

# Assessment of Thai SME Readiness for Industry 4.0 in the Food Supply Chain

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**Abstract**— The assessment of the food industry's supply chain's readiness for the fourth industry assists the business in preparing for the fourth industry concept. The purpose of this study was to evaluate the enterprise's readiness for the Fourth Industrial Revolution. This study begins with the evaluation criteria used to assess and analyze information generated by the Fourth Industry concept. The selection of food and agriculture processing is based on Thailand's agricultural history and the fact that agriculture is Thailand's leading industry. Information was provided by 50 businesses, including 30 small businesses and 20 medium-sized businesses. The businesses were divided into six categories: agricultural food processing, tea and coffee production, spice and flavoring production, dairy product manufacturing, beverage production, and logistics service provider. The Industry4.0 maturity model was employed for data collection. The organization provides fundamental information about itself and evaluates the readiness of four dimensions and forty-two criteria for Industry 4.0. The readiness level for each criterion is between 1 and 5. This study focused on how companies implement Industry4.0 to manage their operations, organizational, and technological concerns, as well as their social culture.

**Keywords**—Industry4.0, Maturity Model, Readiness Assessment

## I. INTRODUCTION

Industry 4.0, which is based on the concepts of the fourth industrial revolution, has brought about significant changes in the manufacturing sector over the past few years. Industry 4.0 is concerned with the integration of manufacturing systems, information technology, and wireless networks. Thus, conventional industrial processes are combined with information and communication technologies in Industry 4.0 [1]. It is necessary to improve lead times, flexibility, and the ability to produce a large number of product variants in small batches to maintain a competitive advantage. The client is provided with additional functionality and customization options, and the supply chain is made more flexible, transparent, and global.

The digital transformation process is not as simple as it sounds and presents challenges to businesses, particularly for small and medium-sized enterprises (SMEs). Enterprises are trying to use Industry 4.0 to improve their global production and competitiveness [1]. The digital revolution can't happen as planned in most cases. In order to implement this change, substantial financial resources are required, which presents a

challenge for SMEs. There are strategic challenges that companies must face. Industry 4.0 is widely debated, so businesses struggle to profit from it. Many struggle to create enterprise-wide strategic action fields [2]. As a result of these issues, many solutions have emerged to help businesses with Industry 4.0. Roadmaps for "Industry 4.0" assist in creating and implementing digital organizational models. [3]. It is recommended that businesses pursue a strategic approach to successfully implement Industry 4.0 in their operations, as this will bring together the most essential components. These roadmap approaches guide companies in unfamiliar territory, but offer no concrete, practical, easy-to-apply recommendations. Which Industry 4.0 concepts are applicable to most business types is unknown.

Consequently, the objective of this paper is to present preliminary findings relating the applicability of Industry 4.0 concepts to businesses of varying sizes. For the purpose of analyzing this, a self-assessment model has been implemented so that businesses can evaluate themselves in relation to how well they have implemented the defined industry 4.0 concepts. Moreover, companies have the responsibility of determining whether or not each of the Industry 4.0 concepts has the potential or is appropriate for the implementation.

## II. LITERATURE REVIEW

### A. Industry 4.0 Concept

The adoption of contemporary ICT in manufacturing can be viewed as the fourth industrial revolution. The first industrial revolution occurred between the mid and late eighteenth centuries when machines began to replace human labor. The emergence of steam and coal energy facilitated the expansion of industries. The second industrial revolution started in the year 1870. Using electricity and assembly line to produce things as a mass production. The invention of the internal combustion engine initiated the use of new energy sources, including electricity, gas, and oil. The digital revolution is the third industrial revolution. It began during the late 19th century. The invention of the internet and the integration of computers into manufacturing systems made production line automation possible. The fourth industrial revolution describes a future development in which products, people, and machines are all directly connected to one another and their environment. The current era is characterized by digital transformations, data analytics, artificial intelligence technologies, wireless network, and IoTs. [4].

Industry 4.0 focuses on mass customization of products and services, adaptability and flexibility of the operating system in manufacturing and logistics, increased potential of decision-making system, integration of Cyber-Physical systems (CPS) and communication technologies, advanced production technologies such as additive manufacturing, and concepts of sustainable development. [4].

The European Commission [5] provides a definition of Industry 4.0, which states that it is comprised of several new and innovative technologies. These technologies include cyber-physical systems, information and communication technology (ICT), big data analytics, artificial intelligence, wireless network communication, simulation, and digital assistance systems.

### B. Industry 4.0 Challenges in Thailand

Thailand considers Industry 4.0 a national issue. "Thailand 4.0" is an economic model that aims to liberate the country from several economic difficulties caused by earlier economic development models. 1.0 agricultural, 2.0 light industry, and 3.0 heavy industry are the stages of previous economic models. The Thai government has established Thailand 4.0 as a transformational plan for long-term development. Thailand 4.0 is characterized by a sophisticated ecosystem and a digitalized business and social environment. The objective of Thailand 4.0 is to make the country an attractive location for innovative and high-value industries. In addition to a strong emphasis on agriculture, food health, and medical technologies, the Thailand 4.0 initiative prioritizes robotics, mechatronics, artificial intelligence, the Internet of Things, and smart devices. [6].

### C. The Role of SMEs in Thailand

In Thailand, small and medium-sized businesses (SMEs) have a significant impact on economic activity and employment. Most people currently working in the country are employed by small and medium-sized businesses. According to reports from the Office of Small and Medium-Sized Enterprise Promotion (OSMEP) [7], there were approximately 3 million companies classified as SMEs in 2018, accounting for 99.8% of all companies. Furthermore, SMEs generate 14 million jobs, accounting for 86% of total employment. Over the last year, the number of SMEs and the jobs they create increased by 1% and 4.7%, respectively. SMEs also made significant contributions to Thailand's GDP, accounting for 45% of the national GDP, or approximately \$215 billion.

Office of Small and Medium Enterprises Promotion (OSMEP) is a government agency that is in charge of making the SME promotion master plan and the promotion action plan by coordinating the efforts of a variety of ministries and agencies. Since 2002, OSMEP has delivered four different master plans covering a period of five years each to promote SMEs. The fourth master plan (2017-2021) places an emphasis on small and medium-sized enterprises (SMEs) as a competitive growth engine and an inclusive growth mechanism, with the goal of increasing SMEs' share of GDP to at least 50 percent by the end of the plan's time period. This plan aims to make it easier for SMEs, increase their competitiveness (Smart SMEs), and encourage new SMEs (such as tech, creative, and cultural start-ups) to develop into high-value start-ups. Based on this vision, OSMEP developed three strategies: growth-driven mechanisms for SMEs, issue-based development and support programs for SMEs, and

business or industry-specific enhancements to competitiveness.

## III. INDUSTRY 4.0 ASSESSMENT TOOL

The industry 4.0 self-assessment model was developed by [8]. The assessment model structure consists of three levels. The first level consists of the industry 4.0 dimensions: 1) Operations, 2) Organization, 3) Socio-Culture, and 4) Technology. The technology dimension includes two sub-dimensions: technology related to data (TG01-TG-08) and technology related to process (TG09) (TG09 - TG20). The second level consists of 22 industry 4.0 categories, including Agile Manufacturing, Monitoring and Decision System, Additive Manufacturing, and Business Model 4.0. The Industry 4.0 concepts, which served as the foundation for the self-assessment tool, comprise the third level (see TABLE I. ). The definition of terminology and maturity characteristics have each been categorized into one of five levels in accordance with the various Industry 4.0 concepts. The readiness of businesses to participate in Industry 4.0 must be evaluated based on the following three factors: the existing maturity level, the target maturity level, and the significance.

TABLE I. IDENTIFIED INDUSTRY 4.

	Categories	14.0 Concept	
Operation	Agile manufacturing system	OP-01: Agile manufacturing system	
		OP-02: Self-adapting manufacturing systems	
		OP-03: Continuous and uninterrupted material flow models	
		OP-04: Plug and produce	
	Monitoring and decision system	OP-05: Decision support systems	
		OP-06: Integrated and Digital Real-Time Monitoring systems	
Big data for production	OP-07: Remote Monitoring of products		
	OP-08: Big data Analytics		
	OP-09: ERP/MES		
Organization	Business model 4.0	OG-01: Digital Product-service systems	
		OG-02: Servitization and Sharing Economy	
		OG-03: Digital Add-on or upgrade	
		OG-04: Digital Lock-in	
		OG-05: Freemium	
		OG-06: Digital point of sales	
	Innovation strategy	OG-07: Open Innovation	
	Strategy 4.0	OG-08: Industry 4.0 Roadmap	
	Supply Chain Management 4.0	OG-09: Sustainable Supply Chain Design	
		OG-10: Collaboration Network Models	
Socio-culture	Human resource 4.0	SC-01: Training 4.0	
	Work 4.0	SC-02: Role of the Operator	
	Culture 4.0	SC-03: Cultural Transformation	
Technology	Big data	TG-01: Cloud Computing	
		Communication & Connectivity	TG-02: Digital and connected workstations
			TG-03: E-Kanban
	Cyber security	TG-04: IoT and CPS	
		TG-05: Cyber Security	
		TG-06: Artificial Intelligence	

	Categories	I4.0 Concept
	Deep learning, M/C learning, AI	<b>TG-07:</b> Object self service
	Identification and tracking technology	<b>TG-08:</b> Identification and Tracking Technology
	Additive manufacturing	<b>TG-09:</b> Additive Manufacturing (3D-printing)
	Maintenance	<b>TG-10:</b> Predictive Maintenance
		<b>TG-11:</b> Tele-Maintenance
	Robotics & Automation	<b>TG-12:</b> Automated Storage systems
		<b>TG-13:</b> Automated Transport systems
		<b>TG-14:</b> Automated Manufacturing and Assembly
		<b>TG-15:</b> Collaborative Robotics
	Virtual Reality, Augmented Reality and simulation	<b>TG-16:</b> Smart Assistance systems
<b>TG-17:</b> VR and AR		
Product design and development	<b>TG-18:</b> Simulation	
	<b>TG-19:</b> PDM and PLM	
Standard 4.0	<b>TG-20:</b> CPS Standards	

Using the firm's industry 4.0 level, the enterprise's maturity level in relation to the concept under consideration is determined. The target level represents the desired level of maturity, which must be attained within a timeframe that is foreseeable and achievable. In conclusion, the importance enables businesses to assign a value to the investigated Industry 4.0 concept.

This paper employs the industry 4.0 self-assessment model to assess the significance level of various Industry 4.0 concepts' suitability. To determine readiness, this work analyzes the level of implementation of Industry 4.0 concepts relative to their target level.

#### IV. METHODOLOGY

##### A. Companies Segmentation

The European Union classifies businesses according to their respective sizes. Many different criteria can be utilized for classification, the most prevalent of which is number of employees. The annual turnover of a company and the total of its balance sheet are two additional criteria that can be used to classify it. In large corporations, Industry 4.0 technologies are being implemented. Large corporations may also invest in Industry 4.0 technologies. The Food supply chain, on the other hand, is comprised of members of various sizes. To make Industry 4.0 challenges a success. Small and medium-sized businesses must be exposed to these concepts and technologies. As a result, in this work, we will emphasize the attractiveness and significance of small and medium-sized enterprises in comparison to large enterprises.

##### B. Design the survey

In order to categorize businesses based on their size, initial company information is requested such as number of employees, sales, and business sector. This information is requested using selection fields, allowing respondents to choose from options or intervals. The 42 Industry 4.0 concepts in Section 2 are then evaluated for existing level and target levels (from 1 to 5). The significance of the concepts to the business should also be emphasized (from 1 to 5).

It is essential to provide value to businesses and encourage respondents to complete the survey. One approach to

achieving this objective is to provide graphical representations of Industry 4.0 readiness (existing levels) and target levels in relation to concepts during the self-assessment. The immediate display of the current status report as spider web diagrams motivates participants to complete the evaluation (which compares the current value of each Industry 4.0 concept with its target value). Participants are also provided with a prioritized list of the Industry 4.0 concepts with the advantage for their business. The most promising ideas are listed on a printable Excel spreadsheet.

##### C. Data collecting

The survey had a total of 50 respondents, 30 of which were considered to be small businesses and 20 of which were considered to be medium businesses. All of these companies were from the food supply chain industrial sector .Fig 1 illustrates the six categories of enterprises. On a scale from one to five, the participating companies were asked to rank the significance of each Industry 4.0 concept to their business. All evaluated the significance of the Industry 4.0 concepts. On the scale, 1 indicated a concept that is not at all relevant, while 5 indicated a concept that is rated as being extremely important. The range for the scale was from 1 to 5.

In accordance with the definition of maturity level, the current level of implementation and the desired level of implementation in each Industry 4.0 concept were evaluated.

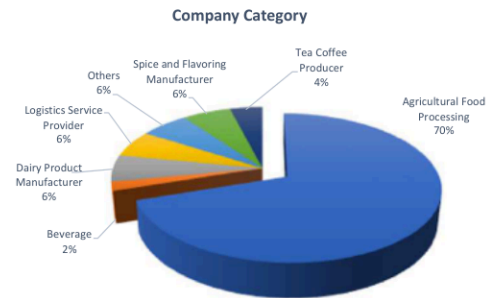


Fig. 1. Categorization of the food supply chain enterprises.

#### V. RESULTS

##### A. Importance of Industry 4.0 Concepts

On a one-to-five scale, the participating companies were asked to rank the importance of each Industry 4.0 concept to their business. On the scale, 1 indicated a concept that is not at all relevant, while 5 indicated a concept that is rated as being extremely important. Fig. 2 shows the results of all 50 companies, with the rankings determined by the average value of the responses. Fig. 3 illustrates a comparison of the significance of Industry 4.0 for small and medium-sized enterprises categorized by the Industry 4.0 dimension.

According to Fig.2, TG-04 IoT and CPS is the most significant Industry 4.0 concept for SMEs, as it is the only concept with an average value greater than 4. There are 17 Industry 4.0 concepts that are considered moderately important to important by SMEs (average value between 3 and 4). Other 24 Industry 4.0 concepts were rated as quite unimportant to moderately important (average value between 2 and 3).

A comparison of the significance of the Industry 4.0 dimension for small and medium-sized enterprises in Fig.3 shows that both small and medium enterprises have a similar opinion. The most important Industry 4.0 dimension is the technology related to data and the least important dimension is the Socio-Culture.

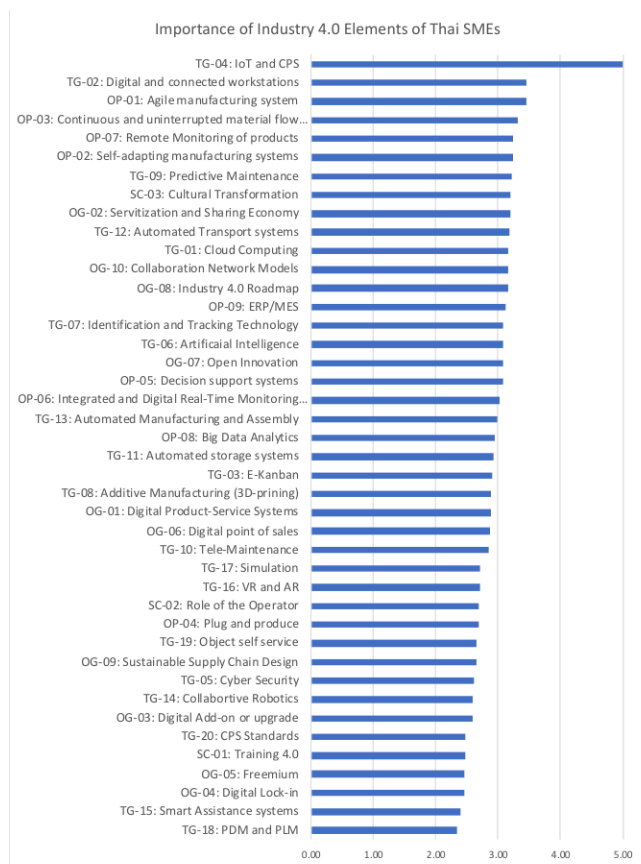


Fig. 2. Results of the importance of Industry 4.0 from 50 companies

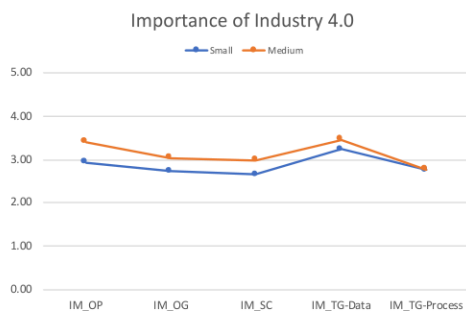


Fig. 3. A comparison of the significance of the Industry 4.0 dimension for small and medium-sized enterprises

### B. Readiness of SMEs

The existing level and the target level of implementation in each Industry 4.0 concept were evaluated. Fig. 4 illustrates the results of the implementation level of small and medium-sized enterprises categorized by Industry 4.0 dimensions.

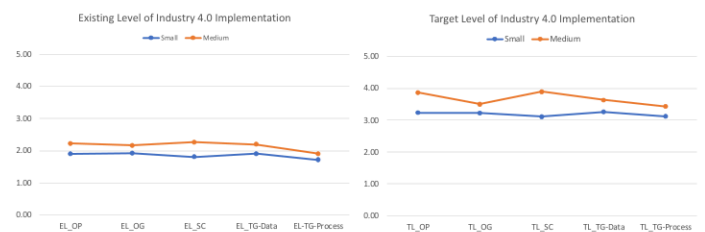


Fig. 4. Existing and target implementation level of Industry 4.0 concepts.

## VI. CONCLUSION

The implementation of Industry 4.0 in manufacturing companies presents a unique set of challenges for small and medium-sized businesses. Through the utilization of a pre-existing self-assessment tool for Industry 4.0 and a survey that was carried out among small and medium enterprises, the objective of this research was to determine which aspects of Industry 4.0 hold the greatest potential for application in businesses of varying sizes. In conducting this research, both of these aspects were taken into consideration (small and medium). According to the findings of the study, medium-sized businesses have a significantly more optimistic view regarding the prospects presented by Industry 4.0 concepts than small businesses do. According to the opinions of industry specialists, the implementation and transfer of Industry 4.0 in businesses of a medium size present a particularly lucrative opportunity. Small- and medium-sized businesses, in contrast to medium-sized businesses, still have significant gaps between their existing level and their target level. This fact highlights the necessity for additional research and the transfer of knowledge in order to bring Industry 4.0 to these types of businesses.

Therefore, further research is required to determine the reasons why some aspects of Industry 4.0 have not yet been implemented in certain contexts. The question of why Industry 4.0 is seen as having less potential, particularly for small businesses, should be the focus of research in the future.

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