Research Paper

EPRA International Journal of Economic and Business Review-Peer Reviewed Journal
Volume - 14, Issue - 1, January 2026 | e-ISSN: 2347 - 9671| p- ISSN: 2349 – 0187

SJIF Impact Factor (2025): 8.862 || ISI Value: 1.433 || Journal DOI URL: https://doi.org/10.36713/epra2012

TECHNOLOGICAL INNOVATION AND INDUSTRIAL COMPETITIVENESS IN INDIAN MANUFACTURING: AN EMPIRICAL ANALYSIS

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ABSTRACT DOI No: 10.36713/epra25703 Article DOI: https://doi.org/10.36713/epra25703

Technological innovation has emerged as a critical determinant of industrial competitiveness in manufacturing-based economies. In the context of India's manufacturing sector, increasing global competition and rapid technological change have necessitated continuous innovation to enhance productivity, efficiency, and market performance. This study empirically examines the relationship between technological innovation and industrial competitiveness in Indian manufacturing. Using secondary data drawn from published industrial statistics and firm-level indicators, the study analyzes the impact of research and development intensity, technology adoption, and innovation activities on key measures of industrial competitiveness, including productivity, output growth, and export performance. The analysis employs descriptive statistics and econometric techniques to assess the strength and direction of the relationship between innovation variables and competitive performance. The findings reveal that technological innovation significantly improves industrial competitiveness by enhancing production efficiency and facilitating value addition in manufacturing industries. The study further highlights the role of policy support, infrastructure, and skill development in fostering innovation-led industrial growth. The paper concludes that strengthening innovation ecosystems and promoting technology diffusion are essential for sustaining the long-term competitiveness of Indian manufacturing in the global market.

KEYWORDS: ***Technological Innovation, Industrial Competitiveness, Manufacturing Sector, Productivity, India***

I. INTRODUCTION

Manufacturing has increasingly become a key driver of India's economic expansion, contributing nearly 16–17 per cent to the country's gross domestic product and providing employment to more than 27 million people. The robustness of the sector is reflected in the strong performance of major industries such as automobiles, engineering goods, chemicals, pharmaceuticals, consumer durables, electronics, and textiles. With policy support through initiatives such as Make in India and the Production-Linked Incentive (PLI) schemes, the government aims to raise the share of manufacturing to 25 per cent of GDP in the coming years. Technological advancement has significantly transformed the structure and functioning of Indian manufacturing. While the sector was traditionally centered on machine tools, it is now increasingly characterized by automation, digitalization, and process-oriented production systems. The adoption of digital technologies has enhanced innovation capabilities, improved operational efficiency, and strengthened the global competitiveness of Indian manufacturers. This positive momentum was evident in July 2025, when the HSBC India Manufacturing Purchasing Managers' Index (PMI) reached a 16-month peak of 59.1, supported by the strongest growth in factory orders in almost five years.

India is also strengthening its position within specialised segments of global value chains. The country has the potential to supply nearly 10 per cent of global wind energy demand by 2030, supported by its expanding capacity in wind power component manufacturing. In the electronics sector, domestic value addition has increased from about 30 per cent to nearly 70 per cent and is expected to reach 90 per cent by FY27. Major multinational firms, including Apple, have expanded their manufacturing presence in India, leading to a rise in smart phone exports to 22.9 million units in the first half of 2025, compared to 15 million units during the same period of the previous year. Owing to its abundant labour force and cost advantages, India is increasingly viewed as a competitive alternative to China for advanced technology manufacturing, as noted by the World Bank.

II. REVIEW OF LITERATURE

Dalnar K,S (2025) Existing studies highlight technological innovation as a key driver of productivity enhancement and competitive advantage in manufacturing firms, particularly through process and product innovation. Recent literature on digital transformation emphasizes the role of digital capabilities—such as automation, data analytics, and interconnected production systems—in improving operational efficiency and market responsiveness. Research further suggests that firms integrating Industry 4.0 technologies demonstrate higher flexibility and stronger participation in global value chains. However, most empirical studies focus on developed economies or examine technological innovation and digitalization independently, offering limited insights into their combined effect in emerging markets like India. Scholars also identify firm size, skill availability, and investment capacity as major constraints influencing technology adoption. Consequently, there remains a research gap in understanding how the synergy between technological innovation and digital capability shapes the global competitiveness of Indian manufacturing firms.

Abhijeet Sudhanshu and etc.al.(2024), This study reviews the concept of Industry 4.0 and its role in transforming Indian manufacturing industries. It explains how digital technologies are changing traditional factories into smart factories. Based on a survey of 73 Indian industries, the study highlights that customer satisfaction and product quality are the main priorities. Most industries are still using Industry 3.0 technologies, while awareness and adoption of Industry 4.0 remain limited, especially among small and medium enterprises. The paper identifies gaps in technology usage and suggests a clear roadmap for Industry 4.0 adoption. Overall, the study shows that embracing Industry 4.0 can improve competitiveness and support long-term growth of Indian industries.

Min, ting and sanfeng Z (2025) this study reviews how technological innovation helps reduce energy use in manufacturing industries in China and India. Using World Bank survey data from 2011–2013, it shows that better innovation capability can lower a firm's energy intensity. The results indicate that energy use falls significantly as innovation levels increase, but this effect is strong only in Chinese firms, not in Indian firms. Large and capital-intensive enterprises benefit more from innovation-led energy savings. The study explains that higher production efficiency and flexible operations are key reasons for reduced energy use. Overall, the paper highlights the importance of technology-driven green growth in emerging economies.

III. OBJECTIVES OF THE STUDY

1. To analyze the impact of technological innovation on the competitiveness of Indian manufacturing firms.
2. To assess the challenges faced by Indian manufacturing industries in adopting advanced technologies.
3. To suggest policy and managerial measures to strengthen technological innovation and enhance industrial competitiveness in India.

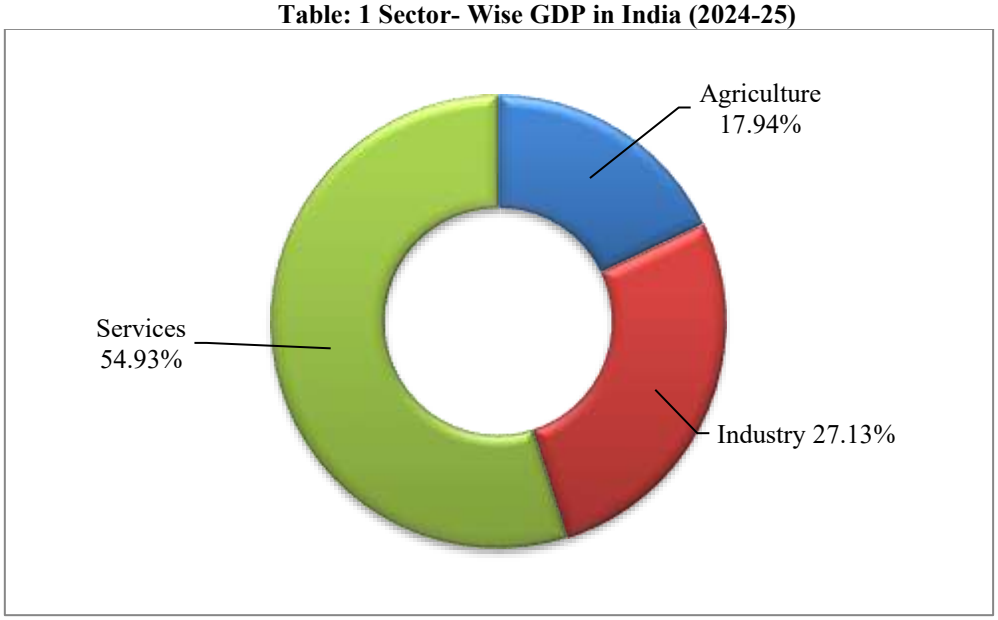
IV. RESEARCH METHODOLOGY

This study uses a descriptive and analytical research design based on secondary data. It examines the role of technological innovation, smart technologies, and public policy in improving competitiveness and reducing production costs in Indian manufacturing. Data are collected from government reports, policy documents, and official statistics. Academic books, research papers, and peer-reviewed journals on innovation and industrial competitiveness are also used. Additional information is taken from authentic online databases, industry reports, and reputed news portals.

V. RESULT AND DISCUSSIONS

The imbalance among the major sectors of the Indian economy in terms of their contributions to national output has long been a matter of considerable concern. Over the years, the share of the industrial sector has remained relatively stagnant, while the services sector has expanded rapidly and the agriculture sector's share has continued to shrink. Historically, agriculture once dominated the economy, but structural transformation has shifted output toward services. As per recent estimates for FY 2024–25, agriculture and allied activities accounted for approximately 17.94 percent, industry contributed about 27.13 percent, and the services sector constituted around 54.93 percent of India's gross value added (GVA), reflecting the relative stagnation of the industrial sector and the sustained dominance of services in GDP composition. In terms of growth rates for FY25, the agriculture sector is projected to grow moderately, reflecting improved performance compared with previous years, while industry and services are expected to grow at relatively higher rates, driven by robust domestic demand, investment activity, and technological adoption across services and industrial segments.

Table: 1 Sector- Wise GDP in India (2024-25)



Source: Ministry of Statistics and Programmer Implementation 2025

❖ India as an Attractive Manufacturing Destination

India offers strong advantages for establishing manufacturing units. As the world's fifth-largest economy, it is also expected to become one of the largest consumer markets by 2025, providing a large domestic demand. The country has a young workforce, with a significant share of the population aged between 18 and 35 years.

India's long coastline, extensive port network, and growing port capacity support trade and logistics. In addition, India follows major international intellectual property agreements and has improved legal frameworks for faster dispute resolution. Recent reforms, including lower corporate taxes, increased foreign direct investment, and reduced compliance requirements, have further improved the manufacturing environment. Overall, India provides a supportive and attractive ecosystem for manufacturing growth.

❖ Advantages of FDI in India's Manufacturing Sector

- **Employment generation and skill development:**
  Foreign direct investment creates job opportunities for both skilled and unskilled workers. It also helps workers gain new skills through training, modern technology, and improved production practices.
- **Infrastructure development**
  FDI in manufacturing supports the growth of infrastructure such as industrial parks, roads, power supply, and logistics. It helps transform underdeveloped regions into industrial hubs, contributing to local economic and social development.
- **Exchange rate stability:**
  A regular inflow of foreign investment strengthens India's foreign exchange reserves. This supports the stability of the Indian rupee and helps the Reserve Bank of India manage exchange rate fluctuations.
- **Growth in export**
  Increased manufacturing activity through FDI leads to higher production of goods for global markets. This results in a rise in exports, increased foreign earnings, and improved trade performance.

❖ Future Growth Potential of the Indian Manufacturing Industry

- India's manufacturing sector is witnessing steady growth and diversification. The country has long been a strong performer in industries such as automobiles, pharmaceuticals, textiles, and electronics. Between April 2000 and December 2023, significant foreign direct investment flowed into manufacturing sectors including automobiles, chemicals, and pharmaceuticals. Government initiatives like the Production Linked Incentive (PLI) schemes have further strengthened the sector by attracting large investments and boosting exports, particularly in electronics, pharmaceuticals, food processing, and telecom equipment manufacturing.
- Policy support and institutional initiatives are enhancing the competitiveness of Indian manufacturing. Programs led by the Ministry of Heavy Industries, such as SAMARTH Udyog Bharat 4.0, aim to modernize production systems and strengthen the capital goods sector. At the same time, new growth opportunities are emerging in areas like electric vehicles, semiconductor manufacturing, space technology, agritech, and waste management. The adoption of advanced technologies such as Industry 4.0, artificial intelligence, the Internet of Things, and 3D printing is transforming production processes, making India an attractive destination for future manufacturing investments.

❖ From "Make in India" to "Made in India"

Strong domestic consumption and expanding export opportunities have placed India among the most attractive manufacturing destinations globally. A key driver of this transformation is the Make in India initiative, launched in 2014, which has played a pivotal role in strengthening India is manufacturing ecosystem. Together with the Atmanirbhar Bharat Abhiyan and the Production Linked Incentive (PLI) scheme, this initiative has significantly reinforced India's standing as an emerging global manufacturing powerhouse.

While Atmanirbhar Bharat emphasizes self-sufficiency, the PLI scheme—with a total allocation of ₹1.97 lakh crore—seeks to

enhance domestic manufacturing capabilities across 14 strategic sectors. Prime Minister Narendra Modi's vision of Make in India aims to position the country as a global center for manufacturing, design, and innovation, covering 27 sectors such as defense production, electronics, and textiles.

Concrete outcomes of these initiatives are already visible. The Tata Group is establishing India's first semiconductor fabrication unit in Dholera, Gujarat, with an investment of around $11 billion. Apple Inc. has scaled up its manufacturing operations in India, with production reaching nearly $14 billion, displaying a major success of the Make in India program on the global stage. Similarly, luxury automobile manufacturer Mercedes-Benz has announced an investment of ₹200 crore to introduce 12 new models in 2024. In the defence sector, the impact has been particularly significant, with exports rising by approximately 32% in FY 2023–24, crossing the ₹21,000 crore mark.

Across the country, several cities have emerged as dynamic manufacturing hubs for automobiles, petrochemicals, pharmaceuticals, and other industries. At the same time, the central government continues to nurture entrepreneurship and production-led growth nationwide. Progressive tax reforms, forward-looking policies, rising foreign direct investment, and an increased emphasis on sustainable technologies are expected to keep India's manufacturing sector on a strong growth path, potentially exceeding the projected growth rate of 8%.

VI.CONCLUSION

The manufacturing sector has emerged as a crucial pillar of India's economic transformation, with increasing contributions to output, employment, exports, and technological advancement. Although the share of industry in GDP has remained relatively stagnant compared to the rapid expansion of the services sector, recent policy initiatives, rising foreign direct investment, and accelerated adoption of advanced technologies indicate a renewed momentum in manufacturing growth. Government-led programs such as Make in India, Atmanirbhar Bharat Abhiyan, and the Production Linked Incentive (PLI) schemes have created a supportive policy environment that encourages domestic production, strengthens global value chain integration, and enhances India's attractiveness as a manufacturing destination.

Overall, India's journey from "Make in India" to "Made in India" signifies a strategic shift toward value-added, innovation-led, and globally competitive manufacturing. With sustained policy support, continued investment in skills and infrastructure, and deeper integration of technological innovation, the manufacturing sector can play a transformative role in correcting structural imbalances in the economy. Strengthening industrial competitiveness will not only enhance export performance and employment generation but also ensure inclusive and sustainable economic growth, positioning India as a resilient and reliable manufacturing hub in the global economy.

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