MANUFACTURING'S ROADMAP FOR THE INTERNET OF THINGS AND EDGE CLOUD COMPUTING

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ABSTRACT

The industrial Internet, often known as the Internet of Things (IoT), is a new Internet development for industry. It entails integrating potentially billions of sensors, cameras, industrial machines, displays, smartphones, and other smart communicating devices (collectively referred to as "things") into cloud datacenters and processing their data in real time on elastic and virtualized cloud resources in order to automate the end-to-end manufacturing lifecycle. Industry consortiums all around the globe are working hard to create and promote an open, standards-based smart manufacturing facility based on the Industry 4.0 vision (the fourth industrial revolution). Industry 4.0, according to Wikipedia, "includes a variety of modern automation, data sharing, and manufacturing technologies. Increased availability of omnipresent, ever-shrinking, low-cost devices such as sensors, smartphones, and wearables; ubiquitous Internet connection and cloud computing services; and pressure on industry to develop quicker to retain competitive edge are driving the IoT's rapid growth.

KEYWORDS: *Automation, Cloud Computing, Internet of Things, Manufacturing, Optimization.*

1. INTRODUCTION

Gartner predicted that 6.4 billion IoT devices will be in operation globally in 2016 (up 30% from 2015), and that their number would reach 20.8 billion by 2020 in other words, 5.5 million new IoT devices would be linked every day in 2016 (1). Furthermore, in 2016, the IoT industry would support service expenditure of US$235 billion (up 22 percent from 2015). Consumer applications will account for $546 billion in hardware expenditure in 2016, while smart services and other corporate applications utilizing connected objects will account for $868 billion(2). Gartner predicts that by 2020, these figures will have risen to US$1.534 billion and US$1.477 billion, respectively. Other sources' estimates are more optimistic(3).Transportation, healthcare, disaster management, and power grids have all been affected by IoT advances. As shown by many recent studies showing IoT-based productivity improvements in manufacturing facilities, IoT and cloud computing are especially essential for the manufacturing industry(4). Cisco, for example, has claimed increased productivity in power tool manufacturing facilities using IoT-based cloud solutions. For data collection and supervisory control, many industrial facilities now use machines, sensors, and portable devices(5). However, because of the diversity and incompatibility of their interfaces and communication protocols, direct, real-time, and bidirectional communication between these machines and devices is difficult(6).

Although some proprietary systems exist, they are costly, seldom open, and do not allow for real-time plant data analysis and transmission of high-value information for immediate decision support(7). The Internet of Things, on the other hand, offers Internet-based and open standards and solutions that bridge the gap in gathering data from any plant equipment or device. More significantly, it allows for bidirectional machine-to-machine communication inside the facility or over the Internet(8). When coupled with cloud services, the Internet of Things enables for real-time processing and transmission of high-value data everywhere. It may, for example, provide real-time key performance indicator (KPI) monitoring and prediction to a plant manager's or CEO's smartphone(9). These benefits are allowing industrial facilities all around the globe to achieve remarkable operational efficiency, boost revenues, and save expenses. Consider a recent Cisco study that identified major production areas where the use of IoT and cloud technologies improves manufacturing plant efficiency(10). The effect of the Internet of Things in each of these major industrial sectors. Manufacturing benefits significantly from IoT and cloud services. Machines, sensors, and handhelds linked to the Internet of Things, for example, are capturing more precise plant data. The use of cloud services to analyze this data in real time yields productivity, quality, and safety insights that drive business and operational change, lowering labor and productivity costs while boosting profitability. These results may aid in the development of manufacturing processes and the timely transmission of task-related information to employees and plant equipment. This section discusses various options for increasing industrial productivity, quality, and safety. A second possibility, smart inventory management, involves electronically marking goods so that they can be tracked and identified both in the factory and as they travel from plant to customer(11). Optimizing product inventory processes to minimize labor costs and time is another part of smart inventory management.

This entails either automation of manual inventory tasks via smartphones or other IoT tracking devices that monitor and direct manual picking and storing activities (which is more expensive and more appropriate for large plants) or optimization of manual inventory tasks via smartphones or other IoT tracking devices that monitor and direct manual picking and storing activities (which is less expensive and more appropriate for smaller plants)(12). A third option is to use specialized camera systems or wearable technology to automate complicated tasks such as evaluating product quality. Workers may be electronically monitored and mentored while working in production lines or doing specialized industrial jobs, which can assist make worker training more efficient. Finally, real-time monitoring (for example, using RFID or proximity sensors) of how employees wear protective equipment, operate machines, and obtain access to restricted work zones may enhance plant safety(13). Because the Internet of Things is built on the Internet, its fundamental infrastructure (such as the National Broadband Network, Wi-Fi, 3G/4G, and so on) is already in place across the globe. IoT devices and data are becoming more widespread, affordable, and accessible(14). RFID tags, for example, are presently available for about $0.01 apiece, making them cost-effective for monitoring low- to medium-value assets. Low-cost sensors, such as the Sensor Tag and iBeacon, are mass-produced in large quantities and contain a variety of on-board sensors as well as the ability to interact through low-energy Bluetooth or Zigbee(15).

They cost about US$20–$30 per device on Amazon, and buying large numbers may reduce the price down to US$10 per device. Epson glasses are available off the market for less than US$700 in the wearable IoT technology sector. Every month, new wearable IoT gadgets arrive on the market that are both cheaper and more capable; in a few months, such devices will likely be half the price they are now(16). These IoT devices have simple plug-and-play functionality and do not need trained personnel to install or maintain, making them easy to incorporate into current manufacturing facilities. Furthermore, their batteries enable for long-term operation up to two years in certain instances. Battery life is also gradually improving(17). Any action or resource engaged in a manufacturing plant's production processes may be captured, bidirectional communicated through the Internet and cloud services, and analyzed using IoT devices. IoT-based systems may analyze data in real time to monitor and forecast KPIs in real time, as well as identify possibilities to reduce the use of plant resources like labor, electricity, and water(18).

2. DISCUSSION

Wearable IoT devices, such as Epson glasses, provide a new way to give production line employees with task-related information, KPIs, and training or mentorship. Plant managers may monitor employees' usage of safety equipment and produce real-time warnings if they identify a significant safety risk using sensors, such as Sensor Tags, connected to their clothes and protective equipment(19). The core of smart manufacturing in the digital era is collecting and analyzing data in real time while minimizing unnecessary data transmission and data processing delays. Cloud services are now housed and provided by huge datacenters run by businesses like Amazon, Apple, Google, Microsoft, and Facebook. Hardware and software services in datacenters are virtualized using different service provisioning paradigms, such as platform as a service and infrastructure as a service, and these virtualized resources are then leased out on a pay-as-you-go basis. Cloud datacenters have long been utilized to analyze IoT data because they provide low-cost, practically limitless processing capacity(20).

With the difficulties presented by the rapidly expanding IoT ecosystem, existing assumptions that the intellect and resource capacity required for IoT data processing are primarily housed in cloud datacenters are being called into question. The onus of uploading data to distant cloud datacenters falls on resource-constrained IoT devices, resulting in wasteful bandwidth and energy use(21). A store-and-process-later strategy may help you save money. This, on the other hand, undercuts the IoT's credo of real-time decision-making. In manufacturing and other industries, very time-sensitive IoT applications require rapid data analysis and reaction(22). They could, for example, alert workers in underground mines and indoor manufacturing plants about roof collapse, air quality, temperature, and humidity; identify workers who don't have the proper equipment or training for a particular machine; or prevent unauthorized workers from entering restricted areas.

As a result, conventional cloud-centric IoT methods (such as Amazon IoT and Google Cloud Dataflow) must move to a distributed architecture in order to benefit from smart and programmable cloud services at the network edge, such as smart gateways and network function virtualization solutions(23). These network-edge cloud services may provide compute and storage capabilities on a smaller scale (commonly referred to as an edge datacenter) to help conventional cloud datacenters address real-time data processing problems. There are two distinct advantages to moving IoT data processing activities closer to IoT data sources or data sinks.The deployment of one or more IoT-based solutions that meet the urgent possibilities mentioned earlier is expected to be the first step on the path to an SMP. However, we envision the creation of an SMP forum initiative (described later) that will enable the industry to share IoT experiences and solutions, allow third-party vendors to contribute IoT solutions for the industry to try, and encourage the industry to jointly develop or adopt IoT solutions, industry-specific interfaces, and standards, as well as identify and use free and open source software(24).

We provide our suggestions for realizing these possibilities, as well as the advantages that an IoT-based solution may provide in terms of better business results. Cloud and edge services offer the networking, storage, real-time data analytics, and information distribution capabilities required for the solutions mentioned below. Cost and quality are the main drivers for manufacturing companies, according to our discussions with industry professionals(25). Major clients provide cost and quality KPIs, which are linked to manufacturing plant operations, inventory management, and supply chain activities. As a result, processing KPIs may be generically classified. The development of IoT solutions for real-time KPI monitoring and evaluation of the plant's production process from the viewpoints of productivity, product quality, and safety is one of the most significant directions for the manufacturing sector. Automatic real-time calculation, visualization, and prediction of plant KPIs, as well as real-time distribution of customized KPIs to management and supervisors through any IoT device, should all be part of such an IoT-based system. Furthermore, an IoT-based system may offer customized KPI dashboards in real time that are tailored to each employee's specific duties. For example, IoT may visually show performance KPIs customized to an employee's job and responsibilities by combining real-time production data from IoT devices with current plant information. This IoT solution may assist employees and management in assessing and responding to consumer and operational KPIs in real time, for example, by dynamically making informed choices regarding productivity, product quality, and safety. Instead of collecting just the data required for current KPIs, manufacturers might utilize IoT devices to capture higher-fidelity production process data that is, more comprehensive data about each action and sub activityto enhance efficiency, product quality, and safety.

Plant equipment may also be monitored using IoT devices to evaluate their operation vs idle time, component quality, and dependability.The Internet of Things is changing the way businesses in a variety of sectors, including manufacturing, operate. Until recently, technology has mainly been utilized to operate businesses and manage industrial operations, as well as to automate procedures and gather data connected to assembly tasks. IoT, on the other hand, takes data gathering to a whole new level. IoT facilitates the gathering of data from various 'Things' - such as operations, production, quality, usage, and consumption - and then utilizes that data to simplify and improve business processes. The manufacturing sector has always been driven by innovation, and it is now experiencing the fourth industrial revolution, often known as 'Industry 4.0.' Modern sensors, motors, actuators, and robots have allowed a revolution in sectors including supply chain, transportation, communication, housing, energy, and production, thanks to advances in manufacturing technology.

Let's take a look at a few examples of how IoT technologies may assist improve industrial processes. The most frequent assessment of a plant's efficiency is overall equipment effectiveness (OEE), which is included in every plant manager's KPI. Failure and planned or breakdown maintenance have an effect on equipment availability (a crucial component). As a result, plant maintenance is now seen as a key component in maintaining maximum availability and near-zero downtime in manufacturing facilities. Maintenance needs may now be anticipated without the need for preventative or planned maintenance by immediately collecting data from the equipment, previous maintenance data, and inputs from OEMs. As a consequence, predictive maintenance may reduce the cost of manufacturing equipment maintenance by almost 30% to 35%, while also increasing the availability of that equipment.

Breaking down plant processes to finer activities, for example, by considering not only how many people and machines are on the job and how many products they produce, but also how much time they spend on less productive activities that could be eliminated, reduced, or replaced, is one direction manufacturers could take to achieve these improvements. Another approach is to utilize technology to identify and monitor activities and sub activities in the manufacturing process, as well as their input/output and resource use. (The Internet of Things is perfect for this since it can take data from current RFIDs, new low-cost sensors, and “bring your own” cellphones and put it on the Internet for KPI calculation and warnings.) Monitoring such activities and resources may also allow manufacturers to calculate higher-fidelity productivity, quality, and safety KPIs (in real time). Other options include refining the manufacturing process to incorporate more productive and less unproductive operations, as well as performing IoT-based production process optimization processes on a regular basis. Manufacturers may gather data from manual inventory management processes using smartphones or IoT wearable devices, then utilize that data to improve and automatically direct employees' picking and packaging activities depending on product weight, age, and quality. IoT-based systems that constantly monitor, optimize, and assist picking and packing operations, in example, may boost plant efficiency by lowering labor costs and decreasing the time spent moving and locating the right goods in warehouses. This approach will also enable facilities to reduce product inventory, storage, and/or heating and chilling capacity to the bare minimum required to meet client demands. IoT-based solutions may also help manufacturers monitor, locate, and store goods depending on their quality and weight, as well as increase manufacturing line agility to handle numerous client orders at once. Consumers can follow the goods they buy from the factory that makes them, and manufacturers can identify the origins of product components using SMP-to-consumer traceability solutions. Such solutions can also aid in the identification of product-related issues throughout the plant-to-consumer supply chain, provide security against counterfeiters in export markets, and enable the creation of a more productive and incentivized market for example, high-quality suppliers can earn more money per product. The Internet of Things is excellent for tracking products from the factory to the customer. Using a combination of RFID and sensor technologies, an IoT system may monitor goods from their producers to their end users.

Manufacturers will be able to identify quality parts suppliers using the Internet of Things' ability to easily integrate IoT devices, transfer information collected at various steps of the supply chain via the Internet, and store and process such information in a cloud datacenter-based infrastructure that supports information sharing. With this knowledge, they can guarantee that their goods fulfill consumer expectations while reducing risk and expense. By generating alarms and offering methods to examine product-related risks and counterfeiting, an IoT-based solution may help enhance product security. This will enable the sector to retain its product reputation.

3. CONCLUSION

When confronted with comparable game-changing technological possibilities, several other sectors have developed and executed roadmaps. For example, via ambitious ideas and efforts like

Cable Labs (www.cablelabs.com) and the Tele management Forum, the telecommunications sector has achieved an incredible degree of automation and interoperability. These efforts have enabled the industry to collaborate and share risks while saving billions in solution development costs. Although the manufacturing sector is unique, lessons gained from other successful industries in the adoption of new technology complement our SMP goal.

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