International Journal of Engineering Sciences Paradigms and Researches (IJESPR)
Vol. 48, Special Issue, (TAME-2019, April 4-5, 2019)
(An Indexed, Referred and Impact Factor Journal approved by UGC- Journal No. 42581)
ISSN (Online): 2319-6564
www.ijesonline.com

MODELLING OF INDUSTRY 4.0 IN INDIAN MANUFACTURING INDUSTRY: A REVIEW

Mahesh Kumar[1] and Rajeev Saha[2]

[1] Department of Mechanical Engineering, J.C BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY YMCA, NH-2, Sector-6, Mathura Road, Faridabad, 121006, Haryana, India.
[2] Rajeev Saha. J.C BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY YMCA, NH-2, Sector-6, Mathura Road Faridabad, 121006, Haryana, India.
Phone: 9911921584. E-mail: rajeevsaha@gmail.com

ABSTRACT

In recent years, industry 4.0 has attracting more and more attention all over the world. Industry 4.0 is a chimera of manufacturing in which smart, integrate production system that enhanced the value-added chain to reduce time and cost from manufacturing state to market state. Industry 4.0 is the severe progress in developing the next generation of manufacturing technology. The purpose of the project is to identify the support system/ factors and prepare a model that are linked with smart manufacturing. Industry 4.0 adopt decentralized control and aim to increase flexibility and productivity. It aims on the fundamental modal of Industry 4.0 and the state of current manufacturing systems. Today's business world is characterized by powerful competitive pressures and growing market demands. This requires high level of integration, connectivity and collaboration between processes which in turn, requires adoption of intelligent technological innovations such as IoT (internet of thing), cloud computing, CPSs (cyber production system), big data and intelligent system. These technological innovations, which enable transparency, real time information sharing flexibility and robustness. Our aim to make Indian manufacturing company more digitization and stronger so that these companies become able to grow and create new jobs and focused on customized products. Model provide a basis for innovation, enabling companies to expand their network or manage new production lines more effectively. It also reduces the risks linked with beginning new products on the market.

Keywords: *Industry 1.0, 2.0, 3.0, 4.0, factors/Support system, model on Industry 4.0.*

1. INTRODUCTION

In the manufacturing era, factors such as agility, proficiency, responsiveness automation and robustness to changing customer demands and in addition center around product quality and administrative consistence decide the survival of manufacturing organizations. To address the previously mentioned difficulties and to meet changing customer demands in exceptionally focused situations, producing and have the capacity to altogether diminish their operational expenses, yet additionally, they should be sufficiently smart to act intelligently and autonomously. This requires abnormal state of digitization and computerization and broad availability in manufacturing conditions and all throughout its associations which in turn, calls for seamless integration of production system and enterprise systems. In spite of the fact that IT is as of now at the core of manufacturing and mechanical developments, for example, sensors, actuators and modernized computerization have been utilized by manufacturing organizations for a considerable length of time enabling advanced manufacturing.

INDUSTRY 1.0

In the 1760s the Scottish engineer James watt discovered the steam engine. It was capable to run factory machines and was powered by coal, which was the primary raw material. Industry 1.0 (from the eighteenth to nineteenth centuries) brought human activities from focusing on agriculture to the industrial society. The demand for industrial products in Industry 1.0 had only one dimension – product volume. We can call this demand environment as the Simple market. In Industry 1.0, supplies were lesser than demands. Outputs of industrial products could not satisfy the demands from society.

Fig 1: Industry 1.0 [6]

INDUSTRY 2.0

The Industry 2.0 is started in the nineteenth century through the invention of electrical energy and assembly line production. Henry Ford (1863-1947) took the idea of mass production from a slaughterhouse in Chicago: The pigs hung from conveyor belts and each butcher performed only a part of work of butchering the animal. Henry ford bring into these procedure into automobile production and change the process. While before one station assembled the entire automobile, now the automobile was manufactured in partial steps on the conveyor belt –significantly faster and at lower cost. Industry 2.0 (from the end of the nineteenth century to the 1980s) was the period when industrial products burgeoned both in volume and variety. Major technological innovations included electricity, electronic and mechanical devices. A milestone of Industry 2.0 was Frederick Taylor's. The Principle of Scientific Management, which was the first publication on modern management theory. Taylor is considered the 'Father of Management'. The demand during Industry 2.0 had two dimensions – volume and variety. We can call this demand environment as Stable Market. Two innovators, Henry Ford and Taiichi Ohno, practiced and extended Taylor's theory. Ford addressed the shortage of supply in product volumes using mass production assembly lines. Ohno addressed various customer interests in product varieties by developing the Toyota production system, the precursor to lean. Yong Yin (2018) By the start of revolution power turned into the essential wellspring of intensity. It was less demanding to use than water and steam and empowered organizations to focus control sources to singular machines. In the long run machines were composed with their own particular power sources, making them more versatile. This period likewise observed the improvement of various administration programs that made it conceivable to expand the productivity and adequacy.

Fig 2: Industry 2.0 [7]

INDUSTRY 3.0

The third industrial revolution started with the introduction of the first programmable logic controller in the year 1969 using automation (gereenwood1997). Efficient machines and robots were used in automation of industries in which the computer system and automation is widely used to manufacture parts. Industry 3.0 (from the 1980s to today) is characterized by technological innovations such as change from analogue to digital, which had big impact, especially on the electronics industry. The product architecture of most electronic products changed from integral to modular accompanied by a dramatic reduction in average product life cycles. The demand for products during Industry 3.0 increased to three dimensions – volume, variety and delivery time. Flexible manufacturing systems is used by industries as supply approaches to match the three dimensions of demand. (Yong 2018). Rifkin (2011) describes five energy pillars supporting the Third Industrial Revolution. These are (I) the shift to renewable energy; (ii) transformation of the building stock into green micro-power plants to collect renewable energies on-site; (iii) deployment of hydrogen and other storage technologies in every building and throughout the infrastructure to store intermittent energies; (iv) use of Internet technology to transform the power grid of every continent into an energy internet that act just like the Internet; and (v) transition of the transport fleet to electric plug-in and fuel cell vehicles.

Fig 3: Industry 3.0 [7]

INDUSTRY 4.0

International Journal of Engineering Sciences Paradigms and Researches (IJESPR)
Vol. 48, Special Issue, (TAME-2019, April 4-5, 2019)
(An Indexed, Referred and Impact Factor Journal approved by UGC- Journal No. 42581)
ISSN (Online): 2319-6564
www.ijesonline.com

Industry 4.0 is concept first initiated from Germany in 2011. In this concept, with the help of cyber physical laws, internet of things and cloud computing industry 4.0 creates (which is also called smart factory). Industry 4.0 advances the trend of automation through digitization and network production. Industry 4.0 stands for a new way of organization and control of complete value-adding systems. The key objective is to fulfil individual customer needs at the cost of mass production. Therefore, it affects all areas from order management, research and development, manufacturing, commissioning, delivery to the use and the recycling of produced goods. The basic components of industry 4.0 are autonomous robots, simulation, system integration, internet of things, cyber security, cloud computing, additive manufacturing, augmented reality, big data, intelligent manufacturing, location detection technologies, human machine interface and authentication and fraud detection (Hermann 2016). They focus on creating smart factories where manufacturing skills are upgraded and changed by cyber-physical systems (CPSs), the Internet of Things (IoT), and cloud computing. In the Industry 4.0 era, manufacturing systems are able to monitor physical processes of the physical world, and make smart decisions through real-time communication and cooperation with humans, machines, sensors, and so forth. The Industry 4.0design principles (M. Hermann ,2016) Interoperability: connect production systems, devices, sensors, and people. Decentralized decision making: enable autonomous systems. Industry 4.0 is an activity with innovation developments, for example, web of things (IoT), enormous information, electric vehicles (EV), 3D printing, distributed computing, man-made consciousness and digital physical frameworks. Industry 4.0 has pulled in consideration from governments, businesses and scientists. Presently, Industry 4.0 can enable these projects to achieve their maximum capacity.

The design principles allow manufacturers to explore a possible conversion to Industry 4.0 technologies. There are following the design principles on which: **Interoperability**: Objects, machines and people need to be able to communicate through the Internet of Things and the Internet of People. Interoperability is the principle that is required for a smart factory. **Virtualization**: Cyber physical system must be able to simulate and make a virtual replica of the real world. Cyber physical system must also be able to monitor objects existing in the adjacent environment. In this system, there must be a virtual replica of everything. **Decentralization**: The capacity of Cyber Physical Systems is to work autonomously. Customized products and problem solving can be analysed by decentralisation. Decentralization provides flexibility in production. In cases of failure or having conflicting goals, the issue is transferred to a higher level. **Real-Time Capability**: A smart factory needs to be able to collect real time data, store or analyse it, and make decisions according to new findings. It also related to market research and internal processes like machine failure in production line. Smart objects recognize the defect and re-delegate tasks to other effective machines. It provides greater flexibility and optimizes product. **Service-Orientation**: Production must be customer-oriented. All the smart objects/devices should work with Internet of Services to build products according to customer requirements. At this stage the Internet of Services becomes pivotal. **Modularity**: It is mandatory for smart factory to work with changing market. In a dynamic market, a Smart Factory's ability to adapt to a new market is essential. On an average, an average company take a week to analyse the market and modify its existing structure according to required production. On the other side, smart factories should welcome seasonal changes and market trends.

Fig 4: The era from industry 1.0 to industry 4.0 [8]

2. LITERARURE REVIEW

Over the last few years, the industry 4.0 revolution has involved more and more attentions all around the world in manufacturing sector. In the current literature, there is still a lack of efforts to systematically review this new industrial revolution 4.0. The aim of this study is to address this gap by investigating the progresses in Industry 4.0. A systematic literature review was carried out to analyse the previous model on Industry 4.0. The term Industry 4.0, shortened to I4.0 or simply I4, initiates from a development in the high-tech strategy of the German government that encourages the computerization of manufacturing. The term Industry 4.0 was rejuvenated in 2011 at the Hannover Fair. In October 2012 the Working Group on Industry 4.0 presented a set of Industry 4.0 implementation guide lines to the German federal government. The Industry 4.0 members are known as the founding fathers. On 8 April 2013 at the Hannover Fair, the final report of the Working Group Industry 4.0 was presented. This working group was headed by Siegfried Dais (Robert Bosch GmbH) and Henning Kagermann (German Academy of Science and Engineering).

Various models of Industry 4.0 have been reviewed. These models have led me to collect the various factors or support system related to Industry 4.0. The study of such models made me to analyse the need of these factors and to drive a model based on these support systems. The model taken by me for reference as follows

- The BIS model (2015).
- The model of Mueller et al., (2017).
- The model of qin and et al, (2016).

According to British standards institution (BIS) there is role of some standards for industry 4.0. For example, role of standards in support of innovation contains technology at different stages of emergence required different response from standards and companies at different stages of maturity also required different standards response. BIS mainly focused on standards like interoperability (between machines and data), business capability (to earn revenue in market place by introducing new business models, automation and service innovation), international (for co-ordination, universal adoption and standard growth of development), design (for manufacture, verification and service), information security (protect internet protocol and controlled sharing of information).
The difficulty with this model is that the various standards which are under industry 4.0 have not been in any relationship. The relationship is very necessary for efficient working in the manufacturing company.

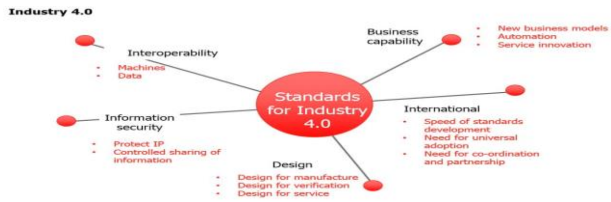

Fig 5: The BIS model (2015) [9]

According to this model execution of industry 4.0 mainly depends on four major perspectives. It tries to eliminate the issues related to these four perspectives (manufacturing process, devices, engineering and software). With the introduction of IoT innovations, all conceivable processing and transport functions of the manufacturing process would be mapped and recorded as in the virtual data framework with real time. This model considered devices as 'things', or 'objects'. These include smart automation devices, PLC, mobile devices, servers and web access devices and so on. The software perspective includes business management software, production management software, control and regulation software and software realization for the interfaces and integration among them. These software makes interaction among things as well as make them capable to achieve planning, directing, organizing and coordinating of things. The engineering view focused on the Production Lifecycle Management in the manufacturing system of an organization. And the responsibilities of resource allocation consist matters related to product design and production development, production planning, production engineering, production and services.
The above two perspective focus on the mapping and merging between real and virtual systems, while the below two focuses on the fusion and application based on the integration of these two systems. The usage of IoT technologies to realize fusion for the autonomous decision makes this model chaotic. So, there is a need of seamless connection of these four perspectives with IOT technologies.

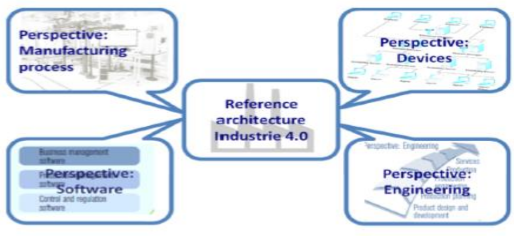

Fig 6: The model of Mueller et al., (2017)

This model of manufacturing for industry 4.0 classified by level of intelligence from low intelligence to high intelligence which is: Control level, Integration level, and Intelligence level. On the automation level, the technologies, like computer numeric controlling, the programmable logic controlling etc., are used for replacing the manual work and increase the production efficiency. On the incorporation level, IoT and CPS technology are going to be applied in manufacturing based on the control level technologies, generating the digital manufacturing atmosphere and networks. It does not only connect the hardware but also makes the communication between the controlling systems. The data is collected from sensors, machines, production lines, or manufacturing controlling and management systems, and it is also received from outside of the factory, such as the customer feedback and the supply chain. On the intelligence level, the manufacturing uses data or information obtained from the integration level to create the plan and make decisions by intelligent technologies, such as advanced data mining and big data analysis.
This model does not give the relationship between IOT, CPS cloud computing, radio frequency identification technology etc and it does not tell about the sub factor which are used in Industry 4.0.

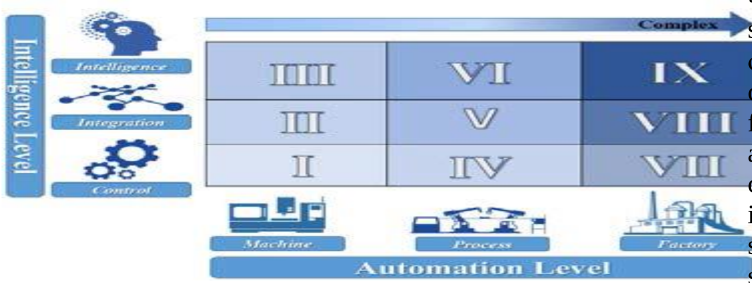

Fig 7: The model of qin and et al., (2016)

3. FACTORS/SUPPORT SYSTEM USED IN INDUSTRY 4.0

In Industry 4.0 there are many factors which are used in making of model of Industry 4.0. these factors are support system for model of Industry 4.0 which are very necessary for implementing the model in manufacturing industry. These factors are as follows

- **INTERNET OF THINGS** The Internet of Things (IoT), sometimes called as the Internet of Objects, will change everything all over the world. It is the network of physical devices which enables these things to connect and exchange information with the help of internet. The Internet has an effect on education, communication, business, science, administration and people (M. A. Ezechina). IoT is the method of converting data obtained from different resources of things to any virtual platform on existing Internet infrastructure (Ling-yuan Zeng). It also affects the manufacturing system by connecting the machines with internet. As we known that the Internet is one of the most important and powerful factor in all of human history and now with the concept of the internet of things, internet becomes more favorable to have a smart life in every aspect which is necessary for the implementation of traditional manufacturing into smart manufacturing. Internet accessing is the new method of internet of thing. By the Internet of Things, objects recognize themselves with unique identification protocol and get a result of intelligence behavior by enabling related decisions thinks to the fact that they can communicate information in the system [14].]. In other word, the internet of things, anything's will able to communicate to the internet at any time from any place to provide any services by any network to anyone. This concept will create a new type of applications can involve such as smart vehicle and the smart industry, to provide many services such as notifications, security, energy saving, automation, communication, computers and entertainment (Saranya, Sapandeep). There are six factors which are used in IOT:

  Coding Layer: It is the basis of IoT which offers identification to the objects of interest. In this layer, each machine is assigned a unique identification which makes it easy to recognize the objects (Xu Cheng).

Perception Layer: It provides IoT a device layer. It provides a physical meaning to each object. It consists of data sensors in different forms like RFID tags, IR sensors or other sensor networks (H.D. Ma) which could sense the temperature, humidity, speed and location etc of the machines. It collects the useful information of the objects from the sensor devices linked with them and converts the information into digital signals and finally passed onto the Network Layer for further action.

Network Layer: The purpose of this layer is obtaining the useful information in the form of digital signals from the Perception Layer and send it to the processing systems in the Middleware Layer by the transmission mediums like WIFI, Bluetooth, WiMAX, ZigBee, GSM, 3G etc with protocols like Ipv4, Ipv6, MQTT, DDS etc (Nich Heath)

Middleware Layer: This layer executes the information obtained from the sensor devices. It consists the technologies like Cloud computing, Ubiquitous computing which ensures a direct access to the database to store all the required information in it. Using some Intelligent Processing Equipment, the information is processed and a fully automated action is taken based on the processed results of the information. (Guicheng)

Application Layer: This layer understands the applications of IoT for all kinds of industry based on the processed data. Because applications help the advancement of IoT so this layer is very helpful in the large-scale development of IoT network. The IoT related applications could be smart factory, smart transportation, smart planet etc.

Business Layer: This layer accomplishes the applications and services of IoT and is accountable for all the research related to IoT. It creates different business models for effective business strategies (Rafiullah Khan).

➢ DATA ANALYSIS SYSTEM

With an aggressive trend toward the Internet and IoT technologies, data is becoming more and more accessible and ubiquitous in many industries, resulting in the issue of data system. Data system typically stems from various channels, including sensors, devices, video/audio, networks, log files, transactional applications, the web, and social media feeds. Under these circumstances, a "data system environment" has gradually taken shape in the manufacturing sector. Although the advancement of the IoT (e.g., smart sensors) has reorganized the collection of data, the question remains of whether this data can be processed properly in order to provide the right information for the right purpose at the right time. In a data system environment, the datasets are much larger and may be too complex for conventional data analytic software. Therefore, for organizations and manufacturers with an abundance of operational and shop-floor data, progressive analytics techniques are critical for detection hidden patterns, unknown correlations, market trends, customer preferences, and other useful business information.

Cloud computing: Cloud computing is the distribution of on demand computing services over the internet on a pay as you go basis.

"Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and related with minimal management effort or service provider interaction" (NIST 2011).

"Cloud Manufacturing (CM) is a customer-centric manufacturing model that exploits on-demand access to a shared collection of diversified and distributed manufacturing resources to form temporary, reconfigurable production lines which enhance efficiency, reduce product lifecycle costs, and allow for optimal resource loading in response to variable-demand customer generated tasking." (Wu D). Cloud permits the synchronization of data from multiple sources into a single dashboard. Hence it relieves employees from the burden of manually transferring data from one system to another. It is used in industries in monitoring and control of plant processes. Cloud helps in synchronization of data by defining a single point as the source of information and allowing access it via the internet. Cloud computing in Industry 4.0 is not a chance but an opportunity. It is time for Industry 4.0 to adopt the technique of cloud.

Then we get confidential, integral and accessible platform which provides smooth flow of information from cloud computing to machine unit which is installed in manufacturing sector. The advantages are On-demand self-service, Broad network access, Dynamic resource pooling, Rapid elasticity& Measured Service:

Data system: It is a set of processes collecting the correct data of high volume, high velocity and high variety data from the cloud computing storage system. Data system is the essential lifeblood of manufacturing company. Data is coming from traditional source like the customer survey as well as more innovative application like smart sensors & use of IoT to capture machine readings. Hence the volume of data is coming is from external source, internal source and generated source by machine to machine. This data is stored in cloud computing and it is extracted when it is required at the time of processing.

Data Encryption: It is the method of converting plain text data into random or meaningless. Data system in manufacturing sector is unprotected when it is being transferred from one location to another or machine to machine. For security from unauthorized user, encryption techniques are used to avoid the data system hacking. For data system security in Industry 4.0, encryption techniques play vital role because Industry 4.0 is totally with online transmission of data and information. Hence encryption is a technique to rewrite data in secrete code. Encryption provides confidentiality, authentication, integrity of the data system and able to access the given data system from one location to another location.

➢ CYBER PHYSICAL PRODUCTION SYSTEM

"Cyber-Physical Systems (CPS) are systems of collaborating computational entities which are in intensive connection with the surrounding physical world and its on-going processes, providing and using, at the same time, data-accessing and data-processing services available on the internet." (Monosporic,). Cyber-physical systems (CPSs) are such techniques which bring the virtual and physical worlds together to form a networked world in which intelligent objects communicate and relate with each other (Industry 4.0, Smart Manufacturing for the Future, Berlin, 2014). Together with the internet and the data and services available online, embedded systems join to form cyber physical systems. CPSs also are a paradigm from existing business and market models, as revolutionary new applications, service providers and value chains become possible.

The cyber physical production system contains safety, security, verification, traceability, real time system and authentication & fraud detection for the successful implementation of the model which is free from the malware practice and cyber attacks.

Cyber security: It is not a product that can be bought and added to a system: instead, it is a process that initiate at or before the design stage and must into all parts of the system produced. Also, it is an ongoing process: the rise of new threats may necessitate a fundamental examination of the security of the entire plant, which can only be done from the perception of system design. Cyber attacks can be in the form of false data injection attack, time delay attack, spoofing attack, man in the middle attack, side channel attack, zero-day attack, physical attack and many more attack. There is some standard of cyber security by which these attacks are to be mitigate.

Information traceability: It is the track and trace each component that comprises product from suppliers and manufacturer through assembly and final delivery to customer. It can be done with the help of some technologies like barcode, radio frequency identification, wireless communication. It can help in achieve real time transparency, increase customer satisfaction & safety, improve data accuracy and many more.

- **INTELLIGENT SYSTEM**

An intelligent system is a machine with an implanted, Internet-connected computer that has the ability to collect and analyse data and communicate with other systems. Other standards for intelligent systems comprise the capacity to learn from experience, security, connectivity, the ability to adapt according to current data and the capacity for remote monitoring and management. The ability of a system is to calculate reason, perceive relationships and analogies, learn from experience, store and retrieve information from memory, solve problems, understand complex ideas, use natural language smoothly, classify, generalize, and adapt new situations.

Artificial intelligence:

Artificial Intelligence is a method of making a computer, a computer-controlled robot, or a software think intelligently, in the similar manner the intelligent humans think. AI is accomplished by studying how human brain thinks and how humans learn, resolve, and work while trying to solve a problem, and then using the results of this study as a foundation of developing intelligent software and systems.

Additive manufacturing: Additive manufacturing uses data computer-aided-design (CAD) software or 3D object scanners to direct hardware to bond material, layer upon layer, in accurate geometric shapes. Additive manufacturing adds material to generate an object. By contrast, when create an object by traditional means, it is often necessary to remove material through milling, machining, drilling, shaping or other means. Although the terms 3D printing and rapid prototyping are informally used to discuss additive manufacturing, each process is actually a subset of additive manufacturing.

Collaborate robot: Collaborative robot is a robot planned to physically interact with humans in a shared workspace. This is in contrast with other robots, designed to operate autonomously or with incomplete guidance. It can have many roles from autonomous robots capable of working together with humans in an office environment that can ask for help, to industrial robots having their protective guards removed. Collaborative industrial robots are highly composite machines which are able to work hand in hand with human beings.

Virtual reality: It is also known as Virtual Worlds, Artificial Worlds or Artificial Reality, Synthetic Experience. Virtual reality is the term helps to explain a three-dimensional, computer generated environment which can be explored and interacted with by an employer. That employer becomes part of this virtual environment and is able to manipulate things or perform a sequence of actions. It is also helps in training of employees, factory planning in terms of designing, testing and maintenance & inspection. [https://www.brainvire.com/blog/3-vr-solutions-that-will-transform-industry-4-0-into-smart-factory/]

Augmented reality: This technology takes employers the chance to practice an augmented world by taking virtual information in the real world. By the use of this technology the employer can be in touch with both the real and virtual world and receive real-time data or information whatever which is required. In the manufacturing company, AR data are used by the system in automation to the intelligent networking of the entire building technology, every user has access to the right information at the right time. Every workstation offers contact to tool data and databases with animations and 3D models on every tool. Augmented reality has potential for enhancing manufacturing operations in terms of productivity, safety, training, reduce error rate and more.

4. A GENERAL MODEL OF INDUSTRY 4.0

International Journal of Engineering Sciences Paradigms and Researches (IJESPR)
Vol. 48, Special Issue, (TAME-2019, April 4-5, 2019)
(An Indexed, Referred and Impact Factor Journal approved by UGC- Journal No. 42581)
ISSN (Online): 2319-6564
www.ijesonline.com

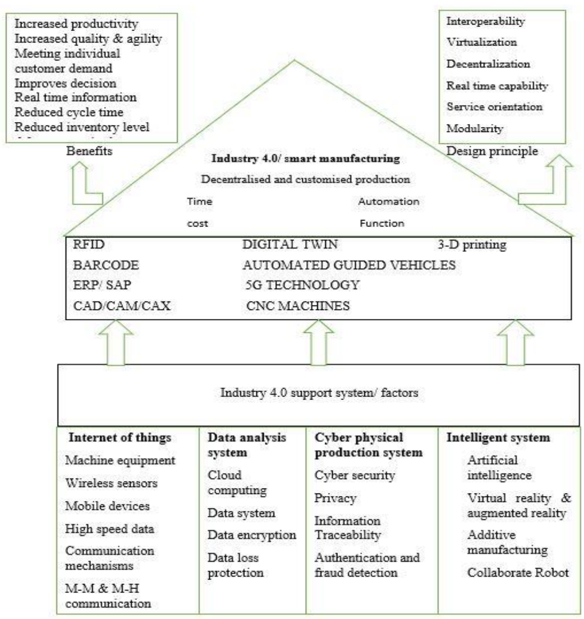

Fig 8 Model of industry 4.0

Due to global competition customized product of high quality at reasonable cost is required to satisfy increasing customer requirements. Industry 4.0 is a general model that shows latest developments in industrial production. This model means the smart factory in which smart digital devices are connected. Flexibility, efficient use of resources and customer integration are the main characteristics of any smart industry.

The model of industry 4.0 consists of support system and some enabling new technology. Support system consists of Internet of things, Data analysis system, Cyber physical production system, Intelligent system. A synergic integration among these support systems provides greater flexibility in smart manufacturing system. Besides this synergic integration also take cares of Data encryption, data loss protection, network security, authenticity and information traceability. After the support system some technologies like Rfid (Radio frequency identification), 5G technology, 3-D printing, ERP etc help in producing decentralised and customized production by smart manufacturing. This model can use any of the mentioned technology as per requirement of size of organization, its capacity and level of production. But that should be efficiently connected to the support system that are mentioned in a general model of Industry 4.0. This general model of Industry 4.0 also considers some design principles like in Interoperability, Virtualization, Decentralization, Real time capability, Service orientation, Modularity. As this model contains support system, efficient technologies and some design principles therefore it will provide seamless flow of origin to source. Meanwhile it takes cares of problems faced during manufacturing of product and provides product satisfying the changing requirements of customers.

5. CONCLUSION

Industry 4.0 is an effective manufacturing practice for successfully implementation for achieving the better performance of the Industry. The problems should be minimized to take the benefits of the Industry 4.0. Industry 4.0 adoption depends on the various support system. By considering these support system, manufacturing company can enable to reduce time, increased digitization and automaton for the manufacturing growth. With the help of support system, a general model of Industry 4.0 is prepared. The model aims to make Indian manufacturing company more digitization and stronger so that these companies become able to grow and create new jobs and focused on customized products. From that model, it is clear that the upcoming of current manufacturing is developing in the direction of Industry 4.0.

1. Meeting individual customer demands.
2. Flexible and agile engineering and manufacturing.
3. Improved information sharing and decision making.
4. Improved integration and collaboration.
5. Improved resource productivity.
6. Mass customization.
7. Increase level of automation

6. REFERENCES

1. Greenwood, Jeremey (1997). The Third Industrial Revolution America.
2. Guicheng Shen and Bingwu Liu, ”The visions, technologies, applications and security issues of Internet of Things,” in E -Business and E -Government (ICEE), 2011, pp. 1-4
3. H.D. Ma, ”Internet of things: Objectives and scientific challenge,” in Journal of Computer Science and Technology, 2011, pp. 919-924
4. Hermann, Pentek, Otto, 2016: Design Principles for Industrie 4.0 Scenario.

5. http://www.nxp.com/assets/documents/data/en/whitepapers/INTOTHNGSWP.pdf
6. https://www.cmegroup.com/stories/_files/images/02-advancements/advancements-industrial-revolution-panel-04.jpg accessed on 24/11/2018
7. https://rctom.hbs.org/wpcontent/uploads/sites/4/2017/11/Industry-4.0-shutterstock_524444866_pk_cut.jpg accessed on 24/11/2018
8. http://allabtinstru.blogspot.com/2016/09/industry4.html accessed on 24/11/2018
9. https://www.nottingham.ac.uk/ifam/documents/dtmi2015/3-2-standards-in-industry-4.pdf accessed on 24/11/2018
10. Ling-yuan Zeng, "A Security Framework for Internet of Things Based on 4G Communication," in Computer Science and Network Technology (ICCSNT), 2012, pp. 1715-1718
11. M. A. Ezechina, K. K. Okwara, C. A. U. Ugboaja. The Internet of Things (Iot): A Scalable Approach to Connecting Everything. The International Journal of Engineering and Science 4(1) (2015) 09-12.
12. Monostori, L.: Cyber-physical production systems: Roots from manufacturing science and technology, at Automatisierungstechnik, Vol. 63, No. 10, 2015, pp. 766-776. (ISSN: 0178-2312) (DOI: 10.1515/auto-2015-0066)
13. Mueller, E., Chen, XL. & Riedel, R. Chin. J. Mech. Eng. (2017) 30: 1050.
14. Nich Heath, "What the Internet of Things means for you". It can be accessed at:http://www.techrepublic.com/blog/europeantechnology/what-the-internet-of-things-means-for-you
15. Qin, J., Liu, Y., & Grosvenor, R. (2016). A categorical framework of manufacturing for industry 4.0 and beyond. *Procedia Cirp*, *52*, 173-178.
16. Rafael, Reif, Ann Jackson Shirley, and Andrew Liveris. 2014. Report To The President Accelerating U.S. Advanced Manufacturing. Washington, DC: The President's Council of Advisors on Science and Technology.
17. Rafiullah Khan, Sarmad Ullah Khan, Rifaqat Zaheer and Shahid Khan, "Future Internet: The Internet of Things Architecture, Possible Applications and Key Challenges," in Proceedings of Frontiers of Information Technology (FIT), 2012, pp. 257-260
18. Sapandeep Kaur, Ikvinderpal Singh. A Survey Report on Internet of Things Applications. International Journal of Computer Science Trends and Technology Volume 4, Issue 2, Mar - Apr 2016.

Saranya C. M., Nitha K. P., Analysis of Security methods in Internet of Things. International Journal on Recent and