10

Smart SME 4.0 Implementation Toolkit

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10.1 Introduction

The term SMEs is normally used to describe businesses that are small or medium in size by which their personnel numbers or investment fall below certain limits (EIP 2005; MOBIE 2014; OSMEP 2017). For example, the European SMEs are those who employ fewer than 250 persons and have an annual turnover not exceeding 50 million EUR, and/or an annual balance sheet total not exceeding 43 million EUR. In Australia, an SME has fewer than 200 employees, while in Thailand, SMEs are those having total asset value of not more than 200 million THB (less than 5 million EUR) and fewer than 200 employees.

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The definition of an SME may vary from each socioeconomic perspective and policy development. However, it is common that SMEs are important to the economy in terms of number, employment, and export. For example, 99.3% of UK private sector businesses are SMEs. SMEs in Poland generate almost 50% of the GDP, while Australian SMEs makeup 97% of all Australian businesses, produce one-third of total GDP and employ 4.7 million people. SMEs represent 90% of all goods exporters and over 60% of services exporters. In the case of Thailand, currently, there are more than 3 million SME operators, accounting for 42.2% of Thailand's GDP, expanding 4.8% annually. Thai SMEs account for 99% of Thailand's enterprises and 78% of the total employment in the country. More than 90% of Thai exports are from SMEs.

SMEs are an important contribution to the creation of new jobs. SMEs are often characterized as reactive, resource limitations, informal strategies, and flexible structures (Hudson et al. 2001; Qian and Li 2003). SMEs are usually characterized by a high level of environmental uncertainty. The OECD report suggests that competitiveness of SMEs is dependent on the role of the owner or manager, intelligence management, technologically suitable equipment, and strategic capability (innovation and flexibility). It is noted that, while technology plays an increasingly important role in all aspects of competitiveness, management methods, the organization of the firm and the training of its staff are also very significant (OECD 1993).

The chapter aims at examining the readiness of SMEs toward the SME 4.0 concept. The research uses Thai SMEs as case study.

10.2 Background and Literature Review

SME 4.0 is a new, modified version of Industry 4.0 (I4) for SMEs. By which the term "Industry 4.0" refers to modern industrial concepts, empowering by technological advancement. Industry 4.0 concepts encourage the industrial systems to be connected and interacted and, thus, make appropriate decisions based on gathered and analyzed data across the manufacturing processes. The production can be faster, more

flexible, and more efficient (Lee et al. 2015; Rüßmann et al. 2015). The concepts of Smart Factory, Cyber-physical Systems, and self-organization are among the key drivers (Lasi et al. 2014; Stock and Seliger 2016; Pereira and Romero 2017).

In order to assess SMEs with Industry 4.0 concept, the scope of SMEs 4.0 is now of interest. The basic idea of SMEs 4.0 is captured per Industry 4.0 dimensions and characteristics and modeled as “SMEs 4.0 assessment modules.”

At first, the keyword “Industry 4.0” is selected to search the published papers from 2015 to 2018. The literature review is conducted considering by following electronic databases: Google Scholar, Web of Science, and Elsevier.

As there are many perspectives related to Industry 4.0; however, the chapter chooses to focus on key factors related to Organization and Management. Organization Management actions are divided into three levels, i.e., Strategic Management, Management Planning, and Management Control/Operational Control. The actions include objective/goal setting, resource determination/allocation, and task assignment/resources utilization, while management functions include, planning, organizing/staffing/directing, and controlling.

Figure 10.1 illustrates the Organization Management scope used in this chapter.

Fig. 10.1 Organization management scope

Hence, the chapter focuses on technological resource and human resource managements in relationship to the Industry 4.0 concept. Here, areas of interest are divided into four categories, i.e., Information Technology, Production and Operations, Automation, and Human Resources.

The significance of different factors is described in the following subsections.

10.2.1 Information Technology

Information Technology (IT) enables an environment that controls the physical operation and allows the collection of data. Advance IT is a new factor in the Industry 4.0 concept. It adopts and requires IT infrastructure for data acquisition, collection, and sharing excellent performance in the manufacturing system (Zhong et al. 2017). IT dimension comprises of four factors, i.e., equipment infrastructure, IT system, information sharing, and cloud based (see Fig. 10.2).

10.2.1.1 Equipment Infrastructure

The primary infrastructure includes IT resource, networking equipment, and hardware considered as a piece of vital equipment for

Fig. 10.2 Information technology factors

implementing and adopting new technology (Dombrowski et al. 2017). The equipment is able to be flexible and changes to adapt to better value creation (Stock and Seliger 2016). All machines and devices are already being prepared to support Industry 4.0 and future requirements (Agca et al. 2015; Lichtblau et al. 2015).

10.2.1.2 IT System

IT systems are fundamental to control the potential and effectiveness of Industry 4.0. It supports and integrates all the organization and includes the operation, production, and process (Agca et al. 2015; Lichtblau et al. 2015). The company has the readiness of IT technology to support the business. It will also use the IT security for data protection (Dombrowski et al. 2017). Modern IT, such as Big Data can provide optimized decision-making in the production planning, process, and management (Schumacher et al. 2016; Qian et al. 2017).

10.2.1.3 Information Sharing

Intelligent manufacturing uses the advantage of information to achieve flexible manufacturing processes. This process requires real-time data and collection with a collaboration between the production department, workers, and information systems (Lichtblau et al. 2015; Leyh et al. 2016). It can allow the information flows in all processes and, as such, delivers in the manufacturing and across the supply chains (Zhong et al. 2017). Therefore, the organization shares information and data resources more efficiently.

10.2.1.4 Cloud Based

Cloud-based manufacturing is a requirement in the concept of Industry 4.0 with intelligent management (Schumacher et al. 2016). It enables data to be generated in multiple locations and can transfer to data center stores for analysis (Agca et al. 2015; Leyh et al. 2016); the system

covers all the production and resources (Dombrowski et al. 2017; Zhong et al. 2017). Cloud system allows for remote use of all devices, machines, and production communication. This system provides a different service. The company can operate cloud based in the field of Industry 4.0 to increase effectiveness and efficiency (Leyh et al. 2016).

10.2.2 Production and Operations

Industry 4.0's vision is the interconnecting of intelligent systems. It has self-control in the processes and manufacturing system. Consequently, the operation and production process, based on technology under Industry 4.0, will provide an innovative value-added process. As such, it provides more flexibility, data reliability, and increases operational efficiency (Dombrowski et al. 2017). The Production and Operations dimension comprises of four factors, i.e., innovation management, data analytics, horizontal/vertical data integration, and expert system (see Fig. 10.3).

10.2.2.1 Innovation Management

Industry 4.0 offers the opportunity to develop business models which use advanced technology and innovation management (Lichtblau et al. 2015).

Fig. 10.3 Production and operations factors

10.2.2.2 Data Analytics

Data analytics is a gathering and assessment of data from many different sources. The data are enabled to collect and be comprehensive to make decisions in the business and operations (Lichtblau et al. 2015).

It includes manufacturing systems and infrastructure, such as information systems (Zhong et al. 2017). The systems must be standard for supporting real-time decision-making and management (Dombrowski et al. 2017).

10.2.2.3 Horizontal/Vertical Data Integration

Companies plan to integrate the system to link processes and traceability solutions. Horizontal/vertical data integration can be, for example, Enterprise Resource Planning (ERP), a system that has efficiency in Industry 4.0. It is a concept of an interconnected and intelligent factory in the production system that communicates directly with the overlying IT systems and value-adding process (Lichtblau et al. 2015; Leyh et al. 2016)

10.2.2.4 Expert Systems

Expert systems (ESs) are a knowledge base that involves the knowledge and experience from experts and expressed in specific structured formats. Applications are developed to solve complex problems in manufacturing. In Industry 4.0, an expert system allows the worker to monitor the organization's activity and control repercussions of the manufacturing (Pan et al. 2015).

10.2.3 Automation

In the factory, operations and automation are the main focus of the Industry 4.0 vision. It is a vision of autonomous production in self-optimization and factory management—an environment in an enterprise

Fig. 10.4 Automation factors

in which the physical and cyber are combined as one (Stock and Seliger 2016). The automation dimension comprises of four factors, i.e., OEE equipment effectiveness, man-machine interaction, autonomous process, and M2M machine connectivity (see Fig. 10.4).

10.2.3.1 OEE Equipment Effectiveness

Overall Equipment Effectiveness (OEE) is a method for assessing the total equipment performance and efficiency. It shows the degree that the equipment is doing and what it is supposed to do. In the current environment for SMEs, the reliability of tools and OEE are the main components for increasing profitability and performance of manufacturing systems. OEE is also a suitable analytical performance evaluation tool for SMEs (Yazdi et al. 2018).

10.2.3.2 Man-Machine Interaction

Industry 4.0 has become more complex and operates as an automatic device. Workers can work together collaboratively with the advanced machinery. For the higher complexity and more control structures, a better quality of cooperation and communication between human and machine is required. The technology and equipment are able to support the change in other work tasks flexibly (Stock and Seliger 2016).

10.2.3.3 Autonomous Process

The production and operation environment in the manufacturing systems are self-organized without human intervention (Lichtblau et al. 2015). The manufacturing equipment and tools can be characterized by the application of advanced automatic machines and robotics (Stock and Seliger 2016). All machines and operating systems can be controlled through smart devices and an automation process (Agca et al. 2015).

10.2.3.4 M2M Machine Connectivity

Machine-to-machine communication or interoperability is where the systems consist of the interaction between intelligent production systems (Qian et al. 2017). It can link with each other device for easy, secure, and fixed data exchange. In other words, controlling, integrating, and coordinating processes. It provides that data accessing and processing of all machines and systems are fully integrated (Agca et al. 2015; Schumacher et al. 2016).

10.2.4 Human Resource

The requirement in manufacturing jobs will contain more knowledge of work. The workers must have potential in both short-term and hard-to-plan tasks. They can integrate the knowledge with the intelligent system, such as data analytics, decision-making, and engineering activities as end-to-end engineering (Stock and Seliger 2016). The human resource dimension comprises of two groups, i.e., technical and non-technical (see Fig. 10.5).

10.2.4.1 Technical

In intelligent systems which are self-controlled and guide the employees in the job task, human skill, and knowledge are required in Industry

Fig. 10.5 Information technology factors

4.0. These are (1) Data Analytics, (2) Information Technology—in the IT system, the human skill set in the personnel resource is required for transformation of the organizational management, and (3) Automation Technology. The workers will monitor the automated devices and equipment, which requires qualification of highly specialized experts and knowledge based on automation technology.

10.2.4.2 Non-Technical

The employee is the core element of Industry 4.0. They consider the different tasks in the current professional and scientific discussion. These are (1) Problem Solving, (2) Teamworking, and (3) Systematic Thinking. These skills will create the value in Industry 4.0.

The main factors of Industry 4.0, as reviewed, can be found in Table 10.1.

10.3 Problem Formulation

It is obviously difficult to apply all Industry 4.0 concepts to SMEs due to the limitation of human resources, technology, and financial potential. Thus, SMEs should start their implementation of SMEs 4.0 concept with prioritized and appropriate measures. Therefore, the Smart SMEs 4.0 Implementation Toolkit is developed.

Table 10.1 Main factors of industry 4.0

Factors	Agca et al. (2015)	Pan (2015)	Lichtblau et al. (2015)	Schumache et al. (2016)	Leyh et al. (2016)	Stock and Seliger (2016)	Qian et al. (2017)	Zhong et al. (2017)	Dombrowski et al. (2017)	Farahani et al. (2017)	Fatorachian and Kazemi (2018)
Autonomous process	X		X			X					
Cloud based	X			X	X			X	X		X
Data analytics			X					X	X		
Horizontal/vertical data integration			X		X						
Expert system		X									
Equipment	X		X			X					
Infrastructure											
Human resource				X		X	X		X		
IT system	X		X	X			X		X		
Information sharing			X				X	X			
Innovation			X								X
management											
Overall Equipment Effectiveness (OEE)										X	
Man-machine interaction						X					
M2M machine connectivity	X			X							X

Fig. 10.6 SMEs 4.0 toolkit framework

The idea is to suggest appropriate implementation guidelines for SMEs, in responding to the SMEs 4.0 concept. The guideline can be strategies, projects idea or investment, depending on the level of implementation readiness. However, the guideline must align benefit and cost of the idea with the organizational strategies. In advanced firms, further analysis can be applicable, for example, sustainability analysis.

The guideline can be developed using consultancy or expert opinion or, at best, learning from best practice. In the case of future work where there are sufficient number of assessed companies in the toolkit database, in the primary framework, the assessment can be divided into beginner, intermediate, experience, and expert levels (see Fig. 10.6).

10.4 Methodology

The methodology of the research is how to design the Smart SMEs 4.0 Implementation Toolkit. Firstly, the related literature is reviewed to address the scope of Smart SMEs. As discussed, the scope of the toolkit is divided into four dimensions, i.e., (1) Information Technology, (2) Production and Operations, (3) Automation, and (4) Human Resources. This will then be used as the assessment module.

In addition to the assessment module, the analysis, and implementation phases are added to the toolkit to assist in the assessment and reflect the requirement of the company. The ideal methodology is starting with the company profile study and site visit with audit checklist. Then, the gap analysis is made using the assessment module of four SMEs 4.0 dimensions. Once complete, the module will be evaluated and the implementation guideline as the appropriate decision can be made accordingly (see Fig. 10.7).

Thus, the Smart SMEs 4.0 Implementation Toolkit is structured and divided into four phases, i.e., organizational analysis, gap analysis, economic analysis, and implementation guideline (see Fig. 10.8).

Phase 1 refers to the Organizational Analysis. The aim is to investigate the assessee on the organizational level. The analysis can be subjective, descriptive or structured into any business assessment. Of interest are type, size, product, process, business position, supply chain relationship, as well as the business strategy.

Fig. 10.7 Smart SMEs 4.0 implementation toolkit methodology

Fig. 10.8 Phases of smart SMEs 4.0 implementation toolkit

Phase 2 refers to the Gap Analysis. This phase starts with need assessment. This can be interview, addressing strategy, target, and limitation of the organization. Then, the investigation of trend and future business environment will be made. Finally, the assessment of four Industry 4.0 modules will be made to identify the “gap” for further steps.

Phase 3 refers to Economic Analysis in which the gap is identified and appropriate measure should be suggested. Here, budgeting, benefit and productivity improvement, benefit and cost analysis, and risk analysis are among the factors of interest. Then, business decision can be made if any measure is suitable and, thus, selected for implementation.

Phase 4 refers to the Implementation guideline. This is the phase to respond to the selected measures from Phase 3. It will address the module, level, and timing for each measurement.

10.5 Problem Solution

The case study of this developed toolkit is four Thai SMEs in Northern Thailand region. The country is part of pilot areas supported by the project “Industry 4.0 for SMEs” from the European Union’s Horizon

2020 research and innovation program under the Marie Skłodowska-Curie grant agreement. Several researches were conducted to identify the potential of the country in terms of Organization and Management, at a national level (Ramingwong and Manopiniwes 2019; Ramingwong et al. 2019).

The first SME is a medium-sized make-to-order snack factory. The second SME belongs to a service industry, a small coffee shop. The third SME is a small plastics manufacturing company. And the fourth SME is a medium-sized multinational company. The company is a supplier of the automotive industry, producing wire mesh and conveyors.

10.5.1 SMEs 4.0 for Make-to-Order Snack Factory

The first case study SME is a make-to-order snack factory. The factory was founded as a joint venture with a Japanese investor in 1991 in a Northern Thailand Industrial Estate. The products were initially exported to Japan as rice crackers using Thai rice. Today, 20% of the products are consumed within Thailand through modern trade channels.

Although the products come with variety, the production processes are quite common due to the raw material preparation and cooking method. However, the shape and size can be varied. For all product, the first phase of the production process is in a closed automated system, including preparing, cutting, and baking. Then, the flavoring is added manually depending on flavoring type and can be coating, powdering or filling. For example, the filling of the flavoring core is done manually by hand. The process is expensive and time-consuming. Finally, the packaging is done by machine.

The company has participated in the study, starting with organizational analysis. It was found that the customers are segmented, the company has positioned itself to different customers and the market is continuously studied. New product development and R&D are the main focus of the company to expand the market and to better respond to customer satisfaction. The strategies are directed by top management and communicated to all personnel. Supplier relationship and customer relationship are the most important key success factors of the company.

Table 10.2 illustrates the assessment of four Smart SMEs 4.0 dimensions of the case study, make-to-order snack factory.

The case study company has assessed four Smart SMEs 4.0 dimensions in terms of Significance and Readiness, as shown in Table 10.2.

The company shows interest to many Smart SMEs 4.0 factors, especially automation. IT, production and operations, and human resource dimensions are comparatively considered low to medium significance. The readiness of the company is also assessed and found to be in the low and medium levels in all factors.

Thus, the company should focus on the automation dimension as a result of the low readiness but high significance. Further investigation should be conducted and the results aligned where the company has struggled with labor cost and labor availability. The autonomous process and machine connectivity can improve the productivity.

Therefore, the suggestion and priority are on automation of the process. The company is surveying on the feasibility of machine investment. Thus, the budgeting, expected benefit and productivity

Table 10.2 SMEs 4.0 assessment of the case study: make-to-order snack factory

Factors	Significance	Readiness
1. Information technology		
Equipment infrastructure	Medium	Medium
IT system	Medium	Medium
Information sharing	Low	Low
Cloud based	Low	Low
2. Production and operations		
Innovation management	Medium	Low
Data analytics	Medium	Low
Horizontal/vertical data integration	Medium	Medium
Expert system	Low	Low
3. Automation		
Overall Equipment Effectiveness (OEE)	High	Medium
Man-machine interaction	Medium	Medium
Autonomous process	High	Low
M2M Machine connectivity	High	Medium
4. Human resource		
Technical	Medium	Low
Non-technical	Low	Low

improvement, expected benefit and cost analysis, and risk analysis can then be done. Moreover, the level of implementation and timing can be strategized.

10.5.2 SMEs 4.0 for Service Industry—A Coffee Shop

The second case study SMEs is a coffee shop, a representative of the Thai service industry. While promoted as Chiang Mai Coffee City, there are more than 4000 coffee shops in Chiang Mai, a capital city of Northern Thailand region. The key value chain activities of the case study coffee shop are inbound logistics, operations, and service. Enjoying good coffee bean as raw material, the procurement and purchasing are critical, yet opportune. There are more than 20,000 rais (3200 hectares) of coffee cultivated area in Chiang Mai. The gross production of Chiang Mai coffee is more than 20,000 tons per year. Many are organic, GAP, and GMP certified.

Moreover, with sophisticated coffee machines and good raw material, the coffees are distinctive. The case study coffee shop is rated high in social media. There are many loyal favorite customers and onetime tourists. The service is also a key success factor of this shop. The owner is a trained barista and serves customers himself. Customer behavior is inspected directly by the owner and coffee formula is adjusted accordingly.

The case study company has assessed four Smart SMEs 4.0 dimensions in terms of Significance and Readiness, as shown in Table 10.3. The company shows interest to many Smart SMEs 4.0 factors, especially the IT and non-technical skills of human resource. The readiness of the company is mostly low and medium. This is not surprising for SMEs. Thus, the interests are in IT as the biggest gap. The investigation was conducted in the IT dimension and it was found that the data are collected yet not properly processed to the information level. For example, sales are collected but not analyzed, best seller items cannot be identified, transaction times are not collected and cost of each items are not known. Therefore, the case study shop is suggested to have an appropriate IT system such as a Point of Sale (POS) system. Then, the transaction can be analyzed and proper strategies can then be made.

Table 10.3 SMEs 4.0 assessment of the case study: service industry

Factors	Significance	Readiness
1. Information technology		
Equipment infrastructure	Medium	Low
IT system	High	Low
Information sharing	Medium	Low
Cloud based	Low	Low
2. Production and operations		
Innovation management	Medium	Low
Data analytics	Low	Low
Horizontal/vertical data integration	Low	Low
Expert System	Low	Low
3. Automation		
Overall Equipment Effectiveness (OEE)	Low	Low
Man-machine interaction	Medium	Medium
Autonomous process	Low	Low
M2M machine connectivity	Low	Low
4. Human resource		
Technical	Low	Low
Non-technical	High	Medium

Figure 10.9 illustrates the developed mobile application for the case. The mobile application performs POS and budgeting functions.

10.5.3 SMEs 4.0 for Small Fabrication Company

The third case study company is a plastic shoemaking company. The factory is considered small size with 20 employees. The production is both make-to-stock and make-to-order. The products are both sold domestically and exported to neighboring countries. The processes of shoemaking are discontinuous and costly. The production is low-technology and labor intensive.

Currently, the company is facing a price war and the competition is higher due to the ASEAN Economic Community's single production area (ASEAN and ASEAN Secretariat 2008).

The case study company lacks capability in the dimension of Production and Operations, and Information Technology, by which

Fig. 10.9 Developed mobile application for coffee shop (Reproduced with permission from Chiang Mai University, Department of Industrial Engineering)

they are important to the company (see Table 10.4). The key concerns of the company are the information sharing and communication within the company and toward its supply chain members. The company agility is low as the information are disconnected and offline. Thus, the decision-making is ineffective.

The company was suggested to pay attention to an Information Technology system. The platform of simple electronic data interchange, e.g., Google Docs, where the data can be updated and accessed openly and freely, can help sharing necessary information at a required time. The template sheets, including inventory and production tracking, and the standard procedures for input and analysis of the data are also designed.

The company was also suggested to develop an information sharing platform within its supply chain, both customer and supplier sides. Thus, the production and other resources can be planned responsively.

Table 10.4 SMEs 4.0 assessment of the case study: small fabrication company

Factors	Significance	Readiness
1. Information technology		
Equipment infrastructure	Low	Low
IT system	Medium	Low
Information sharing	Medium	Low
Cloud based	Low	Low
2. Production and operations		
Innovation management	Low	Low
Data analytics	Low	Low
Horizontal/vertical data integration	High	Low
Expert system	Low	Low
3. Automation		
Overall Equipment Effectiveness (OEE)	Medium	Low
Man-machine interaction	Medium	Medium
Autonomous process	Low	Low
M2M machine connectivity	Low	Low
4. Human resource		
Technical	Low	Low
Non-technical	Medium	Low

10.5.4 SMEs 4.0 for Multinational SMEs

The last case study company is a medium-sized supplier of the automotive industry. The company is a wire mesh and conveyor production site of a Japanese mother company. There are also similar production sites in Japan, China, Singapore, the United States, and Australia. The factory in Thailand is considered a medium-sized and production only. The production plan and the Research and Development are done only by overseas.

After having assessed the company by the Smart SMEs 4.0 Implementation Toolkit (see Table 10.5), the company is suggested mainly to improve their Expert System and Human Resource areas. While the production can be done effectively and efficiently, the knowledge management is limited. The expert system can help improve the knowledge sharing and collect the tacit knowledge, present yet limitedly transferred. Defect and 7-waste management are suggested to be a pilot theme of the project idea. Then, the human resource can be managed accordingly.

Table 10.5 SMEs 4.0 assessment of the case study: multinational SMEs

Factors	Significance	Readiness
1. Information technology		
Equipment infrastructure	High	High
IT system	High	High
Information sharing	Medium	Medium
Cloud based	Medium	Medium
2. Production and operations		
Innovation management	Low	Low
Data analytics	Low	Low
Horizontal/vertical data integration	High	Medium
Expert system	High	Low
3. Automation		
Overall Equipment Effectiveness (OEE)	Medium	High
Man-machine interaction	Medium	Medium
Autonomous process	Medium	Medium
M2M Machine Connectivity	Medium	Medium
4. Human resource		
Technical	Medium	Low
Non-technical	Medium	Low

10.6 Discussion

The chapter presents the initial use of the Smart SMEs 4.0 Implementation Toolkit to four case study SMEs in Thailand. Where the requirement differs from company to company, the toolkit can reflect the needs by assessing the significance and readiness and identify the gap of improvement. The implementation guidelines are initially created, yet, at this stage, only suggestive. Further development is needed to concreate the methodology and validate the toolkit.

10.7 Conclusions

Smart SMEs 4.0 Implementation Toolkit is a modified and implementable version of Industry 4.0 for SMEs. Divided into four phases, i.e., organizational analysis, gap analysis, economic analysis, and implementation guideline, the company can use the toolkit to reflect the gap and the implementation suggestions can be made. With the

scope of assessment identified into four dimensions of interest, i.e., (1) Information Technology, (2) Production and Operations, (3) Automation, and (4) Human Resource, the significance and readiness of each SME can be aligned and the gap can be analyzed. In this manuscript, four case study companies, i.e., make-to-order snack factory, coffee shop, shoe-making factory, and multinational mesh/conveyor factory in Northern Thailand, are used as examples of the toolkit usage. Implementation guidelines are preliminarily suggested. Further study is needed to validate the toolkit.

References

- Agca, O., J. Gibson, J. Godsell, J. Ignatius, C.W. Davies, and O. Xu. 2015. An Industry 4 Readiness Assessment Tool. In *International Institute for Product and Service Innovation*. Coventry: University of Warwick.
- ASEAN, and ASEAN Secretariat. 2008. *ASEAN Economic Community Blueprint*. Jakarta: Association of Southeast Asian Nations.
- Dombrowski, U., T. Richter, and P. Krenkel. 2017. Interdependencies of Industrie 4.0 & Lean Production Systems: A Use Cases Analysis. *Procedia Manufacturing* 11: 1061–1068. <https://doi.org/10.1016/j.promfg.2017.07.217>.
- EIP. 2005. *The New SME Definition, User Guide and Model Declaration*. Luxembourg: Enterprise and Industry Publications.
- Farahani, P., C. Meier, and J. Wilke. 2017. Digital Supply Chain Management Agenda for the Automotive Supplier Industry. In *Shaping the digital enterprise*, 157–172. Cham: Springer.
- Fatorachian, H., and H. Kazemi. 2018. A Critical Investigation of Industry 4.0 in Manufacturing: Theoretical Operationalisation Framework. *Production Planning & Control* 29 (8): 633–644.
- Hudson, M., A. Smart, and M. Bourne. 2001. Theory and Practice in SME Performance Measurement Systems. *International Journal of Operations & Production Management* 21 (8): 1096–1115. <https://doi.org/10.1108/EUM0000000005587>.
- Lasi, H., P. Fettke, H.G. Kemper, T. Feld, and M. Hoffmann. 2014. Industry 4.0. *Business & Information Systems Engineering* 6 (4): 239–242. <https://doi.org/10.1007/s11576-014-0424-4>.

- Lee, J., B. Bagheri, and H.A. Kao. 2015. A Cyber-Physical Systems Architecture for Industry 4.0-Based Manufacturing Systems. *Manufacturing Letters* 3: 18–23. <https://doi.org/10.1016/j.mfglet.2014.12.001>.
- Leyh, C., K. Bley, T. Schäffer, and S. Forstenhäusler. 2016. SIMMI 4.0-A Maturity Model for Classifying the Enterprise-Wide It and Software Landscape Focusing on Industry 4.0. In *2016 Federated Conference on Computer Science and Information Systems (FedCSIS)*, 1297–1302. <http://dx.doi.org/10.15439/2016F478>.
- Lichtblau, K., V. Stich, R. Bertenrath, M. Blum, M. Bleider, A. Millack, K. Schmitt, E. Schmitz, and M. Schröter. 2015. *IMPULS—Industrie 4.0-Readiness*. Aachen-Köln: Impuls-Stiftung des VDMA.
- MOBIE. 2014. *The Small Business Sector Report 2014*. Ministry of Business. Ministry of Innovation and Employment.
- OECD. 1993. *Small and Medium-Sized Enterprises: Technology and Competitiveness*. Paris: Organization for Economic Corporation and Development.
- OSMEP. 2017. *SME4.0 The Next Economic Revolution, White Paper on Small and Medium Enterprises 2017*. The Office of Small and Medium Enterprises Promotion of Thailand.
- Pan, M., J. Sikorski, C.A. Kastner, J. Akroyd, S. Mosbach, R. Lau, and M. Kraft. 2015. Applying Industry 4.0 to the Jurong Island Eco-Industrial Park. *Energy Procedia* 75: 1536–1541. <https://doi.org/10.1016/j.egypro.2015.07.313>.
- Pereira, A.C., and F. Romero. 2017. A Review of the Meanings and the Implications of the Industry 4.0 Concept. *Procedia Manufacturing* 13: 1206–1214. <https://doi.org/10.1016/j.promfg.2017.09.032>.
- Qian, G., and L. Li. 2003. Profitability of Small-and Medium-Sized Enterprises in High-Tech Industries: The Case of the Biotechnology Industry. *Strategic Management Journal* 24 (9): 881–887. <https://doi.org/10.1002/smj.344>.
- Qian, F., W. Zhong, and W. Du. 2017. Fundamental Theories and Key Technologies for Smart and Optimal Manufacturing in the Process Industry. *Engineering* 3 (2): 154–160. <https://doi.org/10.1016/j.ENG.2017.02.011>.
- Ramingwong, S., and W. Manopiniwes. 2019. Supportment for Organization and Management Competences of ASEAN Community and European Union Toward Industry 4.0. *International Journal of Advanced and Applied Sciences* 6 (3): 96–101. <https://doi.org/10.21833/ijaas.2019.03.014>.

- Ramingwong, S., W. Manopiniwes, and V. Jangkrajarn. 2019. Human Factors of Thailand Toward Industry 4.0. *Management Research and Practice* 11 (1): 15–25.
- Rüßmann, M., M. Lorenz, P. Gerbert, M. Waldner, J. Justus, P. Engel, and M. Harnisch. 2015. Industry 4.0: The Future of Productivity and Growth in Manufacturing Industries. *Boston Consulting Group* 9 (1): 54–89.
- Schumacher, A., S. Erol, and W. Sihn. 2016. A Maturity Model for Assessing Industry 4.0 Readiness and Maturity of Manufacturing Enterprises. *Procedia CIRP* 52: 161–166. <https://doi.org/10.1016/j.procir.2016.07.040>.
- Stock, T., and G. Seliger. 2016. Opportunities of Sustainable Manufacturing in Industry 4.0. *Procedia CIRP* 40: 536–541. <https://doi.org/10.1016/j.procir.2016.01.129>.
- Yazdi, P.G., A. Azizi, and M. Hashemipour. 2018. An Empirical Investigation of the Relationship Between Overall Equipment Efficiency (OEE) and Manufacturing Sustainability in Industry 4.0 with Time Study Approach. *Sustainability* 10: 1–28. <https://doi.org/10.3390/su10093031>.
- Zhong, R.Y., X. Xu, E. Klotz, and S.T. Newman. 2017. Intelligent Manufacturing in the Context of Industry 4.0: A Review. *Engineering* 3 (5): 616–630. <https://doi.org/10.1016/J.ENG.2017.05.015>.

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