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INDUSTRY 4.0: LESSON FROM MULTINATIONAL COMPANIES TO MANUFACTURING SMEs IN MALAYSIA

Peter Yacob^a, Gengeshwari Krishnapillai^b, Kwok See Ying^c, Khor Saw Chin^d

^aFaculty of Business and Finance, Universiti Tunku Abdul Rahman, Malaysia,
Email: petery@utar.edu.my

^bFaculty of Business and Finance, Universiti Tunku Abdul Rahman, Malaysia,
Email: gengeshwarik@utar.edu.my

^cFaculty of Business and Finance, Universiti Tunku Abdul Rahman, Malaysia,
Email: kwoksy@utar.edu.my

^dFaculty of Business and Finance, Universiti Tunku Abdul Rahman, Malaysia,
Email: sckhor@utar.edu.my

Abstract

The manufacturing industry has to withstand an increasing global competition on product quality and production costs. Established manufacturing companies have recognized that customers are not willing to pay large price premiums for incremental quality improvements. As a consequence, many manufacturing companies adjust their production focusing on customized products and fast time to market. In order to cope with this challenge, industrial value creation must be geared towards sustainability. Currently, the industrial value creation in the early industrialized countries is shaped by the development towards the fourth stage of industrialization, the so-called Industry 4.0. This development provides immense opportunities for the realization of sustainable manufacturing. The aim of this study is to investigate the recent development and practice of Industry 4.0 in MNCs and provide empirical information on the potentials of implementing Industry 4.0 in SMEs. The present research will be conducted in twofold via sequential exploratory mixed method approach. The first (qualitative) phase will be examining MNCs in Malaysia who have successfully implemented the Industry 4.0. Upon understanding their experiences in implementing Industry 4.0, a research instrument will be developed which will be utilized in the second (quantitative) phase of the study. SME manufacturers will be investigated on their awareness and adoption issues pertaining to the Industry 4.0. The findings of this study expected to provide new directions and new practical insights in Industry 4.0 revolution practices in manufacturing SMEs in Malaysia. Policy makers will be facilitated in appropriately outlining the measures to plan, schedule and implement (1) drivers for the next horizon of operational effectiveness, (2) adapt new business models to capture shifting value pools, and (3) build the foundation for digital transformation.

Keywords: Industry 4.0, Small Medium Enterprise, Multinational Companies, Cyber Physical System, Smart Factory

INTRODUCTION

Small and medium-sized enterprises (SMEs) are the backbone of most economies. However, SMEs have to adapt permanently both in products and production, in order to stay competitive. The constant trends of miniaturization and the decline of prices for sensors, information and communication technologies as well as the trend towards servitization enable approaches related to the vision of Industry 4.0 and Smart Factories. These approaches can help to address these challenges, but the digitization of products and services and the transformation of production will change manufacturing radically. On a technical level, competences in mechanical, electronic and software engineering, in automation technology as well as in ICT are required to develop Cyber Physical Systems (CPS). In parallel, on the business and organizational level challenges are the development of new business models and employee training, that are especially demanding for SMEs (Jäger et al., 2016). SMEs need tailored information and implementation solutions that fit to their size and needs.

In order to canalize and support this transformation, the initiative platform Industry 4.0 has been founded in Germany, driven by German industrial associations, labor unions, politics and research. Within the platform Industry 4.0 a broad range of use cases, implementation examples and funded projects have been collected, providing a basis for various applications. However, the success of these approaches will depend on whether or not SMEs will adopt and implement them. Nevertheless, the barriers for adopting Industry 4.0 approaches and technologies are still high. For SMEs it is difficult to find the suitable research partner and acquire the required administrative knowledge to apply for funding from public research programs compared to Multinational Companies (MNCs) (Bischoff et al., 2015). Therefore, new approaches, methods and tools are required to connect SMEs and MNCs, in order to support SMEs in the development and of new products and services with elements in the physical and digital world along with new business models enabled by these technologies.

LITERATURE REVIEW

Global competition in the manufacturing engineering sector is more and more increasing. In addition, the United States and subsequently the German Industry have recognized the trend to deploy the Internet of Things (IoT) and services in manufacturing industry through Embedded System (ES). The United States are taking measures to combat deindustrialization through programs to promote advanced manufacturing. In Germany and Austria the term Industry 4.0 is nowadays almost used at Industry-related fairs, conferences and many calls for public founded projects (Schuster et al., 2016). The frequently cited fourth industrial revolution seems within reach. The major idea of Industry 4.0 is the introduction of internet technologies into industry. Currently, industrial production is facing serious challenges, because information and communication technologies, e.g. IoT, CPS and ES are entering the factory (Hermann et al., 2016; Liebert, 2016).

Industry 4.0 is an umbrella term, a vision that shows where the journey in industrial production is going. Many companies are already unconsciously on this trip by using individual components of Industry 4.0 concepts today. Industrialization began at the end of the 18th century with the introduction of mechanical production equipment, such as the mechanical loom for goods manufacturing. This first industrial revolution was followed by a second one at the end of the 19th century with the advent of electrically powered machinery used for mass production based on the division of work. The third industrial revolution then started in the early 1970s. It was based on the use of electronics and information technologies to automate production processes. In conjunction with constant miniaturization and the unstoppable advance of the Internet, ubiquitous computing has become reality. Microcomputers (embedded systems) are increasingly connected with each other and with the internet. This results in the convergence of the physical world and the virtual world to so-called cyber-physical systems, the enabler of the fourth industrial revolution (Breunig et al., 2016).

Two fundamental approaches are cited to enable Industry 4.0 in future: CPS are integrations of computation and physical processes (Kagermann et al., 2011). Embedded computers and networks monitor and control the physical processes, usually with feedback loops where physical processes affect computations and vice versa. CPS represents the further evolutionary stage from existing embedded systems and builds the basis of an internet of things, which combines with the internet of services to make Industry 4.0 possible. The internet of things, the next generation of the internet is a global system of IP-connected computer networks, sensors, actuators, machines, and devices. Merging this physical world with the virtual world of the internet and software enables companies and consumers to create and enjoy new services that are founded on web based business models. This will have a big impact on the way we do business (Kagermann et al., 2013; Boer, 2016).

A core element of Industry 4.0 is therefore the smart factory which supports the fast-growing complexity and efficiency in production (Schweer & Sahl, 2017). In the smart factory there is direct communication between people, machines, conveying and storage systems as well as production facilities. Smart products know their manufacturing process and future applications. With this knowledge, they actively support the production process and the documentation (Skowron, 2015; Stock & Seliger, 2016).

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Therefore, Industry 4.0 represents a paradigm change from “centralized” to “decentralized” production, made possible by technological progress which constitutes a reversal of conventional production process logic. This means, that industrial production machinery no longer simply processes the product, but that the product communicates with the machinery to tell it exactly what to do [9]. With its interfaces to smart mobility, smart logistics, smart buildings and smart grids the smart factory is an important element of future smart infrastructures. Conventional value chains will be refined and new business models will become established (Dorst & Ev, 2012; Blanchet et al., 2014; Mahmood & Hushairi, 2016).

Problem statement

Malaysia has readily accepted the advent of Industry 4.0 as where the survey of GE Global Innovation Barometer 2016 discovered that “there has been a significant number of Malaysian executives who are more positive about entering the fourth industrial revolution as compared to their peers globally”. Though globally, the U.S., Germany and Japan remained as the top three leading innovation champions, surprisingly Malaysia, together with other countries such as Australia, Canada and Switzerland, emerged as one of the new entrants to the list (Peng, 2016). However, the GE Global Innovation Barometer survey also reported that the Malaysian businesses only favored incremental innovation and internal innovation, quite a stark contrast to their global peers who often pursue radical innovation. The survey report pinpointed that preference for incremental innovation remained as the main challenge for the country.

Furthermore, the Third Industrial Master Plan 2010-2020 (IMP3) and the new Science, Technology and Innovation Policy 2013- 2020 (STI) designed to assist and to propel the country into the new era of industry 4.0. Surprisingly, none of the Plan and the Policy documents have specifically mentioned about preparing or building the country’s economy based on industry 4.0 though undeniably there are some elements or dimensions in these two documents reflecting such move towards it. Therefore, an inclusive framework to research on Industry 4.0 in Malaysia is strongly recommended to ensure long-term sustainable economic growth and development with the capability of the workforce to innovate and apply advanced knowledge and technologies.

Research objective

Despite the high potential of Industry 4.0 in SMEs, the main limitation lies in a lack of concrete models for its implementation and application in SMEs. Thus the study aims at closing and overcoming this gap through three main objectives:

1. To explore the current state of Industry 4.0 implementation within MNCs in Malaysia.
2. To determine the awareness and adoption level of Industry 4.0 among manufacturing SMEs in Malaysia.
3. To examine the challenges encountered by manufacturing SMEs in adopting Industry 4.0.

RESEARCH METHODOLOGY

This study will employ the Sequential Exploratory Mixed Method approach. This method is useful in the construction of research instrument (Creswell & Clarke, 2007). The lack of literatures on the Industry 4.0 warrant a study which begins with exploratory approach to grasp well the issues at hand before proceeding with further investigation. This study which begins with the qualitative phase will be examining manufacturers who have been successfully implementing the Industry 4.0 project at their premises, through the case study design. Industry reports indicate that manufacturers from German, Japan and United States are the world leaders in implementing the Industry 4.0 project (Breunig et al., 2016). Accordingly, person in charge for the Industry 4.0 project of any 2 MNCs originated from each country stated will be recruited via purposive sampling technique. Pre-communication will be established with the potential participants in getting their consent for the participation, arranging the interview session and furnishing them the list of broad interview questions before hand.

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Briefly, they will be interviewed to understand the underlying substances related to the implementation of Industry 4.0 at their respective premises. They will be probed to reveal about the company's motivation to implement Industry 4.0 besides the challenges faced by their company during the initial stage of implementation. They will be also probed to share about the approaches used by their company in overcoming challenges encountered. This is in addition to the utilisation of the interview protocol in recording the observation made during the sessions. Qualitative data from these series of interviews will be processed (i.e. transcription, cross-checks and coding) and hence analysed via NVivo software. Findings from the qualitative phase will be used to construct the survey instrument which will be utilised in the second phase of the study.

The second phase of the study will be quantitative in nature. Manufacturing SMEs will be the target population of this phase. About 97.3 percent of manufacturers in Malaysia are SMEs (Department of Statistics, 2015a) and hence, examination on the manufacturing SMEs is expected to furnish a fair illustration on the real scenario of the Malaysia's manufacturing industry. The owner and/or managers of these manufacturing SMEs will be considered as the key informants in this phase. Upon pre-testing the questionnaire, about 30 key informants of manufacturers in Perak will be approached in person for the pilot study. Accordingly, SME Annual Report 2015/2016 indicates that there are about 37,861 manufacturers in Malaysia who are micro, small and medium in size; and from eighteen sub-sectors. In order to ensure the participation from each sub-sector, stratified sampling technique will be employed. Strata by each sub-sector will be determined based on the number of enterprises in the sub-sectors. The informants will be then selected from each strata based on the simple random design.

According to Faul, Erdfelder, Lang, and Buchner (2007) for the population size of 38,000, a minimum sample size of 381 is required. Upon getting the contact details from the SME Business Directory, the survey form accompanied by cover letter as well as self-addressed stamped envelope will be mailed to 3,000 key informants of the manufacturers shortlisted. Additionally, there will be two rounds of follows-up to encourage the non-responding informants to complete and revert the survey form within the timeline given. The first follow-up will involves 2000 sets of questionnaire while the second follow-up will involve 1000 sets of questionnaire. The follow up will be done with the interval of 3 weeks. Such mass mailing of the questionnaire is a necessary in order to ensure high response rate as mail survey is often attributed with poor response rate as low as 10 percent (Macpherson & Wilson, 2003; Hikmet & Chen, 2003). The data gathered will be processed and subsequently analysed using appropriate multivariate statistical technique.

DISCUSSION AND CONCLUSION

This study would significantly contribute about the Industry 4.0 and sustainable manufacturing process to both practitioners and academics. Followings are the several benefits of the study:

- It could possibly shows that this study have a value and shall be of relevance in bridging the gap of the slowly growing literature on manufacturing industries and new technological revolution.
- The execution of this study would raise the awareness of manufacturing SMEs towards the Industry 4.0 through their participation in the research's data collection procedures.
- The findings would facilitate the policy makers in formulating appropriate strategies and furnishing more practical supports/assurances to the practitioners by understanding the adoption issues discovered in this research.
- The study and its findings would ear marks the dawn of research efforts related to Industry 4.0 implementation in the local context. Such would open up a new trend of research in the area of manufacturing and technology management practices among local academics and postgraduate students.

As the business environment becomes increasingly competitive, SMEs need approaches to distinguish themselves from their competitors. Industry 4.0 is an innovative initiative established to enable SMEs to take opportunities for creating new and innovative smart products. This will facilitate the collaboration

between SMEs and MNCs for creating new smart products enabled by Industry 4.0 technologies and to deliver highly cost-effective solutions. In terms of SMEs, this approach drives forward the requirement to move from providing simple components to providing complex engineered systems based on Cyber Physical Systems, offer innovative products that meet the needs of their demanding customers, reduce process time and acquire new skills necessary to gain a competitive advantage on a global scale.

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