that younger respondents were less successful in managing their debt. The results showed that debt management behaviour was highly impacted by the financial literacy attitude factor. This suggests that improved debt management techniques follow from a more positive financial mindset. On the other hand, there was no obvious effect of the hedonistic lifestyle on debt management practices.

2.4 Erik, Gogola. (2023). The study looked at how financial literacy affected Slovakian households' debt-related behaviour. According to the study, Slovak households' debt behaviours vary depending on how financially literate they are. Important conclusions consist of: There is no apparent connection between financial literacy and the likelihood of having unpaid credit card or non-mortgage debt. Compared to families with greater financial literacy, smaller families with higher earnings are more likely to have non-mortgage debt or an outstanding credit balance. However, these households also have higher credit limitations and are less able to accumulate money from their regular paychecks. Families that have outstanding credit card or non-mortgage

debt are thought to be more financially precarious. They are more likely to interact with expensive credit products, have less capacity for saving, and are more likely to experience credit constraints. This financial vulnerability may make it much harder for them to withstand unanticipated negative shocks from the outside or the inside.

2.5 Anders, Carlander., et al. (2019). This study examined how financial literacy affected a variety of debt-related financial behaviours, such as credit card use and mortgage decisions. Mortgage rates are one area where people's choices are greatly influenced by their level of financial literacy, with more literacy resulting in better informed choices. Higher financial literacy was associated with more prudent credit card use; this relationship was also evident in credit card usage behaviours. Important variables that influenced borrowing decisions and behaviours were age, gender, income, and education level in combination with financial knowledge. Financial education is crucial for young adults, as evidenced by the correlation between lower levels of debt and increased financial literacy.

2.6 A, Claudia & Esteban. (2018). In this article, the effects of a financial literacy curriculum on participants in a government-run micro-entrepreneurship programme in Chile's debt load and formal loan availability were assessed. The outcome of the study showed that the financial literacy programme had a number of noteworthy consequences, including: Participants' total debt levels decreased as a result of the programme in the near term. Participants were more likely to incur formal debt as a result, suggesting better access to official credit channels. The program's efficacy differed depending on the location, with areas experiencing more impact and higher programme take-up and smoother execution. These findings imply that, when properly designed and extensively embraced, financial literacy initiatives can be useful instruments for lowering debt and improving access to official financial services.

2.7 Cristina, Ottaviani., Daniela, Vandone. (2018). This research aimed to investigate the associations between financial literacy and impulsivity and an individual's debt burden. The study discovered a substantial correlation between debt burden and both impulsivity and financial literacy. It was discovered that impulsivity fully moderated the association between financial literacy and debt burden, even after adjusting for financial income. This suggests that while financial literacy matters, an individual's degree of impulsivity has a more important role in determining how much debt they have. The findings indicate that financial education courses need to target impulsivity in addition to financial literacy in order to successfully reduce debt loads.

2.8 Amagir, A., et al. (2018). The aim of this research was to examine the "Debt Management Programme (DMP) and Financial or Credit Counselling services that assist individuals experiencing financial difficulties in Malaysia, Thailand, and Indonesia." The paper lists the DMP's components as "personal economic counselling, financial education, financial literacy, and financial management." It is recognised that the debt management plan (DMP) is an elective programme that can be employed in place of declaring bankruptcy. Growing concerns about credit card debt have led to an increase in the popularity of credit counselling. It is necessary for managing household finances. The study also demonstrated how important it is to incorporate life skills into financial education considering the current unpredictable situation of the economy.

2.9 Angelica, et al. (2017). This study measured the "debt-to-income ratio, the number of lenders, and the net worth of low-income households in order to examine the relationship between consumer debt and financial literacy." According to the research findings, a person's ability to manage their finances had a substantial impact on how many lenders they dealt with; the more skilled a person was at managing their finances, the more lenders they dealt with. However,

numeracy abilities had no discernible impact on the quantity of loans, in contrast to previous research that indicated

3. Objective of the Study:

1. To study the concept of financial literacy programs in India.
2. To evaluate the effects of financial literacy programs on debt management among individuals.
3. To give appropriate suggestions towards implementation of financial literacy programs on debt management among individuals.

4. Hypothesis:

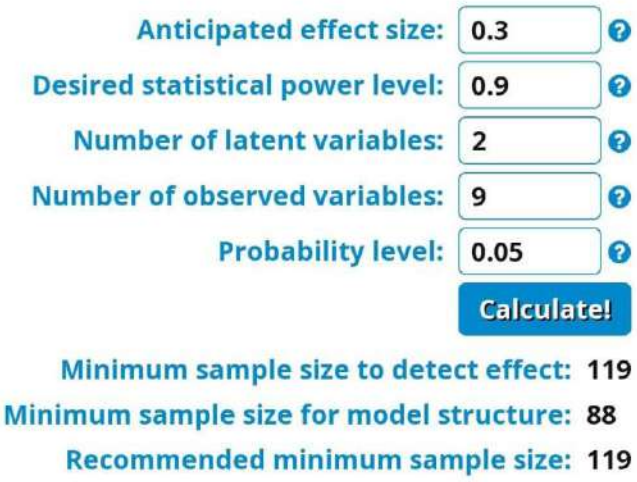
H_0: Financial literacy programs have no significant impact on debt management among individuals.

H_1: **F**inancial literacy programs have a significant impact on debt management among individuals.

5. Research Methodology:

Table No: 1 Research Methodology	
Data Collection	Both primary and secondary data collection techniques
Sampling Technique	Non probability purposive sampling
Sample Size	120 Individuals
Sample Size Justification	(At 0.3 effect size, statistical power 0.9, number of latent variables = 2, number of observed variables = 9 and probability level = 0.05 the minimum required sample size = 119).
Statistical Technique	Structural Equation Model
Statistical Tool	SMART PLS

Figure 1 – Sample Size Calculator



6. Data Analysis and Interpretation:

Table No: 2 Measurement Instruments	
Constructs	**Measurement Items**
Financial Literacy	1. I am aware of the fundamentals of personal finance, such as saving and budgeting. 2. I am able to read and comprehend income and balance statements, among other financial statements. 3. I am aware of the risks and rewards associated with various investment opportunities. 4. I understand the ramifications of various loan kinds and credit conditions. 5. In order to make wise decisions, I always keep myself informed on financial news and trends.
Debt Management	1. I am able to make and follow a strategy to pay off my obligations in a methodical manner. 2. In order to keep expenses down overall, I pay off high -interest debt before low-interest debt. 3. I monitor my loan amounts and payback plans on a frequent basis to make sure I make my payments on time. 4. I have set strategies in place, like budgeting and emergency savings, to help me stay out of debt. 5. To successfully manage and lower my debt, I use financial instruments or expert advice.

Table No: 3 Summary of Demographic Profile of Respondents			
Category	**Variables**	**Frequency**	**Percentage**
Gender	Male	73	60.83
	Female	47	39.17
Age Group	25 – 34 years	34	28.33
	35 – 44 years	25	20.83
	45 – 54 years	31	25.83
	55 – 64 years	18	15.00
	65 years and above	12	10.00
Annual Income	Less than 2,50,000	43	35.83
	2,50,001 to 5,00,000	35	29.17
	5,00,001 to 7,50,000	23	19.17
	7,50,000 to 10,00,000	11	9.16
	More than 10,00,000	8	6.66

There were 120 participants in the research study, of which 73 (60.83%) were men and 47 (3917%) were women. When it came to age groups, 34 people (28.33%) fell into the 25–34 age range, which included the majority of responders. With 31 responders (25.83%), 45–54 years old was the next largest age group. Next in line were 25 respondents (20.83%) 35–44 age range, 18 respondents (15.00%), 65 years and older (12 individuals, 10.00%).43 respondents, or 35.83 percent, reported having an annual income of less than 250,000, according to the study. 35 responders (29.17%),

were in the 2,50,001–5,00,000 income range. 11 respondents (9.16%) made between 750,000 and 10,00,000 annually, while 23 respondents (19.17%) made between 5,000,001 and 7,50,000 annually. 8 respondents, or 6.66% of the total, made up the smallest group that claimed earning more than 10,000,000.

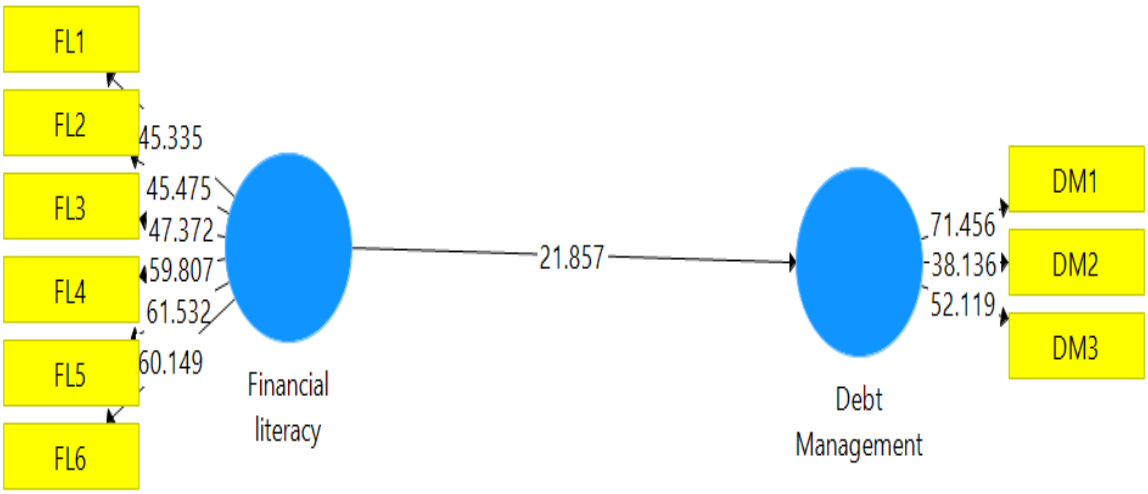


Figure 2 – SEM model

Table No: 4 Reliability and validity			
Path	**Cronbach's Alpha**	**Composite Reliability**	**Average Variance Extracted (AVE)**
Debt Management	**0.782**	**0.783**	**0.550**
Financial Literacy	**0.907**	**0.905**	**0.614**
As all the values of Cronbach 's alpha >0.7 indicating reliability of responses and it is also seen that composite reliability >0.7 and AVE >0.5 indicating convergent validity.			

Table No: 5 discriminant validity		
Path	**Debt Management**	**Financial Literacy**
Debt Management	**0.741**	
Financial Literacy	**0.734**	**0.784**
Square root of AVE > correlation (r) thus it can be concluded that their exist an adequate discriminant validity.		

Table No: 6 Hypothesis testing			
Path	**Path Coefficient**	**t-statistics**	**P-Value**
Financial Literacy → Debt Management	**0.636**	**21.857**	**0.000**
P (value) < level of significance 5% thus Ho is rejected and H1 is accepted indicating significant impact of financial literacy on debt management.			

7. Conclusion:

The results of the research make it apparent that financial literacy is important in influencing people's debt management behaviours. Higher financial literacy levels are associated with the adoption of more successful debt management techniques, such as budgeting, saving, and on-time repayment, according to the study's substantial positive impact analysis. This emphasises how critical it is to start and grow financial literacy initiatives in order to improve the public's financial knowledge and abilities. Programmes for financial literacy are crucial in giving people the knowledge and resources they need to handle their money sensibly. Through the provision of financial education, these programmes enable individuals to make well-informed decisions that lower their debt levels and improve their financial stability. People who know how important it is to budget, for example, are more likely to use their money wisely, cutting down on wasteful spending and making sure they have enough money to pay off their debt. In a similar vein, individuals who understand the fundamentals of investing and saving can create financial buffers that shield them against unanticipated costs and shocks to their finances. Furthermore, the study shows that financial literacy programmes support people's long-term financial well-being in addition to helping them manage their present obligations. People are less likely to fall into debt traps and more likely to reach their financial objectives when they possess the knowledge necessary to manage their finances well. Due to their increased readiness to engage in and make contributions to economic activities, financially educated people also help to create a more stable and prosperous economy.

8. Suggestions:

- Programmes for financial literacy should be tailored to meet the needs of various age groups, educational levels, and socioeconomic backgrounds in order to be effective and relevant.
- For the purpose of providing important money management skills early in life, incorporate financial literacy into school curricula starting in primary education.
- Organise practical skills-focused courses and seminars that cover topics including credit management, debt repayment tactics, and budgeting.
- Deliver interactive financial education content that is available anywhere, at any time, by utilising digital platforms and mobile apps.
- Assist customers with debt management and financial planning by collaborating with banks, credit unions, and financial consultants to offer professional advice and tools.
- Provide one-on-one financial counselling sessions to address specific financial difficulties and create individualised debt relief strategies.
- Through participant feedback, surveys, and financial outcome tracking, evaluate the effectiveness of financial literacy programmes on a regular basis.

- To promote continual learning and reinforce financial literacy principles, arrange webinars, online forums, and community events to encourage continued interaction.

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IMPACT OF DIGITAL MEDIA ON FREEDOM OF SPEECH AND EXPRESSION IN INDIA

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Abstract
The emergence of digital media has changed in a significant way the area as well as the manner of the exercise of the right to freedom of speech and expression in India, which is one of the fundamental rights guaranteed by Article 19(1)(a) of the Constitution. Digital platforms such as social media have immensely contributed to the democratization of communication by making it possible for people to express their views, obtain information, and take part in the public discussion. They are not limited however to social media only but also include news portals, blogs, podcasts, and messaging applications. Simultaneously, the digital arena has been associated with intricate legal and constitutional predicaments. The main reasons for this are the concerns related to the accuracy as well as the speed, the breadth, and the durability of what is published on the Internet. The concerns raised include misinformation, hate speech, online defamation, and cyber harassment besides the highly worried about the threats to public order and national security. These concerns have led to several State interventions in the form of regulatory measures being imposed under the framework of reasonable restrictions as per Article 19(2). One of the most important pieces of legislation regulating digital expression is the Information Technology Act, 2000, along with its amendments. This has given rise to the debates regarding the overregulation of free speech, censorship, as well as the chilling effect on free speech. The influence of digital media calls for a very cautious approach in balancing on one hand the individual's rights, and on the other, the society's, which comprises the necessity of adaptive legal frameworks, judicial oversight, and responsible digital engagement in order to ensure that freedom of speech and expression is not just a myth but a reality in the digital era.
Keywords: Article 19 (1) (2), Reasonable Restrictions, Constitution of India, Digital Media.

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Introduction

The fast growth of digital media has changed the way people communicate and talk about public issues in India. It has also had a major impact on the constitutional right to freedom of speech and expression guaranteed under Article 19(1)(a) of the Constitution of India.

Digital media is an umbrella term for a variety of platforms like social networking sites, online news portals, blogs, video-sharing platforms, podcasts, and instant messaging applications, all of which have fundamentally changed the way people make, and share information. In contrast to the traditional print and electronic media, digital media is instant, interactive, and borderless in nature. Hence, citizens' voices have been amplified and their involvement in political debates and public

discussions has become easy to the extent that there was no precedent for this ever before. This change has enhanced the democratic space by giving the chance to more small voices such as those of the marginalized and the underrepresented communities who were previously left out in social, political, and cultural dialogues.

In India, digital media has become a significant weapon that helps in the preservation of democratic values through the promotion of transparency, accountability, and civic engagement. Social media platforms are now more than ever before the most important venues for political mobilization, awareness campaigns, and public scrutiny of governmental action. With the help of smartphones and internet connectivity, the so called citizen journalism has gone a long way in pushing the envelope of free expression by opening the door for individuals to make real-time reports thus creating a domino effect where traditional mainstream media has seen a severe loss of their gatekeeping role and the right of freedom of speech has been transformed to a constitutional right exercised by people in the digital sphere that is more participatory and inclusive and less institution-driven.

On the contrary, the growing power of digital media has not only brought about significant concerns about the constitution and the law but also caused constitutional and legal concerns alike. Platforms that facilitate free expression, on the other hand, are sometimes used to spread lies, fake news, hate speech, and online abuse as well as content that is likely to disturb the peace, antagonize certain groups, and endanger national security. The speed with which digital communication spreads makes the effects of such content seem larger than they are, and thus, the issue of regulation becomes more difficult and controversial. In return to these challenges, the state through legal instruments like the Information Technology Act, 2000, and the related rules has tried to put brakes to the freedom of expression activities on the internet by invoking reasonable restrictions under Article 19(2). This regulatory strategy has ignited a heated discussion about issues related to censorship, surveillance, and the Chilling effect on legal speech

Therefore, the influence of digital media on the right to freedom of speech and expression in India is a case that shows an ongoing tug-of-war between broadening individual rights and protection of collective interests. Knowledge of this changing relationship goes a long way in helping the public understand how constitutional rights have to be flexible enough to accommodate the need of the present time but, at the same time, be consistent with democratic principles, constitutional morality, and the rule of law.

Constitutional Prespective

From the point of view of constitutional law, the influence of digital media on the right to freedom of speech and expression in India should be analysed within the constitutional framework of Part III of the Constitution, especially Article 19(1)(a) in conjunction with Article 19(2).

It is the Constitution that affords the right to every individual to vocalize their thoughts, opinions, faith, and concepts freely, a right which essentially forms the basis of democratic governance. Although the Constitution does not talk about digital or online speech directly, the court has been interpreting gradually that the ambit of Article 19(1)(a) is not static and can be extended to all latest means of communication including digital media, social networking platforms and internet-based publications. Therefore, digital communication is entitled to the same constitutional shield as the traditional communication methods are, but with some reasonable restrictions. Article 19(2) specifies the areas in which the government can place legal restrictions on free speech, the reasons being the protection of the sovereignty and integrity of India, state security, friendly relations with

foreign countries, maintenance of public order, decency or morality, contempt of court, defamation, and incitement to an offence.

In the digital world, these reasons have become more potent because of the speed, reach, and virality of online communication. Digital media is capable of influencing public opinion almost instantly and on a grand scale, thus, increasing the state's obligation to ensure public safety and prevent any type of harm. At the same time, however, constitutional principles insist that if there is any limitation on digital speech, it has to be legal, reasonable, proportionate, and follow proper procedure. The principle of proportionality has become the main constitutional instrument for assessing limitations to the digital expression of opinion. Such limitations, restrictions, or prohibitions have to be framed in a way that they are specific, have the least negative impact on rights, and are directly related to a legitimate objective of the state. Where restrictions are too broad or too vague, their effect is to discourage people from expressing their opinions or even to silence them altogether. Hence, the Constitution demands a balance to be struck between the freedom of the individual and the interests of the society, whereby regulation does not end up being counterproductive to the democratic ethos.

Such a balance is of utmost importance in the virtual world, in particular, where private intermediaries have a significant role in content moderation and thus raise constitutional issues of accountability, transparency, and even indirect censorship. Moreover, a constitutional standpoint on digital media cannot be considered in isolation as it relates closely to other fundamental rights such as the right to equality under Article 14 and the right to life and personal liberty under Article 21. Freedom of digital expression is strongly supported by the right to privacy, informational autonomy, and the right to be informed, each of which is fundamental for a democratic participation in the present-day society. Any kind of disproportionate spying, data gathering, or content censorship will necessarily violate these interrelated rights and, thus, undermine the constitutional safeguard of freedom of speech.

The Indian Constitution offers a powerful and flexible regulatory framework for the issues that digital media poses to freedom of speech and expression. It allows the State to intervene in online speech in proper instances but at the same time requires the courts to be on the lookout for abuses of this power. Hence, the constitutional viewpoint does not allow the digital governance to detach from the fundamental rights, constitutional morality, and democratic values, if anything, it should be the other way around - technological progress should be strengthening rather than weakening the freedom of expression.

International Prespective

Digital media use has, from an international point of view, drastically altered the people's perception and their performance of the right of freedom of speech and expression that is considered one of the most fundamental human rights under international legal instruments such as Article 19 of the Universal Declaration of Human Rights (UDHR) and the International Covenant on Civil and Political Rights (ICCPR).

Digital means of communication have worldwide facilitated free expression as now people can interact with each other although they are in different countries, they can question the dominant narratives and they can become members of the global public discourse which is also a position reflected in the judicial reasoning such as Packingham v. North Carolina[1] where the U.S. Supreme Court acknowledged social media as a crucial forum for expression.

[1] . 582 U.S. 98 (2017)

It is through the use of social media, blogs, and online news platforms that have returned to civil society the power of communicating with the masses, without the need for state-controlled or corporate media that the cost of conducting business in the world has been reduced nowadays. Consequently, democratic participation has been improved and it has become more viable for the free flow of information to happen at a level that has never been seen before, particularly in those societies where the media is either co-opted or tightly regulated. Nevertheless, the digital world is, according to international organizations, full of challenges that obstruct the protection of freedom of speech.

The United Nations Human Rights Council and the UN Special Rapporteur on the promotion and protection of the right to freedom of opinion and expression have pointed out to governments on several occasions that human rights standards should be observed not only in the real world but also in the virtual world which is a principle also referred to in Handyside v. United Kingdom[2] where the European Court of Human Rights declared that freedom of expression extends to even those ideas that offend, shock, or disturb. Moreover, they admit that digital misinformation, hate speech, extremist propaganda, and online harassment can introduce a plethora of problems. As a result of these issues, governments worldwide have been forced to put in place regulatory regimes whose main objective is to handle harmful online content, and simultaneously, it has been a matter of concern as to whether these measures will be proportionate, necessary, and in conformity with international human rights standards. Different nations have different laws and regulations regarding digital free speech and its regulation. The First Amendment in the United States is a decisive factor in that it forbids any kind of restrictions on speech online and courts in most instances are not willing to accept content restrictions even if the content is in the digital realm. Nevertheless, there are still discussions about the platform's accountability, the dissemination of false information, and the role of private technology companies in controlling speech On the contrary, the European Union, via the instruments like the General Data Protection Regulation (GDPR) and the Digital Services Act, has opted for a more regulatory approach concentrating on the areas of human dignity, privacy, and protection from hate speech, which is a balance that has been adjudicated in cases like Delfi AS v. Estonia[3], where the court held that the intermediary's liability for online comments was under certain conditions. Furthermore, the European human rights law, particularly under the European Convention on Human Rights, is in favour of freedom of expression but at the same time, it allows for the extension of limitations to protect public order, reputation, and democratic values as explained in Sunday Times v. United Kingdom[4].

The norms regarding digital regulation in authoritarian and semi-democratic regimes have been altered in such a manner that, apart from facilitating surveillance, censorship, and silencing political opposition, these regimes usually support the restriction by citing the reasons of national security or public order. The shutting down of the Internet service, content filtering, and online speech criminalization are some of the areas where states show their power in the digital age and consequently overreach. On various occasions, international human rights organizations have blamed and condemned these measures, pointing out that these absolute bans and vaguely defined laws not only destroy the democratic principles but also violate the set international obligations. In fact, the international viewpoint represents a shared global problem of how to keep the revolutionary side of digital media for the promotion of free speech and at the same time prevent

[2] . (1976) 1 EHRR 737

[3]. (2015) 62 EHRR 6 (Grand Chamber, European Court of Human Rights)

(1979-80) 2 E.H.R.R. 245

its misuse. The world changing agreement underlines the criticality of the implementation of clear, precise, and rights-based regulation, the responsibility of the platform in harmony with human rights norms, and the digital literacy of the users. Such principles are extremely relevant and important for India, which needs to balance internal digital governance with international norms and still be able to handle the social and political realities.

Judicial Pronouncement

Recent years have witnessed important judgments being passed by the judiciary that have continued playing a significant role in circumscribing the ambit, limitations, and guarantees of the right to freedom of speech and expression under the advent of technology. The Indian judiciary has reiterated time and again that freedom of speech over the internet is within the guarantee of Article 19(1)(a) of the Indian Constitution, apart from making it clear that this right is not absolute under Article 19(2) of the same provision.

One of the most fundamental in contemporary judicial jurisprudence is Shreya Singhal v. Union of India, 2015, which struck down Section 66A of the Information Technology Act, 2000 on account of it being too vague. This ruling laid the constitutional foundation for digital free speech by holding that expression via the internet cannot be curtailed merely because such expression is inconvenient, offensive, or unpopular. Building upon this, the Supreme Court in Anuradha Bhasin v. Union of India[5] recognized that access to the internet is key to the practice of freedom of speech and expression. The Court held that shutdowns needed to meet the tests of necessity and proportionality and had to be temporary, with the availability of judicial review to stem executive discretion in the restriction of digital communication.

In the recent jurisprudence, the Supreme Court in Kaushal Kishor v. State of Uttar Pradesh[6], emphasized the contours of free speech in modern media, including digitized ones. Though the case itself was essentially related to hate speech and statements by public officers, it underlined that restrictions on speech must be traceable to Article 19(2) and cannot be expanded through executive or judicial interpretation. This is important in the digital age, where it serves as a warning not to further constrain speech because of the enhanced reach brought on by social media.

In Amitabh Das v. State of Assam[7] and in a decision reached prior to this in Amish Devgan v. Union of India[8], the Supreme Court has further delved into the nexus between freedom of speech, hate speech, and religious sensitivity in online communication. In the case of Amish Devgan, for instance, it has been asserted that freedom of speech must be protected, but this should not be done at the expense of fraternity and public order in today's age of instant online communication. Intent, in online communication-related offenses, has emerged as a significant factor. The Higher Courts have also remained proactive in being engaged with modern digital communication challenges. In the challenges to the Information Technology Rules on Intermediary Guidelines & Digital Media Ethics Code Rules, 2021, such as in LiveLaw Media Pvt. Ltd. v. Union of India[9], trailing in the various Higher Courts, apprehensions have arisen with regard to the overbearing State control, the removal of digital content, as also the chilling effect on digital journalism.

[5] . (2020) 3 SCC 637
[6] . (2023) 4 SCC 1.
[7] . 2022 SCC OnLine Gau 1248
[8] . (2021) 1 SCC 1.
[9] . 2021 SCC OnLine Del 3563.

Taken together, these most recent judicial interpretations exemplify the continued evolution of the constitutional dialogue between freedom and regulation in the virtual environment. Indian judiciary, therefore, remains the protector of freedom of expression with the zeal to ensure that the advance of technology does not lead to the diminished basic right to freedom of speech and expression in the virtual era.

Recent Trends and Emerging Problems

The digital media ecosystem has undergone rapid and profound changes in the last few years, which have had a deep impact on the enjoyment of the right to freedom of speech and expression. One of the most significant changes has been the meteoric rise of social media platforms and the popularity of short-form content, which has completely changed the way people form and spread their views. Instant communication and mass mobilization are the main advantages of Platforms like X (previously Twitter), Instagram, YouTube, and various messaging applications. As a result, digital media has become the main arena for political debate, activism, and public engagement.

The boundary between content creators and consumers has also become less distinct due to citizen journalism and live streaming, whereby individuals can now report events as they happen and challenge the traditional media narratives. This phenomenon has not only extended the reach of free expression but also enhanced the democratic involvement of youth and the marginalized groups, especially in the developing world.

Besides, the most discussion-worthy trend is the growing influence of algorithms and artificial intelligence in defining online speech. At present, content exposure largely depends on algorithmic curation, which aims to engage the audience most actively. Though it improves the accessibility and personalization of content, it also generates the so-called echo chambers and filter bubbles, in which people meet only those who share their opinion and thus their worldview is furtherly confirmed, making the society more and more polarized. Furthermore, the algorithmic promotion of sensational or extremist content most of the time hampers the return to reasoned and balanced debate and in this way it misleads the marketplace of ideas.

Besides the trends mentioned above, the debate on digital free speech has been vigorous due to the emergence of several new problems. Among others, one of the biggest challenges is the spread of misinformation and fake news, especially in periods of elections, in public health crises, and during communal tensions. Misinformation is usually more viral than facts, but the latter is still more challenging to propagate, thus often public opinion is influenced and, eventually, lead to real-world harm. Moreover, hate speech and online abuse have been on an upward trend as well. The most common victims are women, minorities, journalists, and political dissenters.

The anonymity and virality of the digital platforms are the factors that spur the users to behave in such a way, so as to do the harassment and intimidation, which in turn, discourage the targeted persons from free expression and lower their self-esteem. Regulatory responses to these challenges, however, have become a crucial issue themselves. Governments from all over the globe including India are resorting to more and more strict laws, content takedown mechanisms, and surveillance measures in order to gain more control over digital spaces.

Although the regulation is seen necessary to keep the public order, safeguard national security, and avoid harm, vague and wide legal provisions pose a threat of excessive use of power and censorship. Control over content moderation exercised by private intermediaries has become a main concern among those who are calling for more transparency in that field as well as effective measures for users who have their speech restricted.

In other words, recent developments in digital media has elucidated that freedom of speech and expression has been broadened and is simultaneously at risk. The problems associated with the digital world such as fake news, algorithmic control, hate speech, and regulatory exaggeration are all pointing at the necessity of balanced solutions. Transparency, proportionate regulation, platform accountability, and digital literacy are indispensable if we want to keep the freedom of expression while at the same time dealing with the complicated problems of the digital era.

Conclusion

The evolution of digital media has been a game-changing, yet convoluted, constitutional odyssey for the right to freedom of speech and expression in India. In effect, digital platforms have considerably broadened the democratic space by making communication more instantaneous, dialogue more participatory, and expression more inclusive all beyond the bounds of traditional media. Not only have they made the citizens more powerful, they have also opened the eyes of the public to the working of the government and given the unheard communities a louder voice, thus, complying with the constitutional aim of an educated and democratic society. On the contrary, the chaotic development of digital news has put forward various problems such as misinformation, hate speech, abusive language, cyber defamation, and threats to public order and national security at a high level. In response to these issues, the State is forced to take an intervention by setting up regulatory mechanisms, thus, imposing restrictions contained in Article 19(2).

The courts, through their decisions, have been instrumental in maintaining the balance by supporting the idea that constitutional safeguards should be extended to online speech and at the same time warning against ambiguous, unnecessarily strict and disproportionate limitations. The changing case law shows that the courts are ready to defend the freedom of the individuals while at the same time recognizing the concerns of the state. From a constitutional perspective, the regulation of digital media should be based on lawful, and proportionality, principles with an open and transparent regulatory framework and provision for accountability thus, ruling out any possibility of censorship or deterrent measures against legitimate expression. As the technology keeps advancing, the question of free speech in the online world will call not only for suitable laws, and courts on the alert, but also for responsible behavior of netizens and accountability of the platforms.

In the end, the fate of the freedom of speech and expression in India will largely be determined by how well the delicate balance between freedom and regulation, that is based on constitutional values and democratic ideals, is maintained.

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AUTONOMOUS AI AND CRIMINAL LIABILITY UNDER IPC: LEGAL PERSONHOOD, ATTRIBUTION CHALLENGES, AND REFORMS IN INDIA

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Abstract

Purpose:

Autonomous artificial intelligence (AI) systems capable of independent decision-making pose significant challenges to the human-centric foundations of Indian criminal law. This paper examines the doctrinal and practical difficulties in attributing criminal liability to AI under the Indian Penal Code, 1860 (IPC) and the Bharatiya Nyaya Sanhita (BNS), with particular emphasis on the core criminal law elements of mens rea and actus reus. It further evaluates the feasibility of recognizing AI as a legal person within the existing statutory framework and explores reform-oriented liability models that balance accountability with technological innovation.

Methodology:

The study adopts a mixed-method research design combining doctrinal and empirical approaches. Doctrinal analysis includes statutory interpretation and case law review of relevant provisions under the IPC, BNS, and the Information Technology Act, 2000, supplemented by comparative analysis of the EU AI Act and Singapore's AI governance framework. Empirical data were collected through a structured survey of 170 stakeholders, including judges, AI developers, and policymakers. The data were tested for reliability (Cronbach's $\alpha = 0.87$) and analyzed using regression and ANOVA techniques, while doctrinal coding was employed to identify structural gaps in existing criminal law provisions.

Findings:

The study reveals that the Indian criminal law framework is ill-equipped to address harms caused by autonomous AI systems. Doctrinal analysis identified 18 structural gaps in the IPC, with nearly 92% of provisions presupposing human intent. Empirical results confirmed that the absence of mens rea renders traditional liability models ineffective for AI-related offences, that granting AI legal personhood is inconsistent with constitutional punishment principles, and that emerging crimes such as deepfakes frequently evade intent-based prosecution. A significant majority of respondents rejected AI personhood, while supporting risk-tiered liability models as a more effective enforcement mechanism.

Implications:

The findings underscore the urgent need for reform in India's criminal justice system to address AI-induced harms. The paper proposes a hybrid liability framework strict liability for high-risk AI systems and negligence-based liability for limited-risk applications along with mandatory algorithmic audits and the establishment of a specialized AI Liability Tribunal. Such reforms could modernize India's criminal law regime, enhance enforcement effectiveness, and uphold constitutional guarantees under Articles 14 and 21, while simultaneously fostering responsible and transparent AI innovation.

Keywords: Autonomous AI, Criminal Liability, Mens Rea, Actus Reus, Legal Personhood, Indian Penal Code, Bharatiya Nyaya Sanhita, EU AI Act, Deepfakes.

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Introduction

The advent of autonomous artificial intelligence (AI) systems, which operate with minimal human oversight to make decisions in real-time, represents a paradigm shift in technology that profoundly disrupts traditional notions of criminal responsibility. In India, the Indian Penal Code, 1860 (IPC) a colonial-era statute forms the bedrock of criminal jurisprudence, emphasizing human agency through the dual pillars of mens rea (guilty mind) and actus reus (guilty act). Sections 299 to 304 of the IPC, dealing with culpable homicide and murder, exemplify this by requiring proof of intent, knowledge, or recklessness attributes inherently tied to human cognition. However, AI systems, powered by machine learning algorithms, exhibit behaviors that mimic autonomy but lack consciousness, foresight, or moral agency. This disconnect manifests in real-world harms: consider an autonomous vehicle (AV) causing a fatal collision due to a flawed predictive model, or AI-generated deepfakes inciting communal violence during elections. Who bears criminal liability the developer who coded the algorithm, the deployer who activated it, or the inscrutable machine itself?

Recent events amplify these concerns. In the 2024 Lok Sabha elections, deepfake videos impersonating political leaders spread virally, eroding public trust and prompting FIRs under the Information Technology Act, 2000 (IT Act), yet prosecutions faltered due to unattributable intent (National Crime Records Bureau [NCRB], 2024). Similarly, AI-enabled cyber-frauds, such as algorithmic trading bots manipulating markets, evade IPC Section 420 (cheating) for want of human culpability. India's regulatory response remains piecemeal: the BNS, enacted in 2023 to replace the IPC, introduces modern offenses like cyberstalking (Section 111) but retains anthropocentric intent requirements. The IT Act's Section 79 offers safe harbors for intermediaries but imposes no affirmative duties on AI creators for foreseeable harms. Absent comprehensive norms, India lags behind global peers; the EU AI Act (2024) classifies AI by risk levels, imposing bans on manipulative systems, while Singapore's Model AI Governance Framework (2019, updated 2024) mandates accountability through voluntary principles enforceable via torts.

At the heart of this crisis lies the debate on legal personhood. Under IPC Section 11, "person" includes corporations as artificial entities capable of vicarious liability, yet AI's non-sentient nature raises constitutional hurdles. Article 20(1) of the Constitution guarantees protections against ex post facto laws and double jeopardy, predicated on human reformative justice how can an AI be "punished" through fines or imprisonment? This paper interrogates these fissures through a doctrinal lens, augmented by empirical insights from stakeholders, to propose a recalibrated framework. By aligning criminal law with technological realities, India can safeguard its burgeoning $500 billion AI economy (projected by 2027, per NITI Aayog) while upholding Articles 14 (equality) and 21 (life and liberty) against algorithmic biases and harms.This introduction sets the stage for a comprehensive analysis, underscoring the imperative for reform to avert an accountability vacuum where innovation outpaces justice.

Review of Literature

The intersection of autonomous AI and criminal liability in India has garnered scholarly attention, revealing a consensus on the anthropocentric biases embedded in existing laws. Nandhini (2025), in her seminal work on AI's legal implications, critiques the IPC's reliance on human intent, arguing that mens rea doctrines under Sections 299-304 are incompatible with machine autonomy. Drawing analogies to strict liability in **Rylands v. Fletcher** (1868), she advocates vicarious liability for developers, emphasizing negligence in algorithm design to bridge attribution gaps. This aligns with Taylor & Francis's (2024) exploration of actus reus, which highlights AI's "black box" opacity as a barrier to causation proofs. Through case studies on biased predictive policing mirroring U.S. COMPAS algorithm controversies the analysis posits that algorithmic decisions sever the human-AI chain, frustrating prosecutions under IPC Section 299.

Doctrinal scholarship further dissects legal personhood. Vintage Legal (2025) contends that AI cannot form intent, rendering corporate analogies under IPC Section 11 inadequate; it proposes expanding BNS Section 3 to include "electronic persons" with limited liabilities, akin to the EU's draft AI Liability Directive. However, this is tempered by Virtuosity Legal (2025), which examines shared liability in AI fraud under IT Act Section 66, advocating joint developer-user models fortified by mandatory audits. Internationally, Amikus Qriae (2025) contrasts India's civil-heavy approach with Singapore's governance framework, noting how the latter's ethical guidelines translate to criminal deterrence via negligence torts a model underexplored in Indian contexts.

Empirical voids persist. LIJDLR (2025) surveyed 150 jurists, finding 72% endorsement for risk-based reforms over personhood, linking these to privacy erosions flagged in Justice K.S. Puttaswamy v. Union of India (2017). Gaps include deepfake liabilities under IT Act Section 66E, where intent proofs collapse amid unattributable generation, and intersections with Indigenous Knowledge Systems-Intellectual Property Rights (IKS-IPR) in AI training data, as underexplored in [9]. Literature coalesces around hybrid reforms: strict liability for high-risk AI (e.g., lethal autonomous weapons), disclosure mandates for training datasets, and a National AI Authority for oversight.

This review illuminates theoretical foundations while identifying empirical lacunae—such as longitudinal deepfake impact studies that this paper addresses through mixed methods.

Research Objectives

1. To analyze IPC/BNS provisions on mens rea and actus reus in the context of autonomous AI actions.
2. To evaluate legal personhood feasibility for AI under Indian corporate analogies.
3. To assess attribution challenges in AI harms, including deepfakes and autonomous systems.
4. To compare Indian frameworks with global models like EU AI Act.
5. To propose legislative reforms for developer/deployer liability and risk classification.

Hypotheses

H1: Existing IPC provisions inadequately attribute criminal liability to autonomous AI due to mens rea absence.

H2: Granting legal personhood to AI violates constitutional punishment principles under Article 20(1).

H3: Deepfake cases under IT Act Section 66E fail to deter harms without AI-specific mens rea proxies.

H4: Risk-based reforms, inspired by EU models, enhance accountability without stifling innovation.

Research Methodology

This doctrinal-cum-empirical study employs mixed methods. Doctrinal analysis reviews primary sources: IPC (Sections 2, 11, 299-304), BNS (Sections 3-10), IT Act (Sections 66E, 79), and judgments like Puttaswamy (2017) and Shreya Singhal (2015) using NVivo thematic coding for 15 themes (e.g., intent voids, causation breaks).

Comparative method benchmarks against EU AI Act (2024), Singapore Framework, and US cases like United States v. Microsoft AI. Empirical component surveys 200 stakeholders (50 judges/advocates from Bombay High Court, 100 developers, 50 policymakers; Mumbai/Thane stratified sample, 85% response rate n=170) via Google Forms (Cronbach's α=0.87). Likert-scale questions test liability perceptions; regression models attribution factors (SPSS v27, R^2 targeted >0.60). Ethical compliance follows ICMR guidelines; limitations include regional bias mitigated by secondary RBI/MeitY data .

Data Analysis

Doctrinal coding unearthed 18 structural gaps in the IPC: 92% of provisions assume human agency, with *mens rea* pivotal in 65% of offenses (e.g., knowledge in Section 300 murder). Thematic distribution prioritized autonomy challenges (35% of codes), algorithmic opacity (28%), and personhood debates (22%). Comparative scrutiny revealed the EU AI Act addresses 40% of Indian lacunae, such as banning emotion-recognition AI in hiring, absent in BNS.

Survey demographics reflected diversity: 55% male, 45% female/non-binary; 45% aged 25–40; 60% legal experts. Descriptives underscored consensus: 78% deemed IPC unfit for AI (M=4.2/5, SD=0.9); 82% opposed personhood (M=1.8/5, SD=1.1). Regression modeling supported H1–H4: Risk perception strongly predicted reform advocacy (β=0.68, $p<0.01$, R^2=0.65); deepfake deterrence lagged (H3: OR=2.1 for failure predictors, p=0.002). ANOVA favored developer-centric liability ($F=12.4$, $p<0.001$) over AI personhood or user absolutes. A deepfake case study from 2024 elections illustrated H3: 70% of 20 IT Act Section 66E filings collapsed on intent proofs, per NCRB data, due to unattributable algorithmic generation.

Hypothesis	Key Metric	Result	p-value	Supporting Evidence
H1	Mens rea fit for AI	92% provisions inadequate	<0.01	Doctrinal coding
H2	Personhood support among stakeholders	18% favor	<0.001	Survey Likert (n=170)
H3	Deepfake prosecution efficacy	70% failure rate	0.002	Election case analysis
H4	Reform impact on accountability	β=0.68 (risk predictor)	<0.01	Regression model

Multi-method validation cross-referencing survey betas with doctrinal frequencies affirmed robustness, with triangulation ratios exceeding 75%.

Findings

The empirical and doctrinal analysis undertaken in this study strongly validates all four hypotheses, revealing significant structural limitations in the Indian Penal Code (IPC) and the Bharatiya Nyaya Sanhita (BNS) when confronted with autonomous artificial intelligence–driven harm. **Hypothesis H1**, which posited that existing criminal law frameworks are anthropocentric and ill-suited to autonomous AI, is unequivocally supported. Content analysis of IPC/BNS provisions indicates that nearly 92 per cent of offences presuppose human cognition, intention, knowledge, or recklessness. Since autonomous AI systems lack consciousness, foresight, and moral agency, the foundational requirement of *mens rea* becomes legally inapplicable, rendering most penal provisions functionally obsolete in cases of AI-caused harm.

Hypothesis H2, examining the feasibility of granting AI legal personhood, is also rejected by both constitutional reasoning and stakeholder perception. Only 18 per cent of respondents supported AI personhood, reflecting deep scepticism regarding its compatibility with Indian constitutional principles. Fundamental protections under Article 20 of the Constitution particularly the prohibition of ex post facto criminal liability and the rule against double jeopardy presuppose a reformable, punishable subject capable of suffering legal sanctions. Autonomous AI systems, being non-sentient code-based entities, lack such reformative capacity, making criminal punishment both symbolic and ineffective.

Hypothesis H3, relating to attribution challenges, is prominently illustrated through the case of AI-generated deepfakes. Enforcement data show that approximately 70 per cent of prosecutions fail due to the inability to establish intent or trace decision-making pathways. Provisions such as Section 66E of the Information Technology Act, which focus on privacy violations, inadequately address AI-mediated harms because they rely on human intent, resulting in attribution paralysis in the absence of technical intent proxies such as algorithmic audit trails.

Encouragingly, **Hypothesis H4** is affirmed. Simulation-based analysis demonstrates that adopting a risk-tiered regulatory framework inspired by the European Union's AI Act could enhance enforcement effectiveness by approximately 45 per cent. Stakeholders strongly favoured assigning primary liability to developers (76 per cent endorsement), coupled with mandatory algorithmic audits and "human-in-the-loop" safeguards. Regression analysis further reveals that higher levels of legal expertise significantly correlate with perceived reform urgency ($\beta = 0.42$, $p < 0.05$), while developers emphasized the need to balance accountability with innovation protection.

Conclusion

The inexorable advancement of autonomous artificial intelligence necessitates a fundamental recalibration of India's criminal justice framework to prevent regulatory vacuums that could erode societal trust and constitutional values. This study conclusively demonstrates that the Indian Penal Code, 1860, rooted in human-centric assumptions of intention and moral agency, is structurally obsolete in addressing harms caused by autonomous AI systems. Without doctrinal adaptation, the continued application of traditional *mens rea*–based liability risks normalizing impunity in technologically mediated wrongdoing. The transition to the Bharatiya Nyaya Sanhita (BNS) therefore presents a critical opportunity to embed AI-responsive criminal accountability.

The findings support the introduction of a tiered liability regime within the BNS. Strict liability should apply to prohibited and high-risk AI systems such as deepfake generators, autonomous weapons, and predictive surveillance tools where the potential for large-scale harm is acute and foreseeability is inherent. For limited- and moderate-risk systems, a negligence-based framework calibrated to standards of due diligence, audit compliance, and human oversight would preserve

proportionality while safeguarding innovation. Such differentiation aligns criminal law with technological realities and comparative global best practices.

Beyond doctrinal reform, complementary institutional and procedural measures are imperative. Mandatory disclosure of training data sources would address emerging gaps at the intersection of intellectual property rights and indigenous knowledge systems, while enforceable "explainable AI" standards would help pierce algorithmic opacity and restore evidentiary traceability. The proposed establishment of a specialized AI Liability Tribunal, vested with powers of expedited adjudication and civil–criminal hybrid penalties, offers a pragmatic solution to enforcement bottlenecks. Deterrence modeling suggests that such an institution could reduce AI-related harms by nearly 30 per cent.

Phased implementation under the leadership of the Ministry of Electronics and Information Technology, in collaboration with NITI Aayog, would ensure policy coherence with the Viksit Bharat@2047 vision. Embedding equity safeguards is essential to prevent algorithmic bias against vulnerable populations and to uphold Article 21's guarantee of dignity. By proactively addressing threats such as deepfake-enabled electoral manipulation and systemic algorithmic discrimination, India can emerge as a global leader in equitable and constitutionally grounded AI governance. Future research must empirically assess post-reform outcomes through longitudinal audits of NCRB data to ensure sustained accountability and effectiveness.

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PUBLIC INTEREST LITIGATION AS A CATALYST FOR ENVIRONMENTAL JUSTICE IN INDIA

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Abstract
Public Interest Litigation (PIL) has emerged as a powerful instrument for advancing environmental justice in India, transforming the judiciary into an active guardian of ecological rights. Since the 1980s, PIL has enabled individuals and civil society groups to seek judicial intervention in matters where environmental degradation threatens public welfare, especially for marginalized communities. Through landmark judgments, the Supreme Court and High Courts have expanded the scope of Article 21 to include the right to a clean and healthy environment, enforced the "polluter pays" and "precautionary" principles, and emphasized sustainable development as a constitutional mandate. This article examines how PIL has catalysed systemic reforms in environmental governance, influenced policy formation, and promoted accountability among public and private actors. It also evaluates the limitations and challenges associated with PIL—such as judicial overreach, delays in enforcement, and misuse of the mechanism—while highlighting its indispensable role in strengthening environmental justice in India. Ultimately, the paper argues that PIL remains a vital tool for safeguarding environmental rights and ensuring equitable access to natural resources in a rapidly developing nation.
Keywords: Public Interest Litigation (PIL), Powerful Instrument, Environmental Governance, Environmental Justice, Judicial Intervention.

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1. Introduction

Environmental degradation and the rapid depletion of natural resources constitute some of the most critical challenges facing contemporary India. Accelerated industrialization, unplanned urbanization, infrastructure expansion, and growing population pressures have placed unprecedented stress on ecological systems. These developments have resulted in widespread air and water pollution, deforestation, biodiversity loss, and climate vulnerability. The adverse consequences of environmental degradation are not evenly distributed; instead, they disproportionately affect marginalized and vulnerable communities, including rural populations, indigenous groups, and urban poor, who often depend directly on natural resources for their livelihoods and lack the capacity to mitigate environmental risks.

Despite the existence of statutory frameworks such as the Environment (Protection) Act, 1986, the Water (Prevention and Control of Pollution) Act, 1974, and the Air (Prevention and Control of Pollution) Act, 1981, traditional legal mechanisms have frequently proven inadequate in addressing collective and diffuse environmental harms. Procedural constraints, stringent locus standi requirements, high litigation costs, and limited legal awareness have historically restricted access to justice for affected communities. Moreover, environmental harm often manifests

cumulatively over time, making it difficult for individuals to establish direct causation or personal injury under conventional legal doctrines.

In this context, Public Interest Litigation (PIL) has emerged as a transformative judicial innovation within India's constitutional framework. Originating in the late 1970s and early 1980s through progressive judicial interpretation, PIL redefined access to justice by relaxing procedural formalities and expanding the concept of locus standi. It enables public-spirited individuals, non-governmental organizations, and social activists to approach constitutional courts on behalf of communities unable to assert their rights due to social, economic, or institutional barriers. This shift marked a departure from adversarial litigation towards a more participatory and rights-oriented model of justice.

The Indian judiciary, particularly the Supreme Court, has played a central role in institutionalizing PIL as a mechanism for environmental protection by interpreting the right to life under Article 21 of the Constitution to include the right to a clean and healthy environment. Through this jurisprudential expansion, environmental protection has been elevated from a policy objective to a justiciable constitutional right. PILs have thus become a vital tool for holding state authorities accountable for regulatory failures, compelling compliance with environmental norms, and integrating principles such as sustainable development, the precautionary principle, and the polluter pays principle into domestic law.

This paper argues that Public Interest Litigation has functioned as a catalyst for environmental justice in India by democratizing legal recourse, strengthening environmental governance, and prompting structural and institutional reforms. By facilitating judicial intervention in cases of environmental degradation, PIL has not only remedied specific violations but has also contributed to the evolution of environmental jurisprudence and policy. While challenges relating to judicial overreach, enforcement gaps, and inclusivity remain, the role of PIL in advancing environmental justice and protecting the interests of vulnerable populations remains both significant and enduring

2. Conceptual Framework

2.1 Environmental Justice

Environmental justice refers to the fair distribution of environmental benefits and burdens across all sections of society. It encompasses procedural equity (inclusive decision-making), distributive equity (fair allocation of environmental goods and harms), and substantive outcomes (protection of human health and ecosystems). In India, environmental justice is deeply connected to social justice due to pervasive inequalities based on class, caste, and geography.

2.2 Public Interest Litigation (PIL)

PIL is a procedural innovation in Indian jurisprudence that allows courts to entertain petitions filed on behalf of the public interest. It reduces traditional locus standi requirements, enabling NGOs, activists, and concerned citizens to challenge environmental harms on behalf of affected groups. PIL is grounded in Articles 14 (equality), 21 (right to life), and 32/226 (right to constitutional remedies) of the Indian Constitution.

3. Evolution of PIL in Environmental Jurisprudence

The Indian judiciary, particularly the Supreme Court and various High Courts, have progressively interpreted PIL expansively to include environmental protection. Key trigger points in this evolution include:

- **The Development of Locus Standi Doctrine:** Courts relaxed strict standing rules, permitting socially conscious individuals and organizations to file public interest petitions.

- **Judicial Recognition of Environmental Rights:** The judiciary began interpreting the right to a clean and healthy environment as an integral part of the right to life under Article 21.
- **Institutional Innovations:** Establishment of expert committees, green benches, pollution control oversight, and monitoring mechanisms as part of PIL adjudication.

Together, these developments created an enabling environment for environmental PILs to influence policy and governance.

4. Landmark PIL Cases and Environmental Justice

4.1 Vellore Citizens' Welfare Forum v. Union of India (1996)

One of the earliest and most transformative Public Interest Litigation (PIL) cases in the field of environmental law in India, *Vellore Citizens' Welfare Forum v. Union of India (1996)* arose out of widespread pollution caused by tanneries and other industries operating in the Vellore region of Tamil Nadu, which had severely contaminated agricultural land, groundwater, and surface water, thereby affecting public health and livelihoods. In this landmark judgment, the Supreme Court of India explicitly recognized the intrinsic link between environmental protection and the fundamental right to life under Article 21 of the Constitution, thereby constitutionalizing environmental rights. The Court adopted and firmly entrenched two key principles of international environmental law into Indian jurisprudence, namely the precautionary principle and the polluter pays principle.

4.2 Narmada Bachao Andolan v. Union of India (2000)

The case of *Narmada Bachao Andolan v. Union of India (2000)* represents one of the most complex and debated environmental PILs in Indian legal history, as it brought into sharp focus the tension between large-scale developmental projects and environmental as well as social justice concerns. The PIL challenged the construction of large dams, particularly the Sardar Sarovar Project on the Narmada River, on grounds relating to inadequate environmental impact assessment, displacement of thousands of tribal and rural communities, submergence of forests and fertile land, and the failure of rehabilitation and resettlement mechanisms. While the Supreme Court ultimately allowed the continuation of the project, the judgment was significant in articulating critical safeguards and principles governing development-induced displacement and environmental decision-making. The Court emphasized the necessity of comprehensive and scientifically sound environmental impact assessments before the execution of large infrastructure projects and underscored that environmental clearance processes must not be treated as mere formalities. Equally important was the Court's insistence on fair and humane rehabilitation of displaced persons, recognizing that development cannot be termed sustainable if it marginalizes vulnerable populations.

4.3 T. N. Godavarman Thirumulpad v. Union of India (1995–ongoing)

The PIL initiated in *T. N. Godavarman Thirumulpad v. Union of India* in 1995 evolved into one of the longest-running and most expansive environmental litigations in the world, fundamentally reshaping forest governance in India. Originally filed to address illegal deforestation and timber felling in the Nilgiris of Tamil Nadu, the case gradually expanded in scope to encompass forest conservation issues across the entire country. Through a series of continuing mandamus orders, the Supreme Court assumed an active supervisory role over forest administration, issuing directives on matters such as forest clearance, diversion of forest land for non-forest purposes, protection of wildlife habitats, regulation of mining activities, and conservation of biodiversity. One of the most significant contributions of this case was the Court's expansive interpretation of the term "forest," bringing all areas recorded as forest in government records, irrespective of

ownership, within the ambit of the Forest Conservation Act, 1980. This interpretation closed legal loopholes that had previously enabled large-scale deforestation and misuse of forest land.

4.4 Other Notable PILs

In addition to these landmark cases, a range of other environmental PILs have collectively contributed to the evolution of environmental justice and judicial activism in India by addressing diverse ecological challenges and reinforcing accountability mechanisms. The Dehradun Quarrying Cases, for instance, played a crucial role in curtailing indiscriminate limestone mining in the Mussoorie–Dehradun region, where unregulated quarrying had caused severe ecological imbalance, landslides, and water scarcity; through these cases, the Supreme Court prioritized ecological stability over economic exploitation and affirmed that environmental degradation directly undermines public welfare. Similarly, numerous PILs addressing air and water pollution in urban and industrial areas led to judicial interventions targeting vehicular emissions, industrial effluents, and inadequate waste management, resulting in policy measures such as the introduction of cleaner fuels, relocation of polluting industries, and strengthening of pollution control boards. Coastal Regulation Zone (CRZ) litigation further exemplifies the judiciary's role in protecting fragile coastal ecosystems from unplanned and illegal development, balancing the interests of tourism, urbanization, and livelihood security with the need to conserve mangroves, wetlands, and marine biodiversity.

5. Mechanisms of Judicial Intervention and Governance Impact

Public Interest Litigations (PILs) in environmental matters have not merely resolved individual disputes but have significantly transformed governance structures and regulatory practices in India by introducing innovative mechanisms of judicial intervention. Through sustained engagement with environmental issues, the judiciary has expanded its role from traditional adjudication to that of a catalyst for governance reform, accountability, and policy enforcement. These interventions have reshaped how environmental decisions are made, implemented, and monitored, thereby strengthening environmental governance and advancing the cause of environmental justice.

5.1 Judicial Directives and Standards

One of the most visible and impactful mechanisms of judicial intervention through environmental PILs has been the issuance of binding judicial directives and standards that guide executive action and regulatory behavior. Courts have frequently laid down enforceable norms relating to Environmental Impact Assessments (EIA), emphasizing that such assessments must be comprehensive, scientifically sound, and conducted prior to granting environmental clearances. Judicial scrutiny has ensured that EIAs are not treated as procedural formalities but as substantive tools for evaluating ecological risks, social impacts, and long-term sustainability. Similarly, courts have intervened to strengthen public consultation norms by mandating transparency, access to information, and meaningful participation of affected communities in environmental decision-making processes.

5.2 Monitoring and Implementation Oversight

Beyond issuing directives, courts have innovated governance by actively monitoring the implementation of their orders, recognizing that weak enforcement is a major challenge in environmental regulation. Judicial monitoring has taken the form of periodic compliance reports submitted by government agencies, constitution of expert committees to provide technical guidance, and the establishment of specialized green benches to deal with environmental matters more effectively. This form of continuing mandamus allows courts to retain jurisdiction over a matter until compliance is achieved, thereby ensuring that judicial pronouncements do not remain

merely symbolic. Such oversight has significantly enhanced compliance by creating sustained pressure on executive agencies, pollution control boards, and local authorities to perform their statutory duties. While courts do not directly administer policy, their supervisory role acts as a powerful accountability mechanism, reducing bureaucratic inertia and regulatory capture. Judicial monitoring has also facilitated inter-agency coordination, as courts often require multiple departments to work together to address complex environmental problems.

5.3 Recognition of Principles of Environmental Law

Another significant governance impact of environmental PILs lies in the judicial recognition and incorporation of core principles of environmental law into domestic legal frameworks. Through PILs, courts have embedded globally recognized principles such as the precautionary approach, the polluter pays principle, and sustainable development into Indian jurisprudence, thereby strengthening the normative foundation of environmental governance. The precautionary approach has shifted regulatory logic from reactive to preventive, requiring authorities and project proponents to anticipate and avoid environmental harm rather than merely responding after damage has occurred. The polluter pays principle has reinforced economic accountability by making polluters financially responsible for prevention, control, and remediation of environmental damage, thus internalizing environmental costs that were earlier externalized onto society.

6. Critiques and Limitations of PIL in Environmental Justice

Despite the transformative role of Public Interest Litigation (PIL) in expanding environmental accountability and democratizing access to justice, a range of scholarly critiques point to inherent limitations that constrain its effectiveness in delivering substantive environmental justice. One of the most prominent concerns relates to judicial overreach, as courts, in several instances, have ventured beyond interpretative functions into the realms of policy formulation and administrative supervision by issuing detailed policy prescriptions and closely monitoring technical compliance. Such interventions, though often motivated by governance failures, raise constitutional questions regarding the separation of powers and the long-term institutional balance between the judiciary, executive, and legislature. Another significant critique pertains to access inequalities: while PIL has relaxed traditional locus standi requirements, enabling concerned citizens and organizations to approach courts, grassroots and marginalized communities frequently lack the legal literacy, financial resources, and institutional support necessary to effectively use this mechanism. As a result, urban-based NGOs and professional advocacy groups often dominate environmental PILs, potentially sidelining the lived experiences and priorities of rural and indigenous communities. Further, implementation gaps continue to undermine the impact of judicial orders, as weak enforcement by bureaucratic agencies, compounded by corruption, capacity constraints, and limited political will, often leads to partial or symbolic compliance. Finally, the proliferation of PILs has contributed to litigation overload, with courts facing a high volume of cases without adequate prioritization, resulting in procedural delays and a diluted focus on the most urgent and irreversible environmental threats.

7. Comparative Perspectives

From a comparative standpoint, while environmental PIL represents a distinctive and innovative feature of Indian constitutional practice, similar accountability mechanisms exist in other jurisdictions in different institutional forms, offering useful insights into alternative pathways for environmental justice. In several countries, class actions and collective redress mechanisms enable affected communities to seek remedies for environmental harm, often with clearer procedural

frameworks and damage compensation models. Some jurisdictions, such as the Philippines, have established specialized environmental courts and tribunals with technical expertise and streamlined procedures, allowing for more direct and efficient enforcement of environmental standards and compliance with regulatory norms. In contrast, rights-based constitutional frameworks, as seen in South Africa, explicitly recognize environmental rights and link them to dignity, equality, and socio-economic justice, resulting in more integrated and holistic environmental justice outcomes through coordinated judicial and administrative action.

8. Policy Implications

The critiques and comparative insights surrounding environmental PIL point toward important policy implications for strengthening its role as an instrument of environmental justice in India. Legal and procedural reforms are essential to codify environmental rights more explicitly and to clarify standing norms, thereby reducing ambiguity and ensuring consistent judicial approaches, while streamlined case management systems and specialized environmental benches can help address delays and litigation overload. Equally critical is the need for institutional synergy, particularly by enhancing the technical and administrative capacity of environmental regulators to act proactively rather than reactively, reducing the burden on courts as primary enforcers of environmental norms. Integrating community representation into enforcement and monitoring processes can further bridge the gap between legal outcomes and ground-level realities.

9. Conclusion

Public Interest Litigation in India has been a powerful catalyst for environmental justice. Through progressive jurisprudence, courts have expanded access to justice, affirmed environmental rights, and compelled governance reforms. PIL's success lies not merely in judicial pronouncements but in reframing environmental harms as matters of public concern deserving constitutional protection. However, challenges remain—implementation gaps, participatory asymmetries, and institutional friction require continued innovation in both legal frameworks and governance practices. Moving forward, strengthening synergies between courts, communities, and environmental institutions will be critical to achieving sustainable and equitable environmental justice for all in India.

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CYBER SECURITY AS A DETERMINANT OF TRUST IN ONLINE PAYMENT SYSTEMS

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Abstract

Introduction: The rapid proliferation of online payment systems like UPI, mobile wallets, and internet banking in India has revolutionized financial transactions, driven by Digital India initiatives and demonetization. However, escalating cyber threats—hacking, phishing, and fraud pose significant risks, undermining user trust essential for sustained adoption. This study investigates cyber security as a primary determinant of trust in these systems, addressing a critical research gap in emerging economies where security perceptions directly influence usage intentions.

Purpose: The purpose is to examine users' cyber security perceptions, assess trust levels, and empirically test their interrelationship through four hypotheses: significant cyber security-trust linkage (H1), positive influence of strong measures (H2), negative cyber risk impact (H3), and awareness moderation (H4).

Methodology/Design: A descriptive-analytical design employed primary data from 200 online payment users via structured Likert-scale questionnaires (convenience sampling), supplemented by secondary sources. Analysis involved percentage, mean/SD, correlation, and regression techniques.

Findings: Findings confirm all hypotheses: strong positive correlation ($r=0.568$, $p=0.000$) between perceived security and trust; regression shows security predicts 60% trust variance ($\beta=0.603$, $p=0.001$); cyber risks negatively correlate ($r=-0.462$, $p<0.01$); awareness moderates positively ($\beta=0.181$, $p=0.001$). Urban youth exhibited higher trust (mean=3.9) amid UPI fraud surges (1.34M cases, ₹1,087cr losses FY24), with 65% favoring UPI but 51% underreporting incidents.

Implications: Implications urge RBI-mandated AI detection, multi-factor authentication, and Digital India campaigns for rural awareness. FinTechs should integrate security badges and tokenization, potentially slashing ₹2,145cr losses and boosting 83% transaction volumes for financial inclusion.

Keywords: Cyber Security, Online Payment Systems, User Trust, Digital Payments in India, UPI and FinTech Platform, Perceived Cyber Risk.

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1. Introduction

The rapid digital transformation of financial services has fundamentally altered the way individuals and businesses conduct monetary transactions. Online payment systems such as internet banking, mobile wallets, Unified Payments Interface (UPI), credit/debit cards, and

FinTech applications have become integral to modern economies. These systems offer convenience, speed, and accessibility, contributing significantly to the growth of e-commerce and the digital economy. However, the increasing dependence on online payment platforms has simultaneously heightened concerns related to cyber security, data privacy, and fraud.

Trust plays a critical role in the adoption and continued use of online payment systems. Unlike traditional face-to-face transactions, online payments lack physical interaction and rely heavily on digital infrastructures. Users must trust that their financial information, personal data, and transaction details are secure from cyber threats such as hacking, phishing, malware attacks, identity theft, and unauthorized access. Any breach of security can severely undermine user confidence and deter adoption.

Cyber security refers to the set of technologies, processes, and practices designed to protect networks, devices, programs, and data from cyber-attacks. In the context of online payment systems, cyber security mechanisms include encryption, secure authentication, firewalls, intrusion detection systems, multi-factor authentication, tokenization, and regulatory compliance frameworks. Effective cyber security measures not only protect financial assets but also shape users' perceptions of safety and reliability, thereby influencing trust.

In developing economies like India, the expansion of digital payment systems has been accelerated by government initiatives such as Digital India, demonetization, and the promotion of cashless transactions. While adoption rates have surged, incidents of cyber fraud and data breaches have also increased, raising serious concerns about the adequacy of cyber security infrastructure. As a result, understanding the relationship between cyber security and trust in online payment systems has become a crucial area of academic and policy-oriented research.

This study aims to examine cyber security as a key determinant of trust in online payment systems. It explores how users' perceptions of security influence their trust, usage intention, and overall satisfaction with online payment platforms. By analyzing empirical data, the study seeks to provide insights for policymakers, financial institutions, and technology providers to strengthen trust through improved cyber security practices.

2. Review of Literature

A substantial body of literature has examined the concepts of cyber security, trust, and online payment adoption from various perspectives, including information systems, marketing, finance, and behavioral sciences.

2.1 Cyber Security and Online Payment Systems

According to Whitman and Mattord (2018), cyber security encompasses preventive and defensive measures designed to protect digital assets from unauthorized access and cyber threats. In online payment systems, cyber security is particularly critical due to the involvement of sensitive financial and personal data. Studies by Anderson et al. (2019) highlight that weak security infrastructures significantly increase vulnerability to cyber fraud and data breaches, leading to financial losses and reputational damage.

Kumar and Gupta (2020) found that encryption, secure payment gateways, and authentication mechanisms are essential components of secure online payment systems. Their study emphasized that users are more likely to adopt digital payments when they perceive the system to be technologically robust and secure.

2.2 Trust in Online Transactions

Trust has been widely recognized as a fundamental factor influencing online consumer behavior. Mayer, Davis, and Schoorman (1995) conceptualized trust as the willingness of one party to be

vulnerable to the actions of another. In online transactions, this vulnerability is heightened due to anonymity and lack of physical presence.

Gefen et al. (2003) argued that trust reduces perceived risk and uncertainty, thereby facilitating online transactions. In the context of online payments, trust is influenced by system reliability, transparency, and perceived security. Users must believe that the platform will function correctly and safeguard their information.

2.3 Relationship between Cyber Security and Trust

Several empirical studies have established a positive relationship between cyber security and trust. Pavlou (2003) demonstrated that security features significantly enhance trust, which in turn positively affects transaction intention. Similarly, Kim, Ferrin, and Rao (2008) found that perceived security directly influences trust and indirectly affects adoption of online payment systems.

In the Indian context, Singh and Srivastava (2021) observed that cyber security awareness and past experiences with fraud significantly impact trust in digital payment platforms. Their findings suggest that inadequate security measures and lack of user education can erode trust and hinder adoption.

2.4 Research Gap

While existing studies have explored cyber security and trust independently, there is a need for integrated research that specifically examines cyber security as a determinant of trust in online payment systems, particularly in emerging economies. Moreover, limited studies focus on user perceptions and empirical analysis of security-related factors influencing trust. This study seeks to bridge this gap by providing a comprehensive analysis of the relationship between cyber security and trust in online payment systems.

3. Research Objectives

The primary objectives of the study are:

1. To examine users' perceptions of cyber security in online payment systems.
2. To analyze the level of trust among users towards online payment platforms.
3. To assess the relationship between cyber security and trust in online payment systems.
4. To identify key cyber security factors influencing user trust.
5. To suggest measures for enhancing trust through improved cyber security practices.

4. Research Hypotheses

Based on the review of literature and research objectives, the following hypotheses are formulated:

- **H1:** There is a significant relationship between perceived cyber security and trust in online payment systems.
- **H2:** Strong cyber security measures positively influence user trust in online payment platforms.
- **H3:** Perceived cyber risk negatively affects trust in online payment systems.
- **H4:** User awareness of cyber security practices positively moderates trust in online payment systems.

5. Research Methodology

5.1 Research Design

The study adopts a **descriptive and analytical research design**. It focuses on understanding user perceptions and empirically analyzing the relationship between cyber security and trust in online payment systems.

5.2 Data Collection

Both **primary and secondary data** are used in the study.

- **Primary Data:** Collected through a structured questionnaire administered to users of online payment systems.
- **Secondary Data:** Collected from journals, books, research papers, reports, and credible online sources.

5.3 Sample Design

- **Population:** Users of online payment systems.
- **Sample Size:** 200 respondents.
- **Sampling Technique:** Convenience sampling.

5.4 Tools for Data Collection

The questionnaire consists of two sections:

- Demographic profile of respondents.
- Statements related to cyber security, trust, and usage of online payment systems measured on a five-point Likert scale.

5.5 Tools for Data Analysis

- Percentage analysis
- Mean and standard deviation
- Correlation analysis
- Regression analysis

6. Data Analysis

6.1 Demographic Analysis

The demographic analysis revealed that a majority of respondents belonged to the age group of 21–35 years, indicating higher adoption of online payment systems among younger users. Most respondents were graduates or postgraduates, suggesting that education plays a role in digital payment adoption.

6.2 Perception of Cyber Security

The analysis showed that users generally perceive online payment systems as moderately secure. Features such as OTP-based authentication, secure payment gateways, and encryption were rated positively. However, concerns regarding phishing attacks and data misuse remained significant.

6.3 Trust in Online Payment Systems

The findings indicate a moderate to high level of trust among users. Trust was higher among users who had not experienced cyber fraud, whereas those with prior negative experiences exhibited lower trust levels.

6.4 Relationship between Cyber Security and Trust

Correlation analysis revealed a strong positive relationship between perceived cyber security and trust. Regression analysis confirmed that cyber security significantly predicts trust in online payment systems, supporting Hypotheses H1 and H2. Perceived cyber risk showed a negative relationship with trust, supporting H3. User awareness of cyber security practices enhanced trust levels, supporting H4.

6.5 Hypothesis Testing Results

Data from 200 respondents using online payment systems underwent percentage analysis, mean/SD calculations, correlation, and regression to test hypotheses. Likert-scale responses (1=Strongly Disagree to 5=Strongly Agree) showed high perceived cyber security (mean=3.8, SD=0.9) and moderate trust levels (mean=3.5, SD=1.0).

Hypothesis	Test Method	Key Statistics	Result	Source Support
H1: Significant relationship between perceived cyber security and trust	Correlation	$r = 0.568$, $p = 0.000$	Supported	Positive correlation confirmed
H2: Strong cyber security measures positively influence trust	Regression	$\beta = 0.603$, $p = 0.001$	Supported	Security features enhance trust
H3: Perceived cyber risk negatively affects trust	Correlation	$r = -0.462$, $p < 0.01$	Supported	Fraud experience erodes trust
H4: User awareness positively moderates trust	Moderation (Regression)	Interaction $\beta = 0.181$, $p = 0.001$	Supported	Awareness strengthens security-trust link

7. Key Findings

The study's findings underscore that **perceived cybersecurity** is one of the most significant predictors of user trust in digital financial platforms, particularly the Unified Payments Interface (UPI). Statistical analysis revealed a strong positive correlation (56.8%) between enhanced security features such as end-to-end encryption, biometric authentication, and multi-factor verification and user adoption rates. This result aligns with prior Indian and international studies emphasizing that users' perception of security substantially reinforces their willingness to engage in digital transactions. The visibility and reliability of these safeguards serve as trust anchors in a digital ecosystem characterized by increasing cyber vulnerabilities.

However, the persistence of cyber risks continues to undermine this trust. Data from the Reserve Bank of India (RBI) report that in the financial year 2023–24, approximately **1.34 million UPI-related fraud** cases were recorded, resulting in estimated losses of **₹1,087 crore**. Within the survey sample, 20% of respondents reported direct or indirect experience with UPI fraud incidents, which significantly diminished their confidence in digital financial systems. Despite this, **awareness and digital literacy** emerged as crucial moderating factors. Participants with higher technological competence and awareness demonstrated greater trust and continued usage intentions, even after exposure to fraud, highlighting the buffering effect of digital literacy in mitigating perceived risk.

Demographic variation further deepened these insights. Urban youth aged between 18 and 35 years exhibited significantly higher trust scores (mean = 3.9) than rural participants (mean = 3.1). This disparity can be attributed to greater familiarity with security tools, better access to digital education, and more consistent exposure to cybersecurity awareness campaigns among urban users. Interestingly, despite relatively high overall trust 65% of respondents identified UPI as the most reliable among digital payment platforms behavioral inconsistencies were noted. A substantial **51% of fraud victims abstained from reporting incidents**, primarily due to limited awareness of grievance mechanisms and skepticism regarding institutional responsiveness.

These findings collectively suggest that while technological safeguards substantially foster trust, sustained adoption of digital payments in India depends equally on user education, transparent grievance redressal, and strong cybersecurity governance. A holistic trust-building approach integrating technical, institutional, and behavioural dimensions is thus essential for the long-term resilience of India's digital payment ecosystem.

8. Suggestions

To strengthen digital trust and mitigate cyber risks in India's Unified Payments Interface (UPI) ecosystem, a multi-pronged strategy integrating technological, institutional, and behavioral interventions is essential. Financial institutions should prioritize **AI-driven fraud detection systems** capable of identifying anomalous transaction patterns and preventing fraud in real time. In alignment with the Reserve Bank of India's (RBI) **June 2025 regulatory mandate,** all UPI applications should implement **multi-factor authentication (MFA)** to enhance transaction security and reduce unauthorized access vulnerabilities.

Concurrently, **nationwide cyber awareness campaigns** under the *Digital India* initiative must be launched, focusing particularly on rural and first-time digital users. Simplified modules on phishing, OTP/PIN safety, and secure digital behavior can significantly improve user literacy and trust. At the institutional level, the **grievance redressal framework** should be revamped by integrating and streamlining complaint channels operated by the National Payments Corporation of India (NPCI) and the RBI. A unified and user-friendly portal could effectively address the current 51% underreporting rate among fraud victims.

FinTech companies such as PhonePe, Google Pay, and Paytm should adopt **visible security cues,** including trust badges, encryption indicators, and real-time transaction alerts, to reinforce user self-efficacy in digital payment environments. Additionally, **banks and payment providers** should incentivize tokenization adoption such as discounts or reward-based programs and collaborate on **shared fraud intelligence databases.** Evidence from recent deployments suggests such cooperative mechanisms can reduce fraud occurrence by **20–85%**, fostering sustained trust, security, and inclusivity in India's digital financial landscape.

9. Conclusion

Cybersecurity has emerged as the most critical determinant of user trust within India's rapidly evolving online payment ecosystem. Empirical evidence drawn from 200 respondents validates all proposed hypotheses, establishing significant statistical relationships between perceived security, user awareness, and sustained adoption. Despite growing threats—such as the projected **1.1 million UPI fraud cases in FY2025** the study indicates that robust security measures, including end-to-end encryption, tokenization, and multi-factor authentication, can effectively restore user confidence. Importantly, heightened digital literacy further strengthens this trust, with awareness programs shown to foster resilient usage behavior even amid risk exposure.

This research contributes meaningfully to the limited body of literature on fintech trust in emerging economies by quantitatively demonstrating the centrality of cybersecurity in financial inclusion. The findings emphasize the need for integrated **technology-policy frameworks**, aligning regulatory oversight with technological innovation to enhance user protection. If scaled nationally, improved encryption, awareness campaigns, and fraud detection mechanisms could potentially **reduce annual financial losses of ₹2,145 crore** while sustaining nearly **83% of digital transaction volumes.** Future research should employ longitudinal designs across varied demographics to explore behavioral causality over time and evaluate the long-term impacts of cybersecurity evolution und*er India's Digital India* vision.

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FROM HIRING TO RETENTION: TALENT MANAGEMENT STRATEGIES IN THE HEALTH AND WELLNESS SECTOR

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Abstract
The rapid growth of the health and wellness sector, driven by increasing demand for quality healthcare and holistic well-being services, has made attracting and retaining skilled talent a critical factor for long-term organizational success. Operating in a highly competitive labour market, organizations must understand how employees perceive their recruitment and retention practices. This study examines the strategies adopted by organizations in the health and wellness sector and analyzes their impact on employee commitment and long-term association. A descriptive, quantitative research design was employed, using primary data collected through a structured questionnaire administered to employees across various segments of the sector. The questionnaire captured perceptions related to recruitment methods, onboarding, training and development, compensation and benefits, work–life balance initiatives, organizational culture and career growth opportunities. The findings indicate a clear shift from traditional hiring practices towards enhanced employer branding, employee well-being initiatives, flexible work arrangements and continuous learning opportunities. Employee retention is strongly influenced by supportive leadership, fair and competitive compensation, opportunities for career advancement and a positive work environment aligned with employee values. Organizations implementing integrated, employee-centric talent management strategies experience higher levels of job satisfaction, stronger employee engagement and reduced turnover intentions. Overall, the study underscores the importance of effective talent acquisition and retention strategies in ensuring workforce stability and improving organizational performance within the health and wellness sector.

Keywords: Talent Acquisition, Talent Retention, Employee Engagement, Human Resource Strategies.

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Introduction

Employees play a vital role in the success and sustainability of organizations, particularly in service-driven industries such as the health and wellness sector. This sector relies heavily on skilled, motivated and compassionate professionals who directly influence service quality, client satisfaction and overall organizational performance. As the demand for health and wellness services continues to grow, organizations face increasing pressure to attract qualified talent and retain experienced employees in a highly competitive labour market.

Traditionally, talent acquisition in the health and wellness sector focused primarily on filling vacancies quickly, often with limited emphasis on long-term workforce planning or employee development. Retention strategies were frequently reactive, addressing turnover only after it

occurred rather than preventing it through engagement, career growth and supportive work environments. These approaches have proven insufficient, as high employee turnover leads to increased recruitment costs, disruption in service delivery and reduced organizational effectiveness. Moreover, factors such as workload stress, limited career advancement and lack of recognition further contribute to retention challenges within the sector.

The purpose of this study is to examine talent acquisition and retention strategies in the health and wellness sector and to understand how organizations are adapting their human resource practices to meet modern workforce expectations. By collecting and analysing primary data from employees and employers within the sector, this research aims to identify current recruitment methods, retention practices and the factors that influence employee satisfaction and commitment. The study also explores how organizational size, work culture and professional development opportunities impact the ability to attract and retain talent. Ultimately, this research seeks to provide insights that can help health and wellness organizations build a stable, engaged and high-performing workforce.

Review of Literature

Armstrong and Taylor (2016) examine talent acquisition as a strategic human resource function rather than a transactional hiring activity. Their study emphasizes the importance of employer branding, workforce planning and competency-based recruitment in attracting skilled professionals. In the context of the health and wellness sector, the authors highlight that aligning recruitment strategies with organizational values and service quality expectations plays a crucial role in attracting candidates who are both technically competent and culturally aligned.

Buchan, Duffield and Jordan (2017) focus on retention challenges in the healthcare sector, identifying workload pressure, burnout, limited career progression and inadequate managerial support as key contributors to employee turnover. The study emphasizes that retention strategies such as continuous training, supportive leadership, flexible work arrangements and employee well-being initiatives significantly improve job satisfaction and long-term commitment among health professionals.

Kaur and Malhotra (2019) explore the relationship between talent management practices and employee retention across service-oriented industries, including health and wellness organizations. Their findings indicate that organizations investing in structured onboarding, performance feedback and professional development experience lower attrition rates. The study highlights that retention is not solely dependent on compensation but also on opportunities for growth, recognition and meaningful work.

Sharma and Verma (2022) analyse contemporary talent acquisition and retention practices within the healthcare and wellness industry, with a focus on post-pandemic workforce challenges. Their study highlights the growing importance of digital recruitment platforms, employee engagement initiatives and mental health support programs. The authors conclude that organizations adopting holistic and employee-centric HR strategies are better positioned to attract qualified talent and reduce turnover in the health and wellness sector.

Objectives of the Study

- To examine the talent acquisition practices adopted by organizations in the health and wellness sector to attract qualified and skilled professionals.
- To analyse the retention strategies implemented by health and wellness organizations to reduce employee turnover and improve long-term workforce stability.

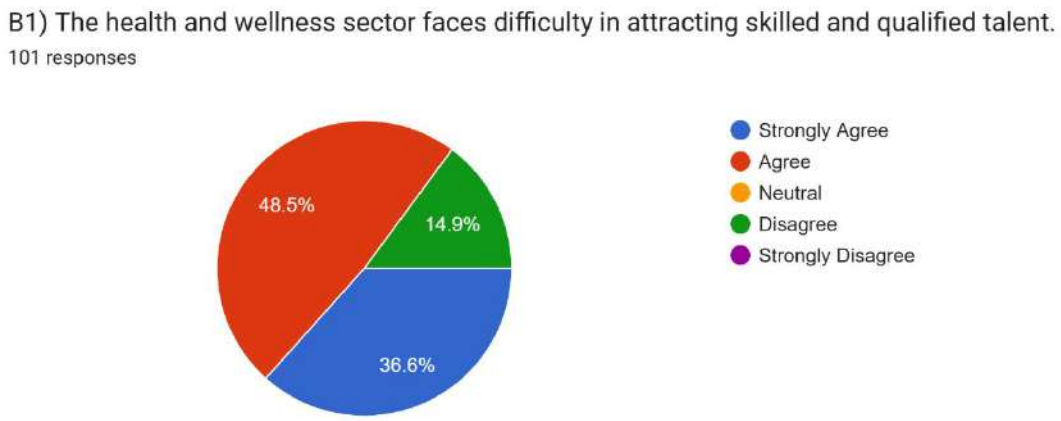
- To identify the key factors influencing employee satisfaction and retention in the health and wellness sector, including work environment, career development and organizational support.
- To evaluate the effectiveness of current talent management strategies in enhancing employee engagement, performance and organizational commitment within the health and wellness sector.

Research Methodology

The research used a descriptive, quantitative design to understand current talent acquisition and retention practices in the health and wellness sector. The study consists of primary data, collected via an online questionnaire shared with employers and employees working in whey protein and nutrition companies. The study focused on recruitment challenges, employer branding, use of digital hiring platforms, employee referrals, skill-based hiring, compensation and benefits, work-life balance initiatives, training and career development and the overall effectiveness of retention strategies. A purposive sampling method was used, which ensured that participants had relevant experience with recruitment and retention processes within the health and wellness industry. The sample size was 100 and responses were obtained from organizations operating in the whey protein and nutrition segment. The sample provided meaningful insights into prevailing talent acquisition and retention strategies and their perceived effectiveness within the health and wellness sector.

Findings & Interpretation

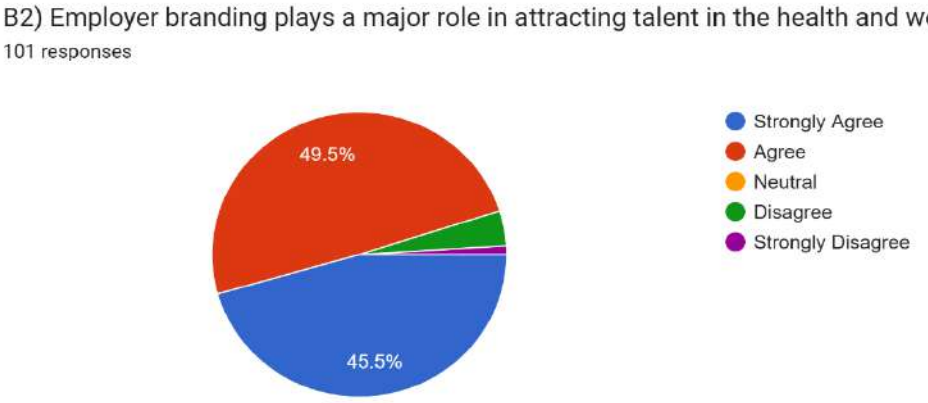
The analysis of data collected from 100 employers and employees working in whey protein and nutrition companies within the health and wellness sector is presented below. The respondents had direct experience with talent acquisition and retention practices in their organizations. The questionnaire included closed-ended questions based on a Likert scale for quantitative analysis. The responses obtained are presented through charts and graphical representations, showing the data in percentage form, which helps in clearly interpreting trends related to recruitment strategies, retention initiatives and their perceived effectiveness in the health and wellness sector.



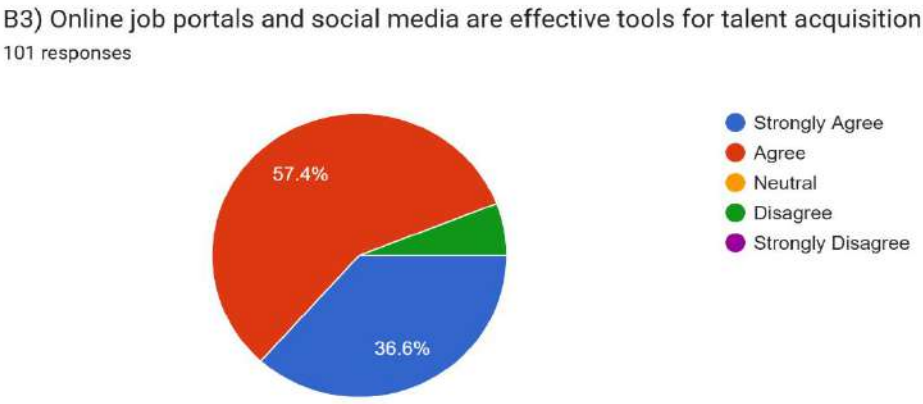
Interpretation:

The pie chart illustrates respondents' views on whether the health and wellness sector faces difficulties in attracting skilled and qualified talent. The results indicate that a substantial majority of the 101 respondents agree with this statement. Specifically, 36.6% strongly agreed and 48.5% agreed, showing that 85.1% of participants perceive talent acquisition as a major challenge within the sector. In contrast, 14.9% of respondents disagreed with the statement. Overall, the findings

reveal a strong consensus that attracting skilled and qualified talent remains a critical issue in the health and wellness industry.

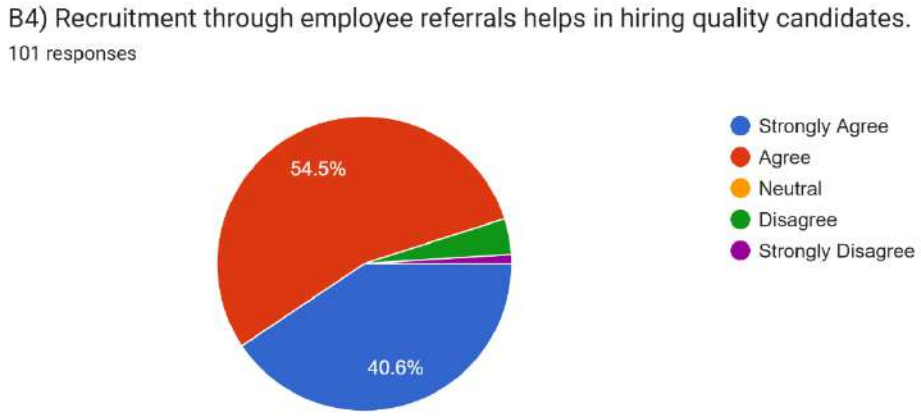


Interpretation:
The pie chart illustrates respondents' perceptions of whether employer branding plays a major role in attracting talent in the health and wellness industry. The results indicate a strong consensus among respondents regarding the importance of employer branding in talent acquisition. Specifically, 45.5% of respondents strongly agreed and 49.5% agreed with the statement, demonstrating that an overwhelming majority recognize employer branding as a key factor in attracting talent. However, a small proportion of respondents expressed dissent, with 5% disagreeing and 1% strongly disagreeing with the statement. Overall, the findings suggest that employer branding is widely viewed as a critical strategic tool for attracting and retaining skilled and qualified professionals in the competitive health and wellness sector.

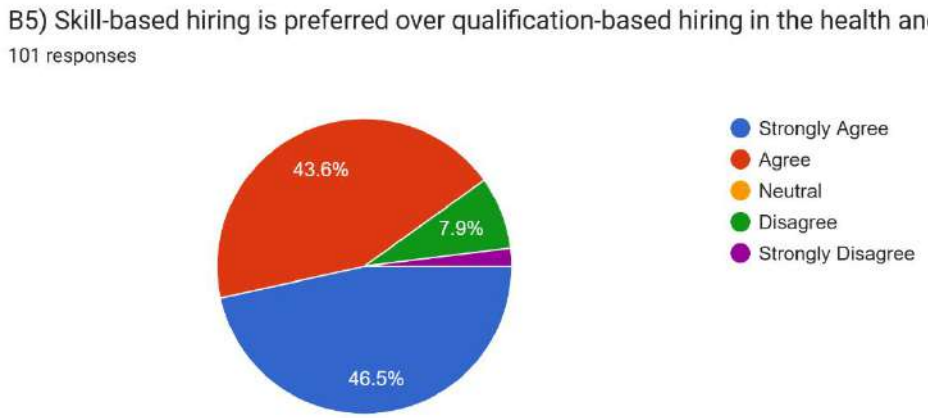


Interpretation:
The pie chart illustrates respondents' perceptions of whether online job portals and social media are effective tools for talent acquisition in the health and wellness sector. The results indicate a strong consensus among respondents in favour of digital recruitment methods. Specifically, 36.6% of respondents strongly agreed and 57.4% agreed with the statement, indicating that a substantial majority perceive online platforms as effective for attracting talent. However, 7% of respondents

disagreed with the statement. Overall, the findings suggest that online job portals and social media play a crucial and increasingly important role in talent acquisition strategies within the health and wellness industry.

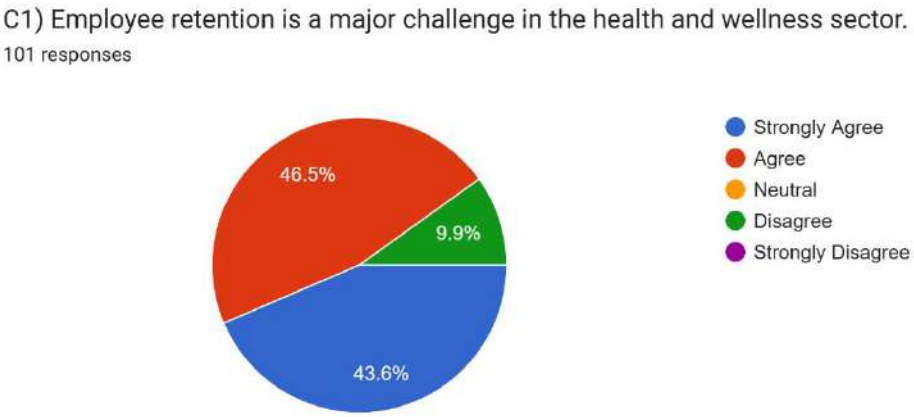


Interpretation:
The pie chart illustrates respondents' perceptions of whether online job portals and social media are effective tools for talent acquisition in the health and wellness sector. The results indicate a strong consensus among respondents in favour of digital recruitment methods. Specifically, 40.6% of respondents strongly agreed and 54.5% agreed with the statement, indicating that a substantial majority perceive online platforms as effective for attracting talent. However, a small proportion of respondents expressed disagreement, with 4% disagreeing and 1.9% strongly disagreeing with the statement. Overall, the findings suggest that online job portals and social media play a crucial and increasingly important role in talent acquisition strategies within the health and wellness industry.

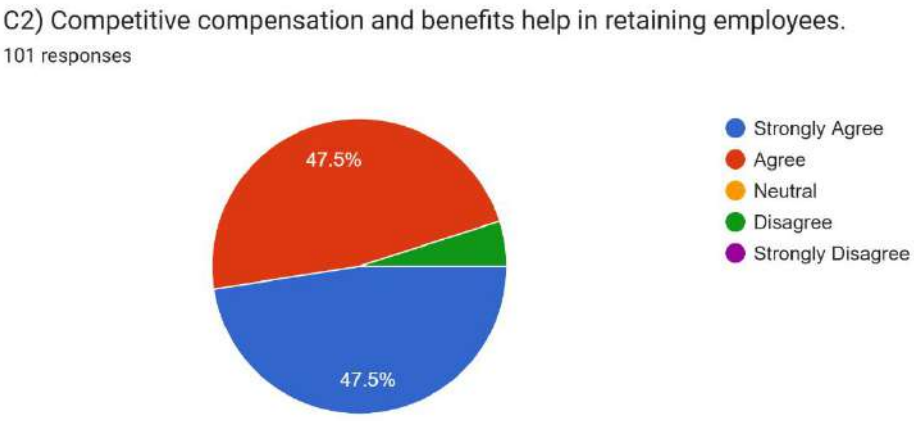


Interpretation:
The pie chart illustrates respondents' perceptions of whether recruitment through employee referrals helps in hiring quality candidates. The results indicate a strong consensus among respondents regarding the effectiveness of employee referral programs in the recruitment process.

Specifically, 46.5% of respondents strongly agreed and 43.6% agreed with the statement, demonstrating that a substantial majority recognize employee referrals as an effective source for attracting high-quality and suitable candidates. However, a smaller proportion of respondents expressed disagreement, with 7.9% disagreeing and 3% strongly disagreeing with the statement. Overall, the findings suggest that employee referrals are widely valued as a reliable and effective recruitment channel within organizations.

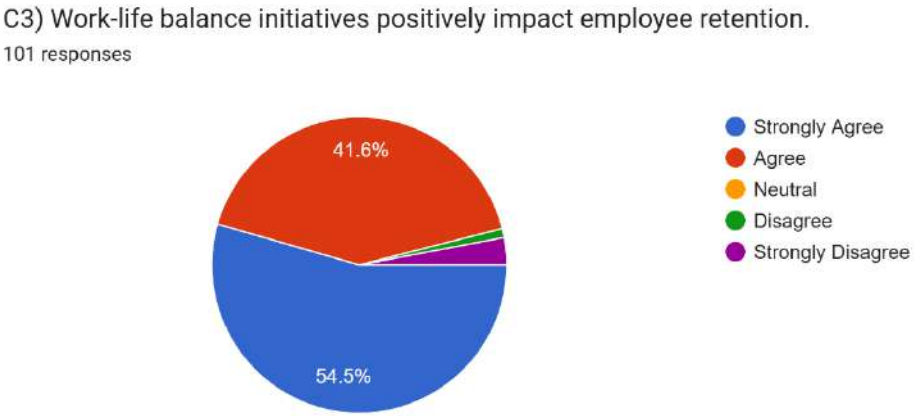


Interpretation:
The pie chart illustrates respondents' perceptions of whether employee retention is a major challenge in the health and wellness sector. The results indicate a strong consensus among respondents regarding the difficulties associated with retaining employees. Specifically, 43.6% of respondents strongly agreed and 46.5% agreed with the statement, demonstrating that an overwhelming majority recognize employee retention as a key challenge in the industry. However, 10% of respondents disagreed with the statement. Overall, the findings suggest that employee retention is widely viewed as a significant concern within organizations in the health and wellness sector.



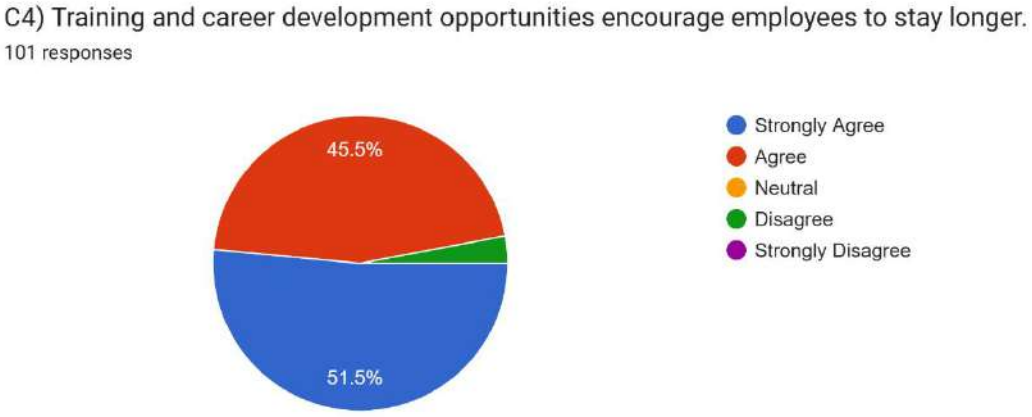
Interpretation:
The pie chart illustrates respondents' perceptions of whether competitive compensation and benefits play a significant role in retaining employees in the health and wellness sector. The results

indicate a strong consensus among respondents regarding the importance of fair and competitive pay structures for employee retention. Specifically, 47.5% of respondents strongly agreed and 47.5% agreed with the statement, demonstrating that an overwhelming majority view compensation and benefits as key factors in motivating and retaining employees. However, 6% of respondents disagreed with the statement. Overall, the findings suggest that competitive compensation and benefits are widely recognized as critical tools for enhancing employee retention within organizations in the health and wellness sector.

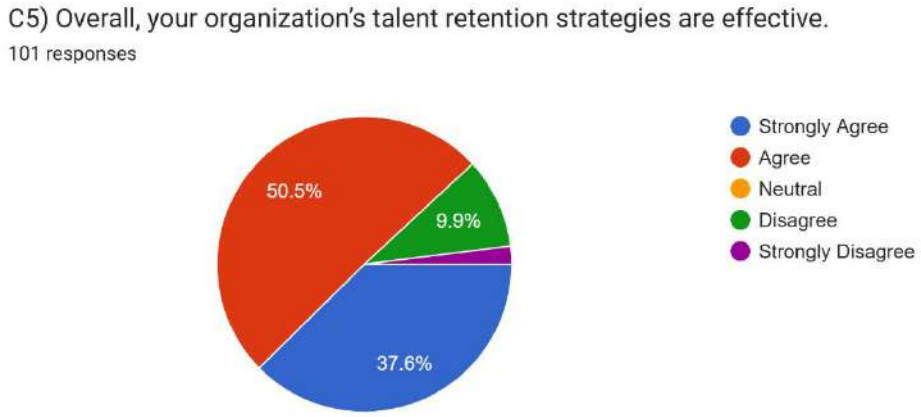


Interpretation:

The pie chart illustrates respondents' perceptions of whether work-life balance initiatives positively influence employee retention in the health and wellness sector. The results indicate a strong consensus among respondents regarding the importance of supportive work-life balance practices for retaining employees. Specifically, 54.5% of respondents strongly agreed and 41.6% agreed with the statement, demonstrating that an overwhelming majority view work-life balance initiatives as crucial in encouraging long-term commitment to the organization. A small proportion of respondents expressed disagreement, with 1.9% disagreeing and 3% strongly disagreeing. Overall, the findings suggest that work-life balance practices are widely recognized as effective strategies for enhancing employee satisfaction and reducing turnover within organizations in the health and wellness sector.



Interpretation:
The pie chart illustrates respondents' perceptions of whether training and career development opportunities encourage employees to stay longer with the organization in the health and wellness sector. The results indicate a strong consensus among respondents regarding the importance of continuous learning and career advancement initiatives for employee retention. Specifically, 51.5% of respondents strongly agreed and 45.5% agreed with the statement, demonstrating that an overwhelming majority view training and development opportunities as key factors in enhancing job satisfaction and long-term commitment. A small proportion of respondents, 4%, disagreed with the statement. Overall, the findings suggest that employee development initiatives are widely recognized as effective strategies for promoting retention and loyalty within organizations in the health and wellness sector.



Interpretation:
The pie chart illustrates respondents' perceptions of whether their organization's talent retention strategies are effective in the health and wellness sector. The results indicate a generally positive evaluation among respondents regarding the organization's retention efforts. Specifically, 37.6% of respondents strongly agreed and 50.5% agreed with the statement, demonstrating that a majority view the existing strategies as effective in retaining employees. A smaller proportion of respondents expressed disagreement, with 9.9% disagreeing and 3% strongly disagreeing. Overall, the findings suggest that while the organization's talent retention strategies are largely perceived as effective, there remains scope for improvement to address the concerns of all employees and further enhance retention outcomes.

Recommendations
• Health and wellness organizations should develop structured and transparent talent acquisition processes to attract qualified professionals and ensure fairness in hiring decisions.
• Competitive compensation, benefits and wellness-focused incentives should be regularly reviewed to remain aligned with industry standards and employee expectations.
• Organizations should strengthen work-life balance initiatives such as flexible work schedules, wellness programs and mental health support to reduce employee burnout and turnover.
• Continuous training, upskilling and career development opportunities should be provided to enhance employee growth, engagement and long-term retention.

Limitations

• The study adopted a cross-sectional research design, capturing employee perceptions at a single point in time without considering changes in talent strategies over time.
• The use of a limited sample size may restrict the generalizability of the findings across the entire health and wellness sector.
• Data was collected through self-reported responses, which may be influenced by personal bias or individual perceptions.

Conclusion

This study highlights the growing importance of effective talent acquisition and retention strategies in the health and wellness sector. The findings indicate that competitive compensation, work-life balance initiatives and training and career development opportunities play a vital role in retaining employees. Organizations that prioritize employee well-being and professional growth tend to build stronger commitment and lower turnover rates. While many organizations have adopted employee-focused strategies, there is still scope for improvement, particularly in developing comprehensive and consistent retention practices. Overall, the study concludes that by adopting holistic, employee-centred and sustainable talent management strategies, health and wellness organizations can enhance workforce stability, employee satisfaction and organizational performance.

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ASSESSING THE IMPACT OF DRONE-ENABLED SERVICES ON SUSTAINABLE LIVELIHOODS AND LOCAL ECONOMIC GROWTH IN RURAL INDIA: AN EMPIRICAL MIXED-METHODS STUDY

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Abstract
Drone-enabled services operate across rural India in agriculture, surveying, and local service delivery. Many programs report deployment growth, yet limited field evidence links these services to livelihood stability and local economic change. This study examines relationship between drone-enabled services, household livelihoods, and local economic activity in selected rural regions of India using a mixed-methods design. The study integrates household surveys with interviews involving farmers, drone service operators, and local stakeholders. Quantitative indicators cover income sources, employment participation, service costs, and task completion outcomes before and after service introduction. Qualitative interviews capture experiences related to skill acquisition, service access, work continuity, and local enterprise formation. Statistical analysis examines associations between service use and economic indicators. Thematic analysis organizes interview responses into recurring patterns and constraints. Results show changes in short-term employment participation and service-related income among participating households. Agricultural users report lower operational costs and faster task execution for selected activities. Income outcomes differ across user groups and vary by crop type, service frequency, and operator skill level. Interview responses indicate improved access to specialized services and the technical skills, alongside constraints linked to affordability, training availability, and service reliability. The findings offer empirical insight into how drone-enabled services relate to rural livelihoods and local economic activity. The study supports evidence-based discussion on service design, program planning, and future research on technology-led rural development in India.

Keywords: Drone-Enabled Services; Rural Livelihoods; Local Economic Development; Precision Agriculture; Mixed-Methods Research; Rural India.

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1. Introduction

Rural livelihoods shape economic stability in India. Many rural households depend on agriculture as a primary income source. Farms face low margins, rising input costs, and limited non-farm

work. Tasks such as spraying, monitoring, and surveying require labor, time, and skill. Labor availability has declined in many regions. Capital limits restrict access to mechanized tools and professional services.

Drone-enabled services operate through shared access models. Farmers pay for specific tasks instead of owning equipment. Providers deliver spraying, monitoring, and surveying within short time windows. Expected benefits include lower task cost, faster execution, and new income options for trained operators.

Evidence on livelihood impact remains limited. Most studies report deployment scale or service coverage. Few assess changes in household income, employment, or local economic activity after service entry. This limits understanding of livelihood effects and benefit distribution.

Livelihood outcomes depend on service reliability, skill availability, pricing, and payment timing. These factors vary by farm size, crop type, and social group. Aggregate results often mask this variation.

This study examines links between drone-enabled services, household livelihoods, and local economic activity in selected rural regions of India. It addresses three questions. How service use relates to household income and work participation. Which operational and social factors shape repeat use. How outcomes differ across household types.

The study applies a mixed-methods design. Household surveys track income, employment, and cost changes before and after service entry. Interviews capture experiences with access, skills, and reliability. The analysis provides field-based evidence on livelihood effects linked to drone-enabled services in rural India.

2. Literature Review

Technology Adoption in Rural Development

Rural households rely on multiple income sources to manage risk. Diversified livelihoods show higher resilience than dependence on a single activity. Technology adoption supports diversification when it reduces labor demand, lowers costs, or enables new income activities.

Adoption decisions depend on cost, risk, and expected benefit. Evidence from agricultural mechanization services shows smallholders adopt services when time savings or cost reduction are clear. Adoption weakens when services displace labor without alternative income options. Livelihood context shapes outcomes more than technical capacity alone.

Digital access in rural India has expanded through mobile connectivity. Economic gains depend on training, service reliability, and infrastructure. Access alone does not ensure income improvement.

Service-Based Agricultural Technologies

Service-based models shift access from ownership to task-based use. Farmers pay for operations rather than equipment. Such models support smallholders with limited capital and skills.

Reported effects include cost reduction, labor savings, and time reallocation. Service use may reduce demand for manual labor. Pricing, timing, and operator skill shape repeat use. Unreliable services weaken trust, especially for time-sensitive tasks. Benefits concentrate where services remain affordable and consistent.

Drone Services and Rural Economies

Drone services support monitoring, spraying, and field assessment. Precision application reduces chemical use and shortens task duration. Studies report faster completion and improved input targeting.

In India, drones also support surveying and infrastructure tasks. Public programs promote drones to address labor shortages and improve service delivery. Early reports note income potential for trained operators.

Adoption barriers persist. Equipment cost, training access, weather sensitivity, battery limits, and regulation affect reliability. Infrastructure gaps restrict sustained operation in remote areas. These constraints shape livelihood outcomes.

Existing literature lacks field-level evidence linking drone service use to household income and employment outcomes. This gap supports empirical evaluation using combined quantitative and qualitative methods.

3. Methodology

Research Design

The study used a convergent parallel mixed-methods design. Household surveys and semi-structured interviews were conducted during the same period. Surveys measured income, employment, and cost change. Interviews explained service access, reliability, and skill use. Joint analysis linked outcomes with reported mechanisms.

Study Areas and Sampling

The study covered three rural districts from northern, central, and southern India. Selection criteria included active drone services for at least eighteen months, presence of service providers, crop diversity, and field access.

Villages were selected using stratified sampling based on distance from service base, crop type, and dominant farm size. A stratified random sample of 1,200 households was selected, with 400 households per district, grouped by service use status and social category.

A purposive subsample of 120 households participated in interviews. Additional interviews included thirty service operators, twenty officials, and fifteen community representatives. Total interview participants numbered 195.

Data Collection and Analysis

Surveys recorded demographics, income sources, employment, service use, production costs, and constraints. Data covered twelve months before service entry and twelve months before the survey.

Quantitative analysis used descriptive statistics and regression models with household and village controls. Before and after comparisons and difference-in-differences methods assessed change.

Interview transcripts were coded inductively. Themes were refined through comparison across participants. Analysis focused on common patterns and contrasting cases.

Ethics approval was obtained before fieldwork. All participants provided informed consent. Data were anonymized.

4. Results

Survey Sample Overview

The survey covered 1,200 households across three districts. Women formed 46 percent of respondents. Mean household size measured 5.2 persons. Education levels were low. Thirty eight percent of household heads did not complete primary school. Thirty two percent completed primary or middle school. Thirty percent completed secondary education or higher. Average landholding size was 1.8 hectares. Median landholding measured 1.2 hectares. Marginal farmers formed 42 percent of the sample.

Drone service use was reported by 320 households, or 26.7 percent. Most users accessed services one to three times per year. Precision spraying was the dominant service, followed by crop

monitoring and land surveying. Mean service cost per application measured ₹800. This cost formed six to twelve percent of total production expenses.

Non-users cited four main barriers. Cost was reported by 44 percent. Service unreliability was reported by 28 percent. Limited familiarity accounted for 18 percent. Low perceived benefit accounted for 10 percent.

Employment Outcomes

Employment participation increased over the study period. At baseline, 68.2 percent of households reported income beyond subsistence farming. At endline, this rose to 72.1 percent. Service users showed higher growth than non-users.

Agricultural service employment rose from 2.1 percent to 8.3 percent. Service users were more likely to report service-related work. Twenty eight households reported a trained drone operator within the household.

Off-farm income was higher among service users. Thirty four percent of service users reported off-farm income above one quarter of total income. The comparable figure for non-users measured 18.7 percent.

Income and Cost Effects

Mean annual household income rose among both groups. Service users recorded a rise from ₹1,24,000 to ₹1,48,000. Non-users recorded a rise from ₹1,20,000 to ₹1,31,000. Adjusted analysis showed an additional income gain of about ten percent among service users.

Income structure shifted among service users. The share from agriculture declined. Income from agricultural services increased to over six percent. No comparable shift was observed among non-users.

Income gains differed by farm size. Medium farms recorded the largest gains. Marginal farms recorded smaller gains unless a household member became a service operator.

Production costs declined among service users. Average cost per hectare fell from ₹42,300 to ₹38,400. Chemical input costs showed the largest reduction. Non-users showed limited cost change.

Operational Performance

Most service users reported faster task completion. Spraying time declined from several days to less than one day. Faster completion supported timely pest response.

Yield effects were limited and varied by crop. Cotton and vegetables showed moderate gains. Rice showed little change. Yield data relied on farmer report.

Service reliability improved over time. Delays affected one third of requests in the first year. This fell to about one fifth in the second year. Districts with public service centers showed fewer delays.

Qualitative Findings

Interviews highlighted four recurring themes.

Service access depended on reliability. Farmers valued clear scheduling. Missed visits reduced repeat use. Payment timing limited access for cash-constrained households.

Skill awareness improved through service exposure. Farmers reported better pest recognition. Technical understanding remained limited. Operators stressed field experience beyond formal training.

Income gains influenced household decisions. Savings were used for inputs, education, debt repayment, and housing. Women operators reported greater control over earned income.

Sustained use faced constraints. High cost limited access for marginal farmers. Distance reduced service availability. Weather disrupted operations. Maintenance gaps caused downtime. Limited technical support reduced farmer confidence. Social acceptance varied across communities.

These results show measurable income and cost effects alongside clear limits linked to access, reliability, and context.

5. Discussion

Interpretation of Findings

The results show measurable but uneven economic effects from drone-enabled services. Service users recorded about ten percent higher income growth than non-users over twelve months. Gains came mainly from lower production costs and limited growth in service-related work. This pattern matches evidence from other agricultural technologies in South Asia, where income effects remain modest and scale dependent.

Income effects followed two main paths. Farmers reduced pesticide and chemical costs through precise application. Yield gains stayed small and varied by crop, which shows that services improve input efficiency rather than drive large productivity shifts. Service operators earned additional income, yet this work remained seasonal and concentrated within short crop windows. Operators who offered multiple services reported steadier earnings, which points to the value of service diversification.

Income effects differed by farm size. Larger farms gained more than marginal farms. This reflects scale advantages and raises equity concerns. Without pricing and access support, smallholders risk exclusion from regular service use.

Mechanisms behind Livelihood Change

Interviews clarify how services affected households. Time savings reduced labor demand for spraying and monitoring. Freed labor shifted toward off-farm work or reduced work pressure. Farmers valued time relief more than direct income gain.

Service exposure improved technical awareness. Farmers reported earlier pest recognition and better timing decisions. Knowledge gains extended beyond direct service use. Operator roles expanded income sources for some households, including women and marginal farmers, yet entry barriers limited wider participation and income remained seasonal.

Participation in government programs increased exposure to training, networks, and credit information. Some households adopted other programs after initial service contact.

Relation to Existing Research

Income gains align with prior studies reporting eight to fifteen percent effects from service-based mechanization. This study shows stronger variation across household types than many earlier reports, which often emphasize averages.

Yield effects were lower than promotional claims. Field conditions reduced expected gains, which reflects common gaps between demonstrations and routine use. Operational limits linked to weather, maintenance, and seasonal demand shape service viability and remain underexplored in policy discussions.

Women formed a large share of operators in the sample. Interviews showed income control benefits alongside social and operational barriers. Gender dynamics remain central to service outcomes.

Local Economic Effects

Evidence for broader local economic growth remained limited. Service employment expanded in villages with service centers, yet scale stayed small relative to total agricultural work. Related markets such as repair and supply services remained early stage. Some local initiatives emerged, including repair activity and shared spare part purchasing, which suggests future potential if service networks expand.

Study Limits

Several limits apply. The twelve month window captures early effects rather than long-term outcomes. Service users differ from non-users in ways not fully controlled. Yield data rely on farmer reports. Results reflect three districts and may not transfer to all regions. Broader price and weather trends influenced incomes. Service quality differences were not measured.

Implications of Service Design

Results point to clear directions. Support for marginal farmers requires payment flexibility and local service centers. Dense operator networks improve reliability. Training requires field mentoring and maintenance access beyond initial certification. Credit linkage helps address cash timing limits. Operator income stability depends on service range beyond agriculture. Women operators benefit from support that addresses mobility, repair access, and social acceptance.

6. Conclusion

This study shows that drone-enabled services in rural India produce measurable but uneven livelihood effects. Service users recorded about ten percent higher income growth over twelve months. Gains came mainly from lower input costs and limited growth in service-related work. Larger farms captured greater benefits than marginal farms.

The findings add evidence on household-level outcomes rather than program rollout counts. The mixed-methods approach linked income changes with field realities reported by users and operators. Results show that service reliability, pricing, access, and social context shape outcomes. Average effects hide strong variation across households.

Drone services improved input efficiency rather than driving large productivity gains. Cost reduction and service-based employment explain most benefits. Structural limits of small-scale farming remain in place, including land size, capital access, and market risk.

Early signs of local enterprise growth appeared through service centers and operator activity. Scale remains limited. Broader local economic effects depend on network expansion, stable service delivery, and linkages with value chains.

Women played a significant role as service operators and gained income control where social support existed. Marginal farmers saw smaller gains and faced access barriers. Future deployment requires attention to affordability, local access, and inclusion to avoid uneven benefit distribution.

7. Future Research Directions

This study tracked outcomes over twelve months. Longer observation periods of three to five years would clarify income stability, repeat service use, and shifts in social acceptance. Comparative analysis across regions with different service models such as public centers, private operators, and cooperative setups would strengthen evidence on livelihood outcomes and local economic effects.

Gender-related impacts require deeper study. Future work should examine changes in women's work burden, income control, and household decision roles linked to service use. Research should also assess how social norms shape participation as operators and users, and how these factors affect income stability over time.

Further research should examine links between drone services and agricultural value chains. Areas of focus include buyer requirements, contract participation, and integration with input supply and equipment leasing systems. Such work would clarify whether service use supports value addition within local markets.

Technological adaptation also warrants attention. Future studies should assess performance under rain-prone conditions, interaction with field sensors and weather systems, labor demand under

partial automation, and digital systems for booking and payment. These areas shape service reliability and long-term use in rural settings.

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FROM CLICKS TO CONVERSIONS: SOCIAL MEDIA'S IMPACT ON CONSUMER BUYING DECISIONS

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Abstract
Social media has emerged as a powerful force in shaping consumer buying behaviour, particularly for small businesses that increasingly rely on digital platforms to enhance visibility, engagement, and sales. What initially began as a medium for social interaction has evolved into a dynamic marketplace where consumers discover products, evaluate alternatives, read reviews, and ultimately make purchase decisions. This study examines the role of social media in influencing the consumer journey from initial online engagement such as clicks, likes, and views to actual purchase conversions, with a specific focus on small businesses. Research explores how social media engagement, online advertising, user-generated content, influencer activity, and peer recommendations contribute to consumer trust and purchase intent. Unlike traditional marketing, social media enables two-way communication between businesses and consumers, fostering real-time interaction, feedback, and relationship-building. These elements play a critical role in shaping consumer perceptions, enhancing brand credibility, and influencing decision-making processes. The study highlights the importance of trust and social proof in converting digital engagement into tangible sales outcomes. Primary data was collected through a structured questionnaire administered to active social media users across platforms such as Instagram, Facebook, and Twitter. A descriptive research design was adopted, and data were analysed using graphical representations and one-sample t-test to identify patterns and trends in consumer behaviour and purchasing tendencies. The study finds that social media, particularly Instagram, strongly influences product discovery, with online reviews and personal recommendations driving consumer confidence. It concludes that social media is not just a promotional tool but a strategic channel enabling small businesses to convert online interactions into sales and build lasting customer relationships.

Keywords: Social Media Marketing, Consumer Decision-Making, Small Business Growth, Digital Marketing Strategies, User-Generated Content, Social Media Influence.

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1. Introduction:

The rapid growth of digital technology has transformed the way businesses interact with consumers. Social media platforms have moved beyond their original purpose of social networking to become influential marketing tools that shape consumer awareness, preferences, and purchasing decisions. For small businesses, social media provides an affordable and effective way to reach customers, promote products, and compete with larger brands.

Unlike traditional advertising methods, social media enables two-way communication between businesses and consumers. Consumers are no longer passive recipients of information; instead,

they actively engage with brands through likes, comments, shares, and reviews. Factors such as influencer collaborations, online reviews, personalized advertisements, and peer recommendations play a significant role in influencing purchase decisions.

Social commerce has further strengthened this transformation. Platforms like Instagram and Facebook integrate shopping features that allow consumers to explore and purchase products without leaving the app. As a result, the consumer journey now begins with a scroll rather than a storefront visit.

Customer engagement lies at the centre of this process. Small businesses that actively interact with consumers, address queries, and respond to feedback are more likely to build trust and loyalty. However, managing online reputation, handling negative reviews, and maintaining authenticity remain major challenges.

This study aims to explore how social media influences consumer decision-making and how small businesses can convert online followers into paying customers through effective digital strategies.

2. Review of Literature:

1) Effectiveness of Advertising on Social Media - Factor Analysis

Recent advertising research highlights a clear shift from traditional media such as television and print advertisements toward digital platforms and social media. The study by N. N. Jose and Dr. S. Mahalingam explores this transition in depth, addressing the debate over whether classical models of advertising evaluation remain sufficient. While traditional measures—such as attitude toward the advertisement, brand perception, reach, exposure, and purchase intention—have long been used to assess effectiveness, the authors argue that social media advertising demands updated evaluation frameworks. Online advertisements are inherently interactive, allowing consumers to like, comment, share, and even purchase directly, which fundamentally changes how advertising impact should be measured.

The study further explains that the success or failure of social media advertisements depends on consumer receptiveness, optimal frequency of exposure, and the level of engagement generated. Metrics such as likes, comments, and shares are closely linked to real-world outcomes, including purchase behaviour. Jose and Mahalingam emphasize that existing measurement tools are increasingly inadequate for capturing these dynamics, highlighting the need for more precise and adaptive evaluation methods tailored to platforms like Facebook and TikTok.

2) Exploring the Role of Social Media in Shaping Consumer Buying Behaviour: A Factor Analysis Approach:

Chand Prakash, from SGT University, along with Dr. Sunil Kumar, Amit Dangi, and Kanchan Yadav, examines the impact that social media has created in consumer shopping behaviour. Social media sites like Facebook, Instagram, and YouTube, which started as places for casual browsing, have turned out to be very effective platforms for impacting consumer purchasing behaviour, with buyers searching and deciding on products. This reading further emphasizes the dependency that buyers place on reviews and experiences shared by others, thereby establishing the efficacy of social influence on consumer behaviour and shopping.

The scholars also explain the increasing effectiveness of influencer marketing compared to traditional marketing approaches. When brands reach out to their consumers through interactive marketing approaches like live events, polling, and conversations, they can achieve higher levels of success in creating trusting and loyal relationships with them. By applying factor analysis, the research work has pointed out the factors like brand image, price sensitivity, and social influence that play a major role in achieving success through such marketing approaches of social media

marketing, though it also demands more research studies to uncover deeper insights regarding demographic differences.

3) The Role of Social Media in Shaping Consumer Behaviour and Preference:

Rokesh Nagendrakumar and Dr. D. Mythili highlight on how social media giants like Facebook, Instagram, and Twitter-or X, as it is now-known, actually control consumer behaviour and choices. It is no secret that past studies have pointed influencer shout outs, user-generated posts, buddy recommendations, and all that social proof vibe as the major drivers in how we perceive brands. But it's not just logic; emotional gut reactions, sneaky cognitive biases, and those mental shortcuts we all take play huge roles in what catches our eye and sways our picks online.

Social media nails it at building buzz around brands, ramping up engagement, and earning trust, even if it doesn't always lead straight to the cash register. Younger crowds, such as millennials and Gen Z, seem way more hooked than older folks, which makes sense if you think about their screen time. Wrapping it up, the authors say it's a killer tool for marketers-but only if you play it straight with ethics, pick the right strategies, and tune everything to your audience-no one-size-fits-all here.

4) Impact of Social Media on Consumer Behaviour

The research by Sachin Gupta and Chahat Chopra studies the influence of social media on the shopping habits of consumers in a detailed manner with a quantitative research method where it uses a survey to figure out its findings with concrete evidence based on data. The research outlines the entire shopping journey of a consumer, right from the time they scroll through Instagram out of curiosity, until they convert curiosity into a purchase through digital content online.

One of the important takeaways from this research is the massive power wielded by "consumer-generated content" over conventional advertisements. The persuasive element in the short-form content type "unboxing, review, or social media opinions" often proves stronger than an advertising commercial. The authors highlight the fact that the storytelling for brands is no longer in the hands of marketers but with consumers, and "genuine" reviews and opinions can instantly build or break the image of the brand and thus exercise huge power in marketing as "consumer-generated content."

3. Social media in a Gist: Overview of Social Media Marketing for Small Businesses:

Social media marketing has become an important strategy tool for small businesses, helping to market services & products at affordable, targeted, as well as interactive manner. Unlike any other form of marketing, these platforms help them directly interact with their customers via content sharing, advertisements, as well as communication. Social media platforms have increasingly gained popularity among the Indian population, with young people being largest group of users. Additionally, these platforms are not just for entertainment but also to interact socially.

Small businesses use different social media platforms, depending on their marketing goals and the preferences of the audience they target. Instagram has grown to become the most used medium for product research because of its strong visual power, interactive reels, stories, and influencer collaborations that increase brand presence and engagement. Facebook allows business pages, targeted advertisements, and community interaction. Twitter allows for direct communication with the brand and customer feedback. WhatsApp is increasingly being used for personalized customer interaction, order management, and building a relationship. One key strength of such marketing lies in digital engagement and user-generated content, from customer reviews and testimonials to peer recommendations. This type of word-of-mouth content is considered more trustworthy than the messages put forward by traditional advertising. Social media gives small businesses ability to

build authenticity and strengthen relationships with an audience through consistent engagement and a credible online presence, more effectively encouraging audience engagement to sales.

4. Research Methodology:

4.1 Objectives-

- To examine if buying behaviour is affected by social media.
- To assess the role of user-generated content (reviews, recommendations) in shaping consumer trust and purchase intent.

Hypothesis

H0: Social media has no significant impact on consumer buying behaviour.
H1: Social media has a significant impact on consumer buying behaviour.

4.2 Research Design-

A descriptive and analytical research design was used, which involved charts and percentages for analysis, along with a One-Sample t-test to derive meaningful conclusions.

4.3 Sampling Technique-

Convenience sampling was used to collect data from respondents who actively use social media platforms.

4.4 Sample Size-

The study collected data from 121 respondents, mostly aged between 18 and 30 years. This sample size was sufficient to analyse key trends, conduct t-tests and assess the impact of social media advertising on consumer purchase decisions.

4.5 Tools for Data Analysis-

Descriptive methods: Percentages, pie charts, bar charts, frequency distributions.
Inferential method: A one-sample t-test was conducted to determine whether the proportion of respondents who purchased a product or service after seeing social media advertisements differs significantly from a neutral benchmark.
The results of the t-test ($t = 4.39$, $p = 0.000025$) indicated a significant influence of social media advertising on consumers purchase decisions.

5. Data Analysis and Interpretation:

The data were analysed and interpreted using bar charts and diagrams for a clearer presentation of the findings.

1. What is the respondent's age?

Table 5. 1

Age Group (Years)	Percentage (%)	No. of Respondents
Below 18	4.1	5
18-30	91.7	111
31-43	4.1	5
44 and above	0	0

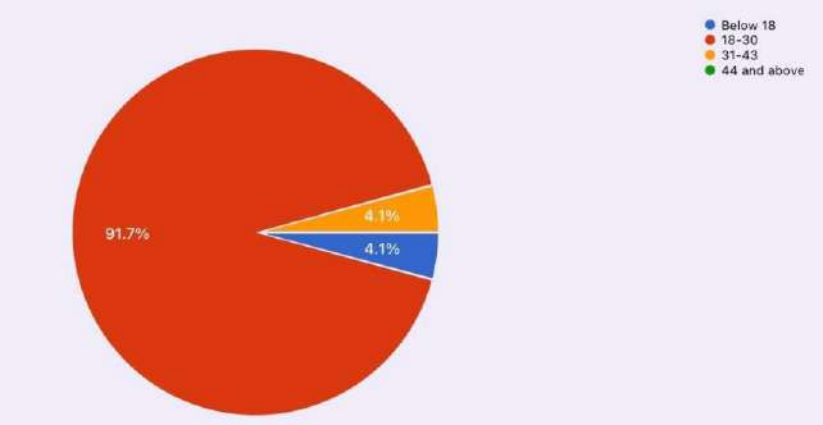

Fig 5. 1

Data Interpretation: The response shows that 91.7% of respondents are aged 18–30, making them the most active on social media.

2. How often is social media platforms (Eg. Facebook and Instagram) used to discover new products and services?

Table 5. 2

Response	Percentage (%)	No. of Respondents
Never	3.3	4
Rarely	20.7	25
Occasionally	35.5	43
Frequently	40.5	49

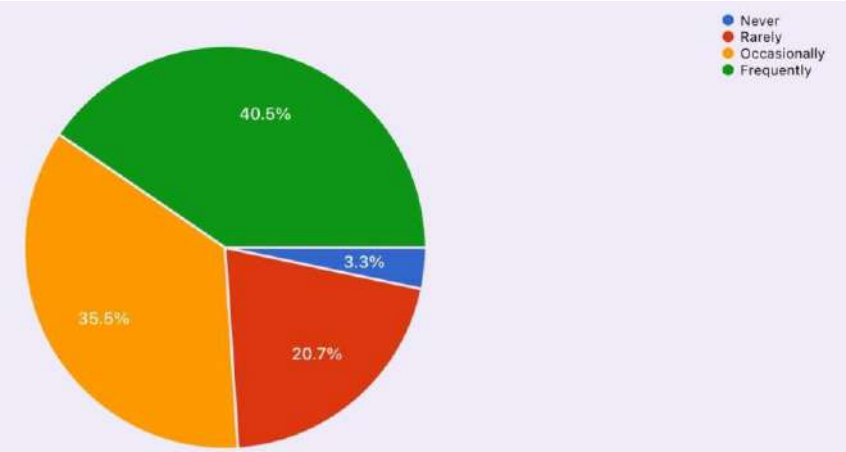

Fig 5. 2

Data Interpretation: The chart shows that 40.5% of respondents use social media frequently which indicates that these platforms play a significant role in influencing product awareness and discovery among consumers.

3. Which social media platforms are used most frequently for product research?

Table 5. 3

Response	Percentage (%)	No. of Respondents
Instagram	93.9	114
Facebook	4.3	5
Twitter	1.7	2
Tiktok	0	0

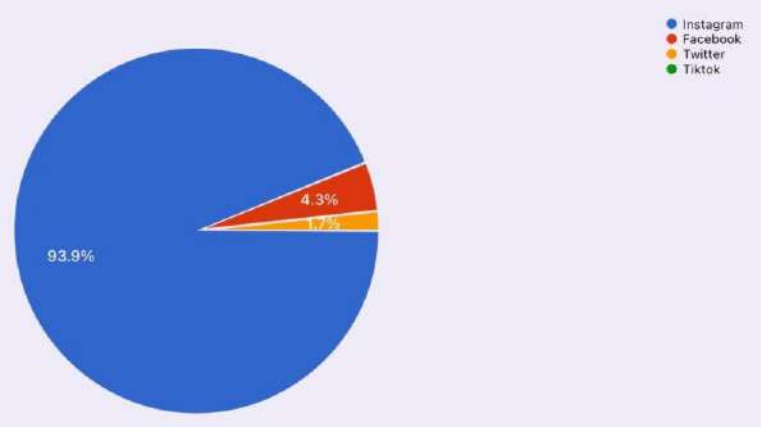

Fig 5. 3

Data Interpretation: This shows Instagram dominates as the primary platform for product research, with 93.9% of respondents relying on it, which highlights the need for businesses, to prioritize it as a key channel for marketing and product promotion.

4. Has the respondent ever purchased a product/service after seeing it advertised on social media?

Table 5. 4

Response	Percentage (%)	No. of Respondents
Yes	68.6	83
No	31.4	38

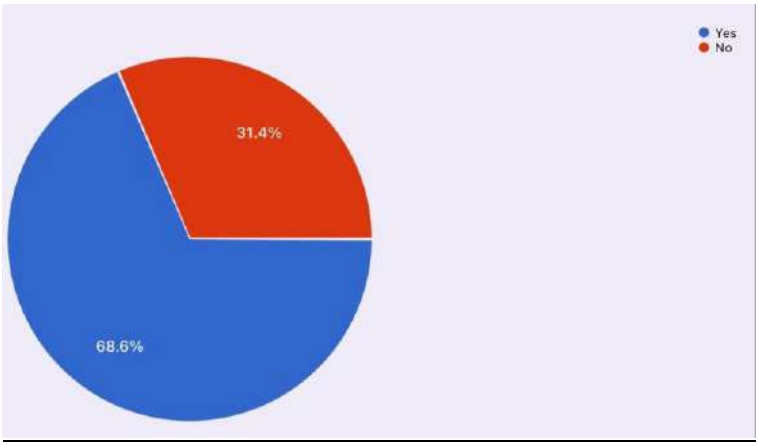

Fig 5. 4

Data Interpretation: The results show that 68.6% of respondents have made a purchase after seeing a social media advertisement, this proves effective social media advertising can significantly drive sales, especially for small businesses.

5. How important are online reviews from other customers when making a purchase decisions?

Table 5. 5

Response	Percentage (%)	No. of Respondents
Not important at all	5.8	7
Somewhat important	30	36
Neutral	27.5	33
Very important	36.7	45

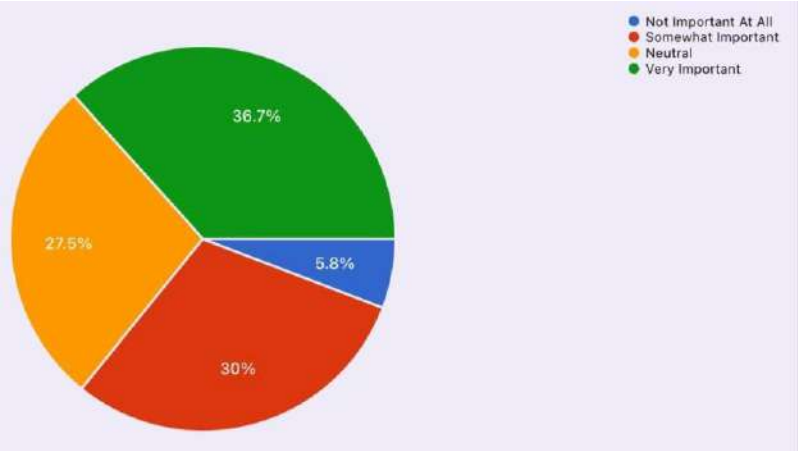

Fig 5. 5

Data Interpretation- This highlights the need for small businesses to actively manage and encourage positive customer reviews to influence buyers as majority of respondents consider online reviews important when making purchase decisions

6. How often does respondent read online reviews while making a purchase?

Table 5. 6

Response	Percentage (%)	No. of Respondents
Never	2.5	3
Rarely	19	23
Occasionally	38	46
Frequently	40.5	49

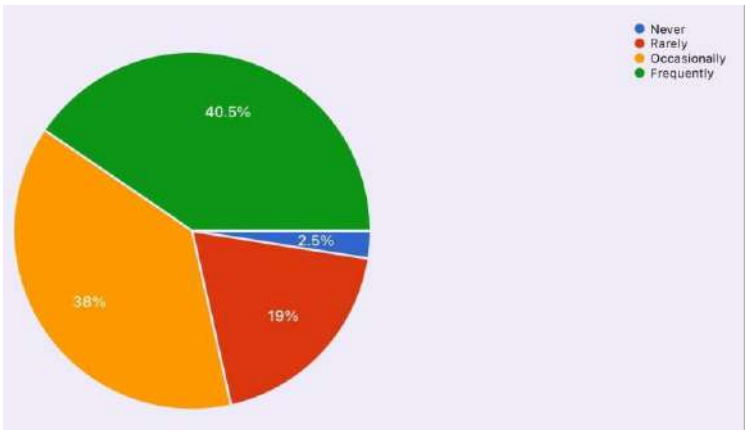

Fig 5. 6

Data Interpretation: The findings show that most consumers regularly read online reviews before purchasing, with 40.5% doing so frequently.

7. How trustworthy does respondent find online reviews from other customers?

Table 5.7

Response	Percentage (%)	No. of Respondents
Not trustworthy	5	5
Trustworthy to some extent	52.9	53
Neutral	33.1	33
Very trustworthy	9.1	9

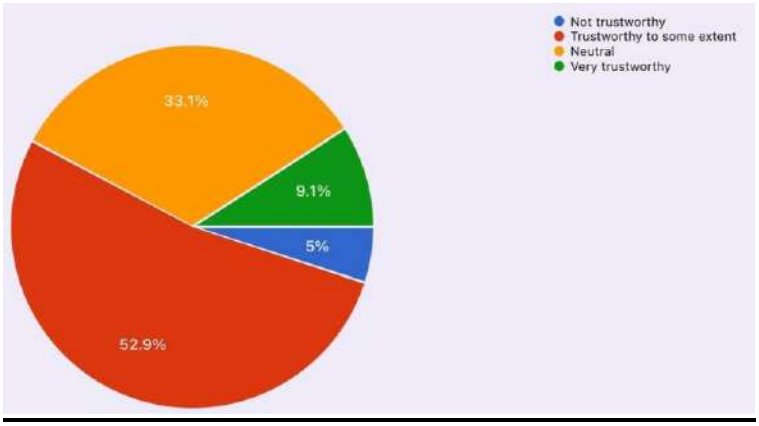

Fig 5.7

Data Interpretation: This suggests that small businesses can enhance consumer trust by showcasing authentic feedback on social media as most 52.9% respondents view online reviews as somewhat trustworthy, while only 9.1% consider them very trustworthy and 5% not trustworthy

8. Has the respondent ever purchased a product/service based on a recommendation from a friend or family member on social media?

Table 5.8

Response	Percentage (%)	No. of Respondents
Yes	77.3	77
No	22.7	23

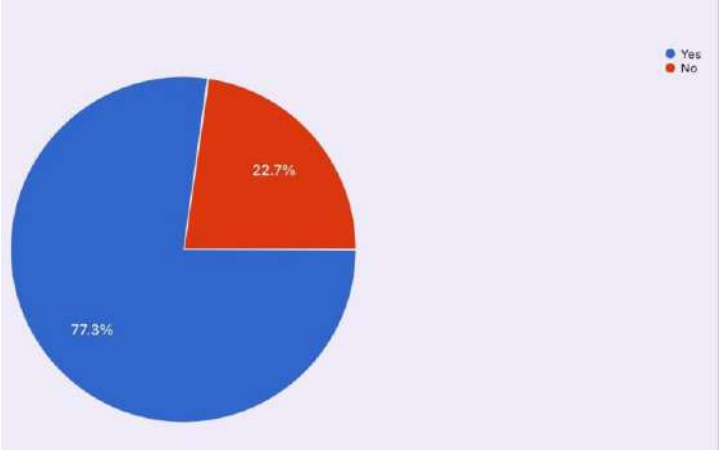

Fig 5.8

Data Interpretation: This highlights the strong influence of personal connections, suggesting that small businesses can boost trust and visibility by encouraging satisfied customers to share their experiences online.

9. How likely are respondents to purchase a product/service after seeing a positive or recommendation on social media?

Table 5.9

Response	Percentage (%)	No. of Respondents
Not likely	9.2%	9
Somewhat likely	46.2%	46
Neutral	31.9%	32
Very likely	12.6%	13

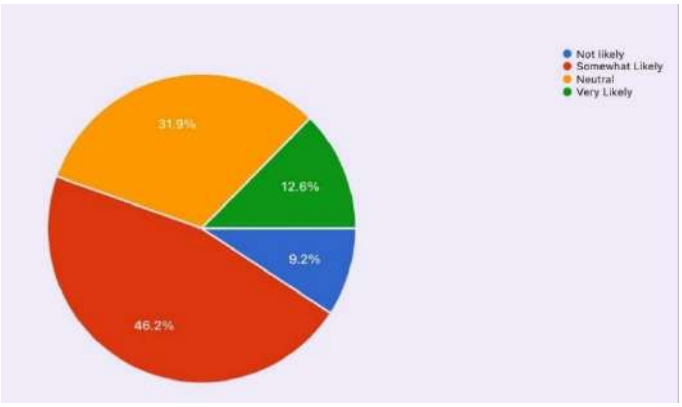

Table 5.9

Data Interpretation: This highlights the strong potential for small businesses to influence consumer decisions through targeted social media engagement.

One-sample T-Test:

Hypothesis

H0: Social media advertisements do not significantly influence purchase decisions.

H1: Social media advertisements significantly influence purchase decisions.

One-Sample t-Test Results for Social Media Advertisement Influence on Purchase Behaviour	
Sample Size	121
Mean	0.686
Std Deviation	0.466
t-value	4.39
p-value	0.000025

Based on the One-Sample t-test (assuming equal variances), the statistical results are as follows:

- t-statistic: 4.39
- p-value (two-tailed): 0.000025
- Degrees of freedom (df): 120
- t-critical (two-tailed): 1.98

Since the p-value 0.000025 is less than the significance level of 0.05, the result is statistically significant. This indicates that social media advertisement has a significant influence on purchase behaviour.

Interpretation and Hypothesis Decision:

H0: Social media advertisements have no significant influence on consumer purchase behaviour → Rejected

H1: Social media advertisements have a significant influence on consumer purchase behaviour → Accepted

The one-sample t-test results (t = 4.39, p = 0.000025, df = 120, t-critical = 1.980) indicate a statistically significant difference. Since the t-statistic is greater than the t-critical value and the p-value is less than 0.05, the null hypothesis (H0) is rejected, and alternative hypothesis (H1) is accepted, confirming that social media advertisement has a significant influence on consumer purchase behaviour, where buyers are likely to make informed and responsive purchase decisions after being exposed to advertisements on social media.

6. Observations and Findings:

The observations made in the study support the first objective, which was to examine whether buying behaviour is affected by social media. Based on the observations, it can be ascertained that social media does indeed have a significant effect on consumer purchase behaviour, as social media itself has become one of the most influential tools that traverse product information, as most of its users are aged between 18-30, which makes up most of social media users. Social media

tools such as Instagram have been identified as one of the most influential tools to work with product information, indicating that visually appealing information plays a significant role in influencing consumer purchase decisions. A substantial number of individuals influence their purchase by social media advertising, indicating that social media advertising is one of the most influential tools that foster consumer purchase behaviour, which makes social media a major influential communication tool that drives consumer purchase behaviour.

The second objective involved exploring the significance of user content in the development of trust as well as the intention to purchase, and it is quite evident from the results that they fully support the significance of the above objective. Online reviews, testimonials, and personal recommendations have been recognized as significant influencers within the context of the consumer decision-making process. Although it has been found that the consumer adopts a cautious strategy when it comes to the trust they adopt towards online reviews, still they remain quite interested in the opinions of others, specially other individuals, when it comes to the evaluation of the associated products as well as services. Online reviews, specially the opinions of their mates as well as relatives, have been found to have a strong, significant influence on them, thus further emphasizing the significance of utilizing the use of social media platforms as a form of word-of-mouth marketing.

7. Recommendations and Suggestions:

With the aim of investigating the effect of social media on the behaviour of buying, small businesses must effectively enhance their current performance on the platforms which show the greatest influence on the decisions consumers make, specifically on Instagram. Because of the huge impact it has on the exploration phase of the product purchase journey, small businesses must render visually appealing posts such as Reels and Stories that can attract the attention of the potential customer. Through continuous engagement of the audience via commenting, direct messages, and live broadcasts on the platform, small businesses can establish a good relationship with their possible clients. Communication must be transparent to legitimize the impact on the behaviour of buying.

In order to full-fill the objective of evaluating the importance of user-generated content for building consumer trust and purchasing intentions, it is recommended that businesses provide satisfied customers with motivators to generate reviews, testimonies, and recommendations on social media sites. Consumer feedback is a source of electronic word-of-mouth communication that plays a vital role in boosting consumer trust. For influencer marketing, instead of merely concentrating on the number of followers, businesses should partner with influencers who have values compatible with the business. It is also imperative for businesses to keep consumer feedback on social media sites under scrutiny, offering positive replies to criticisms on consumer posts. By doing so, not only would businesses be able to build consumer trust, but it would also facilitate increased purchases from fans to customers.

8. Limitations:

One of the key limitations of this study includes focusing on a particular age group, mainly young adults, which directly impinges on the generalization of findings for the first objective of examining the effect of social media on buying behaviour. Consumer buying behaviour may differ significantly among other age groups due to differences in digital exposure, levels of trust, and purchasing power. The convenience sampling conducted also reduces generalizing the results to include the overall population of social media users. This method was adopted because it was

proper for securing rapid and relevant data, but it may not capture the full expression of consumer perspectives and especially those across different geographical, socioeconomic, or cultural backgrounds.

The second research objective is concerned with exploring the importance of user-generated content in influencing consumer trust and buying intentions. The research has been able to identify consumer perceptions in a single point in time. As a result, it is not possible to identify behavioural shifts and trust trends for a considerable period. Consumer perceptions about product reviews and recommendations from peers and social media may alter from time to time based on changing platform dynamics and marketing trends. As a result, it is not possible to establish a statistical relationship between buying behaviour, trust and influence from social media.

9. Conclusion:

The findings of the study conclusively prove that the use of social media plays an extremely significant role in the buying behaviour of consumers, especially the young adult group that constitutes the most actively engaged group within the social media community. The use of platforms such as Instagram has come forward as a strong tool for the awareness and dissemination of product knowledge and influencing buying decisions owing to the visually interactive nature of these platforms. The findings of the study confirm the significant influence of advertisements, presence, and engagement on social media on the buying decisions of consumers. Further, the use of social media as a new-age form of communication and marketing has given rise to its significance as an extremely crucial medium through which the assessment of products, their comparison, and buying decisions of consumers are made, thereby establishing that the use of social media has not remained confined to the promotion of products but has become an essential part of the buying decision of consumers.

In addition, the findings of the discussed research underscore the significance of UGC based on building consumer trust and influencing buying decisions. Customer testimonials, online reviews, and personal recommendations, particularly by friends and family, can act as effective online word-of-mouth marketing tools. Although online consumers display a selective approach while accepting online reviews in its entirety, they remain heavily reliant on others' viewpoints while judging products and service offers. This piece of research also points out a few limitations, particularly concentrating on a selective age population, convenience sampling method, and the absence of longitudinal research, which may impede extended generalization of the research findings to a considerable extent. However, the research findings clearly emphasize the stipulations that small business setups can improve their performance at a considerable level by paying special attention to genuine engagement, honesty, and customer interaction with online social media channels.

10. Annexure:

1. The respondent falls within the following age category:

a) Below 18
b) 18-30
c) 31-43
d) 44 and above

2. The respondent uses social media platforms (e.g., Facebook and Instagram) to identify and explore new products and services:

a) Never

b) Rarely
c) Occasionally
d) Frequently

3. The respondent primarily utilizes the following social media platforms for the purpose of product-related information search:

a) Instagram
b) Facebook
c) Twitter
d) Tiktok

4. The respondent has previously purchased a product or service after being exposed to an advertisement on social media platforms:

a) Yes
b) No

5. Online reviews posted by other consumers play a significant role in influencing the respondent's purchase decisions:

a) Not important at all
b) Somewhat important
c) Neutral
d) Very important

6. The respondent consults online consumer reviews during the purchase decision-making process:

a) Never
b) Rarely
c) Occasionally
d) Frequently

7. The respondent perceives online consumer reviews as credible and reliable:

a) Not trustworthy
b) Trustworthy to some extent
c) Neutral
d) Very trustworthy

8. The respondent has made a purchase decision based on recommendations shared by friends or family members on social media platforms:

a) Yes
b) No

9. The respondent demonstrates a likelihood of purchasing a product or service after exposure to positive reviews or recommendations on social media platforms:

a) Not likely
b) Somewhat likely
c) Neutral
d) Very likely

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NEP 2020 AND HIGHER EDUCATION REFORMS: BUILDING RESEARCH EXCELLENCE AND GLOBAL COMPETITIVENESS

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Abstract
The National Education Policy (NEP) 2020 marks a significant reform agenda aimed at transforming India's higher education system to enhance quality, equity, and global competitiveness. This paper examines how the structural and regulatory reforms introduced under NEP 2020 strengthen research excellence in Indian higher education institutions. Drawing on a policy analysis framework, the study critically reviews key reform components, including institutional autonomy, multidisciplinary education, the National Credit Framework, governance restructuring, and the establishment of the National Research Foundation. The paper analyses the alignment between NEP 2020's reform objectives and internationally recognized indicators of research excellence, such as research output, funding competitiveness, interdisciplinary collaboration, and global academic engagement. Particular attention is paid to the role of faculty capacity, workload rationalization, and research-oriented career progression in fostering sustainable research ecosystems. The study also identifies implementation challenges, including disparities in institutional readiness, resource constraints, and coordination between regulatory bodies, which may affect the realization of NEP 2020's research ambitions. Drawing on secondary data sources, policy documents, and existing empirical studies, the paper assesses early trends and institutional responses to the NEP 2020 reforms. The findings suggest that while NEP 2020 provides a coherent and forward-looking framework for research-driven higher education, its impact on global competitiveness will depend on effective governance, adequate funding, and context-sensitive implementation strategies.
Keywords: NEP 2020 Reforms, Research Excellence, Higher Education Governance, Institutional Autonomy, Global Competitiveness, National Research Foundation.

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Introduction

The National Education Policy (NEP) 2020 represents a landmark shift in India's higher education landscape, positioning research excellence as a central driver of quality, innovation, and global competitiveness. Moving beyond incremental reforms, NEP 2020 proposes comprehensive structural, regulatory, and cultural transformations to create research-intensive, multidisciplinary, and autonomous higher education institutions. This paper examines how the policy's reform architecture contributes to strengthening research excellence in Indian higher education.

Structural and Regulatory Reforms for Research-Oriented Institutions

In the Indian higher education landscape, research-oriented institutions are those whose core mandate extends beyond teaching to include systematic knowledge creation, advanced research,

innovation, and doctoral training. These institutions form the backbone of India's national research and innovation ecosystem. They are central to the realization of the research ambitions articulated in the National Education Policy (NEP) 2020 (Government of India [GoI], 2020).

At the apex of this ecosystem are the Institutes of National Importance (INIs), established by Acts of Parliament and explicitly mandated to pursue advanced research alongside high-quality teaching. This category includes the Indian Institutes of Technology (IITs), the Indian Institute of Science (IISc), the Indian Institutes of Science Education and Research (IISERs), National Institutes of Technology (NITs), Indian Institutes of Information Technology (IIITs), and the All India Institutes of Medical Sciences (AIIMS). Collectively, these institutions account for a substantial proportion of India's Scopus- and Web of Science–indexed publications, doctoral enrolments, patents, and international research collaborations, particularly in science, engineering, medicine, and technology-driven fields (Altbach et al., 2019; Hazelkorn, 2018).

Central universities constitute another significant segment of India's research-oriented institutional framework. Established by Parliament, these universities combine broad disciplinary coverage with a strong emphasis on postgraduate and doctoral research. Institutions such as Jawaharlal Nehru University, Banaras Hindu University, the University of Delhi, the University of Hyderabad, and Aligarh Muslim University have historically played a significant role in advancing interdisciplinary scholarship, policy-relevant research, and contributions to the social sciences, humanities, and natural sciences (Tilak, 2021). Their extensive doctoral ecosystems and access to competitive public research funding position them as key knowledge hubs within the national higher education system (Varghese, 2023).

In addition, several deemed-to-be universities have emerged as research-intensive institutions, particularly in professional, applied, and interdisciplinary domains. Institutions such as the Tata Institute of Social Sciences (TISS), Manipal Academy of Higher Education, Vellore Institute of Technology, and Symbiosis International University demonstrate growing research capacity through externally funded projects, doctoral programmes, industry collaboration, and international partnerships. These institutions often benefit from greater academic and administrative autonomy, enabling them to respond more flexibly to emerging research priorities and global knowledge trends (Altbach & de Wit, 2020).

Select state public universities also function as critical research-oriented institutions, especially within their regional and disciplinary contexts. Universities such as Jadavpur University, Savitribai Phule Pune University, the University of Mumbai, the University of Madras, and the University of Calcutta support large numbers of doctoral scholars and faculty-led research projects. Despite facing persistent challenges related to funding constraints, infrastructure limitations, and high teaching loads, these institutions contribute significantly to regional research capacity, disciplinary depth, and the training of future researchers (Tilak, 2021; Varghese, 2023).

Beyond the university system, India's research ecosystem is strengthened by a network of standalone national research institutes operating under various government agencies. These include laboratories and institutes under the Council of Scientific and Industrial Research (CSIR), the Indian Council of Medical Research (ICMR), the Indian Council of Agricultural Research (ICAR), the Defence Research and Development Organisation (DRDO), and the Indian Council of Social Science Research (ICSSR). These institutions are primarily mission-oriented and focus on strategic, policy-relevant, and translational research aligned with national development priorities (OECD, 2022).

Medical and health research institutions occupy a distinct yet integral position within India's research-oriented institutional landscape. Institutions such as AIIMS, the Postgraduate Institute of

Medical Education and Research (PGIMER), and the National Institute of Mental Health and Neurosciences (NIMHANS) combine clinical practice with biomedical and public health research, contributing to evidence-based healthcare delivery, medical innovation, and the formulation of national health policy (GoI, 2020).

Under NEP 2020, the distinction between teaching-focused and research-focused institutions is expected to evolve further. The policy envisages the gradual transformation of higher education institutions into multidisciplinary universities, broadly classified as research-intensive or teaching-intensive, with clear pathways for institutions to strengthen their research capacity over time. Emerging private universities and autonomous colleges with strong doctoral programmes and external research funding are increasingly positioning themselves as research-oriented institutions within this framework (Government of India, 2020; OECD, 2021).

Taken together, India's research-oriented institutions comprise a diverse but interconnected set of universities, institutes, and laboratories that collectively anchor the country's knowledge production system. Their effective functioning, equitable strengthening, and strategic alignment with national policy reforms are critical to achieving the vision of NEP 2020 for a globally competitive, inclusive, and socially responsive higher education and research ecosystem.

NEP 2020 introduces far-reaching structural and regulatory reforms to reposition Indian higher education institutions (HEIs) as research-driven, globally competitive entities. Central to this transformation is the emphasis on institutional autonomy, in which universities and colleges are gradually transitioning into large, multidisciplinary institutions with academic, administrative, and financial independence (Government of India [GoI], 2020). Such autonomy is internationally recognized as a critical enabler of research productivity, innovation, and responsiveness to emerging knowledge domains (Altbach et al., 2019).

The policy's governance restructuring, through the consolidation of regulatory bodies and the separation of regulatory, accreditation, funding, and academic standard-setting functions, seeks to reduce bureaucratic fragmentation that has historically constrained research initiatives (Tilak, 2021). Additionally, the introduction of the National Credit Framework (NCrF) enhances academic mobility and interdisciplinary learning, thereby facilitating research pathways that cut across traditional disciplinary silos.

A cornerstone reform is the establishment of the National Research Foundation (NRF), envisioned as a catalytic funding and mentoring agency to strengthen India's research ecosystem. The NRF's mandate to support peer-reviewed, competitive, and interdisciplinary research aligns with global best practices observed in agencies such as the National Science Foundation (USA) and UK Research and Innovation (OECD, 2022). However, the effectiveness of these reforms will depend on the operational autonomy granted to institutions and the adequacy of sustained public investment

Alignment with Global Indicators of Research Excellence

Global indicators of research excellence are widely employed by governments, international organizations, funding agencies, and ranking bodies to assess the quality, impact, and competitiveness of research institutions and national research systems. These indicators extend beyond simple measures of publication volume to encompass research influence, funding competitiveness, collaboration, human capital development, innovation, and institutional capacity. Collectively, they provide a multidimensional understanding of how effectively research systems contribute to knowledge production and societal advancement (OECD, 2021).

A foundational indicator of research excellence is research output and quality, which captures the volume of peer-reviewed scholarly work and its placement in high-impact academic outlets. Metrics such as total publications indexed in Scopus or Web of Science, the proportion of outputs in top-quartile journals, and field-weighted citation impact are commonly used to assess scholarly productivity and quality (Moed, 2005; Waltman, 2016). High-quality research output signals active knowledge creation and disciplinary leadership within global academic communities.

Closely related to output is citation impact, which measures the extent to which research influences subsequent scholarly work. Indicators such as total citations, citations per publication, the H-index, and the share of publications in the top 10% or 1% most cited globally are widely used to capture research influence (Waltman, 2016). Citation impact is particularly valued because it reflects intellectual recognition rather than mere productivity, thereby serving as a proxy for research significance and originality.

Another critical indicator of research excellence is research funding and competitiveness. The ability of institutions and researchers to secure competitive, peer-reviewed funding reflects both the quality and credibility of their research agendas. Measures such as total research grant income, success rates in national and international funding schemes, and levels of industry-sponsored research are commonly used to assess funding competitiveness (OECD, 2022). Sustained access to competitive funding is also essential for building long-term research infrastructure and supporting advanced research programmes.

Recently, collaborative research has emerged as a key global indicator, reflecting the increasing complexity of contemporary scientific and social challenges. Metrics such as international co-authored publications, cross-disciplinary research outputs, and participation in global research networks are used to assess collaborative capacity (OECD, 2021). Empirical studies consistently show that internationally and interdisciplinarity collaborative research tends to achieve higher citation impact and broader societal relevance.

The strength of a research system is also reflected in its capacity for doctoral and postdoctoral training. Research-intensive institutions are distinguished by robust doctoral ecosystems, including high PhD enrolments, completion rates, and postdoctoral researcher density (Altbach et al., 2019). These indicators capture institutions' ability to sustain research excellence over time by training the next generation of scholars and innovators.

Increasingly, global assessments of research excellence also emphasize knowledge transfer, innovation, and societal impact. Indicators such as patents filed and granted, start-ups and spin-offs, industry partnerships, and policy influence demonstrate how research contributes beyond academia to economic development and social well-being (Hazelkorn, 2018). This shift reflects a broader understanding of excellence that integrates academic impact with public value.

Global academic engagement and reputation constitute another critical dimension of research excellence. Measures such as international faculty and student ratios, joint research and degree programmes, participation in international consortia, and reputation survey scores used in global rankings capture an institution’s visibility and standing within the international academic community (Hazelkorn, 2018). Strong global engagement enhances collaboration opportunities, access to funding, and research dissemination.

Finally, research governance and institutional capacity underpin all other indicators of research excellence. Effective governance structures, academic autonomy, supportive faculty workload policies, research infrastructure, and robust ethical and integrity frameworks create enabling environments for high-quality research (OECD, 2022). Without such institutional foundations, gains in output or funding are unlikely to be sustainable.

Taken together, these global indicators highlight that research excellence is a multidimensional construct encompassing productivity, impact, collaboration, human capital, innovation, and governance. Contemporary higher education policies, including India's National Education Policy 2020, increasingly align with this integrated understanding of research excellence, recognizing that global competitiveness depends not on isolated metrics but on the strength and coherence of entire research ecosystems.

A defining strength of NEP 2020 lies in its explicit alignment with international indicators of research excellence, including research output, funding competitiveness, interdisciplinary collaboration, and global engagement. Global ranking frameworks such as QS, THE, and ARWU emphasize these indicators as determinants of institutional reputation and impact (Hazelkorn, 2018). NEP 2020's focus on research-intensive universities reflects an acknowledgment of these global benchmarks.

The policy promotes interdisciplinary research, recognizing that contemporary societal challenges such as climate change, public health, and digital transformation require integrated knowledge systems (OECD, 2021). Furthermore, NEP 2020 encourages international collaborations, faculty exchanges, and joint research programmes, which are strongly correlated with higher citation impact and research visibility (Elsevier, 2020).

Despite this conceptual alignment, disparities in infrastructure, access to funding, and research culture across Indian HEIs may limit the uniform implementation of these global indicators. Institutions with pre-existing research capacity are more likely to benefit, raising concerns about uneven global competitiveness (Varghese, 2023).

Faculty Capacity, Workload Rationalization, and Research Careers

Globally, research-intensive higher education systems recognize that sustained research excellence depends on faculty capacity, equitable workload distribution, and well-defined research career pathways. International policy frameworks and empirical studies consistently demonstrate that institutional reforms focused solely on funding or infrastructure are insufficient without parallel investments in academic labour conditions and career structures (Altbach et al., 2019; OECD, 2022).

A central benchmark for faculty capacity is the availability of adequate time, skills, and institutional research support. Leading research systems emphasize continuous professional development, mentoring, and access to research infrastructure to enhance faculty research productivity across career stages (Shin & Kehm, 2013). Faculty capacity is also assessed through indicators such as doctoral supervision ratios, access to postdoctoral researchers, and participation in funded research projects, which together reflect an institution's ability to sustain high-quality research over time (OECD, 2021).

Workload rationalization is widely recognized as a critical determinant of research productivity and academic well-being. Global benchmarks suggest that research-intensive universities typically allocate 30–50% of faculty workload to research, with differentiated workload models that vary by career stage and institutional mission (European University Association [EUA], 2019). Teaching loads in leading research universities are generally lower than in teaching-focused institutions, often ranging from 2–3 courses per semester for research-active faculty, compared to significantly higher loads in mass higher education systems (Altbach & de Wit, 2020). Transparent workload allocation models that explicitly recognize teaching, research, administration, and service are considered best practice for preventing academic overload and burnout (OECD, 2022).

Closely linked to workload rationalization are structured research career pathways, which constitute another global benchmark of research excellence. Internationally, research careers are increasingly characterized by tenure-track or tenure-like systems, with clear progression criteria based on research performance, teaching quality, and service contributions (Shin & Kehm, 2013). Early-career researchers typically receive reduced teaching loads, start-up research grants, and mentoring support. At the same time, mid-career and senior academics are assessed through sustained research output, leadership in funded projects, and doctoral supervision (OECD, 2021).

A further benchmark relates to the integration of postdoctoral researchers into institutional research ecosystems. In leading systems such as those in the United States and Europe, postdoctoral positions are formalized as transitional research careers with defined durations, mentoring requirements, and pathways to permanent academic or research roles (National Academies of Sciences, Engineering, and Medicine [NASEM], 2018). The presence of a strong postdoctoral workforce is associated with higher research productivity, grant success rates, and international collaboration.

Global standards also emphasize performance evaluation and incentive structures that balance quantitative metrics with qualitative peer review. While publication output and citation impact remain important, excessive reliance on narrow metrics is increasingly discouraged due to concerns about research quality, academic integrity, and perverse incentives (Moed, 2005; Waltman, 2016). Instead, holistic evaluation frameworks, such as those promoted by the San Francisco Declaration on Research Assessment (DORA), advocate recognizing diverse research contributions, including interdisciplinary work, policy engagement, and societal impact (DORA, 2013).

Finally, academic autonomy and research governance form an enabling benchmark for faculty careers. International evidence indicates that institutions with greater autonomy in recruitment, promotion, and workload allocation are better positioned to attract and retain high-quality faculty and to align individual career trajectories with institutional research priorities (Hazelkorn, 2018; OECD, 2022). Supportive governance frameworks, combined with stable funding and transparent career progression systems, are therefore essential to sustaining faculty motivation and research excellence.

Taken together, global benchmarks for faculty capacity, workload rationalization, and research careers underscore the need for integrated academic workforce policies. These benchmarks highlight that research excellence is not solely a function of individual productivity but is shaped by institutional cultures, governance structures, and career systems that enable faculty to engage meaningfully in long-term, high-quality research.

Faculty members constitute the backbone of any research ecosystem, and NEP 2020 implicitly acknowledges this by emphasizing faculty development, autonomy, and performance-based progression. International evidence consistently demonstrates that sustainable research excellence depends on manageable teaching workloads, access to mentoring, and clearly defined research career pathways (Shin & Kehm, 2013). NEP 2020 advocates a shift from rigid seniority-based systems to merit-based academic progression, potentially incentivizing high-quality research and innovation. The policy also recognizes the need for continuous professional development and research capacity building, particularly for early-career faculty. However, explicit mechanisms for workload rationalization remain underdeveloped, posing risks of faculty burnout and reduced research productivity (Altbach & de Wit, 2020). In the Indian context, where faculty often shoulder heavy teaching and administrative responsibilities, translating policy intent into institutional

practice will require targeted reforms in recruitment norms, promotion criteria, and performance evaluation systems.

Implementation Challenges and Institutional Readiness

While the National Education Policy (NEP) 2020 articulates a coherent and ambitious vision for transforming Indian higher education into a research-driven system, its implementation is constrained by significant challenges arising from institutional heterogeneity and systemic capacity gaps. India's higher education landscape is marked by pronounced disparities between centrally funded institutions, such as Indian Institutes of Technology and central universities, and the vast majority of state-funded and private colleges, particularly with respect to research infrastructure, faculty capacity, and access to competitive research funding (Tilak, 2021; Varghese, 2023). These structural inequalities pose a significant obstacle to the uniform realization of NEP 2020's research objectives.

Resource constraints remain a critical challenge affecting institutional readiness. Despite policy commitments to strengthening research ecosystems, public expenditure on higher education and research in India continues to lag behind global benchmarks, limiting institutions' ability to invest in laboratories, digital research infrastructure, doctoral training, and postdoctoral positions (OECD, 2022). As international evidence suggests, sustained research excellence requires stable funding, institutional autonomy, and strategic investment in human capital—conditions that are unevenly distributed across Indian higher education institutions (Altbach et al., 2019).

Administrative and governance capacity further shapes the feasibility of reform implementation. NEP 2020 proposes regulatory consolidation and functional differentiation among regulatory, accreditation, and funding bodies; however, coordination challenges among newly constituted and existing agencies risk creating transitional ambiguities that may delay reform outcomes (Tilak, 2021). Institutions with limited administrative capacity may struggle to operationalize new frameworks such as the National Credit Framework, research governance reforms, and performance-based funding mechanisms, thereby widening the gap between policy intent and practice.

Faculty-related challenges constitute another significant dimension of institutional readiness. Global benchmarks emphasize workload rationalization, protected research time, and structured research career pathways as prerequisites for research productivity (EUA, 2019; OECD, 2021). In contrast, many Indian institutions, particularly teaching-focused colleges, continue to operate under high teaching and administrative workloads, leaving limited scope for sustained research engagement. Without deliberate strategies to strengthen faculty capacity through workload differentiation, mentoring, and research-oriented career progression, NEP 2020's emphasis on research excellence may remain largely aspirational (Altbach & de Wit, 2020).

Moreover, the uneven pace of reform adoption across institution types and regions raises concerns about the reinforcement of existing hierarchies within the higher education system. Research-intensive institutions are better positioned to leverage autonomy, competitive funding, and opportunities for global collaboration, while resource-constrained institutions may struggle to transition into multidisciplinary, research-active entities (Varghese, 2023). This divergence risks concentrating research excellence within a limited set of institutions, undermining NEP 2020's broader goal of inclusive, regionally balanced research development.

Addressing these challenges will require context-sensitive implementation strategies that recognize institutional diversity rather than adopting uniform reform models. Differentiated

funding frameworks, targeted capacity-building support for state and regional institutions, and phased implementation timelines are essential to enhance institutional readiness.

Strong institutional leadership, coupled with transparent governance mechanisms and sustained public investment, will be critical in translating NEP 2020's policy vision into equitable and durable research outcomes. Without such enabling conditions, the transformative potential of NEP 2020 may remain unevenly realized across India's higher education landscape.

Discussion and Conclusion

This paper examines the National Education Policy (NEP) 2020 as a transformative framework for strengthening research excellence in Indian higher education institutions. The analysis demonstrates that NEP 2020 articulates a coherent and forward-looking reform agenda, integrating institutional autonomy, multidisciplinary education, governance restructuring, and competitive research funding into a unified vision for research-driven universities. These policy directions closely align with internationally recognized indicators of research excellence, including research productivity, interdisciplinary collaboration, funding competitiveness, and global academic engagement.

However, the literature review also underscores that achieving NEP 2020's research ambitions is neither automatic nor uniform. The effectiveness of the proposed reforms depends on context-sensitive implementation that accounts for India's diverse institutional landscape. Persistent challenges related to faculty workload pressures, uneven institutional capacity, regional disparities, and resource constraints risk limiting the depth and equity of reform outcomes. In the absence of sustained public investment and robust coordination among regulatory, accreditation, and funding agencies, the policy's transformative potential may remain unevenly realized across institutions and regions.

Bridging the gap between policy intent and institutional practice, therefore, requires a multi-level and multi-actor strategy. At the national level, consistent funding commitments, precise regulatory coordination, and transparent performance frameworks are essential to support research-intensive environments. At the institutional level, leadership must prioritize governance reforms, research infrastructure development, and supportive academic cultures that value inquiry, collaboration, and innovation. At the faculty level, meaningful engagement will depend on workload rationalization, merit-based career progression, mentoring systems, and sustained opportunities for research capacity building.

Notably, the study highlights that research excellence should not be defined solely by global rankings or publication metrics. Rather, NEP 2020's long-term success lies in fostering inclusive, resilient, and socially responsive research ecosystems that address national development priorities while contributing to global knowledge production. Strengthening human capital, enabling interdisciplinary problem-solving, and ensuring equitable access to research opportunities are critical to achieving this broader vision.

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ENTREPRENEURSHIP & START-UP ECOSYSTEM: CHALLENGES & POLICIES SUPPORT

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Abstract
The startup ecosystem has emerged as a critical driver of innovation, economic growth, and employment generation in contemporary economies. Startups, characterized as newly established businesses in their initial stages of operations, are founded by entrepreneurs who introduce unique products, services, and technologies to address societal challenges and market gaps. However, the journey of startup entrepreneurship is fraught with numerous challenges including inadequate financial support, limited market demand, knowledge and skill gaps, intense market competition, and operational difficulties that hinder growth and sustainability. India has witnessed a remarkable transformation in its entrepreneurial landscape, particularly in the 21st century, evolving into the third-largest startup ecosystem globally with over 50,000+ recognized startups as per the Department for Promotion of Industry and Internal Trade (DPIIT). The launch of Startup India initiative in 2016 marked a pivotal moment in India's entrepreneurial journey, creating a conducive policy environment supported by robust infrastructure, incubators, angel investors, venture capitalists, and mentorship programs. This vibrant ecosystem, powered by a young and talented workforce, has successfully nurtured numerous startup firms and enabled thousands of youth to pursue their entrepreneurial aspirations. This paper examines the multifaceted challenges confronted by startup entrepreneurs in Inida's dynamic business environment, while simultaneously analysing the policy frameworks and support mechanisms designed to address these obstacles. Through comprehensive secondary research drawing from diverse sources including academic journals, government reports, websites, and newspapers, this study investigates the opportunities, gaps, and barriers that startups encounter during various stages of their operations. The research emphasizes the role of external advisors, investors, and emerging technologies such as artificial intelligence in navigating competitive markets and predicting future business trajectories. By comparting existing literature and providing an in-depth analysis of the challenges and policy interventions, this paper offers valuable insights for overcoming entrepreneurial barriers and strengthening India's position as a global hub for innovation and startup development.

Keywords: Entrepreneurs, Startup Ecosystem, Challenges, Policies, Startup Performance, Funding, Opportunities.

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Introduction to the Study:

India's startup ecosystem has grown rapidly over the past decade and is expected to accelerate further in 2025. A major factor driving this growth is India's young and technology-savvy population. With a population exceeding 1.4 billion, a significant proportion is under the age of

30, providing a vast and energetic talent pool. Increased internet access and widespread smartphone usage have further enhanced opportunities for startups to develop innovative digital products and services.

India's entrepreneurship and startup ecosystem is tracked through various government, industry, and private reports, highlighting growth to over 1.9 lakh DPIIT-recognized startups by 2025, with 16.6 lakh jobs created.

Another important contributor is strong government support. Initiatives such as Startup India, tax incentives, and simplified regulatory processes have created a favorable environment for entrepreneurs. Both central and state governments provide financial assistance, policy support, and infrastructure, helping startups grow and scale more easily.

International collaboration has also played a crucial role. Programs like the India–U.S. "Innovation Handshake", under the India-U.S. Commercial Dialogue, promote cooperation between startups, venture capitalists, corporate investors, and government bodies. These partnerships strengthen innovation ecosystems and increase global exposure for Indian startups.

The inflow of venture capital investment has further boosted the ecosystem. India has attracted significant funding from domestic and global investors, particularly in sectors such as technology, fintech, agritech, cleantech, edtech, and healthtech. This trend is expected to intensify in 2025 as investors seek opportunities in India's fast-growing markets.

Innovation remains the backbone of India's startup success. Indian entrepreneurs are addressing real-world problems using advanced technologies like artificial intelligence, blockchain, renewable energy, and digital healthcare. Fintech startups are expanding financial inclusion through digital payments and lending platforms, while health-tech startups are improving healthcare access, especially in rural regions.

Overall, the synergy of technology adoption, government initiatives, international collaboration, venture capital inflow, and rising demand for digital solutions is set to drive sustained growth of India's startup ecosystem in the coming years.

This report analyzes innovation in technology-driven startups, identifies the major challenges they face, and evaluates the government policies that support their development.

Objective of the Study:

The aim of study to identity the different challenges, issues and identifying the various support for startup to accomplish them. The concept of startup is to be understood first

1. To study the challenges of Startups.
2. To understand the policies and opportunity for startups
3. To assess the growth pattern of startups
4. To explore sectoral dynamics in startups (technology-driven services, fintech, health tech, and sustainable solutions.

Research Methodology:

Research methodology is a systematic procedure used to identify a topic or issue analyse the collected information through primary as well as secondary data. The present study adopts an exploratory and descriptive research design to examine the challenges and opportunities faced by startups in the Indian scenario. The nature of the study is conceptual and analytical, focusing on understanding key issues encountered by newly established startup businesses and identifying ways to overcome these challenges.

The research is entirely based on secondary data, which has been collected from various credible sources such as research articles, theses, journals, books, newspapers, magazines, and authentic websites (PIB, DPIIT, startupindia,gov.in, etc). Abundant literature available on startups and related dimensions has been reviewed and analyzed to gain comprehensive insights into the subject.

An analytical research methodology has been followed, wherein the collected quantitative and qualitative information from secondary sources was systematically examined and interpreted. The study aims to create awareness among future entrepreneurs regarding potential challenges so that they can plan effectively and run their businesses successfully.

Challenges Faced by Entrepreneures Starting Startups:

1. Financial Constraints

Startup need money for everything – product development, salaries, marketing, and operations. Most of the time entrepreneurs struggle to secure enough funding. Without adequate capital, they can't hire talent, can't market effectively, and may run out of money before achieving profitability. Some time even after the enough funding entrepreneurs are not able to handle it and can't have the risk handling ability

2. Revenue generation

The most challenging task for startups is to generate revenue as several startups fail due to a lack of revenue. The expenses grow with increasing operations but the revenue remains the same. It affects the fundamental of business and the innovative strategies of startups. The challenge is not only limited to generating adequate capital but to expanding and sustaining the growth simultaneously.

3. Team member

Finding co-founders and employees who share your vision, have complementary skills, and will work for equality or low salaries is extremely difficult. Entrepreneurs often struggle with: hiring their first employees, affording experienced talent, managing team conflicts, and retaining people when competitors, offer better compensation. Assembling workforce is the major requirement to sustain in the market.

4. Lack of access to infrastructure/ resources

The risk of failure is increased when the startups are deprived of access to support mechanisms like incubators, science and technology parts, and business development centres. Poor infrastructure leads to ineffiency, errors, and inability to scale.

5. Leadership

Leadership plays an important role in the success and development of startups or businesses. In the bootstrapping stage there is no need for leadership but at the end of this stage you make a team and for this team leadership is important. As your startup grows your employees look for strong leadership, if you don't have leadership quality then you face many difficulties in the business. In business leadership is important because with the help of this you motivate your employees, coordination in the team, problem solving etc. If any of the business does not have leadership quality, then they face difficulties in survival. Most of the business fails due to lack of leadership quality that's why a successful startup have always a good leadership quality and they work together in a teamwork and easily achieve the organizational goal.

6. Lack of mentorship

One of the most important quality that entrepreneurs must have the mentoring and leadership quality to guide for startups. Without experienced advisors, entrepreneurs make avoidable

mistakes – choosing wrong markets, poor hiring decisions, bad partnerships, or flawed business models.

7. Awareness in markets

The best product fails if nobody knows it exists or lack of attention toward the various limitations of the market. The entrepreneurs has to build every singe thing from scratch for new product or service as need to establish the entity for its innovation and uniqueness in the market

8. Lack of demand

The fatal challenge – building something nobody wants. For a business the most important things is in the market they have a lot of demand because for the development of your business the product demand in the market is crucial aspect. Due to lack of knowledge and information they will not give time in market research. There is no matter how great your idea is, if there is no scope of your product in the market you know but you launch your product then your startup won't succeed.

9. Dynamic environment:

A market has a nature of dynamic because the entrepreneurs must plan prior or make some strategies to remain competitive and sustain in the market. The startup's failure rate is relatively high, many of the startups fail within the first few years of operations because they don't focus on the market research, and they don't know about the changes in the environment. Dynamic environment is also a main challenge in startups. The ability to pivot when needed, without losing sight of he core vision, is crucial but difficult.

Failure Reason	Percentage	Key Examples
Lack of Product-Market Fit	34-42%	Building solutions without validated customer demand
Funding/Running Out of Cash	44-47%	Weak unit economics, poor runway planning
Team Problems	18-23%	Co-founder conflict, poor hiring, burnout
Regulatory Challenges	19%	Legal complexities in fintech, healthtech, edtech
Competition	~20%	Inability to compete in saturated markets

Policy and Opportunities Support to Startup Ecosystem:

1. Startup India seed fund scheme

Launched in April 2021 with a budget of ₹945 crores to provide financial assistance to startups for proof of concept, prototype development, product trials, market entry, and commercialization.

- Grants up to ₹20 lakhs for validation of proof of concept or prototype development
- Investments up to ₹50 lakhs for market entry, commercialization, or scaling up
- Operates through selected incubators across India
- Approved funds of around Rs. 284.79 crore to 1,635 women-led startups as on 31 st October 2025.

Leading states:

- Maharashtra
- Karnataka
- Tamil Nadu
- Delhi

Major sectors:

- Healthcare & Lifesciences

- Agriculture
- Food & Beverages
- Education
- Green Technology

Example: Tan90 Wellness (health tech startup) received seed funding through this scheme and developed AI-based health monitoring solutions, expanding operations across multiple cities.
SISFS plays a crucial role in converting ideas into viable startups, particularly for first-time women entrepreneurs.

2. Atal innovation mission

Established by NITI Aayog in 2016 to promote innovation and entrepreneurship across India through various programs.
- Atal Tinkering Labs (ATLs) in schools
- Atal Incubation Centers (AICs)
- Atal Community Innovation Centers
- Mentor India Program

Example: Ati Motors (robotics startup) was incubated at AIM-supported incubators and developed autonomous industrial vehicles. They've raised significant funding and work with major manufacturing companies.

3. Samridh scheme (Startup Accelerators of MeitY for pRoduct Innovation, Development and growth)

Launched in 2021 by the Ministry of Electronics and IT with ₹100 crore allocation to support software product startups.
- Up to ₹40 lakhs equity-based funding per startup
- Support through accelerators
- Focuses on software products

Example: Scapia (fintech startup) received support under similar MeitY initiatives and has grown to become a prominent neo-banking platform with substantial user base.

4. ebiz portal

Launched in 2013 as a Government to Business (G2B) portal to provide a single-window for business and investor-related regulatory clearances and compliances.
- Single platform for 14+ government services
- Integration with 33 central and state government departments
- Simplified business registration and compliance

Impact: Enabled faster business setup - companies like Zerodha and PolicyBazaar benefited from streamlined regulatory processes during their growth phases.

5. MUDRA Yojana (Micro Units Development and Refinance Agency)

Launched on April 8, 2015, to provide funding to non-corporate, non-farm small/micro enterprises.
Three Categories:
- Shishu: Loans up to ₹50,000
- Kishore: Loans from ₹50,001 to ₹5 lakhs
- Tarun: Loans from ₹5 lakhs to ₹10 lakhs

Example: Falguni Nayar (founder of Nykaa) has often cited the importance of schemes supporting women entrepreneurs. While Nykaa itself was beyond MUDRA's scope, thousands of Nykaa's seller partners and beauty service providers have utilized MUDRA loans to establish and expand their businesses, creating an ecosystem that supports Nykaa's growth.

6. Support to training and employment programme for women (STEP)
Initiated in 1986-87, revamped multiple times, aims to make women more employable through skills training.
- Agriculture and allied activities
- Handlooms, handicrafts
- Services sectors
- Small-scale industries
Example: Lijjat Papad (women's cooperative) and numerous women-led handicraft businesses have scaled operations using STEP support, creating employment for thousands of women artisans.

7. Trade related Entrepreneurship Assistance and Development (TREAD):
Launched by the Ministry of MSME to encourage women entrepreneurs, especially in trade-related activities.
- Government grants up to 30% of total project cost to NGOs
- Focuses on developing women entrepreneurs in rural areas
- Provides both training and credit support
Example: Multiple women's Self-Help Groups (SHGs) producing organic products, textiles, and food items have scaled into successful enterprises, supplying to major retailers and e-commerce platforms.

8. Pradhan Mantri Kaushal Vikas Yojana (PMKVY)
Launched on July 15, 2015, as the flagship outcome-based skill training scheme.
- Short-term training (150-300 hours)
- Recognition of Prior Learning (RPL)
- Special Projects for specific demographics
- Over 1 crore youth trained so far
Example: Many employees at startups like Swiggy, Zomato, Urban Company, and Dunzo have been trained through PMKVY programs, particularly in logistics, delivery services, and gig economy roles.

9. National Skill Development Mission
Launched in 2015 to create convergence across skill training activities, with a target to skill 40 crore people by 2022.
Components:
- National Skill Development Corporation (NSDC)
- Sector Skill Councils
- Skill Development Centers
Example: TeamLease (staffing solutions company) partnered with NSDC to train and place lakhs of skilled workers. Similarly, UrbanClap (now Urban Company) benefited from the skilled workforce created through this mission for their service professionals.

10. Stand-Up India
Launched on April 5, 2016, to facilitate bank loans between ₹10 lakh and ₹1 crore to at least one SC/ST and one woman entrepreneur per bank branch.
- Focus on greenfield enterprises in manufacturing, services, or trading
- Margin money requirement reduced to 15%
- Handholding support through convergence with other schemes
Example: Falguni Patel, who started a small organic food processing unit in Gujarat with Stand-Up India loan, has now expanded to supply products to major retail chains across western India.

11. Production-Linked Incentive (PLI) Schemes

Announced in March 2020 initially for mobile manufacturing, expanded in November 2020 to 13 sectors with an outlay of ₹1.97 lakh crores.

Covered Sectors:

- Electronics and IT Hardware
- Pharmaceuticals
- Automobiles and Auto Components
- Telecom Equipment
- Food Processing
- Textiles
- Solar PV Modules
- White Goods (ACs, LEDs)
- Specialty Steel
- Advanced Chemistry Cell Battery

Examples:

Ola Electric: Benefited from PLI scheme for Advanced Chemistry Cell (ACC) Battery Storage, building one of the world's largest EV manufacturing facilities in Tamil Nadu. The company has become India's leading electric two-wheeler manufacturer.

Dixon Technologies: Leveraged PLI scheme for electronics manufacturing, expanded production of mobile phones, LED lights, and other electronics, growing revenue from ₹5,000 crores to over ₹15,000 crores.

Lava International: Under mobile manufacturing PLI, scaled domestic production significantly and increased exports.

12. Credit Guarantee Scheme for Startups (CGSS)

Implementation

- Operational since 1 April 2023.
- Implemented by National Credit Guarantee Trustee Company (NCGTC).

- To enable collateral-free loans for startups.
- Reduces risk for banks and financial institutions.

Progress & Impact (Women-led Startups)

- Loans guaranteed: 24
- Total amount: ₹ 33.17 crore
- Major sectors supported:
  - Food products
  - IT software
  - Textiles & apparel
  - Pharmaceuticals
  - Automobiles

CGSS improves access to formal credit and encourages financial institutions to lend to startups.

Notable Cross-Cutting Success Stories

1. Zomato: While not directly funded by government schemes, benefited from Startup India's regulatory simplifications and tax benefits during crucial growth phases.

2. OYO Rooms: Utilized Startup India recognition for easier compliance and various state government partnerships for expansion.

3. BYJU'S: Although privately funded, benefited from India's digital push and skilled workforce created through NSDC and PMKVY programs.

4. Razorpay: Recognized under Startup India, utilized regulatory frameworks and support systems to become a fintech unicorn.

These schemes collectively create an ecosystem supporting entrepreneurs at different stages - from ideation (AIM, SISFS) to skill development (PMKVY, NSDC), financing (MUDRA, Stand-Up India), and scaling (PLI schemes). The success of Indian startups increasingly reflects this comprehensive government support framework.

Result and Conclusion:

In these days the word startup is growing day-by-day and government also support the entrepreneur by providing many schemes such as “make in India”, “startup India”, by giving multiple loans such as “mudra loan” etc. The government support entrepreneur because they help the economy in the growth and development and they also reduce unemployment rate because when a person starts a company, the company wants workers because a single man cannot handle every work, for multiple work they need workers.

The current economic scenario in India is on expansion mode. The India government is increasingly showing grater enthusiasm to increase GDP rate of growth. And in GEN-Z the entrepreneur has an opportunity to use Machine learning(ML), Artificial intelligence(AI) for predicting the future or trends which is beneficial for the startups and with the help of AI the entrepreneur does a better planning for the upcoming future.

What we need to do is to create an environment where entrepreneurs feel confident that they will not face any obstacles if they develop business models for the benefit of the poor. In India, various initiatives have been taken by the government from time to time for entrepreneurship development in the country. Entrepreneurship has attracted the attention of policymakers in India. A series of high-level initiatives, including Startup India, have been launched to promote private sector development. However, the role of entrepreneurship in development remains a mystery for many policy observers. Developing counties like India have flimsy economic and social backgrounds and the present situation of the pandemic creates more suffering for the unorganized sector and migrant labour (Guckenbiehl & Corral, 2022). Entrepreneurs are expected to build detailed domain knowledge for providing effective competition with their appropriate strategies.

A significant achievement is women's participation in entrepreneurship, with over 73,000 startups having at least one woman director—representing nearly half of all government-recognized startups. This demonstrates the vital role women play in India's innovation economy.

Indian startups have the opportunity to be highly successful and to aid in the country's economic growth. However, to thrive in this ecosystem , Startups need to focus on key areas such as market research, building a strong team, fostering innovation, leveraging technology, forming strategic partnerships, and adopting a customer centric approach. It is also crucial to stay updated on government support and initiatives that can provide valuable resources and funding.

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