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Pillar of Smartness: A Market Survey

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INTRODUCTION

Open communication and close collaboration have always been of considerable assistance to those in charge of managing supply networks. In 2013, Baihaqia and Sohal presented the findings of an empirical study that highlighted the influence that information sharing has on the supply chain. The study examined the relationship between information sharing and the efficiency of the supply chain. They came to the conclusion that despite the fact that exchanging information among partners is essential, doing so alone is not enough to make considerable headway in the endeavor. The aim is to focus on making supply chain partners more cooperative and expanding internal integration by working together to complete tasks so that their relationship is established on trust. In order to do this, the focus will be on increasing internal integration and working together to finish tasks. This can be done through collaborative effort toward the completion of tasks. The managers of the supply chain need to identify both the information that must be exchanged and the mode that is most suited for doing so in order to enhance the overall performance of the supply chain.

SMART MANUFACTURING

This is necessary in order to achieve the desired goal of improving the overall performance of the supply chain. Applications of information technology (IT) in the supply chain include things like logistics information systems (LIS), information and communication technology (ICT), and business intelligence (BI). Choy et al. (2014) constructed a fictitious model in order to investigate the impact that the implementation of IT applications in the supply chain would have. Seven presumptions were incorporated into the model. When looking at things from the perspective of the market, service quality was taken into consideration, and when looking at things from the perspective of the resources, competitive advantage was taken into consideration. According to the findings, the vast majority of logistics service providers (LSPs), although obtaining guidance from a diverse range of academics, do not utilize a great deal of variation in their practices. Radio frequency identification, sometimes known as RFID, is one example of this type of technology. The hypothetical model that was presented has the potential to act as a blueprint for LSPs to adhere to as they try to raise the degree of competitiveness at which they operate.

SYSTEM OF SMARTNESS

The function that information systems play in the company's transportation operations as well as the effect that these systems have. These actions include of improving financial outcomes, boosting driver utilization, improving the efficiency of information transmission, and increasing the efficiency of transportation. They stated that in the absence of efficient management of information systems, companies would be unable to make appropriate decisions on transportation, putting such companies at danger of being unable to satisfy the requirements of the market. developed a simulation model in order to evaluate the usefulness and effect of sharing four distinct categories of planning information (point-of-sale data, stock-on-hand data, customer forecasts, and scheduled orders) on inventory capital. These types of planning information include point-of-sale data, stock-on-hand data, and planned orders. In order to evaluate the significance of this information exchange and the value it provides, the model makes use of re-order point methodology. It has been demonstrated that whether or not demand remains constant is a significant factor in determining the value of information that is provided.

DEMAND AND SUPPLY RULE OF SMARTNESS

When demand is stable, having data about stock-on-hand is helpful; but, when demand fluctuates, having data about demand prediction and planned order is crucial. Regardless of whether or not demand is constant, sharing information from points of sale is not particularly relevant; hence, establishing how and when to communicate planning information is of the highest significance. utilizing supply chain and IT integration, Vanpoucke et al. (2017) created an analytical approach in order to establish how successfully operational choices can be made utilizing the technique. It is more helpful to an organization's operational performance to employ information technology for upstream integration rather than customer integration. Upstream integration refers to the process of moving products or services from suppliers to customers. It is possible that this may result in improved delivery performance because it will boost both speed and accuracy. Despite this, Azab et al. (2016) discovered that a substantial proportion of supply chains continue to be plagued by inadequate information transmission and poor communication across a wide range of stakeholders in the supply chain. As a direct result of this, different strategies and procedures have emerged for the sharing of information that are far more efficient.

THE ROOTS OF SMART MANUFACTURING

It is possible that the beginnings of manufacturing in the modern day may be traced back to the preceding half century. As a result of advancements in computing and machine-building technologies in recent years, the use of automation in manufacturing has grown significantly more widespread. Computer programs, rather than people sitting at the controls of the machine tool, are in charge of the majority of today's manufacturing processes. Automated material handling systems and automated storage and retrieval systems, respectively, are responsible for both the movement and storage of goods and components. There have been many different terminologies used to characterize automated manufacturing ever since the 1980s. These phrases span from flexible manufacturing cells and systems to computer integrated manufacturing and intelligent manufacturing. These phrases are used to describe automated manufacturing in varied degrees based on the breadth and degree of automation of a factory floor and the integration of multiple functional production zones. These terms are also used to describe automated manufacturing in varying degrees depending on the kind of product being manufactured.

Businesses are being compelled to rethink their production processes as a direct result of changes in the global market as well as developments within their own industries. As a result, effective factory management is more crucial than it has ever been. If asset utilization and overall efficiency are going to be enhanced through the use of smart manufacturing, data analytics made possible by the Internet of Things are an imperative must. Employees in the manufacturing industry will have the flexibility and capacity to make decisions they need to be able to deal with the increasing market complexity and shifting demand if fresh data, as well as historical data, is integrated with the insights generated by analytics. This is due to the fact that people working in manufacturing will have access to both new and old data. At its core, the idea of smart manufacturing is the creation of an environment in which all of the data that is currently accessible is gathered in real time, made visible, and then translated into insights that can be put into action.

PILLARS OF SMART MANUFACTURING

The inspiration for the creation of smart manufacturing may be traced back to the ideas that were initially developed in the realm of computers. Manufacturing has its own identity, which is captured in six pillars that will be explained in the following paragraphs and can be found below. Even though manufacturing will continue to profit from these concepts and other ideas that may develop in the future (for example, quantum computing might be a significant disruptor), manufacturing has its own identity, which can be found below. They are neither all-encompassing nor unchangeable in their fundamental characteristics. The discoveries of future research, the breakthroughs in technical capabilities, and the applications that will be generated will, taken together, come to define the ultimate pillars. The final pillars may be formally described in a variety of various ways, one of which includes the clustering of the research papers, industry reports, and information about new technical advancements utilizing methodologies pertaining to text mining and data mining. The smart manufacturing framework is supported by six pillars, which include the manufacturing technologies and processes, the materials, the data, the predictive engineering, the sustainability, and the resource sharing and networking. These six pillars have always been a component of the manufacturing sector, despite the fact that during the course of its history, they have been known by a number of names and taken on changing degrees of prominence. To give just one example, data has always been an essential component of the industrial process. In this day and age of "smart manufacturing," it is more commonly referred to by its more recent moniker, "big data." Predictive engineering, which is practiced now and is educated in data science, has been around for less time than production planning and forecasting. After that, we will proceed to a more in-depth discussion of the six components that make up "smart manufacturing."

Pillar 1—The development of new manufacturing technologies and processes: AM is one example of a new technology that has inspired the invention of new materials, had an impact on the design and manufacture of products, and opened the door to new application areas. Another example of a new technology is 3D printing, which is another example of a new technology that has had an influence on the design and production of goods.

Pillar 2—Materials: The technique of smart manufacturing allows for the use of any and all types of materials, including those that are based on organic compounds and biomaterials. On the other hand, the emergence of new materials necessitates the development of both new methods of production and the incorporation of these new materials into existing intelligent production systems.

Pillar 3—Data: We are now experiencing a significant increase in the quantity of data acquired from a broad range of sources, some of which have been driven by the adoption of intelligent sensors, wireless technologies, and data analysis. This is something that we have been observing for quite some time. The data will be included into the development of future software applications and programs, as well as into the production of various modeling tools for use in forecasting.

Pillar 4— Engineering that is predictive develops digital models of the phenomena of interest with a high degree of realism, which may subsequently be utilized to influence choices on future production and market conditions.

Pillar 5— The production of products and processes has to be guided by sustainability standards, which should include sustainable product design, sustainable manufacturing techniques, and sustainable materials. This criteria should also be included.

Pillar 6— Sharing of resources and the establishment of new networks: As the manufacturing sector becomes increasingly reliant on digital and virtual technologies, many of the creative and decision-making processes will be required to involve sharing of resources and the establishment of new networks.

DIGITAL VALUE CHAINS

This research investigates the implications of smart additive manufacturing (SAM), which is also known as smart three-dimensional (3D) printing, for industrial production logistics and inventory management as well as for digital supply chains (DSCs) and digital value chains (DVCs). The research is conducted within the context of Industry 4.0. The fourth industrial revolution is frequently referred to as "Industry 4.0." This transformation has given rise to the development of new digital technologies as well as an increase in the degree to which the production environment is digitized and automated. If organizations want to continue to be competitive in the market, they need to implement manufacturing technologies that support machine-to-machine and human-to-machine communication in a virtual environment. These technologies are called "intelligent factories." The inclusion of advanced digitalization, such as the Internet and intelligent things (machines and products), enables the linking of all aspects associated to production processes. This may be accomplished through the use of intelligent things (machines and commodities). This is made feasible by digital technologies like as artificial intelligence (AI) and SAM, which are examples of advanced digitization. These technologies are examples of what is known as advanced digitization. Various other names for it include the "digital factory," "smart factory," "smart manufacturing," "smart firm," "industrial internet," and "integrated industry." This is due to the fact that the link between the real world and the digital factory generates what is referred to as a "cyber physical system." As a result of

the development of Industry 4.0, manufacturing that is digitally enabled has been the focus of a significant amount of attention.
One of the most intriguing and potentially fruitful study subjects that has been suggested up to this point is the interaction that exists between the developing main enabling technologies of Industry 4.0 (such as SAM) and production logistics and inventory management, as well as DSCs and DVCs. This is one of the most fascinating study topics that has been presented. Because it is difficult to deny the impact that AM technology has had and will continue to have on production logistics and inventory management, SCs and VCs, it is extremely vital to have a fundamental grasp of SAM and the potential ramifications it may have on the manufacturing sector. This is because it is impossible to refute the influence that AM technology has had and will continue to have on production logistics and inventory management, SCs and VCs.
This study provides a critical analysis that analyzes the most current research and advancements that have been done to date on the consequences that SAM has had on the manufacturing industry. The ideas of digital manufacturing, DSCs, and DVCs are discussed in Section 2, which may be found below. After that, you will go on to Section 3, which will explain both smart manufacturing and SAM to you. In the next section, we are going to show and talk about the outcomes of our research. In specifically, we are going to concentrate on the linkages that exist between SAM, production logistics and inventory management, DSCs, and DVCs. In conclusion, Section 5 presents a concise review of the most important discoveries that were uncovered throughout our investigation, which are as follows:

MODERNIZING OF SMART MANUFACTURING

Molding, heat treatment, milling, grinding, and other operations are all examples of phases that are necessary in typical manufacturing processes; however, the techniques that make up these stages are not necessarily related to one another in any way. On the other hand, "smart manufacturing" is a process that is technology-driven and makes use of a production system that is entirely integrated and collaborative. This approach was developed in the 1990s. This makes it possible for enterprises to keep an eye on the manufacturing processes and react immediately to any changes that may occur in order to meet the ever-evolving requirements and conditions of factories, SCs, and the expectations of consumers. The notion of smart manufacturing is one that was developed more recently. The industrial machinery used in this system is supplied with intelligent sensors. These sensors are in charge of the data collecting process and are responsible for gathering information on the machine's operating status and performance. After the data have been collected and examined, possibilities to change and improve production performance are searched for.
The phrase "smart manufacturing" refers to a new generation of production systems that make use of cutting-edge technology to monitor and improve the performance of the manufacturing process. These systems are referred to as the "next generation" of production systems. A good illustration of one of these technologies is the use of apparatus that is connected to the internet. An intelligent factory should not only include automation, but also human and machine interaction; the combination of these two factors will result in greater operational efficiency. As it is implemented in a wider variety of devices and networks, the Internet of Things (IoT) may make it possible to achieve higher degrees of automation. Despite this, other technologies, in addition to the Internet of Things, play an important role in the process of smart manufacturing. Artificial intelligence (AI), machine learning, edge computing, predictive analytics, and digital twins are some of the technologies that fall under this category.
Kusiak defines the six pillars that are related with an intelligent industrial atmosphere:

CONCLUSION

The world in which we presently exist is one in which competition is fiercer than ever before. In spite of the persistent fluctuations in conditions that occur on the worldwide market, every manufacturing company need to make it one of their principal goals to maintain continuity in their business operations. In the modern business environment, the capacity of any company to arrive at the choice that is optimum in every possible way is of the biggest significance since there are a rising number of companies that are in direct rivalry with that particular organization. Because of this, the level of success that an organization achieves is most directly proportionate to two factors: the efficiency with which it makes decisions and the rate at which it works to enhance the quality of its products or services. In addition, the degree of success that any particular firm achieves is directly related to the efficiency with which it employs its available time and resources; hence, this is one of the criteria that is given the biggest weight because it is one of the factors that directly affects the level of success that the company achieves. The role of supply chain management, commonly known as SCM, is the primary factor that determines the amount of development that an organization will experience. This is especially true in a market that is both highly competitive and dynamic.

This is due to supply chain management being the major factor that decides how an organization will grow. One of the links in the chain that connects to a wide variety of various providers is the client. Both the manufacturing business and the service industry are negatively affected by the same issue. The flow of resources, including money and information, is carefully handled so that the firm's demands may be met in an acceptable manner. This is done in order to serve the needs of the organization in an appropriate manner. Not only does the movement of material from a supplier to a producer take place in the course of a procedure that takes place within an organization, but also the movement of knowledge and cash. After that, these are dispatched to be dispersed to the wholesaler, followed by the merchant, and finally the final consumer. The flow chain is accountable for ensuring that the same level of control is maintained. This ensures that all of these flows are connected with one another and coordinated across the entirety of the organization.

Because of this, conventional approaches to the design of products, their production, and their distribution can require some rethinking and enhancement. When faced with circumstances of this nature, the difficulty for a company is to continue creating a product that is simultaneously technologically sophisticated and competitive in the market. Concurrently, the amount of time spent on design, development, and manufacturing needs to be decreased in order to satisfy the requirements of the market. This is necessary in order to meet the demands of the market. After sales service, product lead times, manufacturing cost, and product quality are the four indicators that are utilized in the process of establishing whether or not a supply chain is effective on the whole or not.

The environment in which a supply chain's activities are carried out needs to be intelligent in order for the supply chain as a whole to be trustworthy. By utilizing smart manufacturing, which optimizes the formation of concepts and the transaction of goods, the purpose of manufacturing may be expanded, which may lead to a rise in the need for manufacturing. Because of this, the production process as a whole becomes more efficient. When it comes to the optimization of the supply chain on several levels, a robust supply chain produces greater results. This is true regardless of the level. One of the tasks at the upstream level, which is part of the company's effort to widen the scope of its activities, is to examine potential new suppliers. The phase of the creation of a robust supply chain that is dedicated to the process of selecting new suppliers is one of the processes that is considered to be among the most important steps. The development of fruitful working relationships with a firm's many sources of supply may prove to be beneficial to that company in the long run.

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