INDUSTRIAL INTERNET OF THINGS AN EFFECTIVE MANUFACTURING STRATEGY FOR 21ST CENTURY

Harish Mugutkar[1], Dr.Vishaldatt V Kohir[2]
[1]Assistant Professor, Department of Mechanical,
Anurag Group of institutions, Venkatapur, Telengana , India,
[2]Professor, Mechanical Engineering Department
KBN College of Engineering, Kalaburgi, Karnataka, India

Abstract
Evolution in digital communication enabled machines to exchange information in real time with each other in manufacturing plants. The internet connectivity empowered to have network of the enterprise software system and end users. The internets of things (IoT) help machines to work better and harvest quality products by predictive maintenance. The big data, machine learning and cloud computing are the driving forces for the further development of Industrial Internet of Things (IIoT). A continuous learning from each other leads to the self-sustainable manufacturing industry.
Keywords: IoT, Industry 4.0, Smart factory.

I. INTRODUCTION

The Industrial Revolution was a time in the 18th century when many important inventions were made. Many of these inventions made work easier and cheaper. As these inventions created new manufacturing and industry, many people also moved away from farms into cities. It was a time of very rapid change in the world. Stages of industrial revolution:

1. First industrial revolution
2. Second industrial revolution
3. Third industrial revolution
4. Fourth industrial revolution

1. First industrial revolution (Industry 1.0) - 1784: The invention of steam engines kick started the Industry 1.0. The First Industrial Revolution took place from the 18th to 19th centuries in Europe and America. It was a period when mostly agrarian, rural societies became industrial and urban. The iron and textile industries, along with the development of the steam engine, played central roles in the Industrial Revolution. However, the manufacturing was purely labour oriented and tiresome.
2. Second industrial revolution (Industry 2.0)- 1870: The Second Industrial Revolution took place between 1870 and 1914, just before World War I. It was a period of growth for pre-existing industries and expansion of new ones, such as steel, oil and electricity, and used electric power to create mass production. Major technological advances during this period included the telephone, light bulb, phonograph and the internal combustion engine. The first assembly line production was introduced. This invention was a big relief for the workers as their labour was minimized to the possible extent. Henry Ford the Father of mass production and the assembly line introduced the process in a car manufacturing plant by Ford to improve the productivity using conveyor belt mechanism.
3. Third industrial revolution (Industry 3.0) 1969: The Third Industrial Revolution, or the Digital Revolution, refers to the advancement of technology from analog electronic and mechanical devices to the digital technology available today. The era started during the 1980s and is ongoing. Advancements during the Third Industrial Revolution include the personal computer, the internet, and information and communications technology. Involved advancement of electronic technology and industrial robotics. Miniaturization of the circuit boards through programmable logic controllers, Industrial robotics to simplify,

automate and increase the production. However, the operations still remained isolated from the entire enterprise.

4. Fourth industrial revolution (Industry 4.0) - 2010: The vision of connected enterprise through interconnecting industrial assets through the internet was fulfilled with the introduction of Industry 4.0. The smart device communicate with each other and create valuable insights. IIoT brought with it the advantages of asset optimization, production integration, smart monitoring, remote diagnosis. The Fourth Industrial Revolution builds on the Digital Revolution, representing new ways in which technology becomes embedded within societies and even the human body. The Fourth Industrial Revolution is marked by emerging technology breakthroughs in a number of fields, including robotics, artificial intelligence, nanotechnology, quantum computing, biotechnology, The Internet of Things, 3D printing and autonomous vehicles.

The basic idea of IoT is a system where the physical items are enriched with embedded electronics and connected to internet. So, it relies on both smart objects and smart networks. The Internet of Things (IoT) is the outcome of technology advances in four main areas:

- Connected devices and sensors. Manufacturers are building sophisticated, connected gateway products. These products provide standardized ways to talk to the world of sensors.
- Ubiquitous data networks. Telecom companies are building better and cheaper data networks with widespread coverage.
- The rise of the cloud and the big shift from enterprise to Software as a Service (SaaS) platforms.
- Big-Data Technology: The ability to process large amounts of data in a standardized way.

II. METHODOLOGY TO ESTABLISH IOT

Monitoring of production system plays an important role is manufacturing industries. For execution of the production of product production monitoring and machine data collection is very important. Hence all the activities in the system staring from collection of data from shop floor to the execution of the product need to be interconnected which would solve the problems of integration between the ERP systems and control systems of the manufacturing plant. Fig 1 shows the interconnection of automation of manufacturing plant. Fig 2 shows the interconnection of shop floor in the plant to enterprise resource planning of the company.

Fig. 1. Automation interconnection

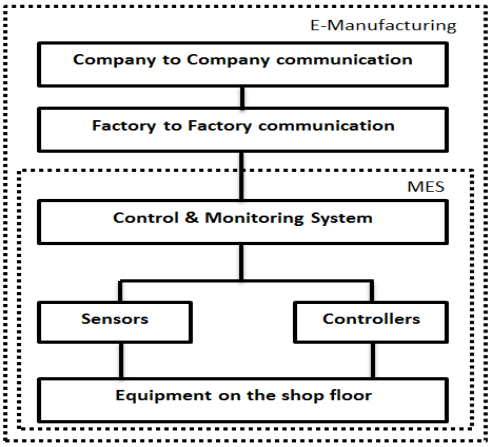

Fig 2. The diagram of the e-manufacturing and MES.

Data collected on the shop floor may be incorrect due to improper monitoring by the operator. That is why smart display which consist of visualization units and storage devices to store statistical reports of the production system without any operator. When the data analysis is to be obtained the presentation can be obtained in various module or models. All the equipments from shop floor to ERP and to office has to be interconnected with connectivity devices by which mobile operation of machines can be done. fig 3 shows how users can connect to various module in IoT.

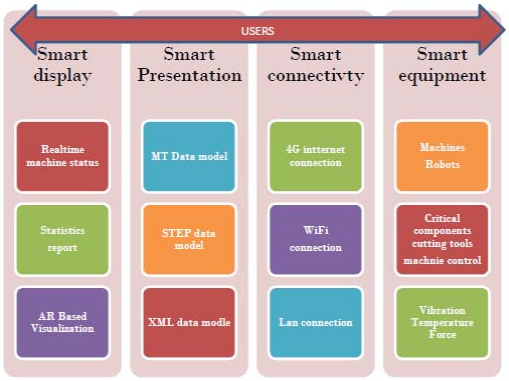

Fig. 3. IoT modules.

III. IOT ENABLED PREDICTIVE & PROACTIVE MAINTENANCE

The predictive and proactive maintenance using Iot has following benefits

1. **Avoid failure of critical Equipment:** It prevents unscheduled failure of the equipment based on the data collected from the equipment thus helps in diminish loss due to failure of costly equipment.
2. **More up time:** The machine learning helps in providing systematic maintenance schedule based on pattern of the data collected from the equipment when it is not in use. This increases the efficiency factories.
3. **Improve products:** The micro analysis of the data collected is carried out by the algorithms of machine learning. This can be used to fine tune the process to obtain better quality products. The costumers will be delighted to use the products.
4. **Value-added services to customer:** Internet of things allows communicating with the products even after its sales. The company can proactively monitor the product and offer predicative maintenance as a value added service to the customer.

IV. REAL TIME MANUFACTURING:

IoT helps the real time manufacturing in following ways:

1. **Road map for SMEs-** It helps in providing the perfect picture of smart factory for building the complete process line automation. SMEs are more flexible in adopting IoT compared to large enterprise.
2. **Improved Savings-** It brings improved productivity and profits of the enterprise. As the IoT helps in monitoring, analyzing, controlling and storing the available data in process line which monitor and controls over the manufacturing process.
3. **Network building and outsourcing:** continuous control over process line needs security and high speed networking to control over manufacturing machines which can be controlled by building IoT enabled system.

V. BENEFITS OF IOT IN MANUFACURING

IoT has become a core component for transformation of industry across the world by connecting industry with the internet, networking and modern technology. More over it bring a rapid change in manufacturing system in production industries.

The major benefits of IoT are-

1. Increased connectivity within and outside the industry.
2. Improved digital transformation like efficiency, automation, etc.
3. Improved savings in manufacturing operations.
4. Good production asset management and maintenance.
5. Usage of various data's.
6. Remote equipment management.

VI. DRIVERS OF IOT

Advancements in information and operational technology are driving the next industrial revolution. IoT is a key part of this revolution. In this revolution, technology moves from being a sector to being a megatrend, kind of a tidal wave that affects everything in its path. Because people will have to trust the data that the IoT generates, vendors must ensure cyber security. For vendors, service providers, and others, the opportunity is widespread. Every industry vertical can benefit from IoT, from the public sector (everything from traffic control to garbage pickup) to the private sector (logistics, transportation, healthcare). The industry with perhaps the biggest immediate opportunity is manufacturing, where legacy companies are embedding sensors in everything from jet engines to oil rigs in order to better monitor devices and extend customer engagement.

Hence, we'll be hearing more about the industrial IoT. currently drivers of IoT are:

- The decrease in the cost per CPU memory and storage makes the collection of big data and subsequent analytics possible.
- Devices such as sensors have proliferated, without which IoT opportunities cannot be realized.
- The decreasing cost of megabytes increases the amount of money available for investment in large processing systems.
- Cloud and big data offer elastic repositories for storing and analyzing the onslaught of data.
- The convergence of information technology and operational technology are coming together to create a new revolution.
- The Internet world is colliding with the industrial world to create unprecedented opportunities.

VII. CONCLUSION

Internet of things is the amalgamation of the automation and communication technologies. The recent development of machine learning, big data enriched merging of machine information and operational data of industry. Thus industrial internet of things is an effective manufacturing strategy for 21st century. This delivers sustainable growth of manufacturing industry by improving the quality, safety, and productivity.

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