Critical Success Factors for the implementation of Industry 4.0 Strategy in the Food Processing Industry of Thailand

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INTRODUCTION

In 2017, Thailand entered the 20- Year National Strategy to lead the country to Thailand 4.0, each parts of government were transmitted this policy and applied with their own strategies. One of strategy was Thailand Industry 4.0 development which created by Ministry of Industry and objective was setting framework to drive Thailand industry development to Industry 4.0 which related with the policy of Thailand 4.0 under the vision "Toward to industry which drive by knowledge and linked with world economy" by setting the goal in 20-year (2017-2036) for Thai industry growth of Gross Domestic Product (GDP) on average at least 4.5% per year. The average investment growth at least 10% per year. The average of export value grown 8% per year and average of Total Factor Productivity (TFP) grown at least 2.0% per year which was expansion rate that affected Thailand move into the highest income country by 2036 as the goal of National Strategy (Ministry of industry, 2017). Therefore, government assigned to Ministry of industry to be a leader to drive Thailand industry 4.0 development via Department of Industrial Promotion by determining the target industry to be the first series at the beginning which was 4 fields and Food Processing Industry was add in. Food Processing Industry was important for Thailand industry because Thailand was agricultural country which was the main ingredient of food processing industry. And food processing industry was one of industry which develop in many years and the export value in 2017 was 1 trillion baht and there are many companies succeed on the business. Then the study of critical success factors should start at food processing industry which can adapt research result in use in other industries efficiently. (Chatutananant, 2018)

Application of Thailand industry 4.0 development in practice and effective had to coordinate between government and industry by setting clearly the development direction with indicators which can identify the strategy progress. Beside of Thailand industry 4.0 development was an instrument for Thailand industry development, it was other necessary instrument which was Critical Success Factors (CSFs) which was the secret key in strategy implementation to achieve the goal according to key performance indicators (KPIs) which defined. In each industry, it would have critical success factors which the director of the company needed to understand and lead them to company success. Critical success factors were variable which affected significant impact for competition in overall in industry. In general, critical success factors were different in each industry and important for defining ability of company which success in industry field (Wheelen TL, Hunger JD, Hoffman AN, Bamford CE., 2018)

In the present, there are many researches studied the implementation of industry strategy 4.0 applying in organization but not many researches studied how to successfully implementation with the strategy. Industrial sector implements the industry development strategy 4.0 by lacking of success factors as a tool, the operation would not reach the goal or if it can reach the goal, it would take a long time. From the importance were mention, the researchers were interested in the Critical Success Factors for the Implementation of Industry 4.0 Strategy in the Food Processing Industry of Thailand. In order that, to find the tools which helped the government and industrial sectors in the implementation of strategy to be success in the future.

RESEARCH OBJECTIVES

1. To study the critical success factors of the implementation of Thailand Industry Strategy 4.0 in Thailand's food processing industry.
2. To study the key performance indicators of the implementation of Thailand Industry Strategy 4.0 in Thailand's food processing industry.

RESEARCH FRAMEWORK

From the literature review, the researcher defined research framework by identify critical success factors of the implementation of Thailand Industry Strategy 4.0, having CSFs would lead success of the

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implementation of Thailand Industry Strategy 4.0 and the last the organization implement Thailand Industry Strategy 4.0 then assess from the defining indicators. The research framework showed as below (Figure-1:)

Figure-1: Research Framework

4. METHODOLOGY

The population was people who related in Thailand Industry Strategy 4.0 in Thailand food processing industry consisted the 3 representatives of government sectors which related in Food processing industry group: the representative of Department of Industrial Promotion, the representative from The Division II Sectoral of Industrial Policy and the representative from National Food institute and private entrepreneurs who were the chief executive of establishment in Food processing industry, 17 people.

Research instrument consisted semi-structure interview forms which applied in in-depth interview with the sample group. The questions related with CSFs and KPIs of Thailand Industry Strategy 4.0 implementation. The researcher brought the interviews form to 3 experts to check the correction and validity according to content structure and develop along comments of experts before adopted in data collection. Questionnaires, the researchers created questionnaires after the result of in-depth interview from the sample group. The method of questionnaires was Pairwise Comparison by setting relatively importance scale to 9 levels to arrange the priority of CSFs and KPIs by Analytic Hierarchy Process (AHP).

Data analysis, the researcher applied data form transcript of in-depth interview to extract key information, interpreted, content structure, analyzed key theme which related to research objectives and descriptive summarize by member checking for correction of analyzing.

After the researchers found the factors from in-depth interview then applied all factors to calculate to find pair factors which compare from the formula (Saaty, TL., 2003)

Number of pairs factors to compare = $\frac{n(n-1)}{2}$ (1)

N was the number of factors

The Analytic Hierarchy Process was assessment factors quality from discretion and opinion form experience and understanding which had the arrangement of priority by Pairwise comparison via making decision from quantity important, the process of analytic hierarchy process had 5 steps as follow:

1.Collection data from questionnaires, the result from questionnaires would be collected and finding mean of priority factors in pair by some sample of questionnaires the comparison of success factors of implementation of Thailand Industry development Strategy 4.0.

2.Making table of data and Normalized Matrix, making table of data to show the comparison of all factors and put the comparison factors until the end and calculate in column line to lead to do Normalized Matrix of factors that had appearance as square matrix ($n \times n$) to adapt in each calculation.

3.Finding Eigenvector, Eigenvector was the specific vector of matrix factors or in other words Eigenvector was value that indicate the important of each factor which showed as proportion and can convert to percentage.

4.Finding Maximum Eigenvalue (λmax) the specific scalar of matrix factors was the value that indicate deviation of factors comparison in each pair. If $\lambda max > n$, showed that the factors comparison in each pair were deviation. The researchers would find consistency. The calculation of λmax had the formula as follow (Saaty TL., 2003)

$$\lambda max = \frac{\frac{[Aij][Wij]}{Wij}}{n} \quad (2)$$

λmax was Maximum Eigenvalue

Aij was Normalized Matrix of factors
Wij was Eigenvector in each line
N was number of factors

5. Finding consistency, when λmax was more value than all factors (λmax > n) showed that factors comparison in each pair were deviation, then the process of finding consistency would start to find out the deviation was acceptable or not which consisted Consistency Index (C.I.), Random Consistency Index,(R.I.) and Consistency Ratio (C.R). The formula as follow:

$$\text{Consistency Index C.I.} = \frac{\lambda \max - n}{n-1} \quad (3)$$

Random Consistency Index (R.I.) found out at table 1 as follow:

Table 1: Random Consistency Index in each factor (Saaty TL., 2008)

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
R.I.	0	0	0.52	0.89	1.111	1.225	1.335	1.40	1.445	1.49	1.52	1.54	1.56	1.58	1.59

$$\text{Consistency Ratio C.R.} = \frac{C.I.}{R.I.} \quad (4)$$

For The consideration indicator the Consistency Ratio showed at table 2

Table 2: The consideration indicator the Consistency Ratio (Saaty TL., 2008)

n	3	4	5 up
C.R. standard	0.05	0.08	0.10

CONCLUSION

From in-depth interview and questionnaires with sample group who related in Thailand Industry strategy development 4.0 in Thailand food processing industry showed the data analysis as follow:

The analysis results characters of sample group found that the majority of informer was 13 male or 61.9%, the age was 50-59-year-old, 8 people or 38.1%, education in bachelor's degree 12 people or 57.1% and having experience in present position working from 5-14 years 10 people or 47.6%

From in-depth interview, the analysis results of CSFs of the implementation of Thailand Industry strategy development 4.0 in Thailand food processing industry had 8 factors as follow; chief executive support (C1), education and training (C2), change management (C3), implementation team (C4), business plan and vision (C5) capital (C6), government support (C7), international partnerships (C8) the analyzation of the priority of CSFs of Thailand Industry strategy development 4.0 showed at table 3.

Table 3: The analyzation of the priority of CSFs of Thailand Industry strategy development 4.0

CSFs	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**hTotal**	**Eigenvector**
C1	0.18	0.27	0.28	0.07	0.28	0.20	0.12	0.12	**1.52**	**0.1901 (1)**
C2	0.06	0.09	0.07	0.07	0.07	0.20	0.12	0.12	**0.80**	**0.0998 (6)**
C3	0.09	0.18	0.14	0.28	0.28	0.05	0.19	0.12	**1.33**	**0.1662 (3)**
C4	0.36	0.18	0.07	0.14	0.07	0.20	0.19	0.15	**1.35**	**0.1686 (2)**
C5	0.09	0.18	0.07	0.28	0.14	0.20	0.19	0.15	**1.29**	**0.1616 (4)**
C6	0.09	0.04	0.28	0.07	0.07	0.10	0.12	0.15	**0.93**	**0.1159 (5)**
C7	0.09	0.04	0.05	0.05	0.05	0.05	0.06	0.18	**0.56**	**0.0704 (7)**
C8	0.04	0.02	0.04	0.03	0.03	0.02	0.01	0.03	**0.22**	**0.0273 (8)**
vTotal	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**8**	**1**
n = 8, λmax = 8.90, C.I. = 0.1286, R.I. = 1.40, C.R. standard = 0.10, C.R. = 0.0919										

From table 3 found that CSFs of the implementation of Thailand Industry strategy development 4.0 can arrange from the most priority to the less as follow: 1) chief executive support (C1) found that the Eigenvector was at 0.1901 or the priority of this factor as 19.01%. 2) Implementation team (C4) found that the Eigenvector was at 0.1686 or the priority of this factor as 16.86%. 3) Change management (C3) found that the Eigenvector was at 0.1662 or the priority of this factor as 16.62%. 4) Business plan and vision (C5) found that the Eigenvector was at 0.1616 or the priority of this factor as 16.16%. 5) Capital (C6) found that the Eigenvector was at 0.1159 or the priority of this factor as 11.59%. 6) Education and

training (C2) found that the Eigenvector was at 0.0998 or the priority of this factor as 9.98%. 7) Government support (C7) found that the Eigenvector was at 0.0704 or the priority of this factor as 7.04%. 8) international partnerships found that the Eigenvector was at 0.0273 or the priority of this factor as 2.73% and the λmax = 8.90 (λmax > n) which showed that the factors comparison of each pair were deviation and the C.R. = 0.0919 (C.R. < C.R. standard) which meant deviation of factors comparison of each pair was accepted.

From in-depth interview the analysis result of KPIs of the implementation of Thailand Industry strategy development 4.0 in food processing industry group had 4 aspects as follow: customer service (K1), capital, sales volume and profit (K2), performance (K3), acceptable and satisfaction of staff (K4) the analysis result of KPIs of the implementation of Thailand Industry strategy development 4.0 showed at table 5.

Table 5: The analysis result of KPIs of the implementation of Thailand Industry strategy development 4.0

KPIs	K1	K2	K3	K4	hTotal	Eigenvector
K1	0.46	0.50	0.46	0.38	**1.80**	**0.4495 (1)**
K2	0.23	0.25	0.31	0.25	**1.04**	**0.2596 (2)**
K3	0.15	0.13	0.15	0.25	**0.68**	**0.1707 (3)**
K4	0.15	0.13	0.08	0.13	**0.48**	**0.1202 (4)**
vTotal	**1**	**1**	**1**	**1**	**4**	**1**
n = 4, λmax = 4.07, C.I. = 0.0233, R.I. = 0.89, C.R. standard = 0.08, C.R. = 0.0262						

According to table 5 found that KPIs of the implementation of Thailand Industry strategy development 4.0 can arrange from the most priority to the less as follow: 1) customer service (K1) found that the Eigenvector was at 0.4495 or the priority of indicators as 44.95%. 2) Capital, sales volume and profit (K2) found that the Eigenvector was at 0.2596 or the priority of indicators as 25.96%. 3) Performance (K3) found that the Eigenvector was at 0.1707 or the priority of indicators as 17.07%. And 4) acceptable and satisfaction of staff (K4) found that the Eigenvector was at 0.1202 or the priority of indicators as 12.02% and the λmax = 4.07 (λmax > n) which showed that the factors comparison of each pair were deviation and the C.R. = 0.0262 (C.R. < C.R. standard) which meant the deviation of factors comparison of each pair was accepted.

6. DISCUSSION

From the analysis result of CSFs of the implementation of Thailand Industry strategy development 4.0 in Thailand food processing industry group found that:

Chief executive support was the success factors of the implementation of Thailand Industry strategy development 4.0 in Thailand food processing industry group. It was the priority factor which related with the research of Mukkamala (2013) the studied of Critical Success Factors for the Implementation of PeopleSoft Enterprise Resource Planning in a Public Organization at Delaware U.S. which found that the chief executive support was important to implementation of PeopleSoft system. The chief executive support in direction, human resources and financial which important in performance process. It was the second important factors (Mukkamala HK., 2013) as same as the research of Holotiuk and Beimborn (2017), the studied of Critical Success Factors of Digital Business Strategy in Leimeister (Digital Business Strategy: DBS) in Germany which found that management team was important to intention in process of Digital Business Strategy and change organization culture and lead the organization succeed in transitioning to digital generation (Holotiuk F, Beimborn D., 2017)

Implementation team was the success factor of the implementation of Thailand Industry strategy development 4.0 in Thailand food processing industry group. It was the second important factor which related to research of Mukkamala (2013) the Critical Success Factors for the Implementation of PeopleSoft Enterprise Resource Planning in a Public Organization at Delaware U.S. which found from the stakeholders interviewing about the importance of implementation team for success of using PeopleSoft which was the third important factors.

Change management was the success factor of the implementation of Thailand Industry strategy development 4.0 in Thailand food processing industry group. It was the third important factor which related to research of Whittaker (2017) the studied of Uncovering Organizational Effectiveness by Assessing Factors Affecting ERP Implementation Success which found that change management affected

to success in applying ERP in the organization. Lacking change management would make incompetent decision making which affected to employee retention and competitiveness of organization

Business plan and vision was the success factor of the implementation of Thailand Industry strategy development 4.0 in Thailand food processing industry group. It was the fourth important factor which related to research of Shatat (2015) the studied of Critical Success Factors in Enterprise Resource Planning (ERP) System Implementation: An Exploratory Study in Oman found that apparently, purposes and goal were the success factors of organization resource planning system processing in Oman. It was the fourth important factors.

Capital was the success factor of the implementation of Thailand Industry strategy development 4.0 in Thailand food processing industry group. It was the fifth important factor which related to research of Müller, Kiel, and Voigt (2018) the studied of The Role of Opportunities and Challenges in the Context of Sustainability Drives the Implementation of Industry 4.0 in Germany which found that implementation of industry 4.0 was the challenges, if the company had not enough financial resources to change especially for SMEs or Startups business (Müller JM, Kiel D, Voigt K., 2018) as same as research of Yeoh, Koronios, and Gao (2006) the studied of Critical Success Factors for the Implementation of Business Intelligence System in Engineering Asset Management Organisations in Australia, which found that business intelligence system was the system which used a lot of resources and high expend (Whittaker M., 2017) so having enough resources would help responsible person get through obstacle in processing and deliver work as the plan especially having enough capital would make responsible person get through suitable equipment and technology which important for industry 4.0 would not block because of lacking funding, otherwise it would be a threat to organization in the future.

Education and training were the success factor of the implementation of Thailand Industry strategy development 4.0 in Thailand food processing industry group. It was the sixth important factor which related to research of Shatat (2015) the studied of Critical Success Factors in Enterprise Resource Planning (ERP) System Implementation: An Exploratory Study in Oman which found that education and training users was the success factors of resources planning system implementation in organization in Oman. It was number seven of important factors (15) and related with research of Mukkamala (2013) the studies of Critical Success Factors for the Implementation of PeopleSoft Enterprise Resource Planning in a Public Organization at Delaware, U.S. which found that training users and giving knowledge were the important things for success of implementation ERP in organization. Organization had budget for necessary training to users in each department in the state and the factors was the fifth important factors.

Government support was the success factor of the implementation of Thailand Industry strategy development 4.0 in Thailand food processing industry group. It was the seventh important factor from in-depth interview of government sectors which related with Thailand Industry strategy development 4.0 also found that government had role in motivator and support implementation of industry by the government offering the program to stimulate economic development such as offering capital for SMEs or Startups, various tax deduction and also developing laws, regulations, rules and investment procedures which related with Mukkamala (2013) the studies of Critical Success Factors for the Implementation of PeopleSoft Enterprise Resource Planning in a Public Organization at Delaware, U.S. which suggested that government sectors should be willing to change practice and traditional practice process which government familiar. In addition, government also played role in support various business to focus on good business planning and effective market research including help in negotiating and managing trade agreements between domestic partners and oversea partners.

International partnerships were the success factor of the implementation of Thailand Industry strategy development 4.0 in Thailand food processing industry group. It was the eighth important factor which related to research of Mukkamala (2013) the studies of Critical Success Factors for the Implementation of PeopleSoft Enterprise Resource Planning in a Public Organization at Delaware, U.S. found that partnership and consulting were success factors of implementation of PeopleSoft system which important range at the last factors from 11 factors. The role of partnership and consulting was giving knowledge of techniques in using, training and support in which necessary processing including system upgrade (Mukkamala HK., 2013). And it related with the research of Shatat (2015) the studied of Critical Success Factors in Enterprise Resource Planning (ERP) System Implementation: An Exploratory Study in Oman which found that supporting from partnership was the success factors of Enterprise Resource Planning (ERP) System in Oman which was the factors number 9^{th}.

From the analyzation result of KPIs of the implementation of Thailand Industry strategy development 4.0 in food processing industry group found that:

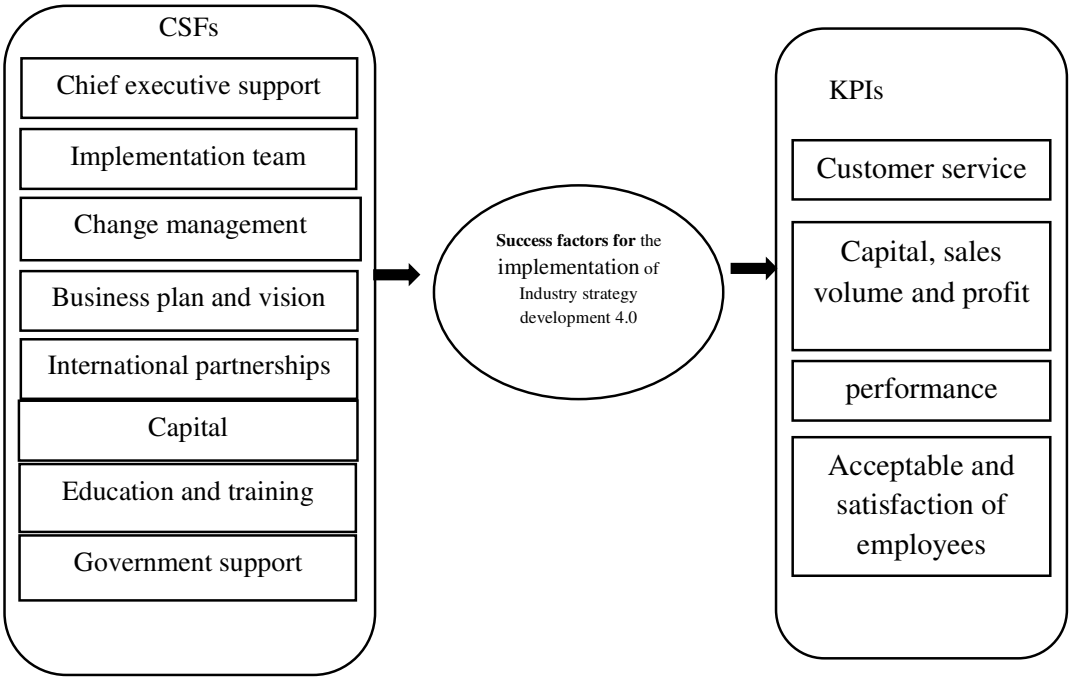
Customer service indicator indicated that how well does the organization service or respond customer needs? Measuring from customer satisfaction, delivery, customer complaints, developing products to reach need of customer, the indicators in of the implementation of Thailand Industry strategy development 4.0 in food processing industry group was the first important indicator which related with research of Kirschner (2013) which studied the Indicator in Digital Transformation Getting in Shape for the Digital World and found that 68% of the participants showed that the satisfaction of customer and brand supporting was the indicator in organization transformation getting for the digital world (Kirschner, 2013) and related with research of Mengistie (2012) which studied Analysis of the Critical Success Factors for ERP Systems Implementation in Federal Government office of U.S. which found that the good indicator in customer service based on success of ERP project implementation.

Capital, sales volume and profit indicator indicated that how well does the turnover of organization? Measuring from capital, sales volume and profit including other financial number of organization, the indicators of the implementation of Thailand Industry strategy development 4.0 in food processing industry group which was the second important indicator that related with Kirschner (2013) the studied of the Indicator in Digital Transformation Getting in Shape for the Digital World which found that 74% of participants agreed that number of financial was the indicator in transformation getting in shape for the digital world (Kirschner, 2013) and related with research of Mathrani and Viehland (2010) the studied of Critical Success Factors for the Transformation Process in Enterprise System Implementation in New Zealand which found that the goal of transformation process to enterprise system was decrease the capital of organization.

Performance indicator indicated that how well does the organization perform? Measuring from productivity, production efficiency, products, number of waste products, quality, standard and number of innovations, the indicators of the implementation of Thailand Industry strategy development 4.0 in food processing industry group which was the third important indicator which related with research of Lehong (2016) the studied of Digital Business KPIs: Defining and Measuring Success in U.S. which found that transformation of present business model to digital business, organization need to assess progress in processing and supply chain of products/services (Lehong, 2016) and related with research of Mengistie (2012) the studied of Analysis of the Critical Success Factors for ERP Systems Implementation in Federal Government office of U.S. which found that efficiency of processing based on success of project process.

Acceptable and satisfaction of employees indicator indicated that how well does the organization management? Measuring from employees satisfaction, resignation rate, the indicators of the implementation of Thailand Industry strategy development 4.0 in food processing industry group which was the fourth important indicator and related with research of Lehong (2016) the studied of Digital Business KPIs: Defining and Measuring Success in U.S. found that in transformation of present business model to digital business, organization need to balance satisfaction of customer and employees acceptant indicator to balance them and related with research of Mukkamala (2013) the studied of Critical Success Factors for the Implementation of PeopleSoft Enterprise Resource Planning in a Public Organization at Delaware, U.S. found that satisfaction of users ERP reflect to success of PeopleSoft system in use in organization.From the research results and discussion showed that CSFs of the implementation of Industry strategy development 4.0 had 8 factors and KPIs of the implementation of Industry strategy development 4.0 had 4 aspects. The researchers would present the model of critical success factors for the implementation of industry 4.0 as Figure-2.

Figure-2 : The model of critical success factors for the implementation of industry 4.0



This research focus on the Thailand food processing industry but other industries can apply this model in use in their industry, including government sectors can apply this model in use and review the implementation of Industry strategy development 4.0 for food processing industry and other industries.

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