Smart Manufacturing for Sustainable Development & Its Future in India

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Abstract— Manufacturing sector is continuously now and then blamed for heavy pollution and contamination. It is always associated with the environment deterioration. Whenever any industry setup its infrastructure, it is essential to get a green go from the environment conservation board. We know the real development of any country very much depends on the industrial development of the country. Manufacturing technologies are considered as the source for providing the goods and services for any further use and development. But it is also true that Environment protection carries the same importance as industrial development. That's why it is mandatory to adopt those manufacturing technologies, which can promote the development without hampering the natural balance. Manufacturing technologies, which helps in sustaining the natural balance of environment come under the Smart manufacturing. Smart manufacturing is considered as the key for sustainable development. Smart manufacturing includes technologies like Artificial intelligence, Digital technologies, 3- Dimension printing, Block Technologies, Data Analytics, RFID and many more. This aim of this research paper is to identify the technologies which comes under Smart manufacturing and helps in Sustainable development. The researcher also wants to find the future scope of these technologies in India.

Keywords— Sustainable Development, Manufacturing, Smart Manufacturing, Technologies, Environment, Industrial 4.0

I. INTRODUCTION

Manufacturing is always considered as an elementary source of production of all the necessary goods and services, that are mandatory for any fundamental requirement of human existence. But it is equally true that human existence is difficult without maintaining the natural balance of environment. That's why the need of Sustainable Development arises in the system and it is very essential in the manufacturing sector as this sector is continuously criticised for hampering the natural balance. Manufacturing Industries are the major contributor of air, land and water pollution. Around Fifty- two percent of the total pollution is produced by the Industrial sector. Manufacturing industries cause water and soil pollution through chemical spillage, acidifying rain, and disposal of hazardous waste. The smart manufacturing includes all the technologies which can help in reducing these kinds of pollution and help in the sustainable development. Smart manufacturing comes with the objective of continuous development with saving resources of manufacturing supply chain and environment.

As per a famous marketing firm i-Scoop "Smart manufacturing has been defined as the fully-integrated, collaborative manufacturing systems that respond in real time to meet changing demands and conditions in the smart factory, the supply network, and customer needs."

Smart manufacturing is an approach where Internet-connected machineries are combined and utilized to guard the total manufacturing supply chain process. Smart manufacturing technologies includes technologies like RFID, Cloud Computing, AI, Data Analytics, Block Chain, Internet of Things, Big Data, Numerical control and many more. This Research paper aims to find out the future scope of these technologies in India.

II. LITERATURE REVIEW

Smart manufacturing supports production efficiency and industrial productivity with sustainability. Industrial 4.0 or smart manufacturing are going to decide the future of manufacturing sector of any country and finally the GDP.

According to Ganeshan Venkateshwaran (Trianz President) Smart manufacturing is transforming the industrial sector. Smart manufacturing not only allows increase in productivity but also help in providing value propositions to customer with customized product-service portfolios. Smart manufacturing provides win for everyone. Manufacture can get higher profit margin and customers can get economic products.

According to A. Awasthi, K.Saxena and A.Vanya, there is a need of replacing the old conventional manufacturing techniques with the smart manufacturing techniques , as old production techniques does not seem competitive in this scenario. With the adoption of new digital

technologies like internet of things, business can increase the production efficiencies and effectiveness.

In the book named "Data Driven Smart Manufacturing Technologies and Applications"; Sheng Wang and Weidong Li, Yuchen Liang , has stated that Smart manufacturing techniques applies Artificial technologies and data information to have suppleness in the manufacturing processes. Big data management & Deep learning, Data Analytics are the advanced smart manufacturing technologies.

As per J. Larreina & A. Gontarz, Sustainable development in the manufacturing processes is required in the industrial sector. This is required due to different factors business goals, legislature, law and regulation and economic growth. This purposes for dipping the adverse environmental effect in production through processes like reprocessing, reuse, recycling and proper waste management.

Klaus-Dieter Thoben, Stefan Wiesner, and Thorsten Wues have mentioned in their research paper "Industries 4.0" and Smart Manufacturing" that Smart manufacturing is very much different from the pure automation. There are several applications are associated with the adoption of these technologies. There are different goals are also attached to these technologies like sustainability, enery saving, economic upliftment and many more.

Baicun Wan, Fie Tao etall. have mentioned in the the research paper "Smart Manufacturing and Intelligent Manufacturing: A Comparative Review" that from the last few years, most of the countries are addressing the importance of transformation of the manufacturing sectors. The transformation of these manufacturing sector depends upon the adoption of the smartness and intelligence in the manufacturing sector.

According to A. D. Jayal and , F. Badruddin etall. If we want to have sustainability in the manufacturing, so we should not just focus on the product , but it should be a holistic approach. The total manufacturing process should be undergo certain kind of changes.

Claudi Favi, Marco Marconi, Michele Germani hve stated that Industry 4.0 revolution can provide scope and opportunities for enhavncing the production systems' sustainability through adoption of technologies like interconnection of manufacturing processes and digitalization.

III. METHODOLOGY

Mainly Secondary data is used to gather the information about the smart manufacturing technologies and their scope. To maintain the reliability of the research paper, all secondary data sources are verified and gathered data was cross-checked with all available sources.

IV. OBJECTIVES

1. Elaborate the technologies which comes under Smart manufacturing and helps in Sustainable development.

2. To find the future scope of Smart manufacturing technologies in India.

V. DATA COLLECTION AND ANALYSIS

Smart manufacturing is a combination of digital technologies and modern manufacturing process. It is considered as the future of Industrial development. Smart manufacturing is about the increasing efficiency, effectiveness performance of business without damaging the environment and tumbling the scrap and waste.

Mr. George Prest (MHI CEO) with his team have conducted a survey regarding the expected industry setup by 2025. This survey has included participants from thousand supply chain professionals of manufacturing industries. As a result of this survey, around 11 technologies were identified as Smart manufacturing technologies. These smart manufacturing technologies have the potential to change the current scenario of manufacturing industry and turn the industry into a sustainable development industry. Different supply chain professional has mentioned their ideology about these technologies and confirmed that there will be a boom in adoption of smart manufacturing techniques in industrial sector. Table-1, Table-2 & Graph-1is the representation for current adoption (2008 onwards) vs expected adoption (2025) of the different smart manufacturing technologies.

Table 1: Current Adoption Vs. Expected Adoption of Different Technologies

Technologies	Adoption in 2008 %	Expected Adoption by 2025 %
Cloud Computing	57	91
Network Optimization Process for Inventory Control	44	90
Sensors	45	86
Predictive Analytics	20	82
IoT	22	79
Robotics and Automation	34	73
Advance wearable Technologies	23	72
Block Chain	6	53
Automatic Vehicles	11	50
3- D Printing	16	48
AI	6	47

Table 2: Percentage Increase in Adoption of Technologies By 2025

Technologies	% Increase in Adoption By 2025
Cloud Computing	60%
Network Optimization Process for Inventory Control	105%

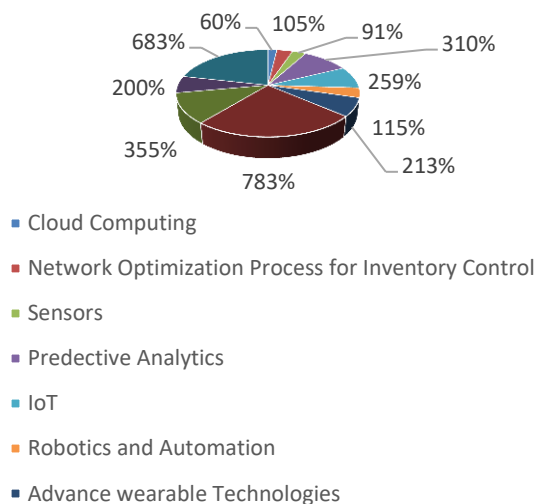|	
Sensors	91%
Predictive Analytics	310%
IoT	259%
Robotics and Automation	115%
Advance wearable Technologies	213%
Block Chain	783%
Automatic Vehicles	355%
3- D Printing	200%
AI	683%

Chart 1: Percentage Increase in Different Technologies Adoption By 2025

The MHI survey clearly indicates that there is a huge improvement opportunity exist in the manufacturing sector. If we see these opportunities in Indian Contest, we will find that in India the adoption of these technologies is in nascent stage.

Fourth Industrial Revolution (Industry 4.0) are about the smart manufacturing. It is considered as the transformation of production/ Industrial/ manufacturing and related sector. The transformation will be done by adoption of these advanced technologies. The main emphasis is on value creation and sustainable development. Industry 4.0 revolution is backup the digital technologies innovations for value creation and better decision-making process. Fourth Industrial revolution is an amalgamation of different digital technologies like Cloud Computing & sourcing, Inter of Thing, Big Data, use of sensors, Automation, AI, 3-Dimension printing and Technologies related to 5G to increase the efficiency in the manufacturing supply chain process and reducing the waste and scarp in the process.

The aim of India's National Manufacturing Policy is to increase the share of manufacturing in GDP up to 25%. If this is to be achieve by 2025, there is no alternative other than adoption of smart manufacturing technologies and to enter in Industry 4.0.

"In 2018, Prime Minister, Shri Narendra Modi launched the centre for Industry 4.0, which was the fourth such centre after San Francisco, Tokyo and Beijing. In 2019 SAMARTH Udhyog Initiative was launched to give an ambience to Industry 4.0 set of technologies in Indian manufacturing sector (Large, medium, small scale business, MNC's) by 2025. SAMARTH Udhyog includes awareness campaigns, trainings, R&D, E-waste management technologies, Industry & Institute collaboration."

In India, manufacturing sector needs to go a long way to reach the goal. But as it is an ongoing process, different companies of manufacturing sector have started to work in this direction. Many private players have started to build up the smart factories' setup in India.
1. "Auto Component Manufacture "Bosch" has already started working on implementation of smart manufacturing at its Fifteen facilities in India in 2018.
2. USD Two hundred million has been invested by GE in its only multi-modal factory in India. In this digitally interlinked supply chains, distribution networks, and servicing units will form the part of this technology driven intelligent ambience.
3. First smart factory in Bangalore is formed by Indian Institute of Science (IISc). This project is funded through Boeing Company.
4. Companies such as Godrej, Continental AG etc. are also implementing smart manufacturing and digital technologies in their infrastructure in India."

VI.   RESULT & DISCUSSION

There is a huge scope exist for the adoption of Smart manufacturing, especially in context of India. We can see the adoption of these technologies is very less. Cloud computing has a maximum adoption percentage (57 %) and Artificial intelligence has a minimum adoption (6 %). By 2025, it is expected that the adoption of these technologies is going to be increased by 60- 700 %. By seeing this data, it is very much obvious that the future of the manufacturing nothing but Smart manufacturing.

VII CONCLUSION, RECOMMENDATIONS AND FUTURE SCOPE

In this Industrial revolution 4.0, we are left out with adoption of smart manufacturing technologies, if we want to have industrial growth with sustainable development. These digital technologies are just not helping in increasing manufacturing productivity but simultaneously helping in getting sustainable development. There are numerous digital technologies are present which may help in smart manufacturing but it totally depends on the business to adopt the suitable technology accordingly.

The future of world, totally depends on these technologies and countries which are going to take advantage of fast adoption will be definitely going to have the competitive advantages over other countries. The aim of this paper was to have the knowledge about the smart manufacturing technologies and its future scope in India. As a researcher, I want to conclude that In India, the adoption of smart manufacturing technologies is at very initial stage. Government of India is taking so many steps to promote these techniques in business. There is no doubt that these technologies are very much helpful to have a sustainable industrial development. Again, there is a need to PPP (Public – Private partnership) model to make the process faster. Massive Research and Development efforts are also needed, if we as a country we want to have the competitive advantage of these technologies.

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