Applicability of Industrial Internet of Things in Lean Manufacturing: A Brief Study

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Abstract – **Day-to-day fluctuations in the market demands, competition in product variety, unit price and viable pressures are exigent to producers to know new paths to produce components to be better, faster and cheaper exclusive of unruly operations. Some of the leading manufacturers are deploying Industry 4.0 solutions to alter parts, methods to create such components and customers unleashing new levels of output from the firms, novelty and economic success. The mechanized firm is leading in the Internet of Things for various reasons such as the promising industrial revolution (Industry 4.0) and then there are the numerous cases of real IoT exploitation that offer quick return in investment and allow producers to realize digital transformations from several perspectives. IoT has moved out from our homes and offices to the industrial segment and hence known to become IIoT (Industrial Internet of Things).**

Industrial IoT in manufacturing industry is a core element of the transformation and by far it has seen the most investment which makes for a potential future. In the present work, a brief discussion on definition of IoT, need to the present industry to withstand market demands to satisfy the customers taste change according to the needs is explained.

Keywords: Smart Manufacturing, Industrial IoT, Digitization, Industry 4.0, Machine-to-machine

I. INTRODUCTION

IN PAST, there was a easy physical way of usage of machinery. Though, with a development of technological methods, new traditions are implemented for managing the machines like automation. By the pat of a button, we can access huge quantity of information due to competence of computers and the Internet (Figure1). One and all want reasonable and safe way to manage their equipment from any smart phone or Internet link. The Internet of Things (IoT) is the setup of bodily items rooted with electronics, software, sensors and linked to allow it to attain superior value and service by transfer of data with the producer, operator or other associated devices. Every item is exclusively expressed through its implanted network system but is proficient to interoperate within the accessible Internet of things. Internet of Things is the subsequently gigantic revolt of the digital world on commercial market in a variety of goods. Everything is related with the internet, several things are involving to monitor the parameters from any place. The Internet of Things in the present day is most trending.
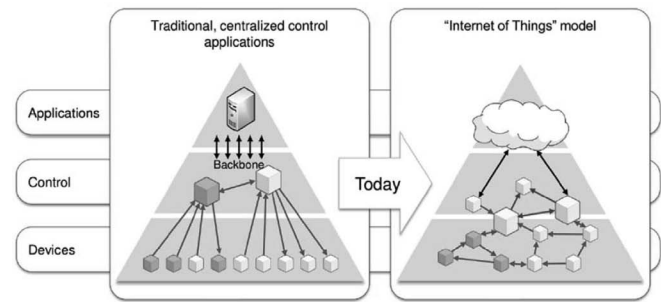

Figure 1. IoT model for manufacturing and industrial automation.

To talk about research trends, we need to know what IoT actually means and to look at its bang on daily existence, manufacturing firm and new business trades. We are still in promising levels where one and all demanding to deduce IoT according to their needs [1]. Because of that, there is no general explanation of IoT and accessible definitions are nebulous. Also, there are a few additional provisions allied to IoT such as IoE (Internet of Everything), WoT (Web of Things), CoT (Cloud of Things), M2M (Machine to Machine), etc. Several researchers believe these requisites which have the identical connotation but the greater part of authors discriminate these meanings according to meticulous hallucination [2] to put together all beneath one sunshade to outline IoT.
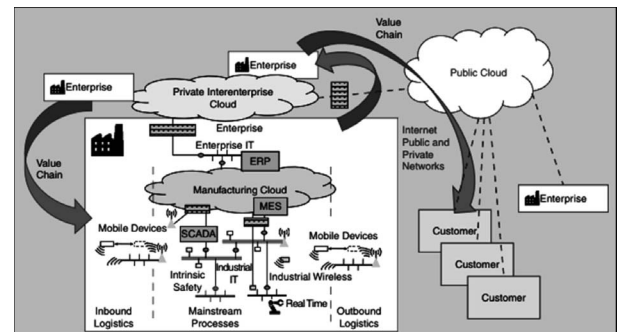

Figure 2. The complexity of communication in industrial automation systems [3].

Figure 2 shows difficulty of messaging the information in manufacturing organization with computer systems. There are several relevance fields with diverse necessities, *e.g.*, concerning authentic instance, movement of man, machines and material, protection and safety measures, flare-up safeguards, ease of use, and so forth. Naturally, up to a managerial control and information gaining system, industrialized network solutions are varied but are optimized to complete the necessities which include field buses, industrial Ethernet and industrial wireless networks. At present, with the integration of internet communication technologies (ICTs), local industrialized cloud computing systems are progressively more.

Smart factory: A smart factory is a highly digitized and connected production facility that relies on smart manufacturing. The idea to be the supposed industrial unit of the expectations is still in its immaturity, the notion of the smart plant is taken a vital result of the fourth engineering rebellion, or Industry 4.0. An industrial unit is in fact a elegant when each and every one machinery and equipments are proficient to pick up processes during mechanization and optimization by adopting technology such as artificial intelligence (AI), robotics, analytics, big data and the internet of things (IoT) and can operate autonomously with the capability to check with feedback system. Smart factories rely on elegant producing of components, which connects the industrial unit to other units in the digital supply network, providing more successful supply chain management. The payback also make bigger further than in a minute the bodily making of goods and into functions like process planning, smart contribute sequence in maintenance logistics and still merchandise progress in creation of new products.

One of the feature parts of any smart manufacturing firm is the service organization. A well mechanized firm enables IIoT motorized stylish maintenance which is foretelling maintenance.

II. INDUSTRIAL IOT (IIOT) IN MANUFACTURING

Industrial Internet of things (IIoT) in manufacturing firm is undeniably empowering the industrial revolution (industry 4.0). Most of the firms have been profitable via IoT enabled services. Companies include Amazon, Hitachi, John Deere, Komatsu, Maersk and more. Though, the operations acquire within the four walls of the firm. And every one of the IIoT (industrial internet of things) strategies makes the procedure extra faultless. The arrangement of a smart industry can comprise a grouping of production, communication technologies and information, some with the possible for amalgamation transversely the whole production contribute fetter [5].

Digital conversion of resources is precedence for producers in the era of Industry 4.0. Computers and automation technology have jointly built competition potential and the overall souk

has been crooked entirely on its skull. To contend worldwide, manufacturers are looking to unite plant equipment to the cloud and turn into more pliable in their making to meet the hopes of the clients. However, they are opposed to alterations to their equipment.

Current industrial inventions in manufacturing sectors deal with these obstructions to smart factory renovation, serving firms acquire linked to the cloud to run information data and strategies, grow impending, and control of ability of machine learning processes. The stamina of this link to connect the Open Platform Communications Unified Architecture (OPC UA), which shortens the interoperability and enables producers to obtain a beginning of converting their resources into stylish organizations (Figure 3).

Figure 3. Open Platform Communications Unified Architecture (OPC UA) (Courtesy: OPC Foundation).

III. THE TASK OF 5G NETWORK SYSTEM IN MANUFACTURING TO DO AUTOMATION

Electronic revolution is the heart of the fourth generation in industrial revolution and 5G network communications will be the means of sustaining material goods. In the subsequent decade the production organizations are predicted to advance in the direction of a scattered units of production with associated goods (products with communication ability), exhaustion processes, shared robots and integrated production systems and logistics [6, 7]. These ideas are especially personified in the Industry 4.0 pattern.

One energetic situation is to shape an arrangement of physically spread industries with FMS (Flexible Manufacturing Systems) capabilities and allocation of resources and assets to get better order performance. Among other possessions, a trustworthy ample communication is desirable for this exercise case. As an outcome of these transform of various signal and systems applied to the current industrial sectors will have improved scientific competence accessible to activate the growth of novel products and services. There is chance to the 5G society to broaden the executive levels beyond the networking features

and contain networked services for safekeeping, information data analysis and cloud/edge computing [8, 9].

In the perspective environment of Industry 4.0, industrial robotics such as AGV's (automated guided vehicles) and RGV's (rail guided vehicles) have drawn amplified notice due to their computerization abilities and low cost. With sustenance of cognitive methods for Industrial Internet of Things (IIoT), manufacturing processes can be momentously optimized and further smart manufacturing to make variety of components can be adopted for smart industries.

IV. POSSIBILITIES FOR DIGITIZATION OF MANUFACTURING PROCESSES IN INDUSTRY

S.No.	Process	Digitization possibilities
1.	Manufacturing operations	Additive manufacturing to produce rapid prototypes
		Advanced planning and scheduling using real time production and inventory data to minimize waste and cycle time.
		Cognitive bots and autonomous robots to effectively execute routine processes at minimal cost with high accuracy
2.	Warehouse operations	Augmented reality to assist personnel with pick and place tasks
		Autonomous robots to execute warehouse operations
3.	Inventory tracking	Sensors to track real time movements and locations of raw materials, work in progress and finished goods and high value tooling
		Analytics to optimize inventory on hand and automatically signal for replenishment
4.	Quality	Inline quality testing using optical based analytics
		Real time equipment monitoring to predict potential quality issues
5.	Maintenance	Augmented reality to assist maintaining personnel while repairing equipment
		Sensors on equipment to drive predictive and cognitive maintenance analytics
6.	Environmental, health and safety	Sensors to geofence dangerous equipment from operating in close proximity to personnel
		Sensors on personnel to monitor environmental conditions, lack of movement and other potential threats

The IoT revolution is enabling industry to work more intelligently and attain enhanced results. Producers are now able to collect the information data from sensor based technologies and use that data to analyze purpose, machine learning techniques and artificial intelligence (AI) to boost up efficiencies, rationalize their various process operations and categorize novel business chances [10].

V. CASE STUDY

A mechanical core industry is considered to automate with possibility to implement Internet of Things to improve and share the data from one plant to other. We briefly discuss how the existing manufacturing firm automates by adopting CAD/CAM/CIM/FMS technologies. Also studied challenges still required to enhance the quality, functions, reduce lead time and withstand the market fluctuations according to customers taste.
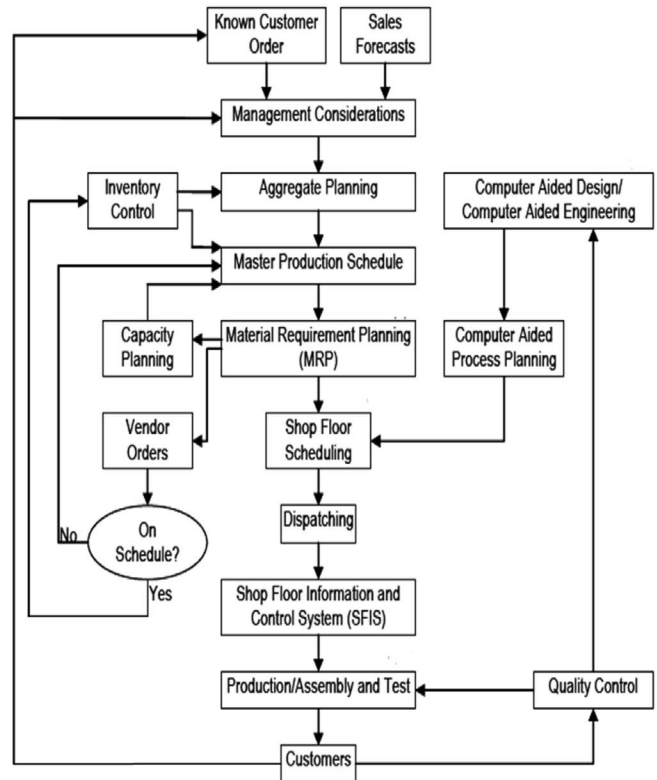

Figure 4. Various stages of product flow in the traditional manufacturing sector.

From figure 4 it is observed that, focus is on time given to the customer according to their quotation. To meet delivery schedule goodwill of the company improves and it helps increase of sales in the market. Via conventional machines and human operators this was not possible.
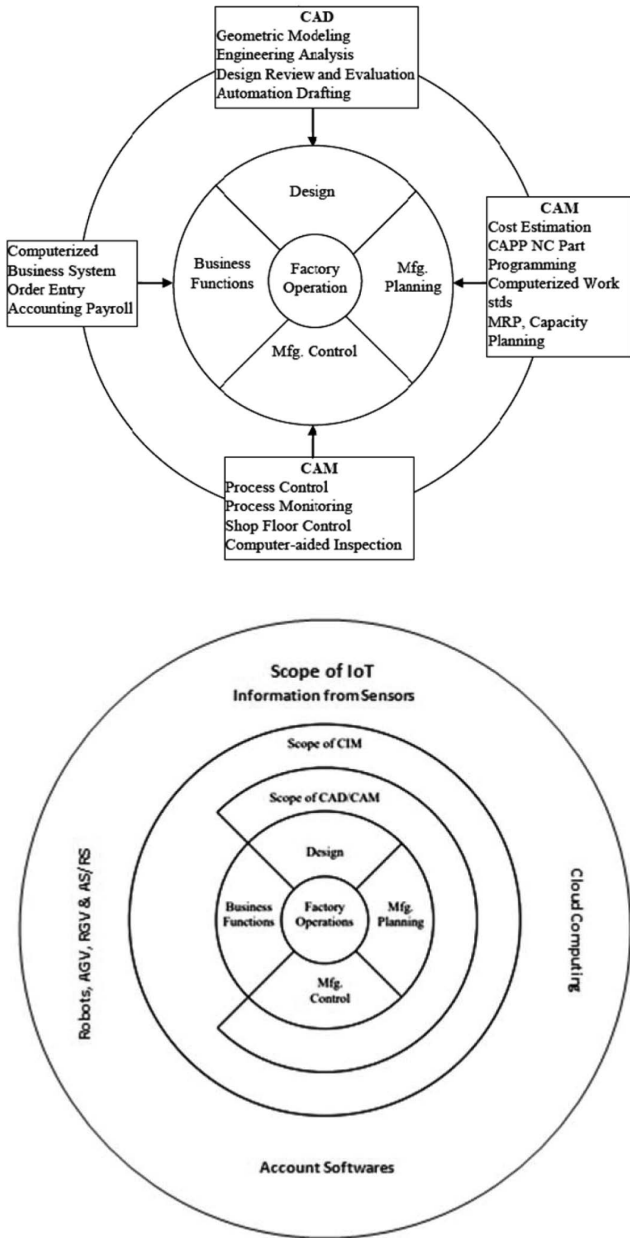
Figure 6. Scope of IoT in manufacturing sector:
beginning of a new era.

Further day-to-day technological developments in manufacturing sector *i.e.*, Computer Numerical Control of Machines (CNC), Industrial robots, Computer aided designing and drafting (CADD), Computer aided manufacturing (CAM) using APT part programming techniques, Adoptive Control techniques, which helps to control variations in the processes using sensors, Computer Aided Process Planning (CAPP) and quality control (CAQC), Group Technology with OPTIZ and MICLASS code systems and further invention of FMS and CIM (Fig.5). These new technologies improve the quality of variety of products in flexible manufacturing cell. Currently,

interesting innovations are developed by young engineers by creation of different types of Apps.

VI. BENEFITS OF INDUSTRIAL IOT IN THE MANUFACTURING INDUSTRY

Inventory Management: Controlling things across the supply chain is currently probable through Internet of Things application. Using IoT, tracking of inventory across the globe on a plant level is possible and the customers get alerts of any momentous changes from earlier arrangements. This information helps to cross-check inventories and managers are provided with practical estimations of the available material, work in progress and the expected arrival time of fresh materials. Eventually these methods optimize the supply and diminish mutual costs in the value of supply chain management.

Increased Quality Control: IoT sensors gather average product information data and other third-party consortium data from different levels of a product life cycle. This data information relates to the entire work of raw materials utilized, operational settings such as temperature, pressure etc, and impact of shipping of goods from raw to final shape of products. Furthermore the final product, the IoT device can supply the various data available at different stages with respect to the customer sentiments on creating the product requirements.

Enhanced health and Safety: Big Data analysis is a means of performance indicator of health and safety, such as number of injuries, little and long-standing absences, infection rates, near misses and so on.

Smart Metering: By implementation of Smart meters in IIoT, it is possible to monitor the utilization of resources like electric current, fuels used in the plant for various purposes, usage of water etc. Through the implement of IoT sensors, entrepreneurs will identify accurately how much is consumed and what for. Through such effective management, expenses can be trimmed significantly.

Predictive Maintenance: Industrial Internet of Things in manufacturing sector has not only perceived a mutiny in the equipment maintenance structure, but also its relief. For the first time, foretelling repairs conveyed from beginning to end by the hardware controls, which acquires the machine tool condition monitoring beyond cloud computing into edge computing. Predictive maintenance (PdM) techniques are intended to aid in determining the condition of equipments in order to envisage when repairs or possible breakdowns are raised in the shop floor. This provides cost savings over process plan.

Smart Packaging: By adopting IoT sensors in goods, parts, components and packaging, producers can get valuable insights into the customized replicas and practice of manufactured goods from numerous clients. Smart tracking methods can

be utilized to path merchandise decline during shipment and impact of climatic conditions on road and other inconsistent environments on the product quality.

Digital Industrialization: IoT enabled equipment and machinery can convey overall process information data to the partners like original equipment manufacturers and to production engineers. This will facilitate shop floor managers (production managers) and factory heads (general managers) to remotely handle the factory units and acquire benefit of process automation and optimization of various influential machining parameters.

VII. CONCLUSION

Manufacturing across the globe has evolved to be more intelligent and data driven. In the era of industrial Internet of Things (IIoT), a smart manufacturing cell can be supposed to be a number of related engineering arrangements of resources, components, equipment and machinery, cutting tools, inventory management and logistics control can communicate data from one to the other.

Present manufacturing industry has started attention on analyzing data from the entire production line, which helps in increasing machine fitness and safety using IIoT. The IIoT applications carry a solution for latest position of critical challenges occurred during production process flow [11]. In addition, earlier techniques to industrial analytics limited themselves to little time slots of records of data. The newest progresses in big data analytics permit to the researcher community to do a depth of research in this area by utilizing readymade existing data information and put attention on new challenges. In this connection, present work summarized and discussed these issues and outlined the main issues that arise in mechanical core industries by predicting the solutions to improve qualitative products with lower prices to meet customer satisfaction. One of the most attractive future research topics is related to the integration of IoT with emerging technologies such as hybrid cloud computing platforms, DBMS, Big data analytics and machine learning techniques apart from CAD/CAM/CIM environments to share the data from one industry to another to reduce research time and improve profits.

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