APPROACHES FOR COMPETENCY DEVELOPMENT OF WORKFORCES IN THE MANUFACTURING AND SERVICE INDUSTRY SECTOR, EASTERN ECONOMIC CORRIDOR (EEC): A CASE STUDY OF INDUSTRIAL LAND IN RAYONG PROVINCE IN THAILAND

Kunlasap Thongprasit, King Mongkut's University of Technology North Bangkok

ABSTRACT

The purpose to study and analyze the confirmatory factor of approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province.

The sample group in the research was establishment administrators in the new target industries (S-Curve) in the Eastern Economic Corridor (EEC) of the industrial land in Rayong Province, with a total number of 488 individuals. The research instrument was a questionnaire with a rating scale with 5 levels according to the Likert method. The statistics used in the data analysis were frequency, percentage, mean, standard deviation, and index values used to determine the coherence of the model with the empirical data by confirmatory factor analysis.

Establishment administrators in new target industries (S-Curve) Eastern Economic Corridor (EEC) of industrial land in Rayong Province had opinions on approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province, for overall and in every aspect, at a high level.

The model of approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province was consistent with the empirical data ($\chi 2=282.66$, $df=249$, $p=0.07$, $\chi 2/df=1.13$, GFI=0.96, AGFI=0.94, RMSEA=0.016), which consisted of The knowledge factor consisted of 13 indicators, the skill factor consisted of 7 indicators, and the desirable attributes factor consisted of 4 indicators. When sorting the importance of factors in descending order, it was found that the knowledge factor and skill factor are the most important, followed by the desirable attributes factor.

Keywords: Workforce Competency; Manufacturing and Service Industry; New Target Industry; Eastern Economic Corridor.

INTRODUCTION

Rapid changes in technology Limitations of Thailand's economic structure and population structure entering an aging society resulted in Thailand's industries and services must adapt to create new business opportunities and grow sustainably. Developing and upgrading the

industries and services of the future is essential for Thailand to lay the foundations for continuous long-term competitiveness. The industries and services of the future of Thailand include industries that build on the old industrial and service bases that are strong on a global scale. Nowadays, industries that are the basis of the modern economy has transformed the traditional way of doing business, and industries that will be in great demand in the future must create value-added based on research, innovation development, and the use of technology that depends on human resources with knowledge and quality. However, changes in the world in terms of advances in science, technology, and innovation, communication, and transport that have been developed rapidly, as well as higher competition in the global market leads to the need for industry and service sectors to be transformed into Thailand 4.0. This is a shift from efficiency-driven to technology and innovation-driven and shifting from basic services to those that require advanced skills and technology (Office of the National Economic and Social Develop, 2018).

The government has a policy that aims to develop the national economy by promoting the industrial sector, service sector, and social sector in the parts that the country already has a basic competence and needs stimulus measures to accelerate its development. This led to the development of a project of the Eastern Economic Corridor (EEC), which was identified as a strategic plan under the Thailand 4.0 economic model that focuses on spatial development with the goal of promoting investment, increasing competitiveness, and making the country's economy grow in the long run. It is also upgrading the area in 3 provinces, namely Chachoengsao, Chonburi, and Rayong, to support the expansion of existing industries with potential in new target industries (S-Curve) and future industries (New S-Curve) whereas Rayong province has strategies and approaches in supporting SMEs to develop, grow, keep pace with economic development to respond to the development that shall support the Eastern Economic Corridor (EEC) and Thailand 4.0 economic model.

Anyhow, in order for the manufacturing and service industry in the Eastern Economic Corridor (EEC) of the industrial land in Rayong Province to be able to expand and attract foreign investment to establish production bases and specialized industries in Thailand, it is necessary to create high-quality workforces to meet the needs of the industrial sector in the Eastern Economic Corridor (EEC) in a timely manner and with sufficient numbers to meet the demand. This is one of the important factors in driving the country's economy effectively which requires cooperation between educational institutions and establishments in developing the workforces to have competencies in terms of knowledge, skills, and desirable attributes. Modern resources that should be assembled to keep pace with changes are included experts, personnel, tools, and educational equipment in order to distribute the resources and reinforce new target industries (S - Curve), which is an important economic engine for innovation to enhance competitiveness. It is imperative to continue to develop the workforces in today's manufacturing and service industry by '*Reskilling*', '*Upskilling*', and '*Multiskilling*' as well as modifying the whole system of mindset, skillset, and behavior set to drive towards Thailand 4.0 economic model that is truly wealthy, stable and sustainable.

Therefore, the development of human workforce competency and capability as required is necessary and beneficial for Thailand since it shall prepare human resources to continually enter the economic area according to the demands of the labor market and enhance the quality of workforces with advanced knowledge and skills. This shall be an important component of enhancing Thailand's competitiveness in the future. Hence, the researchers are interested in studying approaches for competency development of workforces in the manufacturing and

service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province, as they shall be the mechanism for driving Thailand's economy further.

OBJECTIVES OF THE RESEARCH

To study the approaches to competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province.

To analyze the confirmatory factor of approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province.

HYPOTHESIS

Approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province had 3 factors, which are knowledge factor, skill factor, and desirable attributes factor, and every element was under the same major primary factor.

RESEARCH METHODOLOGY

Research Variables

Structural variables include knowledge factor, skill factor, and desirable attributes factor.

Indicator variables consisted of 13 indicators from the knowledge factor, 7 indicators from the skill factor, and 4 indicators from the desirable characteristics factor.

Time Period

Time period used in this research started operating from 1 March 2021-31 August 2021

Area Boundaries

This research was conducted to study and collect data from establishments in the new target industries (S-Curve) Eastern Special Development Zone (EEC) of the Industrial Zone in Rayong Province, registered with the Department of Industrial Works, Ministry of Industry.

The research instruments applied included opinion questionnaires on the approaches to competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province. It is a type of rating scale with 5 levels according to the Likert method; namely highest, high, moderate, low, and lowest. Regarding the criteria set for result interpretation, the mean between 4.51-5.00 indicates the highest level, 3.51-4.5 indicates a high level, 2.51-3.50 indicates a moderate level, 1.51-2.5 indicates a low level, and 1.0-1.5 indicates the lowest level (Srisa-ard, 2002). They were classified into 3 aspects: knowledge, skills, and desirable attributes with the index of item objective congruence (IOC), which was between 0.8-1.0, with a reliability coefficient of 0.96.

Data Processing and Analysis

Analyzing opinions on approaches to competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC) by using fundamental statistical values such as numbers, percentage, mean, and standard deviation.

Analyzing the confirmatory factors of approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC) to examine the construct validity by using the LISREL program.

RESULTS

The study of general information for establishments in new target industries (S-Curve) of the Eastern Economic Corridor (EEC) revealed the results as shown in Table 1.

Table 1
NUMBER AND PERCENTAGE OF ESTABLISHMENTS IN NEW TARGET INDUSTRIES (S-CURVE) OF THE EASTERN ECONOMIC CORRIDOR (EEC)

10 New Target Industries (S-Curve)	Quantity	Percentage
1. Group 5 former industries (The First S-Curves)		
1.1 Modern automotive industry	51[1]	40.8
1.2. Smart electronics industry	8[3]	6.4
1.3. Good income industry and wellness tourism	1[5]	0.8
1.4. Agricultural and biotechnology industries	9[2]	7.2
1.5. Food Processing Industry	2[4]	1.6
2. Group 5 New Industries (The New S-Curves)		
2.1 Industrial robots	10[2]	8
Aviation and logistics	1[4]	0.8
2.3 Biofuels and biochemical industries	31[1]	24.8
2.4 Digital industry	10[2]	8
2.5 Medical and comprehensive healthcare industry	2[3]	1.6
Total	125	100

( ) The number of establishments in new target industries (S-Curve) of the Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province, sorted in descending order.

Table 1 shows that for establishments in new target industries (S-Curve) of the Eastern Economic Corridor (EEC), most establishments are in the group of 5 existing industries (The First S-Curves). 51 establishments are in the modern automotive industry, accounted for 40.8 percent, followed by 9 establishments in the agricultural and biotechnology industries, accounted for 7.2 percent, 8 establishments in the smart electronics industry, accounted for 6.4 percent, 2 establishments in the food processing industry, accounted for 1.6 percent, and 2 establishments in good income industry and wellness tourism sector, accounting for 0.8 percent respectively. As for most of the establishments in the group of 5 new industries (New S-Curves), 31 establishments are in biofuels and biochemical industries, accounted for 24.80 percent, followed by 10 establishments in industrial robots, accounted for 8.0 percent, 10 establishments in the

digital industry, accounted for 8.0 percent, 2 establishments in the medical and comprehensive healthcare industry, accounted for 1.6%, and 1 establishment in aviation and logistics, accounted for 0.8 percent respectively.

Results of the study on approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC) are as shown in Tables 2-4.

Results of the study on approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC), in terms of knowledge, are as shown in Table 2.

Table 2
FIGURES, PERCENTAGES, AND OPINIONS ABOUT APPROACHES TO COMPETENCY DEVELOPMENT OF WORKFORCES IN THE MANUFACTURING AND SERVICE INDUSTRY SECTOR, EASTERN ECONOMIC CORRIDOR (EEC)

| Knowledge | 10 New Target Industries (S-Curve) | | | | | | | | | | Quantity | Percentage |
| | 5 Existing Industries (The First S-Curves) | | | | | 5 New Industries (The New S-Curves) | | | | | | |
	Modern automotive industry	Smart electronics industry	Good income industry And wellness tourism	Agricultural and biotechnology industries	Food processing industry	Industrial Robots	Aviation And logistics industry	Biofuels And biochemical industries	Digital industry	Medical and comprehensive healthcare industry		
Welding (welder and welding robot control)		✓				✓					2[6]	20.00
Computer drawing with CAD, CAM, CNC programs		✓			✓		✓		✓	✓	5[4]	50.00
Computer drawing with a programmable logic controller (PLC).		✓		✓	✓	✓	✓	✓	✓	✓	8[1]	80.00
Industrial robots	✓	✓		✓		✓	✓	✓	✓	✓	8[1]	80.00
Artificial Intelligence (AI)		✓		✓		✓	✓	✓	✓	✓	7[2]	70.00
Management system		✓	✓		✓		✓	✓	✓	✓	7[2]	70.00
Motor	✓										1[7]	10.00
Electrical system	✓	✓							✓		3[5]	30.00
Electronic system	✓	✓		✓	✓			✓	✓		6[3]	60.00
Hydraulic system	✓	✓							✓		3[5]	30.00
Pneumatic system	✓										1[7]	10.00
Sensors and actuators		✓				✓			✓		3[5]	30.00
Software Development for service and linkage to manage Big Data, Data Analytics, Predictive	✓	✓	✓	✓		✓		✓	✓		7[2]	70.00

The figure 1 means the rating of opinions on approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province, regarding knowledge aspect.

From Table 2, it was found that in terms of knowledge, establishment administrators from new target industries (S-Curve) of the Eastern Economic Corridor (EEC) in the industrial land in Rayong Province had opinions on the approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province, the percentage of knowledge aspect can be sorted in descending order as follows:

Knowledge of computer drawing with programmable logic controllers (PLC) in 8 industries accounted for 80.00%, consisting of establishments in the smart electronics industry, agricultural and biotechnology industries, food processing industry, industrial robots, aviation, and logistics industry, biofuels, and biochemical industries, digital industry, and the medical and comprehensive healthcare industry. And knowledge about industrial robots is in 8 industries, consisting of establishments in the modern automotive industry, smart electronics industry, agricultural and biotechnology industries, industrial robots, aviation, and logistics industry, biofuels and biochemical industries, digital industry, and the medical and comprehensive healthcare industry.

Knowledge of Artificial Intelligence (AI) in 7 industries, accounted for 70.00 percent, consisting of establishments in the smart electronics industry, agricultural and biotechnology industries, industrial robots, aviation and logistics industry, biofuels and biochemical industries, digital industry, and medical and comprehensive healthcare industry. Knowledge of software development for providing service and linkage for data management, Big Data, Data Analytics, Predictive in 7 industries, consisting of establishments in the modern automotive industry, smart electronics industry, good income industry and wellness tourism, agricultural and biotechnology industries, industrial robots, biofuels and biochemical industries, and digital industry. While knowledge of management systems is including establishments in the smart electronics industry, food processing industry, aviation and logistics industry, biofuels and biochemical industries, digital industry, good income industry and wellness tourism, and medical and comprehensive healthcare industry.

Knowledge of electronic systems in 6 industries accounted for 60.0 percent, consisting of establishments in the smart electronics industry, modern automotive industry, agricultural and biotechnology industries, the food processing industry, biofuels, and biochemical industries, and the digital industry.

Knowledge of computer drawing with CAD, CAM, CNC programs in 5 industries, accounted for 50.00 percent, consisting of establishments in the smart electronics industry, food processing industry, aviation and logistics industry, digital industry, and medical and comprehensive healthcare industry.

Knowledge of sensors and actuators in 3 industries accounted for 30.0 percent, consisting of establishments in the smart electronics industry, industrial robots, and the digital industry. While knowledge of electrical systems consists of establishments in the modern automotive industry, the smart electronics industry, and the digital industry. And knowledge of hydraulics consists of establishments in the smart electronics industry, the modern automotive industry, and the digital industry.

Knowledge of welding (welder and welding robot control) in 2 industries accounted for 20.00 percent, consisting of establishments in the smart electronics industry and the industrial robot industry.

Knowledge of pneumatic systems in 1 industry accounted for 10.00 percent, consisting of establishments in the smart automotive industry.

Approaches for Competency Development of Workforces in the Manufacturing and Service Industry Sector

Results of the study on approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC), in terms of knowledge, are as shown in Table 3.

Table 3
THE MEAN AND STANDARD DEVIATION OF APPROACHES FOR COMPETENCY DEVELOPMENT OF WORKFORCES IN THE MANUFACTURING AND SERVICE INDUSTRY SECTOR in EEC, IN THE ASPECT OF SKILLS

Assessment Item	Level of Opinion		
	$\bar{X}$	S.D.	Results
1. Specific operational skills of the target industry (skill1)	4.41	0.12	High
2. Digital skills (skill2)	4.38	0.14	High
3. Foreign language communication skills (skill3)	4.36	0.17	High
4. Advanced Thinking Skills (skill4)	4.40	0.11	High
5. Organizational communication skills (skill5)	4.32	0.19	High
6. Operational Collaboration Skills (skill6)	4.34	0.18	High
7. Skills for adaptation and flexibility to situations (skill7)	4.30	0.22	High
Overall	4.36	0.16	High

Remark: the mean between 3.51 and 4.45 indicates a high level.

Table 3 demonstrated that establishment administrators from new target industries (S-Curve) of the Eastern Economic Corridor (EEC) in the industrial land in Rayong province had opinions on the approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province, for the overall aspect of skills at a high level ($\bar{X} = 4.36$). When considering each skill separately, it was found that all skills were at a high level as the mean was sorted in descending order such as the specific operational skills of the target industry (skill1) ($\bar{X} = 4.41$), advanced thinking skills (skill4) ($\bar{X} = 4.40$), digital skills (skill2) ($\bar{X} = 4.38$), foreign language communication skills (skill3) ($\bar{X} = 4.36$), operational collaboration skills (skill6) ($\bar{X} = 4.34$), organizational communication skills (skill5) ($\bar{X} = 4.32$), and skills for adaptation and flexibility to situations (skill7) ($\bar{X} = 4.30$) respectively.

Approaches to Competency Development of Workforces in the Manufacturing and Service Industry Sector, in the Aspect of Desirable Attributes

The results of a study on the approaches to competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province, in the aspect of desirable attributes, are as shown in Table 4.

From Table 4, it was found that the establishment administrators from new target industries (S-Curve) of the Eastern Economic Corridor (EEC) in the industrial land in Rayong Province had opinions on the approaches to competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province, for desirable attributes overall at a high level ($\overline{X}$=4.40). When considering each item separately, it was found that all items were at a high level, and the mean can be sorted in descending order as honesty and ethics (attri1) ($\overline{X}$=4.44), continuous learning and curiosity (attri3) ($\overline{X}$=4.42), leadership (attri2) ($\overline{X}$=4.40) and working towards achievements (attri4) ($\overline{X}$=4.33) respectively.

Table 4
THE MEAN AND STANDARD DEVIATION OF APPROACHES FOR COMPETENCY DEVELOPMENT OF WORKFORCES IN THE MANUFACTURING AND SERVICE INDUSTRY SECTOR IN EEC IN THE ASPECT OF DESIRABLE ATTRIBUTES

Assessment Item	Level of Opinion		
	$\overline{X}$	S.D.	Results
1. Honesty and Ethics (attri1)	4.44	0.13	High
2. Leadership (attri2)	4.40	0.15	High
3. Continuous learning and curiosity (attri3)	4.42	0.14	High
4. Working towards achievements (attri4)	4.33	0.17	High
Overall	4.40	0.15	High

Remark: the mean between 3.51 and 4.45 indicates a high level.

From the confirmatory factor analysis of approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province, which is an analysis to find the importance of variables that vary with each factor, and examine the loading and priorities of each factor, i.e., knowledge, skills, and desirable attributes measured by the loading of each factor, the results are also including an inspection of whether all 3 factors of each aspect are under the same primary factor, and the results of the data analysis are as shown in Figure 1 and Table 5.
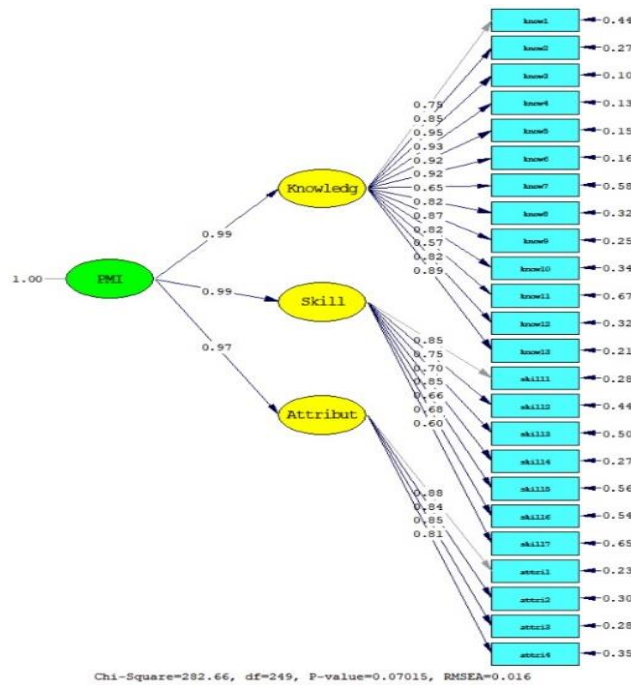
Chi-Square=282.66, df=249, P-value=0.07015, RMSEA=0.016

FIGURE 1

THE RESULTS FROM THE CONFIRMATORY FACTOR ANALYSIS OF APPROACHES FOR COMPETENCY DEVELOPMENT OF WORKFORCES IN THE MANUFACTURING AND SERVICE INDUSTRY SECTOR, EEC

Table 5 STATISTICAL VALUES FROM THE CONFIRMATORY FACTOR ANALYSIS OF APPROACHES FOR COMPETENCY DEVELOPMENT OF WORKFORCES IN THE MANUFACTURING AND SERVICE INDUSTRY SECTOR, EEC					
Variables	**Factor Loading**				
	b	**B**	**SE**	**t**	**R^2**
Outcome variable					
Approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province (PMI)					
Variable					
Knowledge Factor	0.99	0.99	0.05	19.43*	0.98
Skill Factor	0.98	0.99	0.04	22.96*	0.97
Desirable Attributes Factor	0.96	0.97	0.04	23.57*	0.93
Knowledge Aspect					
1. Welding (welder and welding robot control) (know1)	0.54	0.75	0.01	15.43*	0.56
2. Computer drawing with CAD, CAM, CNC program (know2)	0.61	0.85	0.03	15.03*	0.72
3. Computer drawing with programmable logic controller (PLC) (know3)	0.69	0.95	0.02	13.18*	0.90
4. Industrial robots (know4)	0.66	0.93	0.02	13.91*	0.86
5. Artificial Intelligence (AI) (know5)	0.66	0.92	0.02	14.21*	0.84
6. Management system (know6)	0.65	0.92	0.02	14.23*	0.84

7. Motor (know7)	0.47	0.65	0.03	15.59*	0.41
8. Electrical system (know8)	0.59	0.82	0.03	15.19*	0.67
9. Electronic system (know9)	0.63	0.87	0.03	14.92*	0.75
10. Hydraulic system (know10)	0.59	0.82	0.03	15.23*	0.66
11. Pneumatic system (know11)	0.39	0.57	0.03	15.63*	0.32
12. Sensors and actuators (know12)	0.59	0.82	0.03	15.18*	0.68
13. Software development for providing service and linkage to manage Big Data, Data Analytics, Predictive (know13)	0.66	0.89	0.03	15.65*	0.78
Skill Aspect					
1. Specific operational skills of the target industry (skill1)	0.62	0.85	0.01	14.97*	0.71
2. Digital skill (skill2)	0.54	0.75	0.02	14.97*	0.55
3. Foreign language communication skills (skill3)	0.52	0.7	0.02	15.16*	0.49
4. Advanced Thinking Skills (skill4)	0.62	0.85	0.02	13.92*	0.72
5. Organizational communication skills (skill5)	0.47	0.66	0.02	15.30*	0.43
6. Operational Collaboration Skills (skill6)	0.49	0.68	0.02	15.26*	0.45
7. Skills for adaptation and flexibility to situations (skill7)	0.43	0.6	0.02	15.45*	0.35
Desirable Attributes Aspect					
1. Honesty and Ethics (attri1)	0.64	0.88	0.01	12.94*	0.76
2. Leadership (attri2)	0.61	0.84	0.02	13.82*	0.70
3. Continuous learning and curiosity (attri3)	0.63	0.85	0.02	13.61*	0.72
4. Working towards achievements (attri4)	0.57	0.81	0.02	14.28*	0.64

Remark: *p =<.01, t =1.946

Table 5 and Figure 1 show that the model of approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province, is inconsistent with the empirical data ($\chi 2 = 282.66$, $df = 249$, $p = 0.07$, $(\chi 2/df = 1.13$, $GFI = 0.96$, $AGFI = 0.94$, $RMSEA = 0.016$), which consisted of 13 indicators for knowledge aspect, 7 indicators for skills aspect, and 4 indicators for desirable attribute aspect. When the importance of each factor was sorted in descending order, it was found that the knowledge factor and skill factor were the most important, followed by desirable attributes. When considering the loading of each factor (b), it was found to be positive, ranging from 0.43 to 0.69 with a statistically significant level of 0.01 (t>1.946). And when considering the loading of standard factor (B) in each factor separately, they are as follows:

Regarding the knowledge factor, it was found that the variable with the highest loading was computer drawing with a programmable logic controller (PLC) (know3) with a standardized factor loading of 0.95, and had the covariance of the knowledge factor at 0.90%, followed by industrial robots (know4), with the standardized factor loading of 0.93%, and had the covariance of the knowledge factor at 0.86 percent, Artificial Intelligence (AI) (know5), and management systems (know6) had the same standardized factor loading of 0.92 and had the covariance of the knowledge factor at 0.84 percent, Software Development for providing service and linkage to manage Big Data, Data Analytics, Predictive (know13) had the standardized factor loading of 0.89 and had the covariance of the knowledge factor at 0.78 percent, Electronic system (know9) had the standardized factor loading of 0.87 and had the covariance of the knowledge factor at 0.75 percent, computer drawing with CAD, CAM, CNC programs (know2) had the standardized factor loading of 0.85 and had the covariance of the knowledge factor at 0.72 percent, the

electrical system (know8) had the standardized factor loading of 0.82 and had the covariance of the knowledge factor at 0.67 percent, The hydraulic system (know10) had the standardized factor loading of 0.82 and had the covariance of the knowledge factor at 0.66 percent, Sensors and actuators (know12) had the standardized factor loading of 0.82% and had the covariance of the knowledge factor at 0.68 percent, Welding (welder and welding robot control) (know1) had the standardized factor loading of 0.75 and had the covariance of the knowledge factor at 0.56 percent, Motor (know7) had the standardized factor loading of 0.65 and had the covariance of the knowledge factor at 0.41 percent, pneumatic system (know11) had the standardized factor loading of 0.57 and had the covariance of the knowledge factor at 0.32 percent respectively.

Regarding the skill factor, it was found that the variables with the highest loading were advanced thinking skill (skill4) and Specific operational skills of the target industry (skill1), which had the same standardized factor loading of 0.85, and had the covariance of the skill factor at 0.72% and 0.71%, followed by digital skill (skill2) with the standardized factor loading of 0.75% and had the covariance of the skill factor at 0.55%, foreign language communication skills (skill3) had the standardized factor loading of 0.70 and had the covariance of the skill factor at 0.49 percent, operational collaboration skill (skill6) had the standardized factor loading of 0.68 and had the covariance of the skill factor at 0.45 percent, the organizational communication skill (skill5) had the standardized factor loading of 0.66 and had the covariance of the skill factor at 0.43 percent, skills for adaptation and flexibility to situations (skill7) had the standardized factor loading of 0.60 percent, and had the covariance of the skill factor at 0.35 percent respectively.

As for the desirable attributes factor, it was found that the variable with the highest loading was honesty and ethics (attri1), which had the standardized factor loading of 0.88 and had the covariance of the desirable attributes factor at 0.76 percent, followed by continuous learning and curiosity (attri3) which had the standardized factor loading of 0.85 and had the covariance of the desirable attributes factor at 0.72 percent, leadership (attri2) had the standardized factor loading of 0.84 and had the covariance of the desirable attributes factor at 0.70 percent, and working towards achievements (attri4) had the standardized factor loading of 0.81 and had the covariance of the desirable attributes factor at 0.64 percent respectively.

From the hypothesis, it was found that the knowledge factor, skill factor, and desirable attributes factor are under the same primary factor of approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province. In addition, the knowledge factor had a loading of 0.99, the skill factor had a loading of 0.99, and the desirable attributes factor had a loading of 0.97, which is in accordance with the set forth assumption.

DISCUSSION

Results of the study on approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province, shows that the establishment administrators from new target industries (S-Curve) of the Eastern Economic Corridor (EEC) in the industrial land in Rayong Province had opinions on the approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province, in the overall and every aspect, i.e. knowledge, skills, and desirable attributes at a high level. The findings of this research may be due to behavioral

characteristics that result from knowledge which refers to the body of knowledge used in the performance of the position, and skill refers to the application of knowledge in practice, until the skill and competence, which is the integration of all above and below water, including knowledge, skills, and roles that are expressed in society, internal image, character and deep driving force. This manifests itself in the behavioral patterns that enable individuals to perform outstandingly in the organization. The knowledge, competencies, skills, and capabilities required for the position are linked and used in human resource management, starting from recruitment, selection, portfolio management, compensation, training, and development to planning for career advancement according to McClelland (1973) "theory of performance" stated that the development of personnel competency requires development in three aspects: knowledge, skills, and desirable attributes which the person should express as a way of thinking and behavior at work. These factors should affect the performance of the individual and continue their self-development, which should result in success in accordance with or higher than the standards specified by the organization. And in accordance with Thongprasit (2020) who researched the development of a competency model for personnel responsible for energy management in textile factories under the control of the Ministry of Energy. The results showed that the person in charge of energy management had opinions on the competency model of the person responsible for energy management in the textile industry under the control of the Ministry of Energy, in general, and in all aspects, namely knowledge, skills, and desirable attributes at a high level.

The results of the confirmatory factor analysis demonstrated that the approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province, were in accordance with empirical data that consisted of knowledge factor, skills factor, and desirable attributes factor. When sorting the factors' importance in descending order, it was found that the knowledge factor and skills factor were the most important factors, followed by the desirable attributes factor. This is consistent with the research findings of Thongprasit (2020) on the development of competency models for personnel responsible for energy management in textile factories under the control of the Ministry of Energy. The findings of the research show that the competency model of personnel responsible for energy management in textile factories under the control of the Ministry of Energy consisted of a knowledge factor, skill factor, and a desirable attributes factor. The results of a confirmatory factor analysis of the competency model of personnel responsible for energy management in textile factories under the control of the Ministry of Energy were consistent with empirical data. And when sorting the factors' importance in descending order, it was found that knowledge was the most important factor, followed by the skill factor and the desirable attributes factor.

When considering each factor separately, the results can be discussed as follows:

Regarding the knowledge factor, it was found that establishment administrators from new target industries (S-Curve) of the Eastern Economic Corridor (EEC) in the industrial land in Rayong Province had opinions on the approaches to competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province, sorted in descending order as follows: 1) Computer drawing with programmable logic controllers (PLC), industrial robots, followed by 2) Artificial intelligence, software development for providing service and linkage to manage Big Data, Data Analytics, Predictive, management systems, 3) Electronic systems. 4) Computer drawing with CAD, CAM, CNC programs 5) Sensor and actuator, electrical system, hydraulic system 6) Welding (welder and welding robot control) and 7) the pneumatic system respectively. The

results of this research study may be due to the establishments' adaptation to be in line with the government's policy aimed at developing the economy of Thailand by promoting the industrial sector, service sector, and social sector in each field which Thailand already has its authentic capability base and wanted to increase the stimulus measures to accelerate economic development. In addition, new mechanisms had been put in place to attract foreign investment and advanced technology transfers for new industries, which should lead to investments for the expansion of production and an increase in employment. Hence, there is a necessity to develop workforce competency in manufacturing and service industries, in terms of knowledge of operations as mentioned above. This is to be a mechanism to reinforce the economy of Thailand, altogether with increasing the sustainable income of the people as well. Thailand 4.0 economic model, which is an economic model, should lead Thailand out of the trap of middle-income countries, the inequality trap, and the imbalance trap. This model shall make Thailand stable, prosperous, and sustainable in accordance with the approaches of the 20-year National Strategic Plan by building strength from within the country, along with the linkage to the international community, according to the concept of "*Sufficiency Economy Philosophy*" (Office of the National Economics and Social Development Council, 2017). This is in line with the goals of the 20-year Thai Industry 4.0 Strategic Plan (2017-2036) that focuses on industrial restructuring and the transformation of workforces to be in accordance with Industry 4.0 by using technology and innovation as a mechanism to reinforce the economy by enhancing the current industry with the target industry (S-Curve) according to the policy "*Made by Thai, used by Thai, Thai must be the first to acquire*" (Thai First). Thus, there is an imperative necessity to develop the capability of workforces to have advanced knowledge, competence, and skills for the use of cutting-edge technologies directly in the manufacturing and service industries (Ministry of Industry, 2016).

Regarding the skills factor, it was found that establishment administrators from new target industries (S-Curve) of the Eastern Economic Corridor (EEC) in the industrial land in Rayong Province had opinions on approaches for competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province, in terms of overall and each individual skills at a high level when sorted in descending order: 1) Specific operational skills of the target industry 2) Advanced thinking skill 3) Digital skill 4) Foreign language communication skill 5) Operational collaboration skill 6) Organizational communication skill and 7) Skills for adaptation and flexibility to situations respectively. When considering each skill separately, the results can be discussed as follows:

For the specific operational skills of the target industry in times of uncertainty and difficulty predicting, the workforces in an establishment must routinely be reskilled and upskilled for operations in order to develop new skills. It is important that establishments in the new target industry (S-Curve) of industrial land in Rayong Province or other areas should focus on learning as much as working. Workforces should continually learn and develop the necessary skills so that they are capable of performing today's tasks and be prepared for the future. They should be a quality workforce to empower the country's economy in the future. This is in line with Malee (2020), who stated that in times of change, there is uncertainty, and it is difficult to predict. The workforces in the organization therefore must be flexible, ready to fall and get up (resilient), as well as need to be adjusted for the skills (reskill and upskill) to move forward. Successful organizations are those that adapt quickly and focus on caring for the well-being of their employees and have a team that keeps track of the changing situation, deals with challenges, and unites the forces altogether to create innovation. This is in line with Salamzadeh,

et al. (2019) who researched the who researched the corporate entrepreneurship in University of Tehran: does human resources management matter?. The results showed that if more attention is paid to human resources management practices in University of Tehran, corporate entrepreneurship will be improved accordingly.

Digital skills: the key trend scenario in the future of technological leaps and bounds, which has resulted in private establishments, especially in the new targeted industries (S-Curve), a massive technological transformation unprecedented. This may cause the old knowledge, skills, and competencies to not meet the needs of today's world. Therefore, establishments should raise awareness of digital skills among the workforces and accelerate the development of skills in using the existing tools, equipment, and digital technologies such as computers, telephones, tablets, computer programs, and online media to be used for maximum benefit in communication, operation, and collaboration, or use them to develop working processes or working systems in the organization to be modernized and efficient. As organizations move towards greater use of technology and information, it is necessary that personnel learn and understand the fundamentals of technology ethically, in line with Agrawal et al. (2020), who stated that organizations should raise awareness and develop digital skills so that personnel can effectively and efficiently work remotely in all relevant sectors. Therefore, as more organizations move towards the use of technology and information, more personnel need to learn and understand the basics of technology, data usage, and processing also.

Foreign language communication skills: foreign language skills are essential in the age of globalization. Thailand is under the Thailand 4.0 economic model, which aims to transform the economy into an innovation-driven economy. Therefore, it needs to reconstruct industries and transform workforces to be in accordance with Industry 4.0. There is a necessity to develop workforces in the current manufacturing and service industries through the development of foreign language communication skills. Because the establishments in the new target industry (S-Curve) of the industrial land in Rayong Province are in various types of businesses, and each of which is co-operating with foreign countries, so it is important to use foreign languages for communication, such as English, Japanese, Chinese, Korean, etc. in various situations of trade and investment. This is in line with Wankong (2016), who stated that in today's world society, learning a foreign language is very important and necessary in everyday life since it is a significant tool for communication, education, seeking knowledge, occupation, building an understanding of the global community's culture and vision, and being aware of cultural diversity and global social perspectives. It shall bring harmony and cooperation among countries, help to develop a better understanding of oneself and others, cause learning and understanding of the differences in languages and cultures, customs, traditions, thoughts, society, economy, politics, and governance. Thus, people should have a good attitude towards the use of foreign languages and be able to use them for communication, as well as use them to access various knowledge more easily and broadly and have a vision for living. This is in line with Radovic Markovic et al. (2019) who stated that globalization rewards the companies which are innovative and competitive, regardless of the company's size and country of origin.

Advanced thinking skills: rational thinking, good management of work, creative thinking, innovative thinking, problem solving, the current trend of change shows that knowledge has a significantly shorter lifespan. The theories and ideas of the past cannot solve the problems in the context of today's world anymore. Establishments therefore need to adapt constantly because the change comes in the blink of an eye. Hence, for the workforce development in the manufacturing and service sectors to keep up with the changes, reskilling and upskilling are essential to provide

personnel with skills that can respond to the modern world and the 21st century, which include rational thinking, work management, creative thinking, innovative thinking, and problem solving. This is to adjust the workforces in the organization to have the skills that are ready to enable the organization to create its new identity and be ready to cope with changes in any situation. It is consistent with Kanter (1989), who stated that organizations that can face changes well, workforces in the organization must have the characteristics which are ready for changes, as well as having efficiency, innovativeness, and creativity by learning from the changes that occur. The organization therefore needs to develop personnel to have rational thinking skills, good management skills for work, and be prepared to cope with changes in the environment and working methods by developing the thinking skills of personnel such as creativity, innovative thinking, and problem-solving skills.

Good communication skills in the organization can enhance work efficiency and deal with volatility, uncertainty, and difficulty in speculating the changes due to the rapid advancement of modern technology. Therefore, it is extremely important for an establishment to encourage employees to develop themselves, create and communicate their lucid goals, raise awareness of the importance of having a common goal, maintain relationships with colleagues, think positively, see problems as a learning process rather than a barrier, keep mental stability when facing problematic or critical situations, practice looking at themselves in a positive way, and discard of self-blaming. Therefore, it is imperative for establishments to have measures to encourage the creation and development of personnel characteristics to have good communication skills within the organization, to promote a working culture through open communication, to have good social interaction in order to achieve the goals of the establishment. This is in accordance with Agrawal et al. (2020), who stated that having good interpersonal communication skills in an organization is essential and necessary for leaders to drive organizational change and reinforce the work of personnel everywhere.

Good coordination skills of all parties in order to achieve the goals: Because amidst the changes in the 21st century, workforces in the industrial sector have to face a lot of technological changes. As a result of such changes, it affects the morale and trust of employees, causes stress and detachment from the organization, including the management team or heads of various departments that would feel discomfort to alter the process of work all over. Therefore, it is imperative for establishments to find the factors that will encourage employees to create value for the organization by focusing on the use of workforces development strategies to possess key skills, building good relationships at work, raising awareness of empathy among managers and supervisors, creating a sense of security at work, having good social interactions with each other, participating in social activities together, promoting a transparent atmosphere and management method, and building trust with each other, etc. In accordance with Malee (2020), he had presented guidelines for building and developing the workforces. Organizations should have measures that encourage the creation and development of workforce characteristics in terms of the work system, environment, organizational culture, learning, and self-development of workers in order to promote a healthy physical and mental environment. It may take measures such as promoting health and the environment, building a good relationship at work, raising awareness among managers and supervisors to have a sense of empathy, creating a sense of security at work, strengthening the work culture with open communication, creating a strong network, having good social interaction, participating in social activities together, promoting a transparent atmosphere and management method, and building trust with each other. This is in line with Tajpour et al. (2021) who researched the job satisfaction in it department of mellat bank: does

employer brand matter. The results showed that reputation, organizational culture, corporate social responsibility, training and development have a positive effect on job satisfaction of employees and that they have a negative effect on diversity and work-life balance. This is consistent with the research findings of Salamzadeh et al. (2014) who researched the agility path through work values in knowledge-based organizations: a study of virtual universities. The results showed that all people enter organizations with a formed personality and some initial experiences and values depending on the culture, which will, in turn, influence their efficiency and performance. Therefore, great attention must be paid to work values of the employees and the issues which affect them, especially in organizations that are complex in their structure and culture. Today's dynamic environment requires organizations to be agile in their processes, with the issue being even more critical in knowledge-based organizations such as virtual universities.

Possess the skills to adapt and be flexible to any situation at work due to the transformation of Thailand's industrial sector into an industry driven by intelligence. By raising standards in production and creating new innovations by using digital technology as an important tool in accordance with the 20-Year Industry 4.0 Development Strategy (2017-2036) (Ministry of Industry, 2016), establishments in the manufacturing and service sectors thus have to extremely adapt in order to become more competitive. Due to the advancement of modern technologies such as artificial intelligence, robotics, or automation, organizations and establishments can deliver goods and services efficiently and effectively meet changing customer needs and expectations. Establishments in the new target industries (S-Curve) of industrial land in Rayong province have been affected by the aforementioned change. Therefore, efforts have been made to develop the system to be able to support the changes that occur. The leap forward in digital technology change has affected unskilled workers or semi-skilled who have low wages and are often affected by the adoption of automation. And highly skilled or skilled workers with high wages are also affected by advances in artificial intelligence technology as well. Therefore, establishments need to develop their workforces to keep pace with changing conditions, which is difficult to predict. They have to be flexible, adaptable and recover quickly from failures or mistakes, including adjusting and upgrading skills for the transition to new roles or working positions that are important to an establishment, organization, or agency. In accordance with Malee (2020), who stated that workforces in organizations must be flexible to move forward. Successful organizations are those that adapt quickly and focus on caring for the well-being of their employees. They have a team that monitors the changing situation, deals with challenges, and unites the power to create innovation. Organization leaders also must have the ability to create a culture that allows the organization to be flexible.

Regarding the desirable characteristics factor, it was found that establishment administrators from new target industries (S-Curve) of the Eastern Economic Corridor (EEC) in the industrial land in Rayong Province had opinions on the approaches to competency development of workforces in the manufacturing and service industry sector, Eastern Economic Corridor (EEC): a case study of industrial land in Rayong Province, for overall and each factor of desirable distribution at a high level. The importance could be sorted in descending order as 1) honesty and ethics, 2) continuous learning and curiosity, 3) leadership and 4) working towards achievement. The findings of this research may be due to the rapid, sudden, and constant change in the management of establishments in the manufacturing and service industries of the 21st century. So, there must be an adjustment in the management of information technology and workforce competency. An example can be observed from the Corona Virus Disease 2019 (COVID-19) outbreak that has been spreading rapidly around the world and has caused most of

the business sector to change with the introduction of technology to be used for working in accordance with the situation. Personnel in the organization need to develop new skills that are in line with the changing world in the future post-pandemic era of Corona Virus Disease 2019 (COVID-19). Especially the management of the establishment must be aware of the change and assess the situation without sticking to traditional methods, solutions, or practices. Hence, there is a need to develop workforce competency in the manufacturing and service industry sector in rapidly changing situations. Workforces with desirable characteristics such as honesty and ethics, continuous learning and curiosity, leadership, and working towards achievement are highly required. This is in line with the OCSC (2020), the key competencies specified for Thai government executives to perform complex 21st century tasks require continuous learning and curiosity, and the determination to work towards achievement. It is especially important in situations where there are many changes in social, economic, environmental, and cultural aspects. Workforces in establishments must be a leader in teaching work to employees in the establishments by themselves. Consistent with Siriwan (2014), who stated that teaching or coaching is the transfer of knowledge by experts. An advisor conveys knowledge to the person being advised, emphasizing teaching, explaining, and telling stories. While mentoring is counseling, helping, and supporting the staff. And in accordance with (Plaiphet, 2020; OCSC, 2020), who had presented a model for developing human resource managers' competencies in the automotive parts manufacturing industry of the future, which consisted of 1) problem-solving analysis 2) ethics, morality, and integrity, together with 3) new way of thinking and planning for problem-solving. In accordance with the principles and theories of human potential development of Smith et al. (1969), who stated that human resource development is the development that leads to better quality or potential of an individual, more productivity, and must cause satisfaction for the operators, managers, and other people in the organization. It should focus on the development of human resources individually at the person by using an integrated approach, combining various human roles related to self-improvement, career development, and organization development to enable the members of the organization to work according to the organization's goals by focusing on system development (life-organization-society) to be better. In addition to having knowledge, skills, and abilities in the job, they must also be able to effectively apply the appropriate and necessary knowledge, skills, and attitudes to the job as well. This may be expressed in a way of thinking (Raksri, 2013), which is measurable and must be appropriate in accordance with the vision, values, and goals of the organization. In other words, it is a personality trait that is hidden within a person that can drive the person to perform well at work or meet the criteria set forth in the job (McClelland, 1973).

CONCLUSION

General Recommendations

Government agencies or establishments can apply the information from this research for policymaking and planning to develop workforce competency in the manufacturing and service industry to reinforce the economy of Thailand further.

Educational institutions can use the information from this research to improve and develop teaching and learning curriculum and training courses to enhance the capability of workforces in the manufacturing and service industry to be more efficient and increase the competitiveness of Thailand's economy.

Establishments and educational institutions should have an integrated collaboration on the basis of information obtained from this research, to increase the competency of workforces in the manufacturing and service industry in knowledge, skills, and desirable characteristics of workforces in establishments in the new targeted industries (S-Curve) as an important mechanism for the enhancement of the production and service industry of Thailand.

Recommendation for Further Research

Government agencies or establishments can apply the information from this research for policymaking and planning to develop workforce competency in the manufacturing and service industry to reinforce the economy of Thailand further.

Educational institutions can use the information from this research to improve and develop teaching and learning curriculum and training courses to enhance the capability of workforces in the manufacturing and service industry to be more efficient and increase the competitiveness of Thailand's economy.

Establishments and educational institutions should have an integrated collaboration on the basis of information obtained from this research, to increase the competency of workforces in the manufacturing and service industry in knowledge, skills, and desirable characteristics of workforces in establishments in the new targeted industries (S-Curve) as an important mechanism for the enhancement of the production and service industry of Thailand.

REFERENCES

Agrawal, S., De Smet, A., Lacroix, S., & Reich, A. (2020). To emerge stronger from the COVID-19 crisis, companies should start reskilling their workforces now. *McKinsey Insights (Issue May)*.

Kanter, R. M. (1989). *When Giants Learn to Dance: Mastering the Challenges of Strategy, Management, and Careers in the 1990s*. Simon and Schuster.

Malee, S. (2020). Resilient Organization and Workforces: Characteristics of Organizations and Workforces to Survive the Crisis of the 21st Century. *Civil Officials' Magazine: Civil Service e-Journal*, *62*(2), 16-20.

McClelland, D. C. (1973). Testing for competence rather than for" intelligence.". *American psychologist*, *28*(1), 1.

Ministry of Industry. (2016). *The 20-year industrial development strategic plan of Industry 4.0 (2017 - 2036)*. Office of Industrial Economics (OIE).

OCSC. (2020). *Management System*. Office of the Civil Service Commission, Thailand.

Office of the National Economic and Social Develop. (2018). *National Strategy 2018–2037*. Bangkok: Office of the Prime Minister.

Office of the National Economics and Social Development Council. (2017), The 20-Year National Strategy (2017-2036). National Economic and Social Development Council, Thailand.

Plaiphet, R. (2020). The Potential Development Model of Human Resources Executives in the Automotive Parts Manufacturing Industry of the Future. *Journal of Industrial Education, King Mongkut's University of Technology North Bangkok*, *11*(1), 129-139.

Radovic Markovic, M., Salamzadeh, A., & Vujičić, S. (2019). Selection of organization models and creation of competences of the employed people for the sake of competitiveness growth in global business environment. *International Review*, (1-2), 64-71.

Raksri, T. (2013), *The Study of Competency Development Approach of Thai Graduates in the 21st Century and Desirable Attributes of Graduates, students of the Faculty of Industrial Education and Technology King Mongkut's University of Technology Thonburi*. Master's Thesis of Industry and Technology. King Mongkut's University of Technology Thonburi.

Salamzadeh, A., Tajpour, M., & Hosseini, E. (2019). Corporate entrepreneurship in University of Tehran: does human resources management matter?. *International journal of knowledge-based development*, *10*(3), 276-292.

Salamzadeh, Y., Nejati, M., & Salamzadeh, A. (2014). Agility path through work values in knowledge-based organizations: a study of virtual universities. *Innovar*, *24*(53), 177-186.

Siriwan, S. (2014). *Coaching to Develop Excellent Performance*. Bangkok: HR Center, (in Thai).

Smith, P. C., Kendall, L. M. and Hulin, C. L. (1969). *The Measurement of Job Satisfaction in Work and Retirement*. Chicago: Rand McNally Strauss.

Srisa-ard, B. (2002). *Basic Research*. Bangkok: Chomromdek.

Tajpour, M., Salamzadeh, A., & Hosseini, E. (2021). Job satisfaction in IT department of mellat bank: does employer brand matter. *IPSI BgD Transactions on Internet Research*, *17*(1), 15-21.

Thongprasit, K. (2020). *The Development Model of Energy Manager's Potential in textile manufacturing plants under the control of the Ministry of Energy*. Doctoral Dissertation in Business Administration, King Mongkut's University of Technology North Bangkok.

Wankong, A. (2016). English Teaching in the 21st Century. *Journal of Yanasangvorn Research Institute, 7*(2), 1-12.