

Industry 4.0 and Supply Chain Performance in the Oil and Gas Industry

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Abstract

The purpose of this study is to investigate industry 4.0 and supply chain performance. Extant literature was reviewed. Secondary data such as E-books, journal articles projects were used. Exploratory research design was used for the study. Based on the review literature, it was revealed that, integrated supply chain performance measurement system (SCPMS) is paramount for an efficient supply chain management (SCM) at inter-organizational and beyond-the-boundary processes. The recent technological innovations (internet of things (IoTs), big data, and web-based communication systems) revamp the SCPMS through effective data collection, information sharing, and framework integration among the different SC partners across nations. The study recommend for further research on the obstacles facing industry 4.0 and supply chain performance in the oil and gas industries across nations.

Keywords: Industry 4.0 Supply Chain Performance oil and Gas Industries.

Introduction

In the quest for achieving long-term performance goals, industry 4.0 emphasizes the implementation of smart, intelligent, and integrated supply chain management in organizations. Integrated supply chain management is an application of internet of things (IoTs), big data, and artificial intelligence (AI) – helps firms to focus primarily on improving their core competencies while effectively using external agencies for other capabilities and resources, including human resource management, finance and accounting management, logistics, inventory management, supplier-customer relationship management, demand forecasting and information management, etc. (DeVass, & Miah' 2018). (Yin & Qin, 2016). Conventional Supply chain management is a systematic management of coordinated business functions between firms and their SC partners (Molamohamadiet, Ismail, Leman & Zulkifli, 2013). As organizational performance in industry 4.0 increasingly depends on the extended supply chain partnership, management's control at both the firm and the SC levels becomes paramount. While the conventional performance management system (PMS) is limited to one single organization (Doliński & Kolinski, 2011), the integrated supply chain performance measurement system (SCPMS) enables companies to adopt a set of performance metrics that extend to the various processes performed in different firms (Kisomi, Solimanpur & Doniavi, 2016; Zhu, Krikke, Marjolein & Caniel, 2016). The SCPMS improves Supply Chain effectiveness through designing more strategic, responsive, and timely courses of actions. Although the SCPMS is advantageous, it is challenging in terms of consistency in data sharing and integration at both the inter-firm and partnered organizational levels. Improving the efficacy of integrated supply chain management in these areas concerning industry 4.0 is the focus of the current research. Recently, a growing trend in the use of SCPMS has been noted in the literature based on case studies from developed countries. However, the scope is mainly limited to partial SCPMS implementation in one functional area, such as vendor evaluation, inter-firm operations assessment, or buyer-supplier relationship management, very little research is found

concerning the issues faced by developing countries during SCPMS implementation. The present study aspires to methodically define and evaluate literature industry 4.0 the maturity of SCPMS as a discipline in different industrial sectors within selected countries. It then highlights the recent advancements in literature for Africa, as a representation of the developing world. Finally, the study identifies potential gaps in literature to provide a motive for future research.

Literature Review

Literature on integrated SCPMS regarding industry 4.0 reveals that the topic is of great interest to both scholars and practitioners. The important results of the study are the identification of three main dimensions of integrated SCPMS discipline aligned with industry 4.0 and are discussed in the subsequent sections. Integrated SCPMS, Various Techniques/Approaches, and Performance Metrics Development Integrated SCPMS and Techniques Considering the integrated SCPMS where performance measurement process involves inter-firm and beyond-the-boundary levels, literature provides various framework techniques of approaches to design SCPMS such balance score card system, categorical system, weighted point technique, analytic hierarchy process (AHP), Delphi survey approach, and fuzzy logic technique. From reviewed literature, it is revealed that integrated SCPMS is a multidimensional approach, developed by a focal organization and shared to all supply chain partners (Alfalla, Luque, Medina, Lopez & Dey, 2012), Kisomi *et al.*, (2016), Zhu *et al.*, (2016), Abdel Basset, Manogaran & Mohamed, 2019), various components of an integrated SCPMS. It is implemented through a common web-based tool designed by any third party IT firm, which provides flexibility to a focal organization for many-to-many interactions. A set of metrics is shared among all to quantify the efficiency of inter-organization and beyond-the-boundary processes. These metrics can be designed using various techniques such as balance score card system As SCPMS consists of multiple components, it provides a broader avenue for future research. Performance Metrics Successful adoption of SCPMS depends on designing the standard metrics and sharing them among all SC players.

Doliński and Koliński (2011) defined nine criteria using the balanced scorecard technique (price, quality of raw material, punctuality of deliveries, terms of payments, discounts, terms of complains and returns, approach to client's demands, transport, and packaging) for the evaluation of suppliers. Parkash and Veerender (2011) developed a list of metrics (on-time delivery, rate of acceptance of goods, competitive pricing, and proper responsiveness) based on weighted point balanced scorecard method for the assessment of sports goods supplier's performance (Cho, Lee, Ahn & Hwang, 2012) presented a method to design performance attributes using AHP for the hotel industry supply chain. Dey and Cheffi (2013) proposed a performance management system to measure the efficiency of green SC using the AHP technique.

Khan, Bakkappa, Metri and Sahay (2018) applied an integrated SCPMS model designed by Fuzzy-Shannon Entropy and Fuzzy-Inference System in manufacturing organization to prioritize the suppliers based on sustainable dimensions perspective .integrated SCPMS and Technology Information System Literature reveals that an efficient Supply Chain Performance Management System (SCPMS) design is not adequate to guarantee a successful adoption of the system (Maestrini, Maccarrone, Caniato & Luzzini, 2018). Failure during its implementation can occur due to the unavailability of an effective information system that comprises several attributes, such as sensitive information, data standardization, and data reliability. Inefficient information systems impede trust, communication, and collaboration among the SC partners. Innovations in information technology (IT), an essential component of supply chain management (SCM), have decreased its cost and enabled standardized communication (BenDaya, Maccarrone, Caniato & Luzzini, 2017).

Internet-of-Things (IoTs) Several researchers have discussed the benefits of the internet of things (IoTs) for SCPMS implementation in various industrial sectors. For example, Accorsi (Bortolini, Baruffaldi, Pilati & Ferrari, 2017) discussed the goals and strategies for designing and building an IoTs architecture to aid in the planning, management, and control of food supply chain (FSC) operations. Abdel Basset *et al.*, (2019) applied IoTs in supply chain management through building a smart and secure system of SCM which integrates the neutrosophic decision making trial and evaluation laboratory (N-DEMATEL) technique with analytic hierarchy process (AHP) to infer cause and effect interrelationships among criteria of smart supply

chain security requirements. Addo Tenkorang and Helo (2016) thoroughly investigated and analyzed big data and IoTs application in SCPM.

Manavalan and Jayakirishna (2018) discussed sustainable SCPMS in manufacturing companies through the use of IoTs for industry 4.0 transformation. Li, Zheng & Zhuang (2017) explained the conceptual distinctions between formal and informal IT-enabled interactions and their roles in supplier-buyer cooperation. Wu et al, (2016) explained the concepts of an e-supply chain, IoTs, smart factory, and industrial Internet for larger and complicated business systems to become part of the global supply chain network. Finally, Abbasi and Afzal (2011) examined benefits of the e-sourcing achieved for four key business strategies, supply chain management, total quality management, time-based purchasing, and organizational integration for the automotive industry.

Concept of Industry 4.0

The fourth industrial revolution is based on the concept of smart factory. Smart factories have completely new approach to production, as Smart products can always be identified and located. The history, current state and future activities that are necessary to get the final look are known anytime. Well prepared database is very important because it is necessary to filter the required reports in order to receive timely and useful information. Advantages of the virtual world are used because virtual world provides the simulation of different cases. Optimization of products, processes and the entire supply chain are continuously improved. In order to successfully close the circuit, trusted-cloud based networks (Cloud technology). Cloud technology provides “smart” data centres, services and applications so users (companies) can achieve lower costs and operational efficiency. The new approach allows production according to the individual customer requirements. Today many companies have moved away from mass production to mass customization production. The main goal is to have a production system that can resist any dynamic business processes. Such system must be characterized by flexibility, so it can respond to disruptions of various origins in the oil and gas industry.

Concept of Supply Chain Performance

For almost two decades, considerable attention has been paid to the concept of supply chain agility (SCA) as a driver of success and a sign of competitive advantage of a firm (Gligor, Holcomb & Stank, 2013; Ismail & Sharifi, 2006). SCA is considered to be one of the fundamental characteristics of successful supply chains in today’s turbulent and increasingly competitive environment (Agarwal, Shankar, Tiwari & IShboul, 2017; Aslam, Blome, Roscoe & Azhar, 2018; Braunscheidel & Suresh, 2009), especially in global markets (Lee, 2004), because firms with agile supply chains (ASCs) can react and respond more competitively to unforeseen changes in the business environment due to their ability to synchronize the supply with the demand better than their competitors (Dubey, Altay, Gunasekaran, Blome, Papadopoulos, & Childe 2018; wafford, Ghosh,& Murthy, 2008).Despite its popularity, the concept of SCA seems to be vaguely defined and loosely structured (Gligor *et al*, 2013; Li *et al*, 2008).

Some authors have defined it in operational terms(Brusset, 2016; Yang, 2014), some as a management philosophy (Li *et al*, 2006; VanHoek *et al*, 2001; Calatayud, Mangan & Christopher, 2019) and others in terms of strategy (Bal *et al*, 1999 Fayezi, Zutshi & Loughlin, 2016). Moreover, the specific concept of SCA has emerged in the literature as result of drawing on the various perspectives of “agility” that have been developed within the various disciplines to which the broad concept of agility is relevant. In fact, some researchers have commented on the multidisciplinary nature of SCA (Braunscheidel and Suresh, 2009; Gligor *et al*, 2013; Li *et al*, 2008; Swafford *et al*, 2006; Russell and Swanson, 2019). This disparate nature of the SCA literature, spread across many fields and the broad notion of what the concept means have led some scholars to echo the problem of determining what exactly constitutes SCA (Gligor *et al*, 2013; Li *et al*, 2008).

Consequently, theory development in the field of SCA has suffered from an ill-defined paradigm in which neither the definition nor the enablers or the outcomes of the construct are clear or agreed upon among scholars and practitioners. If the field of SCA is to continue to grow and advance theoretically, the time is ripe to address these issues. The purpose of this study is threefold. First, it aims to compare and contrast the

existing definitions to develop a complete and encompassing one, suitable for advancing the theory and practice in this field. Second, the research intends to extract and analyze the enablers of SCA to gain consolidated insights into what makes supply chains agile. Third, it aims to explore the performance implications of SCA to understand the scope of the benefits accruing to firms that pursue SCA. To this end, a systematic review of 56 studies from 17 journals will be performed following the procedures outlined by (Moher, Liberati, Tetzlaff & Altman, 2009) (Tranfield, Denyer & Smart, 2003). This review is believed to be prominent because SCA is a developing field of research that has resulted in several different conceptualizations and has led to mixed research outcomes. As such, by tracking its progress across various disciplines, a consensus regarding SCA's main themes is expected to be reached that can lead to a better formulation of a state-of-the-art conceptual framework. Although few literature reviews were found in this domain, this study is different in many ways. While the previous review developed an SCA definition based on facets of previously addressed definitions, this study will cultivate a definition based on four major themes shared by previously highly cited definitions. The study will end by synthesizing the performance implications of SCA by addressing when and why SCA matters. What makes this study unique is the projection of all the shortcomings of the current literature, leading it to address all the possible avenues to advance the field. Due to the constant changes that a field of research exhibits, investigating the corpus of a body of research frequently remains essential. Another review performed by Fayezi, Zutshi & Loughlin (2016) tackled the evolution and development of SCA by deciphering the ambiguity surrounded agility and flexibility in the supply chain. Although these studies have addressed different yet limited aspects of the SCA field, there is still a lack of scholarly research identifying the factors necessary to achieve SCA and its performance effects (Eckstein Goellner, Blome & Henke 2015; Sangari & Razmi, 2015). Additionally, the focus of the previous studies is limited to a few directions, making the contribution of this paper uniquely comprehensive. This study complements the previous reviews and broadens their scope by combing the SCA literature from different angles.

Conclusion And Recommendation

The present literature review is focused on two main objectives, Industry 4.0 and supply chain performance (SCP) by the oil and gas industries in developed countries supply chain performance (SCP) advancements in developing countries, with a specific focus on identifying the research gap for the industrial sector of Africa. The study is accomplished through a systematic review that is limited to the concepts in the review first defines the components of (SCP) by using different techniques/approaches. It then highlights the critical role of technology for the successful adoption and implementation of (SCP) in various industries. Finally, by listing constraints faced by oil and gas industries, it provides guidelines for the integration of (SCP) into existing systems. Future work will aim to collect data and information to compare current practices being followed, if any, by government sector organizations in Africa to standard SCP practice.

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