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Sustainability impact of digitization in logistics

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Abstract

Today, most enterprises are undergoing a digitization process with the fourth industrial revolution, named industry 4.0. The focus of the digital transformation lies mainly on production, therefore the terms such as "Factory of the Future" or "Smart Factory" are used similar with this concept. However, there are many reasons for considering the impact of digitalization in logistics and the importance of supply chain for industry 4.0. The key promises of this concept are enabling real-time full-transparency from suppliers to customers, small lot sizes, multiple product variants, connected processes and decentralized, autonomous management. These benefits cannot be achieved by production alone, but only along the entire supply chain. Moreover, logistics should gain a greater vision to fulfill the requirements of industry 4.0 as sustainably as possible in terms of using appropriate technologies and enhancing vertical and horizontal integration among the supply chain partners. In this respect, this study highlights the benefits of the digitization of logistics process and examines the sustainability impact of digitization in logistics. The study is pursued as a single case study within the FMCG companies and their transport service providers in Turkey and it is based on a qualitative method and on connected semi-structured interviews.

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Keywords: Sustainability impact; Digitization; Logistics, Industry 4.0., Digital logistics ecosystem

1. Introduction

The accelerated pace in digitization process with "Industry 4.0 (the fourth industrial revolution)" has transformed the business content and contributed an increasingly dynamic environment and market structure. During this digitization process, manufacturing processes have experienced rapid and escalating development, existing processes

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and practices have improved, new technologies have introduced and the size and scale of industrial production have expanded enormously [20]. The core idea of Industry 4.0 is to use the emerging information technologies to implement Internet of Things (IoT) and services so that business process and engineering process are deeply integrated making production operate in a flexible, efficient, and green way with constantly high quality and low cost [17]. However, digital transformation lies mainly on production with respect to achieving the desired objectives towards "Smart Factory" such as real-time full-transparency from suppliers to customers, small lot sizes, multiple product variants, connected processes and decentralized, autonomous management. It is impossible to realize a smart factory unless the relevant logistics processes are also "smart" [16]. Digitization is an important instrument in realizing a reliable and sustainable future transport system and supply of goods [15]. Logistics gains a greater vision in terms of mass adoption of smart and connected digital technologies and applications (e.g. mobile, cloud, sensors, data analytics, machine learning, blockchain, IoT) and enhancing vertical and horizontal integration among the supply chain partners. This is likely to result in radical shift in ways of business thinking and implementation in logistics that has created a need for a new business paradigm toward a connected, smart, highly efficient and sustainable digital logistics ecosystem that is fully transparent to all the players involved - from the suppliers of raw materials, components, and parts, to the transporters of those supplies and finished goods, and finally to the customers demanding fulfillment [14]. However, the industry transformation of matter, energy and labor into goods, services, waste and ambient emissions, has generated high levels of economic wealth, simultaneously it results in increasing human interference with the biosphere, industrial activity produces about 22% in total final energy consumption, and about 20% in global CO2 emissions [18]. The ambition with the digitization of industrial sector should therefore be considered to transformative change towards more sustainable, resilient and just societies, as defined by the World Commission on Environment and Development [19]. Digital alone has the immense opportunity to reduce emissions from logistics by as much as 10 to 12% by 2025 [9] and to help decarbonize the global economy. Hence, the aim of the sustainable digital logistics ecosystem is to rethink digitally-based business models and redesign the way of business processes along the supply chain to sustainable development and to balance the sustainability in terms of economic, social and environmental dimensions and reflect the interconnections between them [7] [8] [9].

This paper aims to examine the sustainability impact of digitization in logistics and also find out what are the digitization characters and associated technologies in logistics network, how the adoption of digitization changed the logistics processes and which benefits have been obtained through digitization. The study is based on a case study qualitative research approach incorporating Delphi panel carried out in four fast-moving consumer goods (FMCG) companies and two transport service providers conducted in Turkey.

2. Digitization in logistics

Digitization or digitalization means basically capturing an analog signal and converting it into digital form for the purpose of generating a digital representation that can be electronically stored or processed [1]. Digitization makes information and communication available anywhere, anytime, within any context, and for any user using any device and type of access. With the increasing use of computer technology, a greater proportion of recorded information has become digital, as in 1993, only 3% of the world's recorded information was stored digitally, this figure had reached to 94% by 2007 [6]. The better information and transactions are captured and processed, the more systems get equipped with certain degree of intelligence, and the more these systems communicate with each other through interconnections, the higher is the level of digitization of a network e.g. an entire supply chain or a single logistics process. The digitization disrupts logistics processes partly or completely [8] but could also create intrinsic value for the industry and wider society. Building logistics network with digital technologies would offer a new degree of resiliency and responsiveness enabling companies to escalate the competition in effort to provide customers with the most efficient and transparent service delivery [14], as using analytic technology (e.g. hyperconnectivity, supercomputing, Big Data) obtains large-scale logistics data and applying complex algorithms into this data helps companies where they can save money, increase margins and operate more cost-effectively and environmentally friendly. According to white paper from the World Economic Forum indicates that digitization in logistics could provide $1.5 trillion in value through the year 2025 [9]. The digital logistics ecosystem is based on four key enablers: technology, process, organization and knowledge [6]. Integrating technology and applications with good knowledge management across organizations and