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Just-In-Time Manufacturing using Cloud Computing

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Abstract:

The aim of this paper to show how manufacturing companies can leverage cloud computing technology to achieve Just-In-time manufacturing philosophy. Objective of this paper is to first acquaint the reader with the overall JIT concept in manufacturing. It also explains in detail about cloud computing technology and its various components. Lastly, article discusses about how cloud computing technology can be used to achieve the various goals in Just-In-time manufacturing.

Keywords — **Just-In-time manufacturing, JIT, Cloud Computing, Supply Chain, IoT**

I. INTRODUCTION

Just-in-time manufacturing(JIT), also known as just-in-time production, is a methodology aimed primarily at reducing flow times within production system as well as response times from suppliers to customers. [1]

JIT seeks to eliminate all sources of waste in production activities by providing the right material at the right place and at the right time.JIT is a form of production scheduling and inventory management where by products are being produced only to meet actual demand and materials for each stage are received just in time for next stage of production. To implement just-in-time system, manufacturing companies has to establish tight coordination with its suppliers.

Cloud computing is an information technology (IT) paradigm, a model for enabling ubiquitous access to shared pool of configurable resources (such as computer networks, servers, storage, applications and services) which can be rapidly provisioned with minimal management effort, often over internet. [2]

Cloud computing provides rich data integration capabilities over internet, collecting data from different data sources in real time. Cloud computing technology also enables to store large amount of structured and unstructured data in nativeformat into data lake. Data being combined and stored centrally into data lake help manufacturing enterprises to do business intelligence and predictive analytics on large amount of data. Cloud computing technology also enables instant access to information via computer, tablet or smartphone. Technology gives supervisors real-time system alerts, suppliers can receive notifications of shortages requiring immediate action, and

management has the information needed to make production decisions just in time.

In summary, cloud computing provides innovative platform for manufacturing enterprises to enable seamless integration of various business functions like engineering design, supply chain management, production planning and control to achieve just-in-time manufacturing.

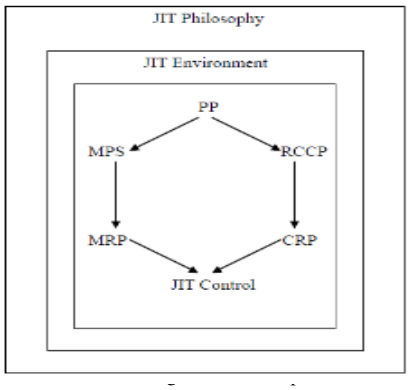
II. JUST-IN-TIME MANUFATURING

Just-In-Time manufacturing is a Japanese management philosophy applied in manufacturing which involves having the right items of the right quality and quantity in the right place and the right time. It has been reported that JIT manufacturing has resulted in increase in quality, productivity and efficiency and decreases costs and wastes. [3]

JIT guides a manufacturing company in organizing and managing business effectively and in planning and controlling its operations more efficiently. It is a way to achieve high velocity manufacturing. [5]

Traditionally, manufacturing companies competes on price, quality, variety and after service, etc. Now, these conditions are merely prerequisites. The Key competitive factor has become speed. Faster a business response to its customers, the more profitable it is. Shorter the lead-time in which manufacturer can supply its products, the higher the probability that it will survive.JIT manufacturing has become common goal for all manufacturing companies.

The principle that underpins JIT is that production should be ‘pull through’ rather than ‘push through’. It means production should be for specific customer orders, so that the production cycle starts only once a customer has placed an order with the manufacturer. Stocks are delivered only when they are needed. Consequently, this approach requires much more frequent delivery of stocks. Developing a JIT approach requires sophisticated planning and effective supply chain management.



III. CLOUD COMPUTING

Cloud computing has been described as an innovation in computing architecture whose central characteristic is the virtualization of computing resources and services. Cloud computing allows computing resources to be delivered with five central attributes: as an on-demand service; with infinite and rapid elasticity and scalability; on a measured basis (meaning the service can be billed); through pooled (i.e., shared) resources; and with broad network access. [6]

Enterprises tend to implement cloud computing in one of three major formats: software as a service (SAAS), platform as a service (PAAS), or infrastructure as a service (IAAS). Software as a service—think online productivity software such as Google Docs or Salesforce's online customer relationship management (CRM) software—allows users to access software applications over the Internet using personal computers, mobile devices, or instrumented machines, instead of having to store software locally on in-house devices. Infrastructure as a service gives organizations access to secure, enterprise-class computing infrastructure that can be infinitely managed and scaled to meet different needs, whether for computer processing or data-storage capacity. Finally, platform as a service allows users to rent virtualized software development or production environments to efficiently develop and deploy new applications without having to invest in expensive hardware or software licenses of their own.

Cloud computing is usually deployed in one of three different configurations: a private cloud, a public cloud, or a hybrid cloud. A private cloud is used exclusively by one organization, usually with multiple business units, and may be deployed either on-site or off-site. In contrast to a private cloud, a public cloud environment is available for use by the general public; public clouds are commonly implemented through data centers operated by third-party providers such as Amazon, Google, HP Enterprise, IBM, Microsoft, VMWare, and many others.Lastly, a hybrid cloud refers to deploying an application or service across cloud-computing infrastructure that spans multiple configurations. [6]

Cloud computing is a general term for the delivery of hosted services over internet. Cloud computing provides you a common platform to share data across multiple business applications. It allows businesses to unify data from disparate sources in various formats. It provides standard connectors to connect to software systems and also include functionality to cleanse, monitor and transform data. Cloud data integration software is offered in a SaaS (Software as Service) model and does not require the client to install software or hardware. It also provides a communication hub for data being passed between cloud applications.

IV. JUST-IN-TIME MANUFACTURING USING CLOUD COMPUTING

JIT in manufacturing is a strategy used to increase efficiency and minimize waste in manufacturing processes. Below we discuss about key objectives of JIT in manufacturing and how cloud computing can be used to achieve these objectives.

A. Low inventory Levels

Inventory should only be received from supplier at the exact time when it is needed for production or sale. This means orders are placed in smaller batches, on a more frequent basis. With JIT, inventory levels are kept low which keeps on-site inventory at a minimum.

In order to implement a JIT inventory system, the business must have strong network of suppliers. Communicating information about the logistics of the supply, including quantity, timing and product detail is vital to this process. If the business can reach out and has strong network of suppliers, chances are the suppliers will be more willing to adapt and help when situations change.

Cloud data integration services can connect to inventory data applications of suppliers and can pull the data in real time. The data pulled from various data sources can be stored in various formats in centralized location which is called as data lake. Manufacturers can do business intelligence on this data to identify nearest supplier who have sufficient inventory of material to ensure delivery of material with shortest lead time.

Cloud enabled Mobile technology using Mobile apps integrated with cloud based ERP systems allows managers and executives to access critical data in real-time over mobile phone or tablets from any location. Managers and executives can instantly view the performance of an entire operation and communicate with their supply chain.

A study from The Aberdeen Group found that companies who have already implemented some kind of mobile software intotheir operations realized a 44 percent increase in efficiency. Manufacturing firms clearly want to enjoy those

same benefits. According to a recent survey by Tech Target, 40 percent of manufacturers plan to use mobile devices for their businesses. [5]

B.Increasing the degree of efficiency within the production process

Cloud computing technology is driving additional efficiency in production process. Cloud enabled "Internet of Things (IoT)" technology enable manufacturers to use real-time data from sensors to track parts, monitor machinery, and guide actual operations.

Manufacturers can use IoT technology to identify machines that needs maintenance and service using sensor data. This helps shop floor to take preventive maintenance activity in time to avoid production down-time due to failure of machines.

Cloud enabled IoT applications also allows manufacturers to optimize operations by using real-time, high granular data from networked sensors in the supply chain and production processes. This data allows ubiquitous process control and optimization to reduce waste and maximize throughput of production process.

Cloud enabled IoT allows manufacturers to control their machines remotely and connect them to supply chain and the rest of their operations. For example, a machine can be prepared remotely to support just-in-time manufacturing of a product, thereby eliminating costly delays that occur between the start of the manufacturing process and delivery.

Industry analysts are seeing a future influenced by widespread adoption of the cloud enabled IoT. Some experts predict that by 2025, 50 billion devices and things will be connected to each other. Others believe that the power the IoT is not only based on manufacturing efficiency but in the ability to create smart devices across the entire supply chain that can automatically sense, predict, and respond.

C. Increasing the organization's ability to compete with rival organizations and remain competitive over the long run

To achieve this objective, manufacturers needs to bring innovation in their product development and manufacturing process to ensure delivery of right product to right customer in right time.

The use of cloud enabled big data services offer further opportunities to accelerate product development. It helps designers to focus on more most important and valuable features based on concrete customer inputs as well as designs that minimize production costs and harness consumer insights to reduce development costs through approaches including open innovation.

To drive innovation and develop products that address customer emerging needs, manufacturers are relying on outside inputs through innovative channels. Cloud computing platform which is integral to web 2.0 brings all sorts of user data online enabling content sharing platform with web access. Manufacturers can invite external stakeholders to submit ideas for innovations or even collaborate on product development through this platform.

Consumer goods companies such as Kraft and Procter and Gamble invite ideas from their consumers as well as collaborate with external experts, including academics and industry researchers, to develop new products.

Over decades, manufacturing companies have implemented IT systems to manage product life cycle including computer aided design, engineering, manufacturing and product development management tools. However, large data set generated by these systems remain trapped within their respective systems. Manufacturing firms could capture significant opportunity to create more value by instituting product lifecycle management(PLM) platforms using cloud integration services that can integrate multiple systems to enable effective and consistent collaboration.

Taking inputs from product development and historical production data (e.g. order data, machine performance), manufacturers can apply advanced computational methods to create digital model of the entire manufacturing process.

Real time data analysis capability of cloud computing with sensor technology enables manufacturers to enable real-input on emerging defects and adjust the production process immediately.

There are also many opportunities to leverage cloud integration services in the marketing, sales and after-sales service activities. With cloud data integration capabilities, we can observe opportunities range from the segmentation of customers to applying analytics for demand forecasting to improve effectiveness of sales forces and avoid overproduction of goods.

V. CONCLUSIONS

Overall objective of Just-in-time manufacturing is to deliver right product to right customer in right time with minimum cost. This requires sophisticated production planning and effective supply chain management.

Cloud computing can enable manufacturing organizations to build robust supply chain network to reduce inventory cost.

Cloud computing technology can help manufacturing firms to brings innovations in product development and manufacturing processes to reduce overall production cost and deliver right product in right time to customers.

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