

## ***GROWTH AND DEVELOPMENT OF THE INDIAN ECONOMY IN THE 21 CENTURY: “TOWARDS ECONOMY 4.0”***

- Maharashtra, Karnataka, Delhi, and Gujarat combined generate about 50% of employment in startup ecosystems, with Maharashtra alone contributing 18% of startup employment.
- The Northeast has seen the fastest relative growth in startup numbers (12.7-fold increase between 2018- 2023), but absolute numbers remain low.

### **TALENT AND UNICORN CONCENTRATION**

- More than 95% of Indian unicorn startups are concentrated in six states: Karnataka, Haryana, Maharashtra, Delhi, Uttar Pradesh, and Tamil Nadu.
- Major metro cities such as Bengaluru, Gurugram, Mumbai, Delhi, Noida, and Chennai act as startup and talent magnets.
- Youth demographics and supportive policies have fueled innovation in these hubs.
- States like Bihar, Odisha, and parts of the Northeast show lower startup outputs largely due to systemic infrastructure and ecosystem challenges rather than lack of talent.

### **REGIONAL DISPARITIES AND DEVELOPMENT NEEDS**

- Western and Southern states such as Maharashtra, Gujarat, Karnataka, and Tamil Nadu dominate in startup density and employment.
- Northeastern and many eastern states lag behind in absolute startup numbers and generate less employment.
- Tier 2 and Tier 3 city startups dominate in Central (86%) and Northeast India (84%), whereas metropolitan hubs dominate the West and South.
- There is a clear need for targeted interventions and ecosystem-building efforts in underrepresented regions to promote equitable startup growth and employment opportunities.

These patterns reflect a startup ecosystem in India that is robust yet unevenly distributed, driven by urban centers with access to capital, infrastructure, and talent pools, while other regions strive to catch up with the right policy and ecosystem support.

### **OBJECTIVES**

- To quantify startup density across Indian states using DPIIT and other official data.
- To assess the distribution of entrepreneurial talent and skill availability.
- To analyze the role of policy, infrastructure, institutions, and demographic factors.
- To identify challenges and opportunities for less-developed regions.
- To suggest strategic recommendations for balanced startup ecosystem growth.

### **LITERATURE REVIEW**

Various studies and reports such as NITI Aayog’s India Innovation Index, Startup India Reports, and industry analyses highlight a disproportionate concentration of startups in Maharashtra, Karnataka, Delhi, and Gujarat. South and Western India show strong innovation readiness from premier R&D institutions and policy support, whereas North-Central and Eastern states lag due to weak infrastructure and limited funding. Scholars point to the importance of university-industry linkages, access to venture capital, and quality of human capital in driving startup success.

#### **1. Key studies on Regional Startup Density**

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- **Mapping the Innovation Ecosystem in Indian States (IJCRT, 2025):** This paper analyzes NITI Aayog’s India Innovation Index, revealing Karnataka's top rank with 0.93% GERD/GSDP and over 13,000 startups, contrasted by Bihar's <0.05% GERD and <500 startups; it emphasizes institutional synergies in high-performers like Maharashtra and Tamil Nadu.
- **Mapping India's Startup Landscape (EELET Journal, recent):** Examines DPIIT data showing uneven distribution, with Maharashtra (high absolute numbers), Karnataka, and Uttar Pradesh leading; per-capita metrics rank Haryana high, while sector specialization (e.g., AI in Karnataka) underscores urban clustering.
- **Spatial Distribution of Start-up Cities of India (IJREAM, 2017):** Traces AngelList data to map startup cities, identifying metro dominance and spatial patterns favoring western hubs over peripheral states.

### **2. Analyses of Talent and Growth Disparities**

- **Asia Competitiveness Institute Report (NUS, 2024):** By Akshaya Balaji and Ammu George, highlights post-pandemic growth in Bihar, Haryana, and Assam surpassing top states like Maharashtra in relative terms, with industry-specific trends showing emerging specialization in lower-tier regions.
- **Startup India Movement: Growth in Madhya Pradesh (IJREAM, recent):** Reviews DPIIT recognition across 29 states, noting Maharashtra's 2,587 startups versus double-digit figures in northeastern states like Manipur, attributing slow progress to ecosystem immaturity.
- **Policy and Ecosystem Rankings**
- **States' Startup Ranking 2022 National Report (Startup India, 2024):** Evaluates 25 action points across states, with leaders like Gujarat and Karnataka excelling in funding and incubation, while laggards face policy intervention needs.
- **Indian Startup Ecosystem: Analysing Investment (ISEC Working Paper, 2023):** By FA Kamaluddin, links VC flows to state-level initiatives, noting success factors like government benefits but persistent regional imbalances.

### **3. Broader Ecosystem Appraisals**

- **An Appraisal of Startups in India (IERJ, recent):** Positions India third globally, yet critiques state-wise talent gaps, with urban centers drawing skilled labor from underrepresented areas.

## **DATA AND METHODOLOGY**

This study uses DPIIT’s recognized startup database, NITI Aayog innovation rankings, VC funding data, and state-level employment figures. Statistical analysis and mapping of startup density per capita, unicorn concentrations, talent indicators (education levels, research outputs), and startup growth trends from 2018 to 2025 are conducted to identify patterns and correlations.

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### **ANALYSIS AND FINDINGS**

- Maharashtra leads with over 5,800 tech startups, followed by Uttar Pradesh, Gujarat, Karnataka, and Tamil Nadu. These states account for more than 60% of total recognized startups.
- Unicorn startups (>95%) are concentrated in six states, including Karnataka, Haryana, Maharashtra, Delhi, Uttar Pradesh, and Tamil Nadu.
- Talent pools are richest in metropolitan hubs such as Bengaluru, Mumbai, Gurugram, and Delhi-NCR, supported by premier institutions (e.g., IISc, IITs) and policy frameworks.
- Eastern, northern, and northeastern states show significantly lower startup density despite having emerging talent, hampered by infrastructural deficiencies and lack of funding ecosystems.
- Startup ecosystems in Tier 2 and Tier 3 cities are growing but require tailored policies to scale.
- States like Kerala have high human capital but face institutional gaps in startup facilitation and tech transfer mechanisms.

### **DISCUSSION**

The disparity in startup density and talent distribution reflects underlying regional economic imbalances. Urban centers attract more investment and skilled professionals, perpetuating growth in some states and stagnation in others. Growth in less developed regions is possible through enhanced digital infrastructure, incubation facilities, financial incentives, and educational linkages. Special attention is needed for eastern and northeastern states to integrate them into the national innovation network.

### **CONCLUSION**

India's startup ecosystem shows promising growth but remains geographically skewed. Balanced regional development requires strategic policy actions and ecosystem strengthening beyond the current metro-centric model. Promoting equitable startup growth will contribute significantly to inclusive economic development and job creation.

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5. Industry reports by NASSCOM, 360 Analytika, India DataMap

## **INDUSTRIAL 4.0 TRANSITION AND ITS IMPACT ON CONSUMER BEHAVIOR: A SYSTEMATIC REVIEW**

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*Abstract: The advent of Industry 4.0, characterized by pervasive digitalization, advanced automation, and interconnected systems, has profoundly reshaped industrial landscapes and, consequently, consumer behavior (Teixeira, 2023). This paradigm shift, driven by global technological advancements, has created an innovation ecosystem that both influences and is shaped by evolving consumer expectations and interactions (Ece, 2023). This systematic review aims to synthesize the current literature on how the Fourth Industrial Revolution's disruptive technologies influence consumer attitudes, preferences, and decision-making processes.*

***Key Words: Digitalization, Advanced automation, Interconnected Systems, Consumer expectations***

### **Introduction**

The integration of cyber-physical systems, IoT, AI, and big data in manufacturing and industrial processes is referred to as "industrial 4.0." It makes it possible for smart factories to have self-optimizing production systems, automation, and real-time data exchange. This change results in faster time-to-market for customizable products as well as notable gains in manufacturing efficiency, flexibility, and quality control.

### **The Impact on Consumer behavior**

Adoption of Industry 4.0 technologies significantly alters consumer expectations and behavior in a number of ways like

- Customization: Customers are calling for goods and services that are specifically catered to their tastes. Businesses can provide personalized recommendations, marketing messages, and product variations without incurring additional costs thanks to AI-driven big data analysis.
- Improved Customer Experience: Virtual try-ons and product visualizations made possible by technologies like augmented reality boost customer confidence and engagement. IoT-based real-time inventory tracking also increases customer satisfaction and product availability.
- Increased Digital Engagement: The transition pushes manufacturers and retailers towards omni-channel strategies with e-commerce platforms and digital touchpoints, facilitating extensive consumer research before purchase and continuous post-purchase engagement through AI and virtual reality.

### **Objectives of the study**

- To determine the main forces behind changes in consumer behavior under Industrial 4.0 such as AI-driven personalization and data analytics.

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- To examine important technologies that allow for omni-channel engagement and personalized customer experiences, such as IoT and big data.
- To assess the effects of Industry 4.0 adoption on market performance, such as loyalty and efficiency.

**Literature Review**

- Pan et al. (2015) and Pejic-Bach et al. (2020) discuss network expansions, noting cybersecurity and public-private partnerships enhance connectivity between consumers, products, and industries.
- Frank et al. (2019) explore business model innovations, where servitization and Industry 4.0 converge to add value through design integration and workforce adaptation.
- Yadav et al. (2023) conducted a systematic review of 155 publications, identifying drivers like data mining, IoT, and AI as central to shifting consumer preferences toward customized products and online shopping.
- (Beheshti et al., 2023) assessed the most prevalent disruptive technologies of the past decade within this context, evaluating them from a dual perspective of technological advancement and consumer response.
- (Farooq & Yen, 2024) examines how artificial intelligence, a cornerstone of Industry 4.0, has permeated various aspects of consumer interaction, from personalized marketing to product evaluation.
- (Dangi & Jain, 2025) explains the integration of AI, for instance, has fundamentally altered how consumers engage with digital platforms and make purchasing decisions, prompting a re-evaluation of traditional adoption models.
- (Monteiro et al., 2024; Pagala et al., 2024) the deployment of AI in personalized marketing strategies has enabled companies to offer highly tailored experiences, significantly enhancing customer engagement and loyalty.

**Key Technologies Tables**

Technology	Consumer Impact	Key Reference
Big Data Analytics & AI	Personalized recommendations and marketing	Yadav et al. (2023)
IoT	Real-time tracking and interconnected experiences	Malik et al. (2021)
Augmented Reality	Virtual try-ons boosting engagement	PwC Survey (2019)
Robotics & Automation	Efficient supply chains for faster delivery	Saucedo-Martínez et al. (2017)
Cyber-Physical Systems	Smart factories enabling customization	Rymarczyk (2020)

**Consumer Engagement Metrics Table**

Metric	Pre-Industry 4.0	Post-Industry 4.0	Change Driver

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Technology usage	<50% multi-tech	90% at least one, 46% three+	4IR integration
Personalization Demand	Basic segmentation	Hyper-customized	AI/Big Data
Loyalty Impact	Standard retention	Enhanced via customization	Effective I4.0 implementation
Productivity Gains	Manual processes	Time savings reported	Automation

**Performance outcome table**

Outcome	Impact Level	Evidence
Marketing Performance	High via loyalty	PLS-SEM on 311 firms
Cost Reduction	0-30% in production/logistics	Bauernhansl et al.
Consumer Excitement	80%+ competitive edge	Business leader surveys
Adoption Barriers	Skill gaps in emerging economies	Yadav et al. (2023)

**Findings**

Industry 4.0 drives consumer behavior toward expecting seamless, data-informed personalization, with 90% of consumers using at least one related technology regularly. Effective implementation boosts marketing performance through product customization and loyalty, as shown in surveys of manufacturing firms. Challenges include skill gaps and cyber security, yet opportunities in supply chain visibility and smart products prevail across emerging and developed markets.

**Conclusions**

The transition amplifies consumer demands for tailored, efficient experiences, urging businesses to prioritize AI and IoT integration for sustained competitiveness. Policymakers should support Education 4.0 to bridge skill gaps. Future research must track long-term socioeconomic shifts in global contexts.

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**BEYOND AUTOMATION: HOW ARTIFICIAL INTELLIGENCE IS RESHAPING  
SKILLS, JOBS, AND WORKFORCE DYNAMICS IN INDIA'S ECONOMY 4.0**

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*Abstract: Global labour markets are being redefined by automation and artificial intelligence (AI), which has important ramifications for developing nations like India. Intelligent technologies are changing work processes, developing new job categories, changing labour dynamics across industries, and redefining skills as the country moves toward Economy 4.0. The impact of AI on India's labor ecosystem is examined in this chapter, with particular attention paid to job creation, sectoral transitions, skill shortages, displacement threats, and governmental solutions. The chapter also presents a conceptual model that explains the relationship between AI adoption, skill transformation, and workforce adaptability, building on international and Indian literature. The findings emphasize the necessity of digital infrastructure, inclusive skill development, and flexible policy frameworks to guarantee that India's labour force stays competitive and prepared for the future.*

*Keywords*

*Artificial Intelligence, Automation, Workforce, India, Skill Transformation, Labor Market*

## **Introduction**

Digitization, automation, machine learning, and sophisticated data systems are driving a significant technological revolution in India. This shift, also known as "Economy 4.0," represents a new economic paradigm in which AI-enabled technologies influence how various businesses function. Automation-driven displacement poses a growing threat to millions of people in regular physical and cognitive activities. On the other hand, the need for highly qualified personnel who can oversee and create AI systems keeps growing. India is committed to enhancing its digital capabilities, as seen by its ambitious projects like Digital India, Skill India, and the National AI Mission. However, there are major obstacles due to differences in technology uptake, school quality, and talent access, particularly between rural and urban areas. This chapter examines the potential and hazards associated with AI's impact on India's labour dynamics, workforce skills, and employment environment. Additionally, it presents a conceptual framework that explains how the adoption of AI causes skill changes, policy reactions, and job transformation.

## **Literature Review**

Global research has shown that automation and artificial intelligence have a double impact on labor markets: they create new employment while displacing existing ones. According to Acemoglu and Restrepo (2019), automation provides new positions in the digital, analytical, and creative sectors while decreasing the need for regular and repetitive employment. In a similar

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vein, the World Economic Forum (2023) projects that while technology will remove 85 million employments, it will create roughly 97 million new positions worldwide.

Literature in India recognizes the difficulties as well as possible advantages. If implemented effectively, AI might boost India's GDP by USD 500 billion by 2025, according to NITI Aayog (2022). In order to lower operating expenses and enhance decision-making, Indian IT organizations are progressively incorporating automation and AI tools into service delivery. AI adoption is prioritized in industries like healthcare, agriculture, manufacturing, and government, according to the Ministry of Electronics and Information Technology (MeitY, 2023).

However, studies also point to dangers. According to the International Labour Organization (2021), 80–85% of India's workforce works in the informal sector, where they are not exposed to technology and are particularly susceptible to disruptions caused by automation.

### **1. Expansion of New Job Categories**

AI is creating whole new jobs in industries like:

- Data science and analytics
- AI model development
- Cybersecurity
- Automation engineering
- Cloud architecture
- Robotics maintenance
- AI ethics & governance

These new careers are made possible by India's significant influence in software development and IT.

### **2. Increased Productivity and Operational Efficiency**

The processes in manufacturing, logistics, healthcare, education, and finance are streamlined by AI-driven predictive analytics, machine learning algorithms, and robotic automation systems. Examples consist of:

- Automated loan processing in BFSI
- Robotic welding in automotive manufacturing
- AI-based patient diagnosis in hospitals
- Inventory optimization in retail

### **3. Upskilling and Reskilling Ecosystem Growth**

Government and private organizations are increasingly offering AI-focused training programs. Examples:

- Skill India AI modules
- TCS iON digital learning programs
- Infosys Lex AI upskilling platform
- NASSCOM FutureSkills Prime

These contribute to a more future-ready workforce.

### **4. Sectoral Transformation**

#### **Healthcare**

AI-enabled scans, diagnostic tools, telehealth services, and predictive models improve healthcare access and efficiency.

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**Retail:** AI manages supply chains, predicts demand, personalizes shopping, and automates warehouses.

**Agriculture:** AI tools forecast weather, analyze soil health, and guide precision farming.

### **Manufacturing**

Industry 4.0 technologies deploy robotics, digital twins, and intelligent quality checks.

Challenges

#### **1. Job Displacement Risk**

Millions employed in routine-heavy sectors (retail sales, manufacturing assembly, transport driving, BPO voice support) face medium to high automation risk.

#### **2. Digital Skill Gaps**

A large portion of India’s workforce lacks computational skills, digital literacy, or AI awareness.

#### **3. Informal Sector Vulnerability**

Informal workers lack training access, legal protection, and automation-resistant skills.

#### **4. Ethical, Social, and Gender Issues**

Potential risks include:

- Algorithmic bias
- Worker surveillance through AI tools
- Wage suppression
- Limited digital access for women

Conceptual Model

The conceptual model below illustrates the relationship between AI adoption and workforce outcomes in India.

**AI Adoption → Work Process Transformation → Skill Shifts → Job Creation /  
Job Displacement → Policy Intervention**

### **Explanation of Components**

- **Adoption of AI:** Including intelligent tools in processes.
- **Work Process Transformation:** Automation of repetitive tasks and modifications to operational structures.
- **Skill Shifts:** There is a greater need for socio-technical, digital, analytical, and cognitive skills.
- **Labor market outcomes:** Include both job displacement (routine jobs) and employment creation (new tech roles).
- **Workforce Adaptation:** Industry and governmental reactions such as policy assistance, incentives, and training.

Table 1: AI Impact Across Major Sectors in India

Sector	Opportunities	Risks
IT/ITeS	Automation of services; new AI roles	Skill mismatch
Manufacturing	Robotics, predictive maintenance	Job displacement

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Retail	Personalization, automated inventory	Reduced low-skill jobs
Healthcare	AI diagnostics, telemedicine	Data privacy issues
Agriculture	AI forecasting, smart irrigation	Low digital adoption

### **Policy Interventions**

India has implemented several initiatives to support AI-enabled workforce transformation:

- **Digital India Mission** — expands digital access & literacy
- **Skill India Mission & PMKVY** — provides skill development for emerging technologies
- **National AI Mission (N-AIM)** — focuses on AI R&D and adoption
- **AIRAWAT (NITI Aayog)** — national AI compute infrastructure
- **PLI Schemes** — incentivize adoption of automation in manufacturing

These policies aim to equip workers with the right capabilities and ensure AI adoption does not widen inequality.

### **Discussion**

India is situated at a special crossroads of possibilities and difficulties. Although AI has the potential to boost GDP growth, increase competitiveness, and provide new job categories, the nation must immediately address:

- Digital literacy gaps
- Unequal access to training
- Rural–urban technological divide
- Lack of awareness about AI-based jobs
- Gender-based digital exclusion

To reap the advantages of AI-driven transformation, a well-rounded strategy that incorporates education reforms, ecosystems for ongoing learning, and protective labor laws is necessary.

### **Conclusion**

Automation and artificial intelligence are major forces behind India's shift to Economy 4.0. They provide substantial chances for innovation, productivity, and new jobs, but they also carry hazards of job displacement and skill obsolescence. India's capacity to invest in digital skills, bolster technology-driven education, and guarantee equitable access to opportunities will determine the country's workforce in the future. How well India adjusts to an AI-driven future will depend on proactive policy action and robust industry-government cooperation.

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**DRIVING INDIA’S ECONOMY 4.0 THROUGH SMART URBAN INFRASTRUCTURE**

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Abstract: India is undergoing a rapid urban transformation driven by its population growth, digitalization, and economic aspirations. In this backdrop, the Smart Cities Mission and larger urban development initiatives have emerged as crucial pillars in preparing the country for Economy 4.0—a technology-intensive, data-driven, and innovation-led economic paradigm. The paper begins with a study of how smart urban infrastructure acts as a catalyst for Economy 4.0 in India. It undertakes an investigation into the conceptual linkage between smart cities and Economy 4.0, followed by an analysis of key components of smart urban infrastructure, highlights certain Indian smart city initiatives, and discusses opportunities and challenges concerning their implementation. The paper concludes that though India has made considerable progress in laying the base for smart and future-ready cities, governance, digital divide, financing, capacity building, and inclusive development are some issues which would need to be addressed if infrastructure has to play the role of a driver for Economy 4.0.

Key Words: Smart Cities, Urban Development, Economy 4.0, Digital Infrastructure, E-Governance, Sustainable Urbanization, India

**Introduction**

India is registering one of the fastest rates of urbanization in the world. A growing share of the population is moving to towns and cities in search of employment, education, and better living standards. At the same time, the global economy is transitioning towards Economy 4.0, an ecosystem shaped by technologies such as Artificial Intelligence (AI), Internet of Things (IoT), Big Data, Automation, Cloud Computing, and Advanced Analytics. In this backdrop, cities are no longer mere centers of population; they are veritable engines of innovation, productivity, and technological adoption.

Recognizing the strategic importance of urban spaces, Government of India initiated the Smart Cities Mission to encourage sustainable and citizen-centric urban development. The core philosophy is that the smart infrastructure—physical, digital, and social—can improve quality of life, enhance service delivery, and create favorable conditions for innovation-driven growth. Thus, infrastructure is no longer perceived merely as roads, buildings, and utilities but as an integrated network supported by data, connectivity, and intelligent systems.

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This paper on “Smart Cities and Urban Development in India: Infrastructure as a Driver for Economy 4.0” aims to analyze how smart infrastructure contributes to India's readiness to move towards a technology-driven economy. It explores the conceptual framework, key components, practical examples, opportunities, and challenges in the Indian context.

### **Conceptual Framework**

#### *Smart Cities*

A smart city can be broadly defined as an urban area that leverages technology, data and innovation to enhance the quality of life of citizens, improve efficiency in service delivery, promote sustainability and support inclusive growth. Smart cities focus on smart governance, smart mobility, smart environment, smart people, smart living and smart economy. In India, the Smart Cities Mission emphasises area-based development and pan-city initiatives, aiming to retrofit, redevelop and greenfield development of urban spaces using smart solutions.

#### *Economy 4.0*

Economy 4.0 refers to an economic model where growth and competitiveness are driven by digitalisation, interconnected systems and knowledge-based activities, often linked with Industry 4.0. Key features include the extensive use of digital platforms and e-commerce, data-driven decision-making through big data and analytics, automation and AI-based systems, integration of physical and digital systems through IoT, and an emphasis on innovation, creativity and human capital.

#### *Infrastructure as an Enabler*

Infrastructure in Economy 4.0 is not only physical (roads, power, transport) but also digital infrastructure, institutional infrastructure and social infrastructure. Smart cities provide a platform where these different forms of infrastructure converge, enabling businesses, governments and citizens to interact more efficiently and participate in the digital economy.

### **Smart Urban Infrastructure in India**

#### *Digital Connectivity and ICT Infrastructure*

Digital connectivity is the backbone of smart cities. High-speed internet, Wi-Fi hotspots, fibre optic networks, public digital kiosks and sensor-based systems are essential for enabling real-time communication and data collection. In many Indian cities selected under the Smart Cities Mission, initiatives such as Integrated Command and Control Centres (ICCCs), city-wide Wi-Fi networks, smart poles with Wi-Fi and surveillance, and online service portals and mobile apps have been introduced to support smarter governance, traffic control, emergency response and public safety.

#### *Smart Transport and Mobility*

Urban transport is a critical determinant of productivity in cities. Smart cities in India are increasingly adopting intelligent traffic management systems, GPS-enabled public transport, smart parking solutions, digital ticketing and payment systems, and infrastructure for non-motorised transport such as bicycle tracks and pedestrian-friendly zones.

#### *Sustainable Utilities and Smart Environment*

Infrastructure for water supply, sewage, waste management and energy is being upgraded through smart solutions such as smart meters for electricity and water, IoT-based monitoring of leakage and theft, sensor-based solid waste management, and renewable energy integration through solar rooftops and energy-efficient street lighting.

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### *E-Governance and Citizen Services*

A key aspect of smart urban development in India is the shift toward e-governance and digital service delivery. Many urban local bodies now offer online payment of taxes and utility bills, digital grievance redressal systems, online building plan approvals and property registrations, and mobile applications for citizen feedback and service tracking.

### **Smart Cities as Drivers of Economy 4.0**

#### *Enabling Digital Businesses and Startups*

Cities with strong digital infrastructure attract technology startups, fintech firms, e-commerce companies and IT-enabled services. The availability of high-speed internet, co-working spaces, incubation centres and digitally skilled talent creates a conducive environment for innovation and entrepreneurship.

#### *Data-Driven Decision-Making*

The deployment of sensors, CCTV cameras, GPS systems and online platforms in smart cities generates huge volumes of data. When analysed properly, this data can provide insights into traffic patterns, energy consumption, public health trends and citizen preferences. Data-driven decision-making enables evidence-based urban planning and better resource allocation.

#### *Enhancing Human Capital and Skills*

Smart cities usually have a higher concentration of educational institutions, training centres and digital literacy programmes. Exposure to smart infrastructure encourages citizens to adopt new technologies and develop relevant skills, strengthening the human capital base, which is vital for competing in the global digital economy.

#### *Promoting Sustainable and Inclusive Growth*

Economy 4.0 places emphasis not just on growth, but on sustainability and social inclusion. Smart city initiatives in India increasingly integrate affordable housing projects, accessible public transport, green and open spaces, and environmental monitoring and climate resilience measures.

### **Case Illustrations of Smart Urban Development in India**

Several Indian cities under the Smart Cities Mission have implemented notable projects. Pune has developed an integrated command and control centre, smart traffic systems and citizen-centric mobile applications. Ahmedabad and Surat have focused on smart transport solutions and digital governance platforms. Bhubaneswar has emphasised child-friendly and inclusive urban design along with ICT-based management systems. Visakhapatnam and Vijayawada have taken initiatives in solid waste management, smart street lighting and e-governance.

### **Updated Recent Data for Smart Cities Mission (as of 2025)**

<b>Indicator</b>	<b>Latest Data / Status</b>
Number of selected smart cities	100 (ETGovernment.com)
Total number of projects sanctioned	8,063 projects, total sanctioned investment ≈ ₹ 1.64 lakh crore (ETGovernment.com)
Number of projects completed (till July 31, 2025)	7,636 projects completed, amounting to ~ ₹ 1.53 lakh crore (ETGovernment.com)
Approximate % of projects completed	~ 95% of total projects completed (ETGovernment.com)

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Areas of infrastructure and services implemented (among many)	— All 100 cities have operational Integrated Command and Control Centres (ICCC) — Over 84,000 CCTV surveillance cameras installed across 100 cities (Manorama Yearbook) — More than 17,000 km of water supply network under SCADA monitoring (Manorama Yearbook) — Approx. 1,740 km of “smart roads” built or improved, and 713 km of cycle tracks developed (Manorama Yearbook)
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**Challenges in Using Infrastructure as a Driver for Economy 4.0**

*Financial and Investment Constraints*

Large capital investments are required for smart infrastructure projects such as ICT networks, sensor installations, modern transport systems and sustainable utilities. Urban local bodies often face limited own revenue, dependence on state and central grants and difficulties in leveraging private participation.

*Governance and Coordination Issues*

Smart city projects involve multiple stakeholders: municipal corporations, state governments, central agencies, private technology providers and citizens. Lack of coordination, bureaucratic delays and weak institutional capacity can slow down implementation and maintenance of projects.

*Digital Divide and Social Exclusion*

A significant portion of the urban population, especially in informal settlements, may lack access to smartphones, internet connectivity or digital literacy. As services move online, there is a risk that marginalised groups could be excluded from accessing essential services or participating in decision-making processes.

*Data Privacy and Security Concerns*

The extensive use of surveillance systems, sensors and data platforms raises questions about privacy, data protection and cybersecurity. Clear policies on data governance, ethical use of AI and citizen consent are necessary in a smart city ecosystem.

*Sustainability and Maintenance*

Smart infrastructure requires regular maintenance, upgrades and capacity building. There is a risk that projects may remain at the pilot stage or become non-functional over time if not supported by proper operation and maintenance frameworks.

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### **Policy Implications and the Way Forward**

To strengthen the role of smart urban infrastructure as a driver of Economy 4.0 in India, several policy measures are important: strengthening urban governance, enhancing financing mechanisms, promoting digital inclusion, focusing on capacity building, ensuring data governance and security, and integrating sustainability goals.

### **Conclusion**

Smart cities represent a transformative approach to urban development in India, where infrastructure is not just about physical assets but about intelligent, connected and citizen-centric systems. By integrating digital technologies, sustainable practices and innovative governance models, smart cities create the conditions necessary for the emergence of Economy 4.0. Overall, the experience of smart cities in India suggests that infrastructure can act as a powerful driver of Economy 4.0, provided that policies are inclusive, institutions are strengthened and citizens are actively involved.

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**THE INFLUENCE OF TRANSFORMATIONAL LEADERSHIP ON EMPLOYEE  
MOTIVATION DURING INDIA’S DIGITAL TRANSFORMATION TOWARD  
ECONOMY 4.0**

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**Abstract:** The digital transformation of workplaces, automation and new technologies have been changing the work environments in organizations in India greatly, as it builds towards Economy 4.0. Transformational leadership in this context is now important in maintaining employee motivation and interest. This paper will explore the effect of the transformational style of leadership behaviours, which include idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration as ways of motivating employees to overcome technological disruptions. The study applies Structural Equation Modeling (SEM) and Chi-Square tests to examine the relationships between leadership style, motivation, and moderating factors of digital transformation using 200 employees working in the IT and technology-enabled industries to obtain its quantitative results. Results show that transformational leadership has a positive influence on employee motivation through reducing technological anxiety, promoting flexibility, and enhancing trust in digital transitions. The study has indicated that human-centric leadership is vital in helping with workforce resilience in the Indian economic 4.0 journey. There are also implications on policy, management and future preparedness.

**Keywords:** Transformational Leadership, Employee Motivation, Digital Transformation, Economy 4.0, Workforce Adaptability, Technological Change, Leadership Behaviour.

**INTRODUCTION**

The accelerated digital transformation in India is a historic move toward Economy 4.0, due to artificial intelligence, automation, cloud computing, IoT, data analytics, etc. This shift is transforming workforce demands, operational processes and organization structures of various industries. Technological preparation is important, but human preparation has proved to be a crucial factor of effective digital transformation. The current employees are experiencing unprecedented changes such as pressure to use technology, the risks of becoming obsolete in a skill, performance demands, and changing job descriptions that are pushing the boundaries of motivation and engagement.

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Transformational leadership has become a significant style of leadership in such an environment that is able to lead a team through uncertainty. Transformational leaders share vision, foster innovation, instil trust, and facilitate personalized development, which are critical in the event of a significant change in technology in a large scale. Transformational leaders contribute to psychological safety and resiliency to make employees accept change instead of oppose it.

During digital transformation, employee motivation, which is an important factor of productivity and competitive advantage, is easily broken. Employees can be demotivated because of the fear of automation, shifting competencies, and altered workflows. Nevertheless, strong leadership is able to moderate such problems by strengthening purpose, offering clarity, and encouraging ongoing learning. The digital transformation of India creates a special opportunity to study these dynamics, especially in the areas of IT, services, manufacturing, and the public sphere where the Economy 4.0 initiatives are gaining momentum.

The paper investigates the role of transformational leadership in motivating employees in the digital economy of India. It researches the way in which leadership behaviours alleviate transformation stress and uncertainty brought about by technology. This study has been able to give empirical evidence on the role of leadership in maintaining motivation amid technological change through structural analysis; SEM test and Chi-Square testing based on a sample of 200 employees. The paper is both theoretically and practically relevant as it will provide leaders, HRM practitioners, and policymakers with a way to create a future-oriented workforce.

### **LITERATURE REVIEW**

- **FBJ (2020)** discovered that transformational leadership correlates positively with intrinsic motivation of employees with a significant positive relationship and less burnout, since TL, in this case, has a direct positive motivational effect on organizational outcomes with meaningful work and perceived responsibility.
- **Yousef, Khan and Paracha (2022)** have shown that inclusive leadership enhances team performance in both perceived workgroup inclusion and a climate of psychological safety, which indicates that behaviours by the leaders that promote inclusion, strengthen the psychological context that facilitates motivation.
- **Li and Peng (2023)** explored the topic of inclusive leadership and demonstrated that it contributed to employee psychological resilience through perceived insider status and favourable organizational climate — indicating that climate and perceived belonging are two mediator variables that maintain motivation during change.
- **Jun et al. (2023)** investigated the influence of transformational leadership on innovative/creative behaviour of followers and identified that commitment to change mediated the TL to innovation relationship and reiterated the motivational impact of leaders during change in an organization.
- **Dongxian & Batool (2024)** examined the issue of distributed leadership and discovered that psychological empowerment mediates the impact of shared leadership on innovative behaviour with references to the empowerment as a cross-style mediator (when considering TL and distributed solutions in the digital work environment).
- **Kaya (2024)** found that melodramatically, creativity is promoted by transformational leadership through the indirect effect of job satisfaction and professional resilience among educators - an indication that TL establishes psychological buffers that consequently increase the motivation to engage in creativity.