The Interlink Between Sustainable Supply Chain Management and Technology Development in Industry

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Abstract

The adoption of the green supply chain, reverse logistics, and re-engineering methodologies have paved the way for advanced and sustainable thinking and led to the emergence of new technologies which may facilitate industrial flow processes in a Supply Chain Cycle (SCC). However, the understanding and full application of current evolving techniques are yet to be fully grasped or explored, especially as it pertains to different organizations' operational structure. Cyber-physical systems (CPS), autonomous vehicles, robotics, additive technologies, and alternative energy systems, are under draconian scientific investigations, leading to incredible achievements, with the promise to replace humans in future supply chain operations. Thus, as the technological trend improves into the future, the question is asked, to what extent do the tendencies support sustainability and how secure is the current technology, or the decision to adopt new ones to improve product delivery, material handling and organize storage conservatively without causing havoc in the society. As such, maximize profits while meeting societal satisfaction. In this paper, we assess current trends towards achieving Sustainable Supply Chain Management (SSCM) and discuss viable implementation strategy of emerging technologies for the future, its impacts, challenges, and the scope of applicability for increased productivity. In conclusion, we share on how the promulgation and proper management of new and developing industrial technologies are essential to maximize time, minimize cost, and improve the value of employee commitment, and customer contentment.

Keywords

Sustainability, Cyber-Physical System, Technology, Industry

1. Introduction

Supply chain management combines events which bring logistics and manufacturing/service operation to a coordinated bearing where resources are transformed and utilized to meet specific demands. The concept of sustainability soon introduced environmental concerns, followed by the derivation of maximum gains over the most optimal utilization of inputs and then, the impact of the whole process on how it affects workers and the end consumers. There exist, numerous definition inspired from the thought of sustainable supply chain management but many often are buttressed in the same vain. However, few capsuling among them are presented in Ref. (Council of Supply Chain Management Professionals, 2015; Gonzalez-Feliu, Jesus. Semet et al., 2014; Trentesaux and Prabhu, 2014). They captured critical terminologies in the area and field in question. Sustainable development as regards to economic, environmental and social security cannot be disjointed if the clamor for climate protection and social well-being is to be emphasized (Fischer, 2017). Hence, Intergovernmental forums, privately concerned conglomerates, Pro-eco practitioners and other involved parties set standards to proffer advice and design strategies for manufacturing, process, and service companies to meet as laid down requirements. Thereby affect the decision making undertaken by industries towards sustainable approaches for increased productivity. In the light of growth and development; innovations, technological integration successes, and coupled with standardization frameworks have become mechanisms for increasing productivity in today's industry. (e.g., The Social Responsibility and Accountability Standards; ISO 26000, SA 8000 respectively and the Environmental, Quality, Energy, and Risk Management Standards; ISO 1400, ISO 9001, ISO 5001, ISO 31000, without failing to mention the Business Community Standard; ISO 22301, respectively). The subsequent sections of this article is organized in the following manner. Chapter two

covers literature and highlights sustainable supply chain concepts with regards to the impact of emerging technological initiatives in different industrial sectors. The envisaged benefits and the barriers when implemented are covered in the third chapter. The paper supplies more on the argument that quantum leap technologies are essential for time and cost savings, as well as ensure quality management which leads to sustainable development in industries, as presented in the discussion and conclusion chapter.

2. Overview of New and Emerging Technology for Industry

The adoption of Information Communication Technology (ICT) in Industries has seen extensive coverage in logistics operations and production sequencing. In other to drive a sustainable supply chain management, factors embedded in the logistics processes (to manage information, items, cash, and abstraction while considering the mechanism of how, where and when) must interplay with the supply chain management in itself. Procurement, collaborations within and across companies, coordination and resources conversion down the tier in the network (Supply, Company, and Distribution to Customer), from upstream to downstream ought to be optimized to gain effectiveness as per manufacturing/process or service delivery operations, and in perspective with the use of a conservative approach. Real-time process control has found beneficial use in manufacturing across many industries for performance optimization, and minimizes unscheduled downtime with improved quality. Process control, also, is done using the information flows and mostly through ICT. The economic practice of enterprises and the implementation of logistics goals is feasible, primarily through management strategies, where the use latest innovations to acquire, and process or transmit information; through the implementation of technological changes are met (Komisji et al., 2017). Researchers (Gonzalez-Feliu, Jesus. Semet et al., 2014; Hasan et al., 2013) support the pivotal role of information systems about enterprise resource planning and electronic data interfacing within a business supply chain network to increase productivity. A socio-technical perspective of sustainability in the logistics process, with regards to the likelihood of beneficial policies sufficient to facilitate the implementation of strategetic decisions have received insight by Ref. (Fischer, 2017), proposes an approach in line with efficient equipment which are network-controlled and via sensor technology to drive the logistics process for urban transport systems.

Product tracking in real-time forms part of strategic managerial approach, and advantageous for determining specific product location at any given time in the supply chain while using tags; electronic, barcodes or Radio Frequency Identifier (RFID) systems. Hence adopting adequate product information to organize and ensure implementation of sustainable operations. The attachment of RFID tags to manufacturing component provides an opportunity for easy retrieval and is essential for future supply chain according to Qi et al., (2016). They came up with this conclusion, after testing the level of security and performance efficiency of RFID tags on a third party supply chain system. Ma et al., (2015) investigated the potential of RFID technology to track and trace items in a large scale distribution network. Hence, they develop innovative ways to effectively manage the unpredictability problem of RFID to handle large data in a business network. The idea behind traceability is to provide productive monitoring and withdrawal of product in case of any abnormality timeously and only for the contaminated lot so that a single anomaly would not affect the whole lot of products. Traceability also protects against counterfeit products, through active tracking to be able to verify the full information of that product. Moreover, according to Nasir et al., (2010), used RFID combined with navigational systems (GPS) for tracking materials and equipment in other to maximize project management throughput in the supply chain, and basing their research on two separate industrial sectors (Refinery and power) by testing their model on automation systems. Hence, they established that different technologies have considerable benefits when adequately managed and for different project.

Digital evolution through the development of the Internet of things (IoT) ideology is rapidly transforming global perspective on trade, manufacturing, process and service operations. Current trend sees monitoring of the industrial operation processes through the lens of sensors technologies, wherein a communication network allows machines to be organized and to actualize effective control during production, thus, leading to a reduction in the cost of design, efficient design of the end product, requiring little or no labor, and precautionary safety measures occurring a conventional system of man and machine interface. However, there exist considerable challenges with regards to the robustness of technologies which can handle large-scale production in manufacturing, transport logistics, and process industry. Investigations concerning the integration of CPS in manufacturing for sustainability performances have also received insight by the Trentesaux and Prabhu, (2014), specifically for factory production-line energy conservation.

There is assurance that the CPS will gain benevolence in the future, in areas of smart manufacturing and proffer dexterity in operations and sustainability in the supply chain process (Lee et al., 2015). The complex combination of wireless and, or wired controlled component requires a lot of expertise as envisaged for integration in the SCC. Regardless, the inclusion of CPS in large-scale operations and supply chain processes holds the potential to bridge the gap between energy conservation, environmental preservation, and production waste control. Furthermore, CPS integration in transport facility can stimulate inter-coordinated activities between the transporting medium and the storehouse, citing product dispatch and delivery, reorganizing the total operation process, and giving new, and specific details as to what is missing or sending notifications about what next to do. Thereby, reconfiguring for new activities and events in the supply chain process.

According to literature ref. (Mahajan and Vakharia, 2016), about 1.3 billion tonnes of solid wastes are generated annually on a global scale. Lean manufacturing which in recent times have gained popularity as one of the most conservative approaches to manage waste within the production factory (Abdu et al., 2016) was first initiated by the Toyota automobile company and have received significant attention and improvement to create increased productivity in diverse factory operations. The need for efficient material management practice has become pivotal to increased productivity (Nasir et al., 2010). Also, the initiation of sustainability supervision to ensure material utilization to meet non-toxic standards is gaining global support. The reality becomes true for employees to work, and be content in a less risky industrial space, where the waste from production processes released to the environment (Land Conservation) are non-catastrophic to human health. Also, efficient material utilization will save cost, time, and equipment, thus, further facilitate the supply chain processes. Additive technologies are also taking over the future of Manufacturing production operations (Galba and Reischle, 2015; Hossain et al., 2016) through 3-D Printing, by utilizing a variety of sustainable material to develop components and new parts (D'Aveni, 2015). From the energy perspective, the manufacturing sector uses 33% of world energy produced and contributes up to 38% of CO_2 to the global carbon emission footprint (Trentesaux and Prabhu, 2014). According to the world energy outlook report (International Energy Agency, 2016), active energy monitoring and control of manufacturing processes across the supply chain will increase profitability, reduce the risk in organic and nonorganic wastes release within chemical industries, and lead to improvement in power savings from energy-intensive sectors. This can be achieved through modern technological development that allows the combination of alternative materials, renewable energy sources, smart and energy sufficient equipment or infrastructures. Wegrzyn et al., (2012) draws a correlation in the food industry, stating that companies must upgrade and automate their supply chain processes through the adoption of advanced technology systems to re-enforce their manufacturing and production process. Hence, the next significant change waiting to happen; where environmental, social and economic concerns are addressed, and include advanced technologies.

Subsequently, the paper showcases the argument where efficient and robust SSCM in the future will depend significantly on the new trend and technology springing up, driven by the Industrial-IoT, thus, cuts across the SCC process. Figure 1. Describes the SCC and the flow of material and information within the three tiers in a simple supply chain structure, from upstream to the downstream (where the good and services meet consumers' needs).

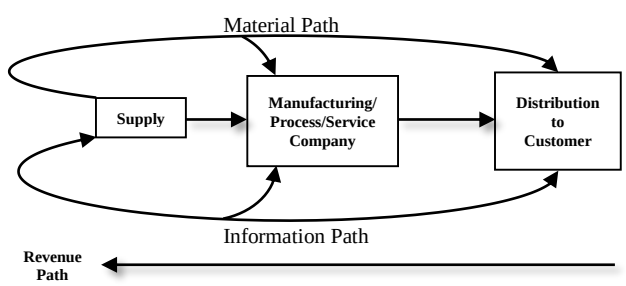

Figure 1. Supply Chain Cycle

The fusion of ICT and operational technologies are breaking barriers in traffic delays while promoting emission control in the transportation sector, thus, the adoption of cars that use alternative energy sources; electric automobile and the opputunity to development autonomous vehicles is a revolution waiting to occur in the logistic supply chain. Production will become more effective and carried out more efficiently, and sustainably while storaging, monitoring,

delivery services and order services will be cordinated within click of a button. The logistics at the final tier of the SCC process is a crucial part of the very definition of logistics in an all-encompassing and general sense. Delivering the right product, at the right time, right place and in the right amount. Hence, in an approach primarily known as the Efficient Consumer Response (ECR), the most efficient and reliable technology is required. The use of drones and robots or in other cases cloud computing to conduct businesses is changing the playing field for product delivery. Mobile telephone devices also play essential roles in today's business economics. Portable electronic hardware proof to be a dynamic technological concept which facilitates tracking, tracing, and real-time reports on products information, services availability and event time.

3. Challenges and Gains of New Industrial Technology

The desire to execute industrial operations in a fast, flexible and reliable sequence is profitable and required to align the economic benefits which accrue when work is organized in a reasonably quick and flexible manner. Thereby improving the safety of personals will ameliorate downtime and increase equipment lifetime. The specific outcomes of initiating sustainable factors into supply chain management, also, will breed technological competitiveness among companies that will directly or indirectly create room for more innovation and new opportunities' research & development, and for job creation. SSCM and the integration of new technologies have open doors to new programmes like industry sustainability certification and auditing which may help to stimulate quality, expertise, and to promote the business integrity of a company. Despite the benefits and tremendous potentials of developing technologies, there are also challenges that pose hindrances to their adoption. Flexibility and objective consideration is a disadvantage to implement most of the emerging techniques (Liu et al., 2013). Changing old protocols to adopt new ones and operational scale or sizing, and activity execution time are factors to be considered. The quantity of service and the durability of the technology in question to operate effectively are also a limitation, and again, the assurance of optimum control. For example; the chances that an autonomous control system will reliably run at high speed while handling products or delivering services without necessarily undergoing failure? Lack of information and the deficit in know-how to manage technology and technology transfer on a local and international scale presents another challenge for the use of new techniques in the supply chain management process to achieve its full benefits. In other cases, a chief executive officers or an operating officers may dwell on the uncertainties due to the return on investment, over the high execution cost of embracing a new technology/concept for optimum business operation. The imagination of shorting down the old and commissioning of a new, with no guarantee for the time of adjustment to the unused.

Hence, to achieve SSCM, a clear-cut strategy, and reliable legal framework is required, which requires long-term planning. Despite a mountain of uncertainties and challenges, the gains supersede the odds, as innovation looks beyond pragmatism and evolution in technology will only get better and lead to dynamism.

4. Discussions and Conclusion

The rapidly increasing digital dive to conduct business using artificial intelligence seeks more innovation and require robust decision-model that will facilitate successful implementation. As digitalization progresses, energy-intensive companies; manufacturing and power sectors must metamorphose their supply chain and integrate new ideas that will increase productivity through a re-evaluation of their current operational models and strategies, and also adopt new path in technological assistance. Hence, allow companies to compete favorably in all facet of their business. Successful implementation of innovative technological ideology will create the avenue for an unbroken value chain. Although the scope of this research does not cover applicability of technological advancement in any specific industry that aligns sustainability in their supply chain based on the business type, or sizes of the sector (small, medium, and large scale). The paper establishes that; the need to transcend to a new and advanced method of operations is not contestable in other to meet the current inclination to achieve general growth in businesses through sustainable supply chain management approach. As such, any business passionate about survival in the future must transform with the new paradigm shift; to automate operations processes, implement sustainability standards which call for eco-friendly-materials, designs, service delivery, energy efficient plants, and operations, among other benefits like fast effective and secure delivery of the most convenient methods. Hence, we summarize that the selection of new technology and

its use is an industrial sustainable supply chain should encompass utilization for; (1) Tracking and tracing (2) Automation of production line (3) Materials Management (4) Ergonomic reliance, and (5) Energy Savings.

The remaining part of this article reports the outlook of sustainable supply chain management strategy from three perspectives; planning and control, organizing, and operations processes as shown in Figure 2. The convergence of technology and sustainability implementation practices can lead to optimum coordination between the tiers of the supply chain, reached through the decision making and organizing process from upstream to the downstream (consumer). I.e., operations upgrade through modern technological inclusion is a decision process concern that ensures all the players in all perspectives enjoy equal socioeconomic outcome from the supply chain framework of events planned. It is pertinent therefore that the process of organizing must incorporate the latest, and most useful technique to achieve maximum outcome which supports aggressive marketing to roll-out sustainable business operations (cost-effective, protect against environmental degradation and promotes employee behavior to work more diligently in the pursuit to meet customer satisfaction). Hence, all the factors expected to drive the sustainable supply chain management must be embedded within the organizing process to ensure sustainability and also, to execute specific operations along the supply chain.

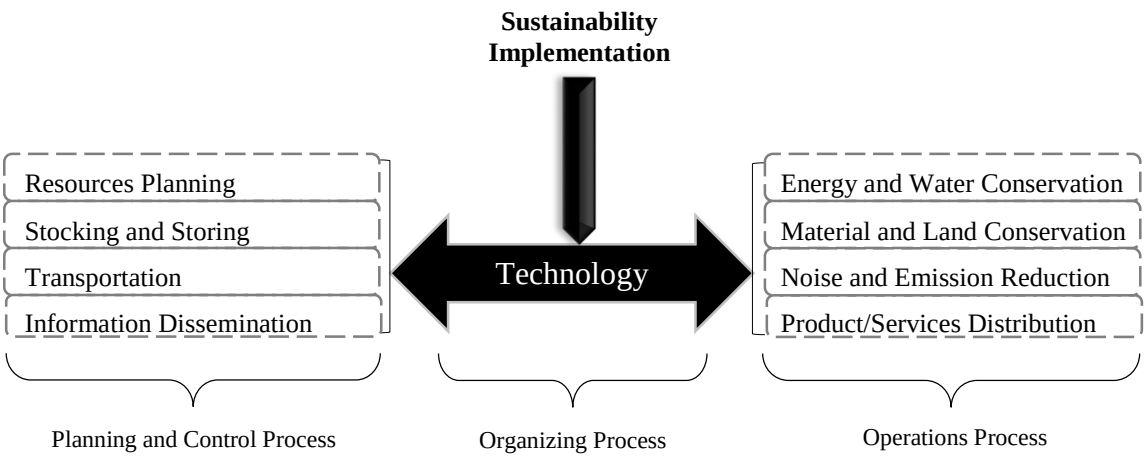

Figure 2. Sustainable Supply Chain Strategic Decision Implement Process

As the role of customers' preferences and awareness to patronize economically friendly, ergonomic and highly sophisticated designs becomes significant, it invariably affect the resolve to settle for sustainable supply chain management. No doubt that as revenue generation flow is toward the entrepreneur, from their prospective consumers. Their capacity to control production becomes a tool which influences the companies' decision to embrace environmental protection perspective, as such, become eco-friendly. More so, customers become more loyal overtime based on business satiation and soon promotes the organizations' statuses in the market matrix. In conclusion, the adoption and proper management of newly developed industrial technology are consequential to time-saving, cost minimization, increased value for the customer, as well, benefit the collective global society.

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Biographies

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