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Industry 4.0: A Korea perspective

Tae Kyung Sung

Department of MIS, Kyonggi University, Republic of Korea

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ABSTRACT

The objectives of this paper are (1) to have a detailed, practical discussion of Industry 4.0, and (2) to suggest policy implications to transition toward Industry 4.0 in Korea. Companies should consider Industry 4.0 very seriously as they develop their future initiatives since traditional manufacturing business models do not fit with the emerging technologies of Industry 4.0. Some issues should be addressed with care: IT security, reliability and stability needed for critical machine-to-machine communication; a need to maintain the integrity of production processes, avoid IT snags, and protect industrial knowhow; and the lack of adequate skill-sets, general reluctance to change by stakeholders, and loss of many jobs to automatic processes and IT-controlled processes. To successfully transform Korean industry toward Industry 4.0, it is necessary to (1) refine and elaborate the strategies enacted by the central government to build economic and social systems that can flexibly respond to changes, (2) establish some kind of operational system to maximize the effectiveness of initiatives and policies, (3) develop concrete and workable action plans to transition toward economic and social systems that can accommodate innovative changes, and (4) establish infrastructure to lead all initiatives.

1. Introduction

'Industry 4.0' was first coined at the Hannover Fair in 2011, and the term has drawn great attention from academics, practitioners, governmental officials, and politicians all over the world. Kagermann et al. (2013) considers Industry 4.0 as the current trend toward automation and data exchange in manufacturing technologies. It includes cyber-physical systems, the Internet of Things, and cloud computing. Industry 4.0 creates what has been referred to as a "smart factory". Within modular, structured smart factories, cyber-physical systems monitor physical processes, create a virtual copy of the physical world, and make decentralized decisions. The Internet of Things refers to cyber-physical systems that communicate and cooperate with each other and with humans in real time via internet services, through which both internal and cross-organizational services are offered and used by participants throughout the value chain (Hermann et al., 2016).

In many countries, including Korea, the fourth industrial revolution is a more widely used term than Industry 4.0 because the term "the fourth industrial revolution" is more appealing and familiar than Industry 4.0. Schwab (2016) argues that we are at the beginning of the fourth industrial revolution that builds on the digital revolution with much more ubiquitous and mobile internet, smaller and more powerful sensors that become cheaper and affordable, and artificial intelligence and machine learning.

These concepts regarding the fourth industrial revolution and Industry 4.0 are similar, so can we use the two terms interchangeably? In this research, Industry 4.0 will be used as the representative term to explore whether there are differences in the two terms. The next section will describe the origin, concept, design, characteristics, and challenges of Industry 4.0, and then the effects and impact of Industry 4.0 will follow. The final section will discuss policy implications and related issues.

2. Industry 4.0

2.1. Definition and concept

The term "Industry 4.0" originated from a project initiated by high-tech strategy of the German government to promote the computerization of manufacturing. Industry 4.0 is considered as the next phase in the digitization of the manufacturing sector, and it is driven by four disruptions: the astonishing rise in data, computational power, and connectivity, especially new low-power wide-area networks; the emergence of analytics and business-intelligence capabilities; new forms of human-machine interaction such as touch interfaces and augmented-reality systems; and improvements in transferring digital instructions to the physical world, such as with advanced robotics and 3-D printing (Lee et al., 2013). These four trends are not the reason for the "4.0," however. Rather, this is the fourth major upheaval in modern manufacturing, following the lean revolution of the 1970s, the outsourcing phenomenon of the 1990s, and the automation that took off in the 2000s (Baur and Wee, 2015).

E-mail address: tksung@kyonggi.ac.kr.

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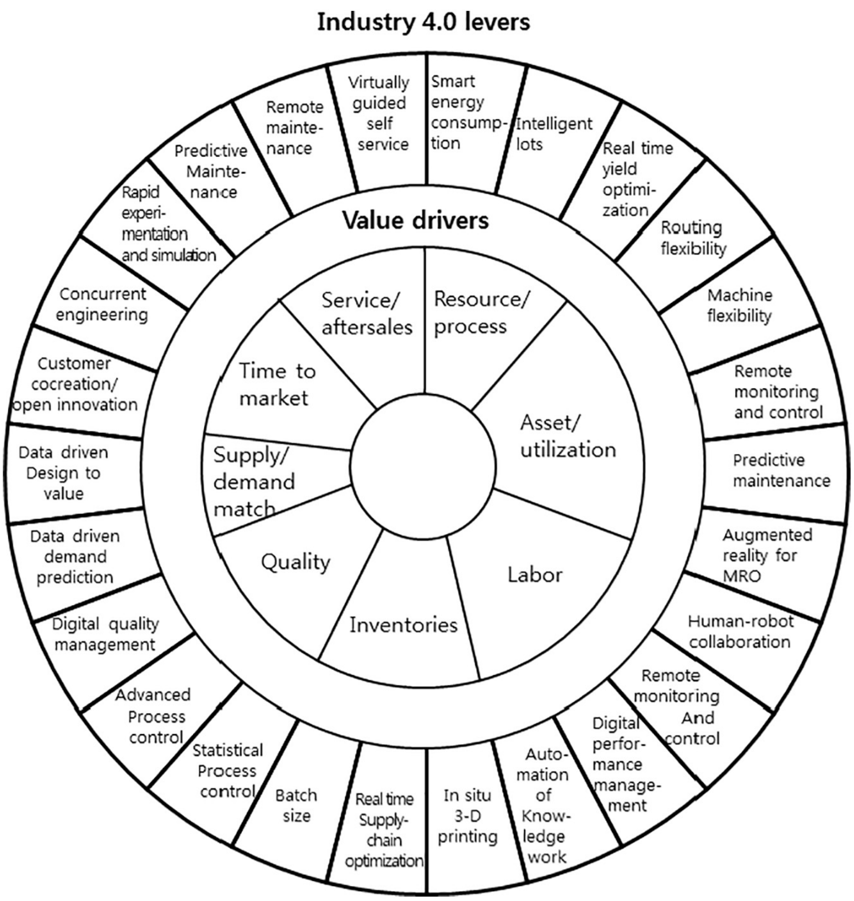

Fig. 1. Digital compass.
Source: Baur and Wee (2015).

Most of the digital technologies mentioned above have been developed for years, and while some technologies are not yet ready for use at scale, many are now at a point where availability, reliability, and cost are attractive enough for some industrial applications. According to a survey by McKinsey, companies are not consistently aware of these emerging technologies. McKinsey surveyed 300 manufacturing leaders in January 2015, and only 48% of manufacturers consider themselves ready for Industry 4.0. Seventy-eight percent of suppliers answered that they are prepared (Baur and Wee, 2015).

According to Kagermann et al. (2013), Industry 4.0 takes manufacturing automation to a new level by introducing customized and flexible mass production technologies. This means that machines will operate independently or will coordinate with humans to produce customer-oriented manufacturing that constantly works to maintain itself. Rather, the machine becomes an independent entity that can collect data, analyze it, and give advice upon it. This becomes possible by introducing self-optimization, self-cognition, and self-customization into industry, and manufacturers will be able to communicate with computers rather than just operate machines.

A smart factory, a key feature of Industry 4.0, adopts a so-called calm-system that deals with both the physical world and the virtual world. Such systems are referred to as “background systems” that operate behind the scenes. A calm system is aware of the surrounding environment and the objects around it (Hermann et al., 2016).

2.2. Industry 4.0 vs. the fourth industrial revolution

Progress in digital technologies in combination with other key enabling technologies is changing the way we design, produce, commercialize and generate value from products and related services. Advances in technologies such as the Internet of Things (IoT), 5G, cloud computing, data analytics and robotics are transforming products, processes and business models in all sectors ultimately creating new industrial patterns as global value chains shift (EC, 2016).

In general, Industry 4.0 has been compared to and used interchangeably with the fourth industrial revolution. However, the latter refers to a systemic transformation that includes an impact on civil society, governance structures, and human identity in addition to solely economic and manufacturing ramifications. The first industrial revolution achieved the mechanization of production using water and steam power; the second industrial revolution then introduced mass production with the help of electric power, followed by the digital revolution to use electronics and IT to further automate production (Schwab, 2016). The term “fourth industrial revolution” has been applied to significant technological developments over the years, and its meaning is up for academic debate. Industry 4.0, on the other hand, specifically focuses on manufacturing in the current context, and it is thus separate from the fourth industrial revolution in terms of scope (Hermann et al., 2016).

2.3. Value drivers

To fully exploit the potential of Industry 4.0 and deliver value to companies, manufacturers should consider the importance and role of information. Companies can gather more useful information and make better use of it (Baur and Wee, 2015). For example, an oil-exploration company collected over 30,000 pieces of data from each of its drilling rigs – yet most of data was lost due to problems of data transmission, storage, and architecture. The small portion of data the company captured was incredibly useful to create efficient internal operations.

In order to provide useful insight for factory management and gain correct content, data has to be processed using advanced tools (analytics and algorithms) that can generate meaningful information. Considering the presence of visible and invisible issues in an industrial