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Big Data management in Manufacturing Industries for Internet of Things

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Abstract: In the current scenario, enormous technology improvements are happening in the field of Network communication, cloud computing, Big Data and IoT. Information technology is bringing a new business paradigm by introducing Internet of Technology (IoT). Nowadays adoption of IoT and Cloud computing has become mandatory for the Modern enterprises. The biggest challenge in front of us is handling the IoT generated Big Data. Big Data provides an opportunity to find the insights from the machine generated data that converts the business environments into more agile and it answers the questions which were considered beyond our reach before. This paper focuses on the requirement of IoT and Big Data in the modern enterprises.

Keywords : Big Data, IoT, Smart Manufacturing.

I.INTRODUCTION

Various researches are happening in the field of Cloud Computing , Network communication, Big Data and Internet of Things. Fastest growing business environment require modern technical interfaces to address their inter and intra enterprise requirements. Automation inside the industries will change the ordinary product to intelligent product along with processes. Traditional enterprises with static architecture can not address the requirements in the dynamic business environment.

IT infrastructure is a must for the organisation to move to innovative environment called Internet of Things (IoT). Internet of Things will be the next revolution in the IT field. IoT implementation required in various domains like SCM, military, manufacturing environment and healthcare. The Internet of Things along with computational intelligence leads to Big Data shift. Various types of sensors used to collect data from these applications. These data can further be used for analysis purpose.

Huge volume of data generated by IoT also referred as "Big Data" and this is used for finding intelligent insights. Data analytics helps the higher level management to derive effective decisions. Big Data provides effective business advantage and business prediction. But does't necessarily guarantee for better decisions. Traditional database management system can't handle huge volume of data. Big Data management is required to handle various kind of issues which traditional database management system can't handle.

IoT is an extended technology of internet which is the basic for sensors, connected things and other smart technologies. IoT provides remote access to details about the physical objects in the production environment which leads to innovation in the manufacturing sector and improves productivity and leads to higher efficiency than ever. Internet of Things may be defined as the "things" that are embedded with software, electronics, sensors and network connectivity which allows these things to gather and replace data. These things are also known as the Smart objects. These smart objects provide services to people. The Internet of Things is actually heading towards connecting all objects or things on the earth which is very intricate and the environment gives rise to more challenging needs. The rapidly increasing volume of data gathered from and exchanged among things will need highly scalable environments able to hold the high resulting network traffic, and provide the required storage capacity and computing power for data preservation and transformation.

Combination of IoT and Big Data will move the industries towards modern technology and provide useful intelligent insights for move the business to the next level. Smart manufacturing is an integrated machines , data enabled in which all operating actions are found and done proactively with the outcome of the information and a wide range of performance metrics.

II.IOT FOR MODERN MANUFACTURING

This section describes the importance of iot in the manufacturing industries.

A. Iot infrastructure for enterprises

Iot solve the purpose of connecting the devices in the modern manufacturing enterprise. an enterprise model has a set of modular components and their interactions. likewise, each system section in an enterprise system needs an information unit to make decisions on the component's behaviors based on the received data. the essential function of each module is data acquisition, communication, and decision-making. the internet of things is able to provide essential solution to planning, scheduling, and controlling of manufacturing systems at various stages and levels.

B. Features of next-generation enterprises

The distinctiveness of next-generation enterprise are discussed to assess if an internet of things-based enterprise system is capable of facing these challenging requirements.

Decentralized decision-making: domains and levels of manufacturing activities are rising and becoming diversified. the most efficient enterprise architecture for system integration uses the hierarchical architecture. however, system complexity can be augmented exponentially with the system scale and dynamics. an important time delay and inflexibility to respond changes promptly is shown as a way through the centralized system. hence, to deal with system complexity and dynamics distributed and decentralized architecture would be precious means.

C. Flat and dynamic organization:

Timely responses to qualms need distributed and decentralized enterprise architecture. in such a way, acquired data can be directly used for decision-making in real time. as far as the interactions among system components are concerned, it forms the challenges to distribute the information to associated components; in particular under a centralized structure. the data are gathered and sent to the center database, and after that it is sent to an object when the system gets the request from this object. however, a centralized model has its challenges in dealing with massive data and the heterogeneity of environment.

D.Massive data:

Two situations are going to be faced by the next generation manufacturing enterprises from the viewpoint of data management, information systems: 1) the price for decision-making unit is probably increasing with system complexity and the need of fast receptiveness and 2) it causes resources superfluous to maintain data locally and the wastes of time and resources for connections when the data are public to further decision making units Heterogeneous environment: Increased and diversified manufacturing resources have increased the heterogeneous nature of a manufacturing environment.

Agility and adaptability for real-time changes: Manufacturing enterprises are functioned to meet customers' needs, including functionalities, quantity, quantity, delivery time, and changes. Dealing with changes at realistic time and making products accessible as early as possible to hold the market position should be possible by the enterprises. The profit margin will be reduced significantly when there lacks such a capability.

E. Reconfigurable capabilities:

To increase system flexibility, the structures of hardware and software systems are not static anymore.. Extra system components are required to support hardware and software system configurations. Interoperability, which is extremely important in the globalized market, is decided by the system modularization.

F. Features of IoT for Manufacturing Applications

Integrated Networks of RFIDs and WSNs: The communication infrastructure for data acquisition and sharing is one core function of IoT . A manufacturing system has numerous sensors to obtain real-time data of actuators,machine tools, fixtures, and conveyors; traditional wired communications are restricted as one-to-one, and it is nonflexible to make changes. RFID and WSN provide an efficient means to hold the distribution and transference of manufacturing resources [5].

Dynamics: The architecture of Internet of Things is not standard, which permits the system components be reconfigured whenever it is needed. The information integration across the boundaries of enterprises is facilitated by it. A host enterprise can fit in with virtual enterprises and set up dynamic relations for a particular project. The enterprise has its power in scheming the reorganization of virtual enterprise alley.

Cloud Computing : Intensive information and high ability of computing is required for the operation of a modern enterprise which involves numerous decision making activities. Manufacturing enterprises used to need number of computing resources as servers as databases and decision-making units. This causes the investment wastage, no proper resources utilisation, lower productivity, and ineffective data connections among servers. It provides a vital solution to those problems. All data can be stored in public or private cloud servers, and the complex decision-making can be supported by superior cloud computing.

Human and Things: Communications happen between humanand human, human and thing, and thing and thing. Different Interactions used to have various mechanisms to support these interactions. All of the interactions can be performed under the same umbrella with the growth of Internet of Things. In human–machine interaction, how to symbolize human behaviors in virtual environment is vital, Tao et al [6] discussed the recognition of human behaviors in wireless sensor networks.

G. Merging Internet of Things in ESs:

Varying trends of manufacturing paradigms have been explored by many researchers [7]. In this section, the needs of modern manufacturing and the features of IoT are compared to see how modern manufacturing can benefit greatly from the adoption of Internet of Things infrastructure. It is found that critical needs on the next-generation ESs are unswerving to core features the Internet of Things can provide. The manufacturing systems can benefit greatly by adopting Internet of Things infrastructure at all aspects of the information systems including data acquisition, communication, and decision-making at higher levels. The evolution of enterprise system has been discussed by many researchers. For example, Neal [8] to describe the evolution of information system from manual operation of the databases based on service-orientated architecture provided a roadmap of IT. In addition, the impact of IT on manufacturing systems has been discussed as well. Information systems are the key to the success of manufacturing systems; the advancement of information systems is revolutionizing manufacturing systems. After comparing the features of next-generation of enterprise system in Section II-B and those of Internet of Things in Section IV-C; it is discovered that the amalgamation of Internet of Things within an enterprise system can be expected to address the challenges of the system adequately.

Grid computing and ubiquitous computing may be useful for network manufacturing resources. Everything can be connected, so that the data can be received on time and readily shared by all administrative units that take decision. This makes it realistic to combine manufacturing resources at a very wide scope, including virtual resources from prospective participators in a supply chain and the resources within an enterprise.

The empowerment of customers is done by the IT through electronic commerce (e-commerce). IT allows customers to change product needs, place and change orders in real time based on their needs besides the privilege of comparing products from different vendors around the world.

On the one hand, the satisfaction level of customers can be improved greatly from the customers' perspective; on the other hand, many new variables for qualms and modifications are involved in the organization and tasks of an enterprise's business.

A network-based environment completely supports the collaboration of design, manufacturing, and assembly among different partners. The system is aimed at an optimal equilibrium of flexibility and efficiency. On the one hand, the selection of modules and assembling topologies offer system flexibility to meet various functions at the system level; on the other hand, the manufacturing system is modularized each and every module is optimized at the module level for its specified function. Moreover, the topology of system configuration can be optimized with the available global information over the system. The phases of system design, reconfiguration, and deployment are highly corresponded.

Design database, data acquisition, monitoring and diagnosing are connected together by information integration to help in making right products without iterations. The traditional information system will be integrated with real-time control system at hardware level which is at the macro level planning and scheduling. Online data acquisition systems are not only used to serve for real-time control for machines, but also give feedbacks about the modifications and misgivings to high-level system planning and controlling. The plans and schedules can be adjusted to accommodate changes and uncertainties promptly. The changing trend of systems applications products (SAP) software tools; SAP tools are used to focus on the enterprise resource planning before 2005; they have been integrated with manufacturing execution systems is a good example. With the emerging of Internet of Things, they would be included with online process control eventually [9]. Service-orientated architectures become common in industries to get better system suppleness and flawless transition of reconfiguration in contrast to hierarchical enterprise architectures [10].

III.BIG DATA IN MANUFACTURING INDUSTRY

In manufacturing industries, the operational analysis is done using big data. It is actually used to analyze variety of machine data to get improved business results. There are number of business challenges like the complexity and nonstop machine data outcome, difficult to capture the very small amount of machine data for better decision making and difficult to do the analysis on the machine data and combine it with traditional enterprise data to get the full view analysis.

Manufacturing companies require improvements in the product quality, efficiency and operations. Due to globalization, manufactures also outsourced their production into low-cost regions. Big Data helps the manufacturers to reduce their product development time, proactive actions to eliminate defects, accurate dynamic production planning. These are all possible with the availability of the Big Data which are generated through IoT.Big Data leads to dramatic improvements in the managing very complex and global supply chain and provides innovative product. The use of Big Data suggests the manufacturing industries to adopt the best global practice which is derived from enormous amount of data available for usage.

The advancement of information andcommunication technology is required in the manufacturing sector to meet the huge production capacity and capability easily and to provide quality product. The application of big data paves a way for innovation in product development and helps the designers to produce products with valuable features and design which can reduce production cost by using the best insights of consumer with the help of Big Data. The implementation of Internet of Things in the plant helps the manufactures to access the actual data generated by sensors which can help to track components, monitoring machines and to provide guide to actual operations.

In general, Big Data provides opportunities to improve efficiency as well as to create quality products. The efficiency improved by changing the assembly process and make changes in the product developments. The quality of the product improved by providing customer's requirements.

Digital Factory - digitization of manufacturing environment helps the manufacturers to monitor the production related data like customer order, job order, machine performance. Several computatinal methods to be applied to conver the entire factory to digital factory. It helps the manufacturing environment to setup production layout of new plants , utilization of space and distribution of resources. It helps in testing the products also. In general plants adopted this digital factory methods achieved cost savings, reduction in assembly hours and product quality improvement.

Sensor based operations – Various devices in the manufacturing environment can be connected with various sensors which can provide online valuable data which can lead to online decision making for the supervisors, operational people or for the plant manager. The data generated by sensor provides online decision making.

Sales and Marketing – feedback through customer interactions are used to improve the sales and also to modify the product development decisions. But it is possible to embed a sensor in the product itself to get the performance of the product. We can improve the product performance without getting feedback from the customers. The sensor data received by the product will play a major role in identifying the performance of the product. This can be used in future product development process and to understand the forecast.

There must be a cultural change required in Big Data implementation. The companies must come forward for big IT investment and organisation wide cultural changes.

There is apparently an association between Big Data and IoT. In fact, it can be inferred that big data is a subset of the IoT. Big data is regarding data, plain and simple. Different adjectives can be added to "big" data. Internet of Things is about devices, data, and connectivity. Data big and small– is all about the Internet of Things world of connected gadgets.

According to Gartner, the revenue generated from IoT products and services will cross $300 billion in 2020, and that maybe the tip of the iceberg.

Given the enormous amount of revenue and data that the IoT will produce, its force will be felt across the big data universe, forcing companies to improve current tools and processes, and technology to develop to put up this added data volume and get advantage of the insights all this new data certainly will deliver

Big Data Analytics: Internet of Things and Big Data fundamentally are two sides of the same coin. Managing and extracting value from Internet of Things data is the major challenge that organizations face. Companies must set up a proper analytics platform/infrastructure to examine the IoT data. And they should keep in mind that not all IoT data is essential.

An appropriate analytics platform should be based on three parameters: performance, right-size infrastructure, and potential growth. For infrastructure and future growth, hybrid is the best approach. The best feature from various platforms into a single optimal environment includes the hybrid deployments, cloud, managed hosting, collocation and dedicated hosting. MSP vendors are in general working on the infrastructure, performance, and tools side to cover up the entire IoT domain.

An IoT device generates nonstop streams of data in a scalable way, and organizations must handle the high volume of stream data and carry out actions on that data. Event correlation, metric calculation, statistics preparation, and analytics may be some of the actions. In a normal big data scenario, the data is not always stream data, and the actions are diverse. Constructing an analytics solution to manage the scale of IoT data be supposed to be done with these challenges in mind.

The application of the Internet of Things heralds a new age of technology, and organizations that hope to participate in this new age will have to change the way they do things to hold new data types and data sources. As the

IoT grows and businesses grow with IoT, they will have many more challenges to solve.For most companies, big data analysis is a challenge. Consider the complete volume of data and the various formats of the data that is collected across the whole company and the many various ways various types of data can be collected, contrasted and analyzed to find out patterns and other useful business information.

The first dispute is in breaking down data is to access all data a organization stores in various places and often in various systems. A second big data challenge is in building platforms that can pull in unstructured data as simply as structured data. This enormous volume of data is typically so large that it's hard to process using traditional database and software methods.

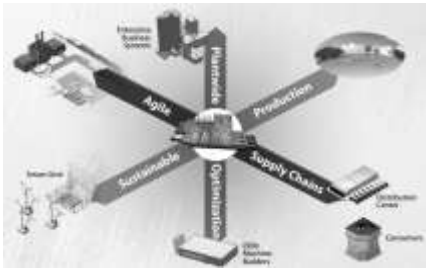
IV.SMART MANUFACTURING

The application of manufacturing intelligence converts the traditional factories into Smart manufacturing. It converts the factories into profitable innovation centre. Application of IoT and Big Data converts the factories into smart manufacturing.

Smart manufacturing marries information, technology and human creativity to bring about a rapid revolution in the growth and application of manufacturing intelligence to every trait of business It will basically change how products are made-up, manufactured, shipped and sold. It will progress worker safety and protect the environment by making zero emissions, incident manufacturing possible [2]. This helps to keep the competitive business in the global marketplace. Investments in a smart manufacturing infrastructure are important for the industrial future.

Smart manufacturing will interconnect and go with the individual stages of the manufacturing production to obtain the efficiency in the plant. A typical manufacturing setup uses sensors, computerized controls, cloud computing, data acquisition devices. Integration of all these converts the factory into Smart factory.

Smart manufacturing paves a way to increase the plant wide performance, enterprise wide management objectives, worker safety and sustainable business environment. Applying human intelligence in the machine generated data will provide intelligent insight which converts the business environment into more agile and answer the questions which were beyond our reach before. Businesses require advanced infrastructure in the manufacturing setups to develop the current and future operation environment. Figure 1 depicts the structure of a smart manufacturing.



Core Componenets and Enabling Technologies

RFID: To identify and track the data of things.

*Sensor:*To gather and process the data to sense the change in the physical status of objects.

Smart Tech: To augment the power of the network by devolving processing capabilities to various part of the network.

*Nano Tech:*To make the smaller and smaller things have the capability tointeract and connect.

The growth of connected devices is not localized to particular industries alone. This is being applied across various segments of manufacturing and logistics. Here we consider the case of proactive maintenance. Manufacturers have accepted the concept of preventive and condition-based monitoring, but lots of are still in the process of implementing these programs. If the manufacturer has equipment that needs to operate within a definite temperature range, the company can use sensors to actively monitor when it goes out of range and avert malfunctions. Measuring vibrations to detect operations that are out of specification is another example.

V. CONCLUSION

In this paper we have discussed about Internet of Things, Big Data and how smart manufacturing related to IoT and Big Data. The outcome of the paper brings out the importance of of the Integration of IoT and Big Data and the requirements of change and adoption to latest technologies in manufacturing industries. Big Data databases ensure better performance than traditional RBDMS in various applications. But the choice of selecting best Big Data tool is a challenge for the developers for creating efficient scalable application especially in the IoT field. Clear study and analysis required before selecting the tools from developer and users point of view for IoT and Big Data.

The biggest challenges in front of all the enterprises are the requirement of cultural and technological change to adopt the new technology. Valuable insights will be derived from available traditional data also. So the integration of machine data with the traditional data is also required for the enterprises to to have good data analytics. Organisational leaders should take the initiative to understand and move

torwards the Big Data. Future research problems will promise the benefits of Big Data.

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