Application of Quick Scan Technique to Increase Productivity in Garment Manufacturing Industry

Katesara Wongchaiya
Department of Industrial Engineering
Chiang Mai University
Chiang Mai, Thailand
katesara_1412@hotmail.com

Poti Chaopaisarn
Center of Excellence in Logistics and Supply Chain Management
Chiang Mai University
Chiang Mai, Thailand
poti@eng.cmu.ac.th

Sainatee Chernbumroong
Faculty of Business Administration
Chiang Mai University
Chiang Mai, Thailand
sainatee.c@cmu.ac.th

Abstract

The Quick Scan Technique has been pioneered by the Cardiff Logistics System Dynamic Group (LSDG) in collaboration with two of their industrial research partners, enables a heath check to be undertaken on a supply chain to identify and rank areas where improvement would yield most value. One of the main types of product produced by the company is long sleeves shirt. The purpose of the Quick Scan method is to understand and inspect the related raw materials, cost, and resources. In addition, this research identifies the advantages and disadvantages of using the recommended "Quick Hit" for process improvement in applying with the short-term and long-term strategy. According to the preliminary finding, The one of the most important factors in the supply chain. Furthermore, production analysis was undertaken in conjunction with Value Stream Mapping. It was found that several non-value-added activities was presence in the production flow. The application of ECRS was applied to eliminate and reduce unnecessary process and to re-integrate production flow. Finally, the advantages and disadvantages of applying Quick Scan was discussed which offers a new dimension of diagnosing supply chain activities within the garment manufacturing plant in Thailand and ways it can compete with domestic and global market.

Keyword
Quick Scan, Value Stream Mapping, Garment Industry, Thailand

1. Introduction

At present, business in small and medium industries plays an important role in Thai economic system in various aspects. Informal small industrial enterprises or enterprises with single owners are regarded as small and medium enterprises (SMEs). The number of these enterprises is around 540,000 – 720,000 enterprises i.e. 90% of SMEs so these enterprises provide a large source of employment in Thailand. On the other hand, textile and garment industry is also important for Thai economy in terms of employment and export. It is a manufacturing industry from upstream to downstream in 3 types namely; upstream includes industry in natural and synthetic fibers; midstream includes industry in spinning, woven and knitted fabrics, bleaching, dyeing, and printing; and downstream includes industry in finished production.

According to high competition in this industry, competitive capability needs to be improved for surviving in the global markets. Products needs to be developed with high quality, distinctive features, and variety in order to meet market demands. As the heart of competition in such industry, advanced technology should be adapted in the process to produce works with higher quality and response to various demands. Nowadays, most entrepreneurs of garment industry turn to focus more on system integration and development of supply chain management in order to reduce cost, high delivery in times, and quality. Supply chain management has been proclaimed as the center of business strategies for increasing competitive capability in customer service. Therefore, manufacturing processes should be improved on effectiveness of the whole production system. The strength of Thai textile and garment industries is the integrated industry. Entrepreneurs are skillful with experience and reliable for buyers and importers. In addition, workers are skillful and specializing in production with variety of goods, and product quality and models are continuously developed in various forms. The main development obstacle of Thai garment industry is from the obsolete machines, in compared to machines and production technology in Vietnam and China. Stopping production lines is one problem because of machine improvement for accelerating the production to deliver products in time. As a result, the production cost increases. However, entrepreneurs do not realize such problem but still solve it by increasing labors, machines and overtime production. This problem solution focuses on the results, rather than the root cause without awareness of production loss.

The company case study was the manufacture in finished garment business in the form of original equipment manufacturing (OEM) for owners of international trademarks. Moreover, it is a manufacturing contractor to produce finished garments in the form of make to order for modern trade malls. According to the primary data collection in 2019, the number of orders were found in 245 types of shirts, followed by 125 types of hoodies, and 112 types of t-shirts. The case company encountered the effectiveness problem in production lower than the target. The company attempt to improve the operational process continuously in production layout for reducing the movement distance, setting priority to reduce waiting time for the machine improvement. In this paper, the researcher is interested in applying performance measurement tool to diagnose and to solve the problem of lack of effectiveness in the production process as well as for increasing supply chain potentials by reducing lead time in timely delivery to customers.

1.1 Research Objectives

The objectives of the study were to find out problems and causes to obtain guidelines for increasing productivity of shirt production process by using Quick Scan technique in a finished garment manufacture, and to increase production effectiveness in shirt production process by reducing lead time which was loss in shirt production process. The study focuses on the production of long-sleeves shirts. The activity flow in supply chains of each related activity was analyzed, starting from fabric examination to packing. Quick Scan technique was used for analyzing data in the shirt production process of the case company. In addition, Value Stream Mapping (VSM) analysis was used for improving the shirt production process of the case company based on the Eliminate, Combine, Rearrange and Simplify (ECRS) principle. Manufacture's layout was also used in the process improvement for identifying non - value added activities, leading to the case company management for loss reduction, more effectiveness of the shirt production process, and reduction of lead time in the shirt production process. In this case study, the emphasis was on reduction of lead time for the case company's timely delivery. Initially, the effectiveness of the production process was assessed by using Quick Scan technique in order to understand about work procedures and production flows from the first activity of the production process.

2. Literature Review

Previous research widely studied in theories and practice of supply chain as well as in assessment of supply chain effectiveness. Effective assessment is an important instrument for appropriate management to improve organizational performance. It is helpful for understanding situations among organizations' members and for measuring progress of organizational operation regularly.

Supply Chain Management refers to activities related to integration and managing process relationships related to supply of goods and services. This has a target to build value added and meet the demand of the market, production, distribution and delivery of goods as well as information communication (Sukonthip Hongpiriyakul, 2014). Council

of Supply Chain Management Professional (2006) views this as planning and designing the system in the supply chain in terms of purchasing, procurement, production, logistic transportation, and distribution whereby fast and efficient coordination from upstream to downstream is focused. Performance assessment of supply chain is evaluative measurement of supply chain management for reducing costs or increasing values for organizations. Palevich (1999) states that most industries at present use cost for supply chain management at 75% of the whole operating cost. In addition, Lankford (2004) suggests that performance assessment of supply chain can be divided into 3 aspects on: 1) efficiency with the focus on minimizing cost, 2) responsiveness measured from lost sales from inventory reduction to respond with market uncertainty, and 3) effectiveness by managing supply chains with effectiveness corresponding to value creation for customers, known as value chain. Moreover, Zhang et al. (2009) classify assessment of performance effectiveness in 3 categories: financial performance, operational performance, overall supply chain performance. In performance measurement of supply chains in an industrial sector, various instrument and techniques has been applied such as SCOR Model, Balanced Scorecard (BSC), and Quick Scan.

The SCOR model is designed to detect and classify problems within the framework. The model is built on a structural model in showing the relationship in between each process. The measurement has been determined to have the same standard and compared with identified business champions in order for the users to identify the hindering activities and to achieve best practices. Regarding the comparison with another tool used to measure the supply chain capacity, which can help determine strategies well, Balanced Scorecard (BSC) is another tool to assess the supply chain capacity. It is a management tool which can take strategies to implementation based on measurement or assessment. This allows organization to align with one another in unity and focuses on what is important to the organization. The basic principle of BSC has 4 perspectives which are: Financial; Customer; Internal processes and Learning and Growth. Quick Scan is a method used for finding causes by examining supply chain operation of organization. It is in the form of questionnaire to record data on logistic and production processes. The target of Quick Scan is on managing supply chain documents relating to materials, information, cost, and resource flow. Quick Hit provides quick suggestions to build opportunities for development and long-term strategies. This technique can be used for examining completion of supply chains to identify and prioritize improvement tasks to obtain optimal results (Lewis et al., 1998).

Quick Scan was initiated by Cardiff University in cooperation with Lucas Variety, Computer Science Corporation, and The Logistics Systems Dynamics Groups under the project entitled 'Supply Chain' in 2001. The committee determine the instrument for analysis, and then teams use it for assessing business supply chains. Quick Scan looks through business processes including personnel, relationship, communication, work procedures, and processes of product and information flow. Regarding the supply chain improvement, the interest is paid on quality, price, service, and cycle time in the supply chains. The application of Quick Scan in business agencies encourages reviews on business process and supply chains. Its results increase ability to look through the problems causing slower production. Naim, Childerhouse, Disney and Towill (2002) propose a Quick Scan process which can be achieved within 2 weeks. The first 2 steps point out appropriate supply chain and involvement of business leaders in only 3 days which is minimal in interruption of business processes of related working units (Figure 1).

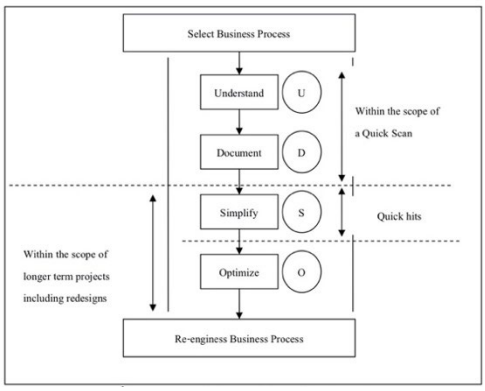

Figure 1. Scope of Quick Scan in the UDSO model

According to the UDSO model, U (understand) refers to understanding the business process to be studied; D (document) is concerned with document systems including business information useful for analysis, improvement, adjustment, and development for short-term solutions; S (simplify) is for short-term solutions to increase effectiveness of work operation without effects on business structure but with effects on appropriate medium and long term changes; and O (optimize) is to increase the process effectiveness.

3. Methodology

In the present study, the researcher applied the assessment concepts of supply chain management by using Quick Scan technique to find out effectiveness of supply chains in the shirt production process in combination with Value Stream Mapping to study and find out different problematic conditions to identify value added and non - value added activities in the shirt production process. Then, the ECRS principle was used for improving the production process to reduce loss or eliminate non-added value activities. The research procedure is detailed as follows.

Related concepts, theories, and previous research were studied. Primary data were collected from the case company on such as general work in process, sequences of operational flow, the number of employees, and the number of machines in the production process. The aims were to understand the relation among each activity, and to present primary data for administrators to select the production line to be studied. The assessment procedure of the production process by using Quick Scan was explained. Preparation for instruments and readiness for the production process assessment by using Quick Scan was done on production layout, questionnaire, and interview. The effectiveness assessment of the production process by using Quick Scan started from the production process lay out. The production data were collected with the questionnaire about activities in 6 issues: cost, reliability, flexibility, quality, and service ie. 4 items of each issue. The questionnaire was concerned with operation effectiveness in 5 assessing levels: Level 5 = full operation, Level 4 = operation more than half, Level 3 = half operation, Level 4 = operation less than half, and Level 1 = no operation at all. In addition, the interview was used with related personnel who were heads of different units in production.

Value Stream Mapping Current State was written to analyze causes of production loss, to study work operation and operation diagrams, and to record steps of each activity in Value Stream Mapping (VSM). Primary data of steps and working hours of each sub-activity were recorded with of 20 cycle times with means and standard deviation.

Mean

$$\bar{x} = \sum \frac{X_i}{N}$$

,

Standard Deviation

$$\text{S.D.} = \sqrt{\sum \frac{(x-\bar{x})^2}{N}}$$

Lead time of the shirt production process was studied by calculating the number of cycles, according to Maytag's timing method to find average time $\bar{X}$ and ranges (R) for R/$\bar{X}$ in comparison with the number of cycles (N) in Maytag's reference table. The study was on the steps with bottlenecks in the shirt production process to perceive the overview of the process, the flow direction of raw materials, lead time, and the process loss. The calculations are as follows.

$$\text{Cycle Time} = \frac{\text{Sum of working hours in sub-processes}}{\text{Number of units produced}}$$

$$\text{Lead Time} = \text{Working hours from fabric examination to packing}$$

$$\text{Average Lead Time} = \frac{\text{Total lead time}}{\text{Number of total orders}}$$

$$\text{Takt Time} = \frac{\text{Net regular working hours a day}}{\text{Number of units on demand a day}}$$

$$\text{Standard Output (Number of units)} = \frac{\text{Total working hours available}}{\text{Standard time for production per unit}}$$

$$\text{Effectiveness (\%)} = \left(\frac{\text{Real output}}{\text{Standard output}}\right) \times 100$$

The data analysis from the assessment of the production process by using Quick Scan consisted of the following steps. Process chart was written for displaying information flow and material flow, work in process, and coordinate. The questionnaire data were analyzed with data analysis statistics in percentages, means, and standard deviation, and hypotheses were tested with One Sample T-Test at the significance level of 0.05 or at the confidence interval of 95 percent. The data analysis from the interviews with related personnel was content analysis in combination with fish bone diagram to find problems and solutions in each activity.

Value Stream Mapping Future State was for process activity analysis to identify value added (VA) activities, non-value added but necessary (NNVA) activities, and non-value added (NVA) activities. The production process was improved with the ECRS principle (Eliminate, Combine, Rearrange, and Simplify). The production process was adjusted into a flow process, and Kaizen production to obtain a continuous production process. Tasks were managed to make the production process balance and appropriate, reduce employees' movement, and trial in real practice in the shirt production process in 1 purchase order (PO).

4. Data Collection

Regarding the problems occurring in the process of garment manufacturing of the company in the case study, it was found out that the problems were caused by the working process which lacked standards, clear methods of work and communication during doing activities, relying on operators in making decisions to solve occurring problems at hand. This has an effect on working efficiency, which brings about waste in working due to complicated working, non-linear transportation. In order to solve the mentioned problems, the researcher selected instruments in data analysis from assessing the production process by using Quick Scan together with waste removal based on the principle of ECRS and the analysis of value steam (Values Stream Mapping: VSM). Data analysis from assessing the production process by using Quick Scan. This step was preparing questionnaires to find the data of causes of handover taking so much time by applying the method of Quick Scan in preparing questionnaires regarding activities occurring in the business plan to be questionnaire topics. There were also scoring criteria according to the priority of activities to consider if the packing activity is the cause of handover which makes up most of the activity time.

Regarding assessing questionnaires and interviewing, 54 people were interviewed. These people had years' experience of work for more than 1 year in 3 divisions, namely marketing division, production division and accounting division. They gave scores, making assessment of opinions regarding the concept of logistic efficiency and supply chain consisting of 6 aspects, namely costs, response, reliability, flexibility, quality and service levels both in their own departments and next departments. For making assessment, the rating scale ranged from 1-5 ranked according to the priority from finding mean, percentage and standard deviation.

After studying the supply chain structure of garment manufacturing, the layout of the production process was created (Process Activity Mapping) categorizing activities starting from the activity of fabric checking up to packaging. After that, each activity was analyzed in order to categorize activities into the activity with Value Added (VA), the activity with Necessary Non-Value Added (NNVA) and the activity with Non-Value Added (NVA). The activities were categorized into 5 main activities whereby Cycle Time, Changeover Time, Up-Time, Available Time, Work In Process, Processing Time, Processing Lead Time, Manufacturing Time were to be found. After calculations were done to find values, value steam mapping was conducted and an analysis was made.
Eliminating waste with the principle of ECRS

- Eliminating wasteful work, shortening time in transporting pieces of work, reducing procedures of organizing parts.
- Combining work procedures together, combining certain work procedure in the Sewing and Packing activities, and combining the requisition process from the supermarket into Sewing.
- Rearranging work appropriately, rearranging working in the Sewing activity appropriately with shirt production.
- Simplifying work, changing the working system (Push System) to the time attendance card system by using the visual control system.

5. Results and Discussion

The case-study company of garment manufacturing has 273 employees. It operates made-to-order business with a marketing division, For the production division, there are 5 main activities, namely Store, Cutting, Supermarket, Sewing and Packing. There is also an accounting division. For this company, the employees work 6 days a week, 8 hours per day (not including overtime). From calculating the numbers of cycles in timing based on the Maytag theory, the appropriate numbers of cycles in timing of every activity were 20 cycles which were enough for further study. Preparing questionnaires regarding the concept of the efficiency of logistic management and supply chain in working of their own departments and the next department to find the cause of delayed handover. The Quick scan method was applied to prepare questionnaires. The topics of costs, responses, reliability, flexibility, qualities and service levels were assessed. Regarding the details of assessing opinions, the operation scale went like this: full operation = at a very high level; > 50% operation = at a high level 50% operation = at a moderate level; < 50% operation = at a low level and no operation = at a very low level. In their own activities and the next activity from the assessment, it was found out that most of the samples had opinions about the efficiency of logistic management and supply chain both in their own departments and the next department at a high level whereby they viewed that their own departments had efficiency in the aspect of reliability at a high level with the average = 4.05, cost = 4.01, response = 3.99, quality = 3.96 and service level = 3.81. In their own departments and the next department, there was efficiency in the aspect of quality at a high level with the average = 4.14, costs and flexibility having the average = 4.10, response = 4.07 and service levels = 3.98. This shows that there was operation more than 50% of that aspects. Number and percentage of the sample Classified by comments on logistics and supply chain management efficiency of their own department and the next department (Table 1).

Table 1. Number and percentage of the sample Classified by comments on logistics and supply chain management efficiency of their own department and the next department.

Efficiency of logistics and supply chain management	Own department N = 54		Efficiency Level	Next department N = 54		Efficiency Level
	$\bar{X}$	SD		$\bar{X}$	SD	
1. Cost	4.01	0.80	High	4.10	0.66	High
2. Response	3.99	0.76	High	4.07	0.69	High
3. Reliability	4.05	0.72	High	3.98	0.62	High
4. Flexibility	3.93	0.65	High	4.10	0.63	High
5. Quality	3.96	0.67	High	4.14	0.61	High
6. Service	3.81	0.71	High	3.95	0.56	High
Average Total	3.96	0.72	High	4.06	0.63	High

The overall summary of the survey using the Questionnaire can been seen that the concept of efficiency in logistics management and supply chain is high. Reliability is important for the own department and Quality is Important for the next department.

Table 2. Average and standard deviation of logistics and supply chain management performance

Efficiency of logistics and supply chain management	$\bar{X}$	SD	Level
1. Cost	2.98	0.74	2
2. Quality	2.20	0.71	3
3. Service	1.43	0.92	4
4. Lead Time	3.39	0.94	1
Average Total	2.50	0.83	

According to the interview each department priority lead time as the first with an average of 3.39 and the last service 1.43. Value steam analysis was conducted by calculating Cycle Time, Changeover Time, Up-Time, Available Time, Work In Process, Processing Time, Processing Lead Time, Manufacturing Time for Value Steam Mapping (Table 2). After that, it was found out that Reduction Lead Time was equal to 25 days of value steam analysis of the current

status. By studying the working plan of the case-study company for improvement and finding the fact that in every activity, there were activities creating no values, bringing about waste in the process and they could be eliminated. The Production Lead Time was equal to 19.83 days from steam value analysis of the future status.

In 2020 production, various types of products were manufactured. Normally, the company manufactured shirts, hoodies, pants, sweaters, and t-shirt. Because of the pandemic situation in this year, the sales amount increased in masks and PPE sets, as shown in Figure 2.

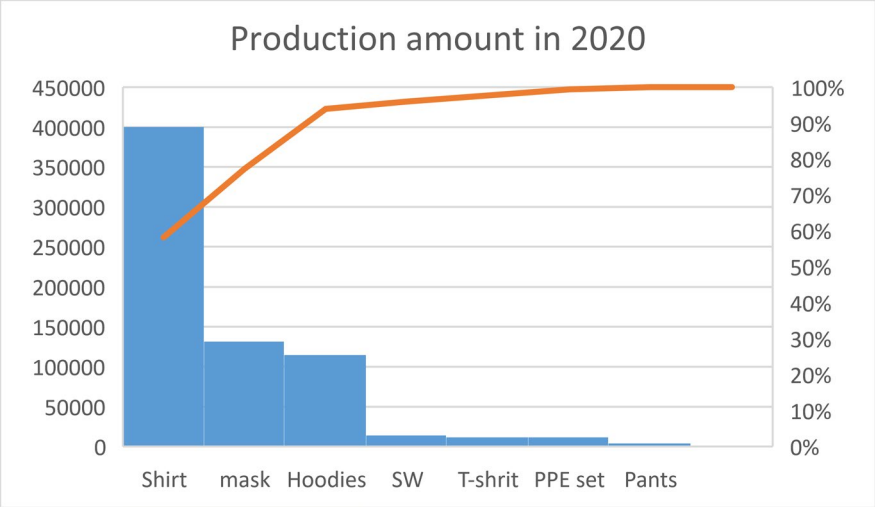

Figure 2: Production amount in 2020

Production time per 1 unit to respond to the customer's need (takt time) of the finished garment (shirt) manufacture was 128 seconds. No data of working hours were found over takt time (Table 3). However, the working hours were still imbalanced, so they were adjusted for production balance with the ECRS instrument.

Table 3. Cycle Time in shirt line

Station (sawing, Packing)	Cycle Time (sec)		Different (sec)
	Pretest	Posttest	
1	63.63	61.47	2.16
2	28.46	28.12	0.34
3	52.79	50.05	2.74
4	96.24	95.94	0.3
5	49.15	43.20	5.95
6	40.22	36.75	3.47
7	74.56	62.22	12.34
8	79.11	73.85	5.26
9	49.67	48.06	1.61
10	34.27	30.22	4.05
11	38.36	38.11	0.25
12	143.01	121.42	21.59
13	84.05	75.65	8.4
14	95.42	86.32	8.92
15	89.28	74.49	14.79

16	71.88	64.89	6.99
17	155.72	123.65	32.07
18	127.20	105.00	22.22
19	145.81	111.95	33.86
20	37.50	36.30	1.2

Eliminating waste by using the principle of ECRS was used to increase the efficiency of the activities.

- Eliminate - Travelling distances of the staff and the numbers of rounds in travelling were reduced. Travelling to bring production parts accounting for the numbers 3-3 rounds per day was reduced to travelling to bring items at the supermarket accounting for 1 time per day. Moreover, for staff in the sewing activity instead of bringing pieces of work to the ironing activity by themselves, this was replaced by staff in charge of delivering pieces of work to come to take them to the ironing activity. Therefore, the seamstress did not have to go over there.
- Combine - Methods of working were combined in the sewing activity. At every station, methods of work for some procedures which were activities with no value added were reduced.
- Rearrange - There was working rearrangement in the sewing activity. From the previous work sequencing, there was work positions arrangement unsuitable for working such as non-linear flow of work classes, complicated handover etc. Suitable work sequencing would facilitate working and bring about more efficiency.

6. Conclusion

Application of Quick Scan technique in garment industry It helps case studies companies to understand the problem and the cause. Due to the delay in delivery from a total of 25 days of work, work can be reduced to only 16 days. That reduction of work has adopted Quick Scan techniques for finding the cause and solving. Together with the use of value stream mapping and ECRS, it is a tool that provides a clear view of wastes in the manufacturing process. Because the stream of value analysis must be analyzed in the present and future state, in line with Quick Scan that can be formulated in the medium term. The reasons for delivery delays found from the study are for several reasons, such as inefficient production planning problems. Complicated production planning Including the import of raw materials which affect the production within the company. The lack of technology to help communicate within the organization. Causing communication delays and each department does not have a standard or a strict requirement. Which will give wrong communication or errors in operations The benefit of the Quick Scan application in this industry is that it gives the company a clear overview of the organization. Clearly see the problems in the processes And can act quickly to fix And does not affect the production process As we deliver faster, the company can accept more orders. And employees will be able to work with standards

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Biography / Biographies

Katesara Wongchaiya is a master's degree student in the Department of Industrial Engineering, Chiang Mai University. She has earned her bachelor's degree of Industrial Engineering in Chiang Mai University.

Poti Chaopaisarn is an Assistant Professor and Researcher at Department of Industrial Engineering, Faculty of Engineering at Chiang Mai University, Chiang Mai, Thailand. Dr. Chaopaisarn holds a Bachelor in Business Administration in Marketing from Thammasat University, Bangkok, Thailand, a Master of Science Degree in International Transport, a Master of Philosophy Degree in Social Science Research Method and a Ph.D. in Logistics and Operations Management from Cardiff University, Wales, United Kingdom. He has published in journal and conferences and has conducted research projects domestically and internationally. He has over 10 years of business and industrial operation consultancy experience in Thailand. His research interests include logistics and supply chain management, operations management, simulation and modelling, multimodal transport system and business improvement theory. He is a member of Excellence Centre in Logistics and Supply Chain Management, programme chair of ICLT and MPM.

Sainatee Chernbumroong is a lecturer in Department of Management and Entrepreneurship, Faculty of Business Administration, Chiang Mai University, Chiang Mai, Thailand. Dr. Sainatee holds a Bachelor of Arts in English from Chiang Mai University, Chiang Mai, Thailand, a Master of Business Studies from University of Sunderland, Sunderland, United Kingdom, and a Ph.D. in Hospitality Management from University of Surrey, Surrey, United Kingdom. She has published in journal and conferences and has conducted research projects domestically and internationally. She has years of business consultancy experience in Thailand. Her research interests include hospitality management, entrepreneurship, and human resource management.