A Review on Industry 4.0 Strategy and its Awareness among Punjab Industries to Build Smart Manufacturing Units

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ABSTRACT:

This study examines the degree of Industry 4.0 maturity among Small and Medium Enterprises (SMEs) in a few districts of Punjab, India. Industry 4.0, also known as the fourth industrial revolution, is integrating digital intelligence technologies like robotics, artificial intelligence (AI), big data analytics, and the Internet of Things (IoT) to fundamentally transform industries. The purpose of this research is to evaluate Punjab's business digitalization as well as the region's preparedness and reaction to the developments in smart manufacturing. The role of cyber-physical production systems in changing manufacturing processes and managing massive data volumes for business intelligence and decision-making are covered in the findings and discussion section. The report also examines India's aspirations to boost the GDP contribution of the manufacturing sector and its ranking as the world's digital economy.

Keyword: *Industry 4.0, Smart Manufacturing, Digital Intelligence Technologies, SMEs in Punjab, Cyber-Physical Production Systems, Artificial Intelligence in Manufacturing, Internet of Things (IoT), Big Data Analytics*

1. Introduction

Industry 4.0 refers to the integration of digital intelligence technologies in industrial operations, manufacturing, and marketing, to optimize business processes' efficiency and efficacy. Numerous technologies are incorporated into this evolution, including robotics, automation, big data analytics, artificial intelligence (AI), and industrial Internet of Things (IoT) networks. There's a big push in Punjab to connect the Industry 4.0 revolution with the state's economic development. Adopting cutting-edge technology is prioritized in order to boost the steel plant sector and subsequently support the state's overall economic development.

1.1 Background of the Research

By encouraging the growth of smart factories, which in turn promotes industrial stability and economic growth, the state government of Punjab is playing a critical role in this transformation. This strategy not only encourages a sharp increase in factory productivity but also facilitates the sharing of specialized knowledge among different steel companies, which results in a notable improvement in the quality of the production line. The use of autonomous digital technologies in production lines is central to the concept of Industry 4.0. In 2011, Bosch first presented this idea at the Hannover Fair in Germany (Pfeiffer, 2017). Businesses, academics, and policymakers have shown a great deal of interest in Industry 4.0 since its launch. Being one of the first countries to adopt this idea, the German government included it in their national strategy as part of the "High-Tech Strategy 2020 Action Plan" (Cugno, Castagnoli and Büchi, 2021).

1.2 Objectives

1. To evaluate how industry 4.0 strategy, create the enterprise fully digitalized.

2. To analysis the awareness among Punjab industries to build smart manufacturing units and factories by using advanced technologies

2. Literature review

- **Industry 4.0 Strategic Effects to improves the Industrial Digitalization of Punjab**

One sizable and varied economic sector in Punjab is the automotive component industry. This industry is located throughout the state and is made up of a huge, complex network of suppliers from the formal and unofficial sectors. The formal sector, also known as the "organized sector," comprises Original Equipment Manufacturers (OEMs) that produce precision automotive parts and systems, and this is the case in Punjab as well as the rest of India (Unido, 2021). The primary industries served by the informal or "unorganized" sector are aftermarket services and non-automotive industrial sectors.

Like other regions of India, Punjab's industry is primarily composed of Micro, Small, and Medium-Sized Enterprises (MSMEs), which are essential to the growth of the state's economy (Bisht, Singh and Sandhu, 2021). The automotive component industry in Punjab has many subsectors that are similar to those in India as a whole. With the "Make in India" campaign, the Punjab state government has been aggressively promoting the manufacturing sector and has seen a notable shift in favor of technological advancement (Gita, 2022). This program is essential for adopting the Industry 4.0 revolution in manufacturing as well as the automobile industry, which is vital to the state's economic growth.

The steel industry in Punjab, especially in Ludhiana, has been facing difficulties lately, which has resulted in the closure of more than 100 units (TimesofIndia, 2021). But with the use of Industry 4.0 technologies, there's fresh optimism for revival. The Metal Scrap Trade Corporation's initiative is a significant development that is contributing to this revival (Tribuneindia, 2022). This company has launched an online marketplace called MSTC Metal Mandi which offers a centralized venue for the buying and selling of iron and steel scrap. This platform is a big step toward bringing the industry up to date and making it compatible with the newest tech trends.

- **Awareness among Punjab industries to adopt and implement smart technologies to build develop manufacturing units, factories**

The Punjabi industry is becoming more and more conscious of the need to embrace and apply smart technologies in order to advance and improve factories and manufacturing facilities (Tribuneindia, 2022). The global trend of Industry 4.0, which emphasizes the use of digital and smart technologies in industrial operations, is what prompted this shift towards modernization and technological integration. Realizing the potential of these developments, Punjab's industrial sector is concentrating more and more on incorporating technologies like robotics, big data analytics, "artificial intelligence (AI)", and the "Internet of Things (IoT)". The goal of this action is to increase manufacturing's competitiveness, productivity, and efficiency.

In Punjab, as in the rest of India's manufacturing sector, the use of smart manufacturing technologies is a developing trend. Globally, the necessity of cutting-edge technology to maintain competitiveness is becoming more widely acknowledged (Trade.gov, 2022). Nearly half (44%) of manufacturers in the Asia-Pacific area, which includes India, intend to implement smart manufacturing within the next 12 months (ETCIO.com, 2021). Some smart manufacturing components are already being used in 59% of Indian manufacturing projects. Similar trends are seen in the 8th Annual State of Smart Manufacturing Report, where 97% of participants said they are currently using or plan to use smart manufacturing technology in the upcoming one to two years. This widespread adoption points to a substantial shift in manufacturing practices toward the higher-tech ones, which is probably indicative of the circumstances in Punjab as well.

- **Theoretical overview**

The current revolution in manufacturing processes is largely dependent on the integration of smart technologies in manufacturing, also known as Industry 4.0 or the fourth industrial revolution. The integration of cutting-edge digital technologies such as robotics, big data analytics, artificial intelligence (AI), and the Internet of Things (IoT) characterizes this era. These technologies significantly increase automation, boost productivity, and make data-driven decision-making easier. Traditional manufacturing techniques are being redefined by this evolution into more sophisticated, "smart" manufacturing processes (Trade.gov, 2022).

Using smart technologies in manufacturing has a significant financial impact. Through increased productivity and efficiency, smart manufacturing can significantly contribute to faster GDP growth. This adoption is viewed as essential to the revival of important industrial sectors in areas like Punjab, such as steel and automotive components, which are essential to the state's economic prosperity.

3. Findings and discussion

Objective 1

Cyber-physical production systems, which are highly intelligent and interconnected systems that form a fully digitalized value chain, are the main feature of Industry 4.0. These systems turn traditional manufacturing facilities into smart factories by fusing data, IT, communication, and physical components. Real-time information processing and distribution are accomplished by machines interacting with products and with each other in such an environment (Gita, 2022). This has a profound impact on the automotive industry, where it is anticipated to bring about a comprehensive transformation in both processes and products. It also causes significant changes across the industrial landscape.

Handling enormous volumes of data is crucial to this industrial revolution. Interpreting this data and sending it to various business domains, such as supply chain partners or enterprise resource planning (ERP) systems, requires the use of business intelligence software (Bisht, Singh and Sandhu, 2021). India's standing on the Network Readiness Index shows swings in the country's place in the global digital economy. India was ranked 61st out of 139 countries in 2013 but by 2016 it had fallen to 91st. According to this ranking, India came in first place, behind countries like Sri Lanka, Malaysia, and China, and ahead of countries like Bangladesh and Pakistan. The top two spots were held by the United States and Singapore. The report by the World Economic Forum underscores the noteworthy disparity in digitalization between developed and developing nations (Unido, 2021). While many developing nations, including India, have seen a decline in their rankings, developed nations such as the United States and Singapore continue to maintain high rankings. By 2025, the Indian government hopes to raise the manufacturing sector's share of GDP from 16% to 25%, in keeping with the objectives of Industry 4.0 (TimesofIndia, 2021). One of the main components of Industry 4.0, the Internet of Things (IoT) is anticipated to account for a sizeable portion of the global IoT market; in the next five years, India is expected to account for about 20% of this market.

The India Brand Equity Foundation (IBEF) has projected that the IoT market in India will expand at a compound annual growth rate (CAGR) of more than 28% from 2015 to 2020. This expansion reflects India's growing interest in Industry 4.0 technologies and their possible influence on the industrial

and economic environment of the nation.The few Indian states that charge more than 14% in road tax are Uttar Pradesh, Punjab, and Bihar; in most other states, road tax is essentially nonexistent (Tribuneindia, 2022). The Value Added Tax (VAT) that is typically levied on environmentally friendly vehicles in India is approximately 4%. The government's tax rate on green vehicles should be lowered temporarily or kept at the current level, according to automakers' requests. It is expected that this measure will have a substantial positive impact on India's electric vehicle industry because favourable tax laws may increase demand and lower the cost of eco-friendly vehicles.

Objective 2

Punjab is a prominent economic center is situated in northwest India. Though it makes up only 1.5% of India's land area, it makes a significant 2.5% contribution to the country's GDP. Punjab has been recognized as a 'Top Achiever' in the Business Reforms Action Plan (BRAP) 2020 assessment by the Department for Promotion of Industry and Internal Trade (DPIIT) of the Government of India, in recognition of its business-friendly environment (Pfeiffer, 2017).

To improve skill training and combine different skill training programs for scale and efficiency, the state created the State Skill Development Mission. Recognizing the pressing need for industries to adopt advanced manufacturing in order to remain globally competitive, Punjab is concentrating on retraining and upgrading its present workforce in order to fulfill the demands of modern industry (Unido, 2021). In order to guarantee that the industry has access to a skilled workforce, this involves the establishment of cluster-specific skill centres across multiple manufacturing sectors. Punjab is also training its youth for jobs in the service industry, which is a major employer and where the province is focusing its efforts. A major focus is also placed on enhancing the partnership between business and academia, to boost youth employability and supply businesses with a trained labor force.

It is projected that a sizable portion of large businesses (roughly 75% of them) will have incorporated intralogistics smart robots in some capacity into their manufacturing processes by 2026. The need for more automated solutions to lower operating costs and handle labour shortages in manufacturing settings is the main factor driving this adoption boom. These developments, which are a part of the Industry 4.0 movement, are a big step forward for smart manufacturing companies (Pfeiffer, 2017). Chief Information Officers (CIOs) can fully profit from process automation in smart factories by combining visioning technology with intralogistics smart robots. This lessens labour difficulties in addition to assisting with cost reduction. Conversely, businesses that do not adopt these technological developments run the risk of being left behind in the quickly changing field of digitally enabled smart factories.

4. Conclusion

This conversation has shed light on different organizational contexts and structures, with a special emphasis on how manufacturing companies, like those in the steel sector, are incorporating artificial intelligence systems into their daily operations. These industries can convert their production processes into more effective, "smart," production systems thanks to AI and machine learning technologies. The development of autonomous steelworks is being aided in Punjab's steel industry by the implementation of Industry 4.0 technologies, specifically the Internet of Things (IoT). In smart factories, for instance, AI-enabled sensors are used to gather vast amounts of data, which promotes collaboration between various facilities and results in optimized production lines.

5. Recommendations

It is recommended that the Punjab government initiate training initiatives aimed at preparing the younger generation and seasoned employees in big data analytics, machine learning, and artificial intelligence software. These kinds of training programs are crucial to raising Punjab's people's consciousness, understanding, and technical proficiency and reducing the number of unskilled workers in technical fields (Trade.gov, 2022). This plan is in line with Punjab's objective of encouraging long-term industrial development and job growth, particularly in preserving the province's competitive advantage in the steel sector. The goal of these training initiatives is to assist staff members by offering knowledgeable counsel and promoting cooperation between industrial professionals and scientists. To create and execute a smart factory model, this cooperation is essential.

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