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A review of the effect of Industry 4.0 on supply chain systems

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Abstract

One of the biggest challenges faced by manufacturing companies today is the significant increase in range of supply chain (SC) problems that must be solved. Unfortunately, the traditional planning approach cannot match the diversity of these complex problems. There is a huge place for leveraging new technologies in supply chain and logistics. Industry 4.0 aims to link smart operations and supply chain design and processes to salvage some of the operational shortfalls in the supply chain. Industry 4.0 is expected to be driven by emerging technology breakthroughs to help facilitate network of interaction of products and services with interconnection of robots and artificial intelligence. This technology is gaining so much attention in virtually all sectors particularly in manufacturing operations which require product flow at inbound and out-bound operations. This research is an exposition of Industry 4.0 technologies and how it can aid advance Supply Chain operations in manufacturing settings. The conclusion drawn from this research further reiterates on the gains of attaining high level of performance improvement with the implementation of innovative technologies in all aspect of supply chain network(s). Thus, effective integration of the Industry 4.0 technologies into supply chain operations will greatly improve productivity, product delivery, cost optimization, asset management, reliability, efficient processes, better sales and overall performance of manufacturing systems.

Keywords: Industry 4.0; supply chain; emerging technologies; in-bound and out-bound manufacturing operations.

1 Introduction

Recently, manufacturing organizations are faced with issues of business sustainability that may have significant impact on business operations (Luthra & Mangla, 2018). Another issue confronting manufacturing organization has to do with the complex processes involved in launching into digitization or managing new technologies. There is fundamental transformation in technology from classical to advanced high-tech innovations as a result of intricate rapidly evolving market conditions and consumer demand. There is equally need for organizational versatility and responsiveness (Oberg & Graham, 2016). The value of technical innovations has been recognized by organizations and technology is seen as a powerful strategic tool to ensure total sustainable efficiency and radical progressive change (Chavez et al., 2017; Shrivastava et al., 2016). In order to streamline business processes, several industries are already implementing e-business technology. High level of convergence and new innovations are required to boost operational efficiency in systems, (Srinivasan & Swink, 2015). The fourth industrial revolution require aggressive innovations which has to do with investing extensively in automation and robotics, and to incorporate more sophisticated technical philosophies and concepts to achieve total transformation (Uchechi et al., 2020).

This transformation will result into major production advantages, consequential in the development of smart factories by consenting to comprehensive integration of processes (Rashid & Tjahjono, 2016). Integrating effectively will in no doubt lead to profitability, cost optimization, higher reliability, improved management control and efficiency. Industry 4.0 requires great transformation in every aspect of business operation. Substantial investment and considerable time for effective planning is required to achieve this transformation. Since many companies are struggling to be at the top of the game in the new revolution, competitive strategies which require aggressive approach to responsiveness and diversity in every aspect of supply chain operation is significant (Um, 2017).

As the world's population continues to increase, the need for sustainability in terms of resource utilization becomes necessary (Islam & Managi, 2019; Gorman & Dzombak, 2018). Rahman et al., (2020) anticipated that the fourth industrial revolution will focus on the economic, social and environmental dimensions of sustainability. They equally believe that continuous study focused on technology developments should be strongly supported especially from the economic perspective. Karadayi-Usta (2019) stated that the adaptation of the fourth industrial revolution processes entail high level of

adjustment of workforce and infrastructure. Companies operating traditionally must start looking deeper for solution to transformation in all aspect of their production process (Ku et al., 2020).

1.1. The Fourth Industrial Revolution (Industry 4.0)

Industry 4.0 is making rapid progress as a transformational process and this is happening at an exponential speed. The first industrial revolution which surfaced in the eighteenth century (1800) brought about significant improvements to the industries as a result of breakthrough in the steam engine discovery which was used as a source of electricity. This led to migration of people from rural to urban area. The second industrial revolution was witnessed in late 1800, with the implementation of scientific management theories to accelerate production in factories; this led to perfect arrangement of assembly line for mass production. The third industrial revolution witnessed around 1950 to 1960 led to the incorporation of computers and internets in offices and factories which facilitated timely completion of tasks and fast delivery of information and products. (Machesa et al. 2020).

The fourth industrial revolution as a current viewpoint, is gaining attention globally (Uche et al., 2020). This current technology and its enabling proficiencies, however, are believed to have the ability to manipulate available machines thereby making factories and organizations smart, this will greatly facilitate major changes in our society especially the ease of moving products in supply chain and logistics operations (Baur & Wee, 2015). Technology study dwells on exposition of current technologies to improve supply chain performance in manufacturing operations. Other section of this article cover: Supply chain at inbound and outbound operations; enabling technologies to enhance supply chain in the new revolution; the importance of industry 4.0 technologies in supply chain manufacturing and operations; challenges of industry 4.0 technologies; benefits of adopting the technologies; other industry 4.0 technologies which can bring about changes in supply chain network for advancement in manufacturing operations; conclusion and suggestion for further studies.

1.2. Supply Chain

Supply chain is a global network for delivery of products and services from source of raw materials to end customers. As the network of product interaction continues to get complex, new technologies are needed to match the complexity of the system. According to Govindan et al., (2017), good number of companies are currently participating and investing in high-tech innovations to help facilitate and develop collaboration mechanisms and active communication channels which will greatly improve

performance of supply chain through improved and sharing of vital information. Supply chain performance improvement is vital in manufacturing organizations (Datta, 2017). For effective information exchange in any organization, supply chain integration is considered important and critical especially in end to end business process (Chavez et al., 2017). For great performance and improvement in supply chain network interaction, flexibility enabled by teamwork or strong collaboration is required (Datta, 2017).

Altay et al., (2018) also confirmed that dexterity and flexibility in supply chain have great impact on supply chain performance. Swift et al., (2019) further pointed out that transparency and higher perceptibility in supply chain network of interface will meaningfully improve effective performance. In supply chain management (SCM), traditional pattern of supply chain operations will not yield great result, therefore, implementing the fourth industrial revolution-enabling-technologies is a positive strategy to revolutionise SCM (Kache & Seuring, 2017). According to Luo et al., (2018), many organisations are currently adopting the new technologies through Electronic business solutions for total enhancement of their integration, capabilities and operational excellence.

1.3. Digitalized Supply Chain and Technologies of Industry 4.0

The fourth industrial revolution as earlier explained is a transformational process which involves the use of contemporary smart technologies to facilitate production, service delivery and other work operations in manufacturing or service systems. The use of technologies in manufacturing and business environment has facilitated Industry 4.0 (Wiengarten & Longoni, 2015). This digitalized global concept encompasses high level of connectivity among people, entrusted customers and agile manufacturing systems. The new revolution is such that supply chain operations are done timely as people are vastly connected with on-time information 24 hours a day and 7 days a week using application software, supply and delivery platforms and other vital means to access and exchange information timely. The current revolution, in no doubt will help companies adjust to swiftly ever-changing patterns in supply chain operations, enthralled on the behaviour of consumers and responding to stochastic and deterministic business operations at all levels.

Ground-breaking ideas, originality and agility are required to match the new revolution. There is no doubt that this new revolution has aided smart process organization which has equally set new standards for effective management of industries (Moeuf et al., 2017). Industry 4.0 is an occupational environment characterised by high-tech innovations which require the use of smart machines for

communications. It must be noted that the more complex the supply chain, the more necessary it becomes to setup a structure for ground-breaking or innovative ideas for total business and system transformation. Three major causes of complexity in supply chain system have been discussed elsewhere (Handley, 2020). The sophistication of coordinating and synchronizing all interconnecting supply chain system is a serious task which require great attention and there is no doubt that the easy way or steps to adopt is the implementation of industry 4.0 technologies like artificial intelligence, Big Data Analytics, Internet of Things (IoT) and others (Oberg & Graham, 2016). Autonomous systems are not left out as one of the incredibly significant and advantageous industry 4.0 enabling technologies (Okwu, 2020). If these technologies are properly integrated, there is guarantee for development and total transformation in all aspect of manufacturing systems (Uche et al., 2020). Fisk (2020) listed three innovative companies in the year 2020 based on digitalized system of operations to include Telsa, Microsoft and Snap. This is a testament to the fact that the Industry 4.0 technologies will in no doubt lead to high innovation and performance in manufacturing systems. Some of the fourth industrial revolution enablers for supply chain sustainability are presented in Table 1.

Table 1: Fourth Industrial Revolution Technologies for Supply Chain Sustainability

S/N	Fourth Industrial Revolution Tech. Enabler(s)	Description	Accessible Literature
1	Meta-heuristic analysis of barriers in Supply Chain Activities	Improving supply chain performance by digitizing supply chain activities in supply chain sustainability	Ghasemian Sahebietal.,2017; Okwu et al. 2018; Machesa et al. 2020; Olayode et al. 2020.
2	Digitization of Supply Chain Activities	Technologies of Industry 4.0 and applications in Supply chain for sustainability.	Agrifoglio et al. 2017; Lu, 2017; Müller & Voigt, 2018; Agrawal, 2019.
3	Promoting Knowledge Management in Supply Chain (SC)	Supply chain performance and sustainability is improved by practicing knowledge management in SC.	Latif et al.,2017; Stoychevaetal.,2018; Aggarwal et al., 2019.
4	Commitment of	High level algorithms for	Chen et al., 2018b; Seuring et al., 2019.

	Supplier for Sustainable procurement	Sustainable procurement	
5	Supply Chain for SMEs	Optimization of Supply Chain for SMEs	Moeuf et al., 2017; Schwabetal., 2019.
6	Business Process Performance	Importance of procurement 4.0 in business operation	Banker, 2015; Baur & Wee, 2015; Garcia-Muiña et al., 2018; Bag et al., 2020.
7	Smart Factory Operations and IoT	Technologies of Industry 4.0 can facilitate process Improvement in factories	Mishra et al. 2016a. Chen et al. 2018a.
8	Big data Analytics	Improvement in operations management	Acter et al., 2016; Babiceanu & Seker, 2016; Addo-Tenkorang & Helo, 2016; Mishra et al. 2016b; Gunasekaran et al., 2017; Nguyen et al. 2017; Papadopoulos et al., 2017; Wamba, 2017; Choi et al., 2018; Gunasekaran et al., 2018; Olayode et al., 2020.
9	3D Printing Technology		Holmstrom & Gutowski, 2017; Feldmann & Pumpee, 2017.
10	Robotics and Automation, AI and ML.	Path Planning and Navigation of Autonomous Vehicles	Jazdi, 2014; Ukaegbu, 2020.

2 Technologies of the Fourth Industrial Revolution

This section is focused on the major Industry 4.0 technologies that will help facilitate supply chain in manufacturing operations. Some of the industry 4.0 technologies include: Big data analytics, Cloud computing, 3D printing technology, Machine learning and Artificial Intelligence, Internet of Things (IoT), Cyber-Physical Systems, Automation and Robotics and others. These are further explained in detail.

2.1 Big Data Analytics

Big data analytics is a current global digitalization which involves the extraction of knowledge in form of dataset from systems thereby facilitating data-driven decision-making. Big data analysis has been recognized in literature as an area of digital technology which is quite elaborate and extremely useful in decision making process. Robust and unprecedented information can be gathered and converted to digital format. This has become extremely useful since past information can be obtained and stored for future use. There is no doubt that big data analytics can provide tremendous opportunity for maximizing the use of capacity, enhancing customer service, developing new logistics business models and reducing risk in a system.

2.2. Cloud Computing

Cloud computing is a global computing technology capable of computing and storing massive amount of data in such a way that organizations have higher chances of expanding and performing effectively at a larger space (Mitra et al., 2017). Supply chain design and processes can be obtained, computed and stored for future use based on cloud computing technology. Branger & Pang (2015) are of the opinion that cloud manufacturing is anticipated to appear as the next and highly effective model and driver of manufacturing in the fourth industrial revolution. According to Xu et al., (2018), cloud computing can facilitate data sharing and exchange efficiently, thereby promoting complex decision making in manufacturing systems.

2.3. 3D Printing Technology

High-tech automatic manufacturing is possible using 3D printing technology. 3D printing or additive manufacturing offers new potential in manufacturing systems as products can be made available to customers at the right time. 3D printers could be shipped to manufacturing sites where parts can be quickly fabricated on site. Most manufacturing companies are currently introducing the innovative technology of 3D printing to their production process, taking the next step towards fully advanced and automatic manufacturing. This process is based on an automatic production process where products are made faster and easier than ever before and which allow consumers get easy access to products made by manufacturers. Inventory buildup is almost impossible since the exact number of products required periodically can be made available. Also, customized models can be made available to customers. The use of 3D printing at different level of supply chain will enhance service delivery, cut cost and inventory

buildup, increase flexibility in manufacturing and product individualization will increase (Feldmann & Pompe, 2017; Holmstrom & Gutowski, 2017).

2.4. Machine Learning and Artificial Intelligence

Machine learning is the study of computer algorithms and Artificial intelligence is the simulation of intelligent behaviour of machines (Machesa et al. 2019). Very few companies are extremely dominant, considering the ground-breaking and ongoing trend towards computerization or automation and sustained advances in the world of computing, Artificial Intelligence (AI) is speedily changing the pattern of operation of logistics providers.

2.5. Internet of Things (IoT)

The Internet of Things (IoT) implies the interconnection of things (physical objects) using the internet for easy communication and sharing of information with other systems and devices. In a simpler term IoT is the connection between objects and machines using the internet. This is another new wave of technology which can connect practically any useful information to the internet and speed up logistics driven by data. This systematically means that information can easily be sent, received, processed and stored in the form of useful data which can dynamically contribute in event-driven, self-steering, logistics processes. IoT has unlimited capabilities where data can be used from the linked objects to produce actionable insights that drive improvement and innovative ideas to achieve payoffs for logistics providers. Jazdi (2014) concerted his study on the influence of connecting several devices in a system under IoT and the impact of cyber physical systems in the life of individuals daily. He further argued that the fourth industrial revolution will have huge impact on the advances of new technologies and consumers lifestyle.

2.6. Cyber-Physical Systems

Cyber-physical systems are machines in which mechanisms are monitored, controlled or computed by algorithms. It is the connection of machines to interact, visualize and make decision autonomously. Data collected by smart sensors can help professionals understand critical situations faster and more accurately while implementing this technology in in-process supply chain system. This will enable customers to be informed about the pattern of product flow or services rendered. Autonomous vehicles will be made available in few years as many companies are currently testing self-driving vehicles on road in different countries of the world. It is certain that most manufacturing companies are getting ready to

launch autonomous ground robots in the form of lorries, buses and vans where vehicle to vehicle can communicate with each other, accidents will be reduced, traffic congestion in unsignalized road intersections will be a thing of the past, new ways of monitoring navigational pattern of vehicles will be established.

2.7 Automatic Guided Vehicles (AGV) and Unmanned Aerial Vehicles (UAV)

One of the useful Industry 4.0 technologies that will enhance supply chain is the autonomous robots. It could be ground robot - automatic guided vehicle or flying robot - unmanned aerial vehicles. AGVs for product distribution in manufacturing settings will be of great economic benefit since they are programmed to function autonomously. AGVs can be implemented in factory settings as material handling devices or delivery agents for moving items from one location to another. Unmanned aerial vehicles (UAV) will be particularly useful either for moving raw materials to factories or for delivering ready items to customers at various locations.

3 Importance of 4IR Technologies in Supply Chain and Manufacturing Operations

3.1 Big data analysis - has been recognized in literature as an area of digital technology which is quite elaborate and useful in supply chain operation. A good example is demonstrated in a research conducted by Simchi-Levi & Wu (2018) which focused on the analysis and application of big data in retail channel. Price optimization model was used for the analysis as retailers strive to grow their revenue, margins and market share. This technology has equally been demonstrated by Nguyen et al., (2017) as a prevalent technique in transportation and logistics. Other areas where big data analytics has been applied in supply chain management include(s) transportation and logistics operation, inventory system in warehousing, routing optimization, safety management (Gunasekaran et al., 2017; Nguyen et al., 2017; Zhong et al., 2017). There is no doubt that big data will provide tremendous opportunity for maximizing the use of capacity, enhancing customer service, developing new logistics business models and reducing risk in a system.

3.2. Cloud Computing is a high-level computing technology capable of computing and storing massive amount of data in such a way that organizations will have higher chances of expanding and performing effectively at a larger space (Mitra et al., 2017). Supply chain design and processes can be obtained, computed and stored for future use based on cloud computing technology. Branger and Pang

(2015) are of the opinion that that cloud manufacturing is anticipated to appear as the next and highly effective model and driver of manufacturing in the fourth industrial revolution. According to Xu et al., (2018) cloud computing can facilitate data sharing and exchange efficiently thereby promoting complex decision making in manufacturing systems. Successful implementation of Industry 4.0 is based on intelligent computing of which cloud-based manufacturing is a key driver. The service-orientation in the field of manufacturing is supported and facilitated via cloud computing (Xu et al., 2018).

3.2. 3D-Printing in Manufacturing Systems - Difficult to weld components can be remanufactured with ease and delivered to customers timely using 3D printing techniques. This technology is quite expensive but offer robust benefits which include: It is faster and more precise than the traditional system; wastage is reduced via 3D printing; Internal object can be built unlike traditional machining; complex stochastic structures difficult to produce via conventional method can be produced with ease; It uses the same language used by classical machining process; fantastically complex objects can be produced; lighter weight and stronger structures can be made; customization process is quite affordable; products are delivered timely. In addition, personalized models can be delivered much more easily and quickly to customers as a result of short distance between production and customer. This application is particularly useful in supply chain operations from manufacturing of parts to redesigning of full components for global supply chain production at inbound and outbound level.

3.3. Machine Learning (ML) and Artificial Intelligence (AI) - will make a big difference especially in promoting supply chain processes. Looking at the recent trend in the dynamics and operational performance of companies, it is a clear indication that companies like google, Facebook, Uber operate in such a manner that a single company controls a very large part of the market.

3.4. Internet of Things (IoT) and Cyber-Physical Systems- Internet of things and cyber-physical systems work hand in hand. Considering the manufacturing industry, smart machines can work with humans for easy assembly task, they can also operate autonomously and communicate directly with manufacturing systems, leveraging the capability of the Internet of things, solving complex problems and making decisions independently. This will have an extraordinarily strong impact on the factory of the future. For example, advanced manufacturing process and rapid prototyping will make it very possible for customers to order any kind of product without significant increase in cost. These technologies will greatly reduce cost and time associated with product design and engineering of the production process while prompting simulation and virtual testing throughout the product lifecycle.

Advanced human machine interaction handling systems will help increase safety in production plant and reducing physical demand of workers and physical handling of products by man.

3.5. Automatic Guided Vehicles (AGV) and Unmanned Aerial Vehicles (UAV) - Autonomous vehicles offer very specific benefits which include: Safety – Most accidents are caused by human errors, the use of computer algorithms and automation to drive machines or vehicles offer a perfect solution in terms of service delivery; effective coordination and navigational endurance; reduced cost of delivery; great economic benefit as autonomous vehicles are programmed to perform task for a very long time with great endurance limit; social exclusion can be removed by autonomous vehicles; they are more transformational, cleaner, affordable, safer and highly efficient.

4 Discussion

It is no doubt that a new data architecture and global network has emerged where people and machines can interconnect for effective and continuous interaction. This has led to high standard of safety and has changed the society and our daily lives. Currently, the traditional approach to the supply chain is exceedingly popular, particularly in developing and emerging nations. The fourth industrial revolution has ushered modern technological advancement and information network infrastructure to facilitate things. A global network has emerged, which allow direct and continuous interaction between man and machine. This is gradually changing the way we think and carry out our daily operations. Different technologies to support the fourth industrial revolution has been discussed which include big data analytics; 3D printing technology, Internet of things, artificial intelligence and robotics. These technologies are useful to facilitate supply chain operations. There is no doubt that the technologies of the fourth industrial revolution will greatly enhance supply chain design, processes, engineering and management. Considering product delivery aspect, the use of autonomous systems (aerial and ground robots) will facilitate delivery process timely inbound and outbound operations.

4.1. Challenges of the Industry 4.0 Technologies in Supply Chain Operations

According to Elon Mosk, artificial intelligence is considered the biggest existential threat to humanity (Guardian, 2014). While many workers fear losing their jobs, some see AI as a terminator that will wipe out all humans from the surface of the earth. It is important to focus on the impact of the current revolution in our society especially in the manufacturing and service industries. These new technologies

will no doubt, significantly transform our system, workforce and path planning process. In the physical world, it is important to take safety into consideration before deploying Industry 4.0 technologies. There is a huge disconnect between using a traditional or non-autonomous vehicle for conveyance and transportation of materials and using a self-driving vehicle. Synchronization of autonomous systems which are key players in the scene of activities is a complex task which requires systematic and strategic approach for effective coordination.

With the ever-growing demand of data in every industry, the need to safeguard and manage sensitive data has increased dramatically. Many countries are already implementing strict regulations, a trend that likely to continue into a conceivable future. ML and AI are required harness and secure data for company use. One of the major challenges with this new technology is the issue of security. However, in the coming years there is tendency of increase in decentralized technology for data security, integrity and privacy especially for machine to machine interaction.

In manufacturing and supply chain operations where machine agents and AIs are the key players, the instructions given to AI must be tested and confirmed satisfactory before using the technologies to avoid any form of disaster. Deploying the technologies could be so complex with multifaceted operational constraints. Setups need to be dynamically routed through a network and other machine agents; such networks are highly unpredictable and much volatile.

Considering the current Industry 4.0 technologies already discussed in this study, there are still lot and more technologies evolving, but very often most of the technologies may not scale through real-life or real-world applications. Some may end up as useful techniques in teaching space or research for solving numerical or quantitative problem solving and not really techniques that can drive innovations. Looking closely at the new technologies discussed in this context, artificial intelligence, robotics and machine learning tend to scale perfectly in supply chain operations if well implemented. There is a great advantage of the new Industry 4.0 technologies over the classical techniques in supply chain management and manufacturing operations.

4.2. Benefits of the Industry 4.0 Technologies in Supply Chain Operations

Fully integrated digital supply chain requires dynamically adjustable and synchronized network. Artificial Intelligence (AI), Machine learning (ML) and Robotics are particularly useful technologies in the current revolution especially in supply chain operations. There is no doubt that they will greatly support

intelligent machine agents for product monitoring and fast delivery in manufacturing systems. ML will be fundamental to optimizing production processes and reducing lead time. Some benefits of Industry 4.0 technologies include:

- (i) Already available infrastructures can be reused in supply chain operations especially where the methods are well implemented by strategists and managers of manufacturing companies managing the setup. Systems that are in place can integrate with already existing AI infrastructure to facilitate the network system. Many of the machines learning type of approaches can perfectly fit in. A good example is dynamic routing as a new technology, experts can make good use of already existing routing in place in a manufacturing company add the python script to execute task effectively, same is applicable using reinforcement learning and other innovative Industry 4.0 technologies for supply chain operations.
- (ii) Faster return on investment - At every point in time, product and service-based organizations currently springing up globally, require network of product or service interaction either at in-bound, in-process or out-bound operations. Some produce similar products where competition abounds. Standing tall and making a difference is a function of strategies implemented in the new era. As already discussed, technologies of the fourth industrial revolution will go a long way to facilitate supply chain network which remain particularly useful in manufacturing companies with great possibility of achieving faster return on investment.
- (iii) Work performance can be easily measured- In a manufacturing company or establish, workers are employed to facilitate work operations for efficiency, effectiveness, productivity and profitability. There is no doubt that performance of task could be overly complex and diverse since contextual and environmental factors are considered. It is therefore extremely hard to make a fair assessment of performance of workers in the system. Knowing the rate of performance and strength of workers in a chain system of work operation is important to rate the efficiency, fulfilment or task accomplishment rate of the company. This will equally help assign the right person to the right task. The traditional approach of using the time study -method study and work measurement is time wasting. Machine learning based approaches like extra trees, deep learning algorithm and others can help achieve work performance as they have the capacity and capability to train and view the task by focusing on the history of workers to give a very good prediction of the duration of the task and

possible expectation of workers in a complex supply chain network and manufacturing operations.

- (iv) Inventory management is equally important aspect of supply chain and the traditional approach often used in manufacturing organizations is time wasting and fundamentally based on assumptions regarding demand distribution which has never guaranteed optimality in terms of replenishment strategy. In the era of fourth industrial revolution, it is important to implement the AI technology focused on deep reinforcement learning for perfect inventory control where learning process is automatic, the process is fast, and no assumptions are required. Though there may be possibility of slow convergence.
- (v) Cyber physical systems and machine to machine communication will all work together to share data from the shop floor in order to reduce idle time. Intelligent drones can be used to supply or deliver products timely and analyze vast demand of data's in seconds. Companies like Uber and Google are extremely strong in the machine learning space when it comes to autonomous vehicles. The method adopted by uber which require building retrofit kits, autonomous sensors, and high-level software technologies has made the company stand tall among many other corporate organizations. The interesting part is that the already established knowledge can be reused for developing vehicles and making them autonomous.

5 Conclusion

Industry 4.0 is the major trend in global manufacturing. Organizations need to follow digital transformation to stay competitive and equally achieve sustainability. This ensures gaining environmental, social and economic advantages. This study is focused on exposition of industry 4.0 technologies and the benefits of integrating the technologies into supply chain operations. There are numerous technologies springing up, but the vital few has been discussed. Industry 4.0 technologies, if effectively implemented in supply chain, will greatly improve productivity in manufacturing operations as products will be delivered timely from source to destinations. Other advantages to be gained from the new technology include better asset management, lower cost, better sales and overall improvement in financial performance. To achieve all these, there will be need for strategic planning, improvement in high-tech, holistic global leadership, business process transformation and best knowledge for global practices.

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