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Information Communication Technology and Intelligent Manufacturing Industries Perspective: An Insight

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ABSTRACT
The integration of all the processes that smart factories will use will take time, as they are very different from the norm. Among these procedures is: Machine learning: Every aspect of manufacturing is optimized, cutting time to market and energy usage, as systems acquire and evaluate fresh data. Over the past few decades, the growing trend of intelligent technology in industries such as manufacturing has drawn extensive study attention from all around the world. Numerous cutting-edge technologies are included in Smart Technology (ST), including blockchain, cyber-physical production systems, the Industrial Network of Things (IOT), internet of things, artificial intelligence and systematic data analysis. In order to reduce the distance between humans and machines, we give an overview of several smart technologies that can be used to regulate the sophisticated characteristics associated with computers and sensor technologies. This research paper shows the complete literature review of ST to increase the production and maintenance of machinery equipment and future threats faced by ST. This paper also includes a survey report on the rate of adoption today as compared to the past five years, to obtain real-time results, cost-effective techniques and the use of different sensors to reduce the human workload in the manufacturing sector.

KEYWORDS
Blockchain, cloud computing, artificial intelligence, cyber-physical production systems, internet of things, big data analytic

INTRODUCTION

The Smart Technology (ST) has a basic origin in Information Communication Technology (ICT) and intelligent manufacturing. It involved many terminologies including time synchronization, AI and network communication associated with accuracy with rapid and blistering work. Many manufacturing sectors developed their Smart Technologies (ST) to turn their raw work into quality-derived work with great and brisk production. The intention of Smart Technologies (ST) is meteoric development and vanguard technologies like energy saving/efficiency, cloud manufacturing, Cyber-Physical Production Systems (CPPS) and smart factories, intelligent manufacturing and advanced manufacturing. Smart manufacturing has attracted attention from industry, government organisations and academia. Various consortia and

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discussion groups are formed to develop architectures, roadmaps, standards and research agendas. The overall concept of smart manufacturing systems has to be translated into architectures that are quite specific. Efforts are under thanks to develop such architectures. Smart manufacturing has caught the attention of industry, government organizations and academia. Consortia and stakeholder groups are being created to create architectures, plans, standards and a research program. The overall idea of smart manufacturing needs to be translated into architectures that are very specific. Work is being done to create such architectures[1]. Because the world is beyond the fourth generation, we are going towards the integrated and collaborative system of ICT; moreover, every field of science has its tools and mechanisms to use it. To leverage automation control data, Industry 4.0 manufacturing systems require industrial devices to be connected to the network. Potentially, this could increase the chance of cyber-attacks, which might compromise connected industrial devices to accumulate production data or gain control over the assembly process[2-5].

Globally the huge automated data and network operating system is significant, though in smart technologies the issue of cyber security arises many web search engines are utilized to direct the cyber-attack named Sentient Hyper-Optimized Data Access Network (SHODAN) also utilized[6]. Manufacturing operations can be closed somewhere around a cyber-attack, along these lines, organizations have money losses, yet the fundamental issue is cyber-attack targeting systems requiring safety operations and representing a serious risk to the safety of the operations[7]. Smart manufacturing is a broad idea that something will be executed during a production process directly with some tools and technologies with diversified technologies and solutions which simultaneously if evaluated in a manufacturing industry is termed as smart manufacturing[8]. These technologies also called problem solver[9] assists in boosting the whole manufacturing process[10] and this will enhance the profit[11].

Smart Technologies (ST) collect manufacturing site data analyse it and then provide summarized better decision-oriented and optimized results[12]. The benefits of IOT are goof off, enhanced production. The core concept behind Smart technologies in manufacturing means to establish a smart factory to derive accurate and efficient results.

It's been nearly 260 years since the start of the initial age, thought to have started around 1760 in the USA[13,14]. The most recent iteration of this process, the fourth technological revolution, has been called "smart manufacturing[15]", while in Europe it's referred to as "Industry 4.0."IOT,5G, AI (Artificial Intelligence), Blockchain, Edge Computing[16], Predictive Analysis and digital twins are coined together as smart technologies that derive long-term savings, safety and security and increase productivity as shown in Table 1 and 2.

The structure of this research paper includes the introduction:

- A new definition of smart technology is advised
- The state of art research literature review
- Structure of any Smart Manufacturing Technology
- Various technologies related to manufacturing sector
- Challenges in smart technology
- Conclusion

Smart technology[17] is the term that is used to reduce human load, error-free and highly productive industries along with productive and predictive maintenance using artificial intelligence and internet of things[18,19]. Industry 4.0 is the recent technology used to run efficient collection and maintenance of data, technical and skillfull staff are required to run these computer sensing machines and communication networks[20-22].

Table 1: Survey themes

Sr. no.	Theme of survey
1	Article shows the industrial internet of things, recent advances, enabling technologies and open challenges
2	Massive Internet of Things for Industrial Applications: Addressing Wireless IoT Connectivity Challenges and Ecosystem Fragmentation
3	Articles show brief descriptions of smart manufacturing
4	This article presents a systematic review of determinants of information and digital technology implementation for smart manufacturing
5	This article shows technology Using Graphs to Link Data Across the Product Lifecycle for Enabling Smart Manufacturing Digital Threads
6	This article shows a complete literature review of a smart manufacturing adoption framework for SMEs
7	This article shows Digital driven Smart Technology prioritisation challenges towards Development of Smart Manufacturing Using BWM method
8	This paper shows the fundamentals of smart manufacturing, a multi thread perspective.
9	This article shows the literature review of a conceptual framework of enablers for smart manufacturing tools
10	This article shows smart manufacturing based on cyber-physical systems and beyond

Table 2: Abbreviation of technologies used in manufacturing sectors

Terms used in ST technology	Abbreviation
CPPS	Cyber Physical Production System
ML	Machine Learning
CAPEX	Capital Expenditures
OPEX	Operating Expense
CNC	Computer Numeral Control
CAD	Computer Aided Design
CAM	Computer Aided Manufacturing
IOT	Internet of Things
IIOT	Industrial Internet of things
RFID	Radio Frequency Identification
MEMs	Micro-Electrical-Mechanical Sensor
SNA	Social Network Analysis
CCT	Computer and Communication Technology
AI	Artificial Intelligence
MBE	Model Based Enterprise
MIOT	Manufacturing Internet of Things

Literature work: The paper shows IIOT the latest technology in the manufacturing sector, including the latest framework communication and protocols and also highlights the different heterogeneous technologies that are involved in meeting the challenges of ST[1]. The author of the paper has elaborated on the solution how to make smart manufacturing more effective and more productive and also discussed the pillar of smart manufacturing[2]. It discusses the issues of digital twin deriving techniques in the view of Industry 4.0 and its future challenges in smart manufacturing and also define industrial communication twining tools[3-5]. The literature review of smart manufacturing that smart manufacturing is not a single domain but this is a multi-domain that shows the different perspectives of smart manifesting using hardware and communication tools, showing the difference between resilient manufacturing and Sustainable manufacturing[6,7]. Researchers also elaborated the graph cycles and linking of different diagrams to access the different technologies for designing and quality domain for increasing the lifecycle of the product defined by the term MBE (Model Based Enterprise)[8-10]. It also elaborated the research about the cost analysis of smart manufacturing technology like digital twin is affordable[11]. Give attention towards the trending technology in Smart manufacturing like CPPS also defined the SCPS including eight tuples of CPS-based smart manufacturing to society. It also elaborated the terms like cloud computing, fog computing and edge computing[12].

During the past decade, communication has assisted in boosting our technologies and techniques, networks and artificial intelligence to reduce the cost of Capital Expenditures (CAPEX) and Operating Expenses (OPEX)[12-15]. The advances in the communication and computer intelligence industry enhance the

Fig.1: Smart technologies

accuracy towards perfection of automation in the manufacturing sector[15-19]. In publishing a Journal of Automatic Manufacturing in 1995 the work of Intelligence Manufacturing System started for the support of industrial industry[20-22]. Well-reputed companies from different countries like Japan, Korea and USA started the intelligence manufacturing system to give worth to their industrial sector. Some of the Smart Technologies (ST) are discussed in Fig. 1.

MATERIALS AND METHODS

Manufacturing led design: This smart technology is used to give direction to design, making early decisions and efficient industry. This smart technology officially decides the right things at the right time. The integrated CAD/CAM software used provides solutions for the integrated complex design with the help of computer network protocols.

3D printing: The 3D Printing is additionally clear as additive manufacturing mainly focuses on the hardware. Numerous Companies utilize compulsive technologies for improving their products, to meet the product application and material necessity. Its name 3D originates from three measurements as given in Fig. 2. The 3D printing begins by making a virtual plan of the article you wish to frame. The virtual structure is utilized as a format for the article to be made. This virtual plan will be made by utilizing a 3D modelling program like CAD (Computer-Aided Design) to form a design from scratch. On the other hand, a 3D scanner will be utilized for an existing object. This scanner makes a 3D digital copy of a product and places it into a 3D modelling program.

CNC machining: The abridgement of CNC is Computer Numerical Control, the purpose of this Smart Technology (ST) is to run and control machinery in the manufacturing sector through computer software, whereas it is used to discipline and supervise of machinery parts and their cutting tools through material removal.

Cloud computing and storage: Cloud computing storage devices involve the handling of data, this also involves the collision of cyber security intelligence and many other machine-elated smart techniques to make effective and reduce the cost by using many efficacious data storage techniques. The main idea behind Cloud computing is to create bonding between chain suppliers to make the product. Distributed devices are used for cloud computing, three formats are mostly used for cloud computing: PAAS, SAAS and AAS[22].

Internet of Things (IOT): This smart technology includes sensor technology and coin of many internet technologies like artificial intelligence, network and immutable communication. There is a central system on which the data is delivered and then provided to a central system many researchers used different protocols at different topologies using different hardware and software with different designs for different industries. The main issue is to cover the different problems of the industry to provide the connectivity

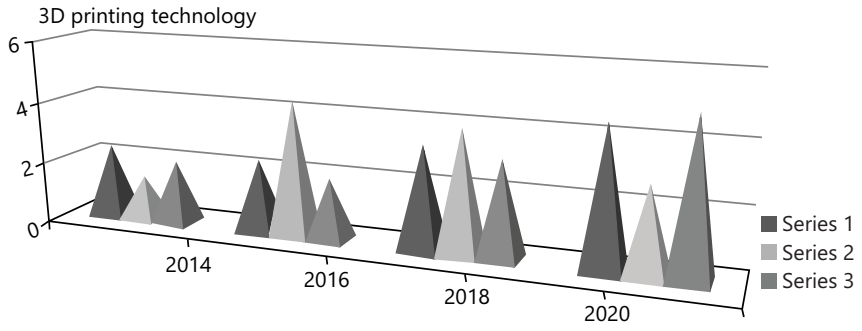

Fig. 2: Chart of 3D printing in different years
x-axis indicates three number of series and y-axis indicates years

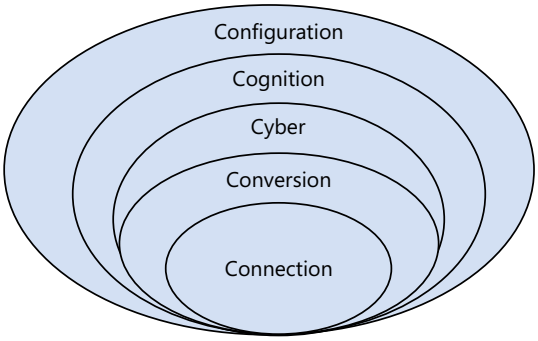

Fig. 3: 5C Architecture of cyber physical production system

between the manufacturing software tools and hardware, to support the company terms related to the computer wireless device to reduce the labour cost. This smart technology starts from the collection of raw data implementation of smart using computer-aided assistance (CAD) and manual system management. This Smart Technique also required a platform of technical staff to run the smart technologies to meet the challenging task.

Cyber-physical production systems: Cyber-Physical Production System (CPPS) is a Smart Technology that is proposed for artificial intelligence, this system is a collection of collaborative technologies with this global world and its ongoing process related to the further development of Computer and Communication Technologies (CCT), this becomes the cause of fourth generation industry named as 4.0. The heap of raw data that is collected for industrial manufacturing from different sensors is very helpful for the detection of faults or to prognosticate equipment wear. Different five level architectures of CPPS produce an efficient productive system. The five C levels of architecture are described in the following diagram given in Fig. 3.

These five 5C surface levels of CPS show the close bonding from 1st level to 5th level. All levels start from C, CPPS starts from the connection of self-senses and collection of data that has to be obtained from this system to network implementation to produce cost-reducing products. The main architecture of Cyber-physical production system is given in the Fig. 4.

Sensors and automatic identification: Different types of sensors are used in automatic identification of different factors like cost, temperature, motion and environment, however most popular sensor that is used in automation is called RFID (Radio Frequency Identification), these sensors are used to meet the complete quality of the products in manufacturing sectors. The tags are used in the RFID technology to control wireless technological devices, every product is labelled with different tags, however, these tags are used to perform all particular activities including storing and retrieving data given in Fig. 5. The cyber

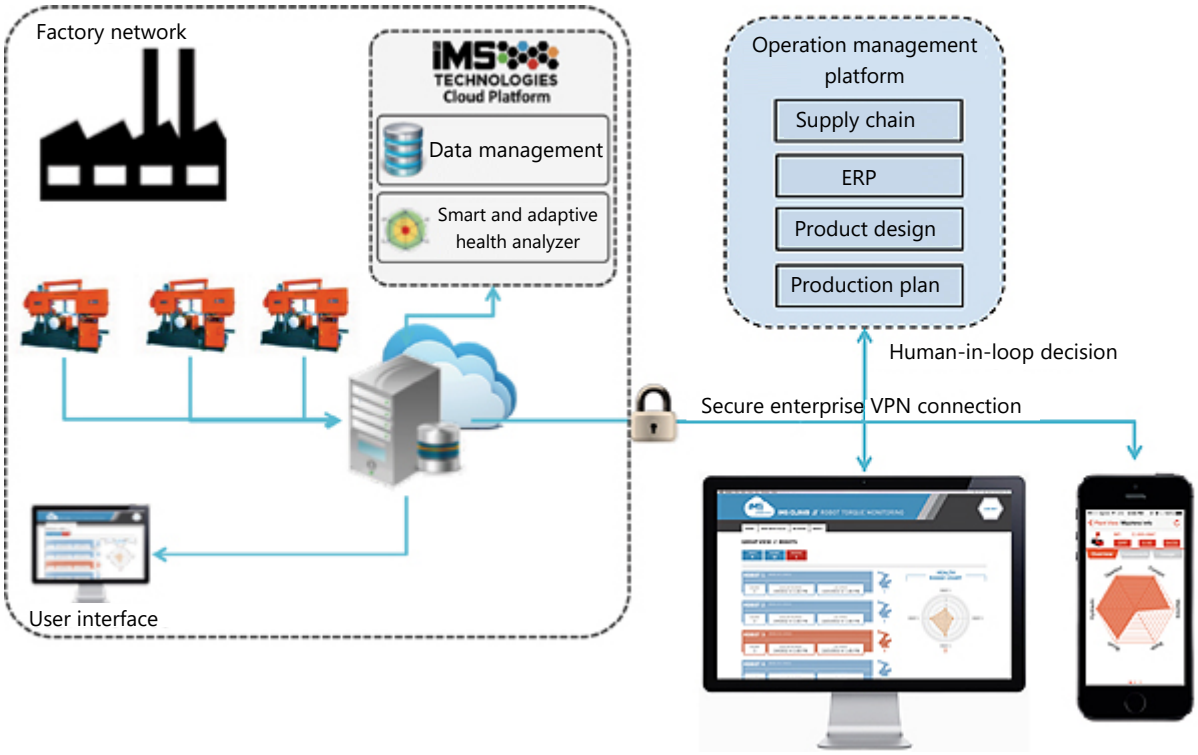

Fig. 4: Working of CPPS system

Fig. 5: Some types of sensors

security and privacy issues always involved in the RFID, the tags that are used in RFID that are used in these sensors have some range and can be easily hacked from other RFID sensor tags[22]. Many sensors are used in the industrial and automation industry like temperature sensors, pressure sensors, MEMs (Micro-Electro-Mechanical Sensors, motion sensors and torque sensors.

Big data analytics: There is colossal amount of data also requires a highly productive computing system, the demand of high amount of data that is collected and then analysed how to handle, how to work with this data, some specific data collection techniques are used in the smart manufacturing technique to reduce the cost, time constraints and budget issue, there is also need of a collection of correct raw data, Big Data analytic system plays as a key role in the manufacturing sector. The research on the big data analytic industries and their challenges in his research also defined the term Manufacturing Internet of Things (MIOT)[22]. It performs the big analytic data technologies gives comprehensive reviews of different big analytic data in smart manufacturing and gives an enhanced briefing on how to get productive results[10].

Table 3: Survey report of MHI in 2018

Name of ST	Rate of adoption in manufacturing sector (%)
Cloud computing	57
Inventory and network optimization	44
Sensors and automatic detection	45
Predictive analysis	20
Internet of things	22
Robotics and automation	34
Block chain	6
Driverless vehicle and drones	11
3D printing	16
Artificial Intelligence	6

Blockchain technology: In the latest smart technologies, Blockchain has a key role in IIOT leading towards the next generation in the manufacturing industrial sector. Blockchain technology does not involve not only the manufacturing sector but also healthcare, finance supply chain and car insurance. The unique characteristics of Blockchain technology are dispense nature, discoverability, durability, trust, security and cost-effective characteristics making it the trending smart technology in IOT. Ethereum is a term that is defined by the researcher Blockchain platform, the user can sign the ethereum[20], this ethereum is decentralized and run not only by one person but also by a peer. Ethereum Virtual Machine is also established, mainly the nodes that are present in ork. Latest research shows how Blockchain can be developed for DT (digital twins) to produce authentic, efficient and secure manufacturing[22].

Artificial intelligence: Artificial Intelligence is a key element of ST, due to AI Industry 4.0 coming into exist, without artificial intelligence there may be no concept of ST, the success of any smart technology depends upon the rate at which level of AI is involved in that technique, the term AI and ML (machine learning) are related to each other. The motivation behind the AI and ML to create ST is to increase the fast process of analysis and decision-making, SNA (Social Network Analysis) is derived from Social Network theories. In Table 3, the survey report of MHI in 2018, MHI and his team took a survey of different STs that are used in the whole world, this survey takes a long time of five years.

DISCUSSION

Present and future challenges: Due to the diverse and complex nature of ST due to the diversity of communication and network intelligence, many challenges are present in this sector that should be resolved. Some of these challenges are given below.

Technical staff: The technical staff is required to run this complex and compatible architecture, however processing of efficient ML, understanding of communications networks and smooth running of these topologies over the network with a better understanding of fast data-driven techniques and operating systems. If the staff is technical, then it is easy to handle data managing schemes and machine integration with the software strategies to gain efficient results of ST in manufacturing sector to meet the security and sustainability of computer-related results.

Difficult to handle huge data analytic and management techniques: There are many data analytic techniques to cover the collection of data, sensing of data and process of future decisions based on these data management techniques, the running of different IIOT run effectively by handling and retrieving a large amount of data.

System integration: The compatibility of different smart technologies with machine learning and the new manufacturing system required IPV6 connectivity for smooth running of different interfaces. In the previous decades, many technologies and platforms have been used to attain productive results for the

manufacturing sector, but this is a bit difficult to integrate all the platforms. The technology moved from mechanical manufacturing to man production and then proceeded further to IT (Information Technology) and now a day's cyber-physical production system is used.

Big data analytic tools: This is difficult to handle a large amount of data and then analysis of that data has occurred, many data analytic tools are used and the big issue behind these tools is sharing and maintaining that record on different networks.

Robustness and security issue: To cover the security issue, cyber and many artificial intelligence tools are used but lack of security is also occurring in different technologies over the network, the trust issue in the use of smart technology arises because all the data between different resources are through the use of different communication networks.

Use of wireless technologies and different protocols: This is not easy to use the different technologies by use of wireless, all the communication between the machine and human is done through the use of networks by using different topologies over the centralized or distributed network. There are many communication networks and wireless technologies used, this is not easy to make a decision about which communication network is better for the productive manufacturing system. Many technical issues are related to communication networks like latency bandwidth and many more factors.

Invention of specific operating system: There is a need for specific operating systems that are used in manufacturing sectors. The TinyOS and ConTiki are the most commonly used operating systems that meet the requirements of smart manufacturing techniques. There is a need to design the operating system that has characteristics of running smooth traffic, smart grid, intelligent communication framework, bandwidth consumption and interoperability.

Supply chain is complex: There are many heterogeneous systems used in the smart manufacturing industries that are interconnected one to another and there is a long chain of stakeholders and systems and suppliers. The challenge behind the smart manufacturing system is to handle large supply chains between different stakeholders and technologies that are involved in ST all over the world and there is a requirement to remove all the conflicts in the communication between different platforms that are used in the smart Industrial Manufacturer.

Customer trust involvement: The product that should evolve from smart manufacturing should be system integrated, reliable and durables techniques are used in this term, there are many wireless technologies including many challenges that are used in IOT and Industrial 4.0. The customer should be awarded of these technologies by making effective software models that are human to machine-oriented.

CONCLUSION

This research paper gives a perspective review of smart technologies that produce energetic and profitable products, involving wireless communication by using different operating systems using reliable and effective systems and communication protocols. However, smart technologies are also emerging towards robotic technology to reduce the involvement of human machines and human workload. Digital Twins involve the use of sensor technologies and have many benefits to reduce the cost of the products and enhance the quality of products.

SIGNIFICANCE STATEMENT

Smart factories are far away from the norm and it will take time to integrate all the processes they will use. These processes include machine learning, as systems gain and analyze new data, the whole production process is optimized, resulting in lower lead times and energy consumption. Smart Technology (ST)

involves many emerging technologies like Internet of Things, Industrial Internet of Things (IOT), cyber-physical production system artificial intelligence, blockchain and systematic data analysis. This study provides an overview of different smart technologies to control the intensive features of computer and sensor technologies to dwindle the gap between humans and machines.

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