SUPPLY CHAIN 4.0: DIGITAL TRANSFORMATION DISRUPTIONS AND STRATEGIES

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ABSTRACT

Around the world, traditional manufacturing industry is in the throes of a digital transformation that is increased by exponentially growing technologies. Disruptive innovations are presently changing the landscape of many industries and their business models. Supply chains are also affected by industry 4.0. A theoretical framework is employed to evaluate key technologies and concepts with respect to their impact on the supply chain. Networking within IoT, services, data and people will transform the future of manufacturing. This paper explains how manufacturing companies can position themselves in relation to this digital transformation and the opportunities the switch to industry 4.0 offers them.

Keywords: Industry 4.0, Disruptive innovations, Sensible data, Digital transformation, Automation.

INTRODUCTION

The Fourth Industrial Revolution (4.0), is a concept based on IoT (Internet of Things) and CPS (Cyber-Physical Systems). The key idea is the internet connection with relevant equipment such as machines, products, materials, factories, customers and the entire supply chain (QIN; LIU; GROSVENOR, 2016; SCHUMACHER; EROL; SIHN, 2016; LEE, 2015). This connection, are essential because, the main principle of the industry 4.0, is consciousness. Consumers increasingly demand for improved product-service innovation, product variety, quality standards, support services, and immediacy or order satisfaction (QIN; LIU; GROSVENOR, 2016). The industry 4.0 is transforming the value chain network relations. Based on IoT concepts, is emerging a new generation of smart products that is possible follow all life cycle. Smart data, based on big data approach responsible for valuing creation networks, connecting different elements via the cloud and smart logistics applications using CPS for supporting not only the smart factory but also the entire supply chain (STOCK; SELIGER, 2016). The industry 4.0 is an ample concept, which also involves e-supply chain applications to facilitate the flow of the smart products.

DEFINING INDUSTRIAL 4.0

The term "Industry 4.0" was collected based on the structured literature review and enclosed within a conceptual analysis, in which all mentioned technologies and concepts. Industry 4.0 is the sum of all disruptive innovations derived and implemented in a value chain, in the following, the seven characterizing features are reflected and described in detail.

Digitalization: The firms' internal processes, product components, communication channels and all other main aspects of the supply chain are undergoing an accelerated digitalization process (Geisberger and Broy, 2012).

Autonomization: "Industry 4.0" technologies and concepts are allowing machines and algorithms of future companies to make decisions and per- form learning-activities autonomously (Angelov, 2013).

Transparency: Worldly supply chains are characterized by greatly complex structures, the existing "Industry 4.0" technologies are increasing the transparency of the entire value creation process (Wang, Heng and Chau, 2007).

Mobility: The mobility of devices is altering the way customers are relating with companies, and the communication and interaction of machines in the production process (Schweiger, 2011).

Modularization: "Industry 4.0"-technologies are supporting the modularization of products and the entire value creation process (Koren, et al., 1999; Putnik, et al., 2013).

Network-Collaboration: Like human beings in our society are inter- acting in social networks, the firms' processes will be defined and activities will be decided through the interaction of machines and human beings inside specific networks in and out of the company's organizational borders (Bauer, et al., 2014).

Socializing: The association in networks is allowing machines (not only smartphones) to start communicating and interacting with other ma- chines and/ or humans in a socialized manner (Oswald, 2014).

CHALLENGES WITH SUPPLY CHAIN MANAGEMENT

The supply chain management comes with hurdles. The hurdles are customer service, cost control, planning risk management, supplier/partner relationship management. Currently, manufacturers deal with vast quantities of information, both structured and unstructured, which exists in in databases that are not always well connected. To produce business value and meet customer expectations in terms of innovation, personalization and speed to market, it is essential to connect these silos and allow a single, unbroken collection of data that is woven throughout the supply chain.
Supply chain managers have seen increasing challenges to create, and keep, efficient and effective supply chain methods. The five biggest supply chain challenges are:

Customer service - Supply chain management mainly focuses on providing the right product in the right quantity to the right place and the right time. It may look simple but it can take ample amount of time.

Cost control - Operating costs are beneath extreme tension by the increasing energy/fuel and freight costs, bigger number of global customers, technology, rapidly increasing labor rates and new regulations and rising commodity prices.

Planning & risk management – If we want to stay as efficient and effective as possible, periodic assessments and redesigns are essential. These alternations are with regards to changes in the market - changes such as new product launches, global sourcing, credit availability and the need to protect intellectual property. These risks should be recognized and quantified in order to control and mitigate.

Supplier/partner relationship management - It is very crucial to create, understand and follow mutually agreed upon standards to better understand current performance and opportunities for improvement. With two different methods for measuring and communicating performance and results wastes time and effort.

Talent - It is becoming increasingly more challenging to find qualified and interested talent candidates. Supply chain leaders require an elaborate knowledge of the key competencies and duties essential for supply chain management roles and the ability to efficiently source specific skill sets and methods for developing future leaders.

STRATEGIES TO OVERCOME CHALLENGES IN SUPPLY CHAIN MANAGEMENT

The IoT and CPS is a base to Industry 4.0. The IoT crucial ideas are the connection of the devices or sensors and have a vast presence in supply chain context. From a supply chain point of view, it contains RFID, wireless sensor networks, machine to machine systems, mobile apps and many more.
The Industry 4.0, develops the three dimensions of integration, Horizontal integration, vertical integration, life cycle engineering- but the key approach is to horizontal integration. The value creation comprehends a link between value activities with materials flow in a smart factory and the connection with smart logistics (STOCK; SELIGER, 2016). The smart logistics will operate autonomously between the start point and the destination, and has to be sufficiently intelligent to react to unforeseen events, such as traffic congestions and weather conditions. These activities are allowed by cloud infrastructure, which includes the activities and the flow of the smart products. These smart products are embedded with sensors and storage all information and knowledge to transverse the supply chain to customers and feedbacks to the smart factory. The smart supply chain can be properly defined as a business system integrated which extends applications to supply chain by systematic smart implementations, including, but not limited to IoT, intelligent infrastructure, smart products, smart machines, and interconnectivity that provides real-time communications in all supply chain stage with intelligent and responsive process. In order to achieve better

results, the smart supply chain needs a lot of information and communication technology (ICT), (including not limited to) cloud environment and supply chain software (MUKHTAR et al., 2009). The smart supply chain has a high of smarts objects, customers and suppliers interconnected in an intelligent manner, capable of learning and operate autonomously in various cases. The smart supply chain environment evolves autonomously transport provided by automated guided vehicles (AGVs), RFID, QR codes, sensors, conveyers etc.

Awareness: Numerous manufacturers are still uninformed of the possibilities that Industry 4.0 technologies can offer for the betterment of c companies.

People: Presenting new business models, business processes, and connected products and services will transform the way employees perform everyday tasks. To deploy Industry 4.0 solutions, companies require new people and skills. Jobs like those of industrial workers will modify or might even become redundant. Warehouse workers, for example, are likely to be replaced by autonomous robots. New roles, such as "robot coordinator" and "data scientist", have been formed, while routine and physically demanding jobs will disappear. In this scenario, where resistance to change is the main barrier, people will need to be motivated and trained to deliver new products, services and business processes.

Cybersecurity: With digital factories and a digitally-connected value chain, traditional IT security is not enough to protect the business. To oversee this reality is to compromise the stability and security of the company. As companies innovate, the "attack surface area" or the enterprise area that is vulnerable, gets bigger. This can also help manufacturing organizations differentiate themselves from the competition.

Investments: To apply Industry 4.0 solutions, significant investments are essential to create a robust and secure network infrastructure and promote or exchange legacy systems. To validate these investments, benefits have to be unequivocally and reliably quantified.

Collaboration: Presently, no vendor can produce all the skills required to implement Industry 4.0 solutions, as they are based on various technologies and devices that run on multiple networks. The delivery of Industry 4.0 solutions will be facilitated by an ecosystem of IT vendors, OT vendors, system integrators and emerging IoT startups. The critical success factor is close collaboration between the business, IT and OT.

Standardization: Existing manufacturing standards are insufficient to completely aid Industry 4.0 and new technical, architectural and business standards are essential. With increasing number of devices and systems that use proprietary communication protocols enter the market, data silos are formed, creating a complex network of connections between isolated data sources. Though various standardization bodies and industry consortia have published reference architectures and standards, there are no universal standards. This makes it tough for organizations to eliminate data silos.

IT modernization: Currently, industrial automation system deployments are a group of proprietary technologies and networks. In near future, we will need to connect business planning and logistics solutions, manufacturing operations management solutions and industrial control systems, such as supervisory control and data acquisition (SCADA), distributed control system (DCS), programmable logic controller (PLC) and human-machine interface (HMI). Processes will not be controlled by a standard programmable logic controller (PLC) anymore, still by a service-oriented, decentralized control system consisting of distributed microcontrollers that communicate using Internet standards.
The e-supply chain has transformed the traditional supply chain models (SAMMON; HANLEY, 2007). The internet provides real-time information's for the value chain network (LANCASTER; YEN; KU, 2006). Because of this, in a smart context, there are necessities of large applications in cloud and big data for smart products to flow efficiently. Several technologies as electronic data interchange (EDI), value-added network (VAN), virtual private networks (VPN), extensible markup language (XML) has been utilized to e-supply chains approach

CONCLUSION

Industry 4.0 will transform the entire manufacturing system, from the architecture and organizational structure to products, services and business models. The development and deployment of these solutions will be incremental and part of a long-term trend, but the opportunity is already here today. Firms that fail to educate themselves on these new technologies and invest in pilot projects will lose their competitive advantage and miss the opportunity to lead the

transformation that is presently sweeping across the manufacturing industry. We first stated a definition for the term "Industry 4.0" based on the characteristic features digitalization, Autonomization, network-collaboration, socializing, modularization, transparency and mobility. A structured literature review about industry 4.0 and then the smart approach, including smart supply chain, smart logistics, smart products, smart factory and E-supply chain.

REFERENCES

Bauernhansl, T., Ten Hompel, M. and Vogel-Heuser, B. (2014). Industrie 4.0 in Produktion, Automatisierung und Logistik, Wiesbaden, *Springer*.

Herman, M., Pentek T., Otto, B.,(2015). Design Principles for Industrie 4.0 Scenarios: A Literature Review, Technische Universität Dortmund, Audi Stiftungslehrstuhl Supply Net Order Management.

Kawa, A.(2012). Smart Logistics Chain. Intelligent Information and Database Systems. In: Pan, J.-S., Chen S.-M., Nguyen, N.T., 2012, ACIIDS 2012, Berlin, *Springer.*

Klinck, J.(2014). Turning Big Data into Smart Data, *Institutional Investor.*

Leavitt, H.J.(1965). Applied Organizational Change in Industry: Structural, Technological, and Humanistic Approaches, In: March, J.G., 1965, *Handbook of Organization*.

Lee, H.L., Padmanabhan, V. and Whang, S.(2004). Comments on "Information Distortion in a Supply Chain: The Bullwhip Effect, *Management Science*.

Zheng, Z.E., Fader, P. And Padmanabhan, B.(2012). From Business Intelligence to Competitive Intelligence: Inferring Competitive Measures Using Augmented Site-Centric Data, *Information Systems Research*.