CHAPTER 6

Discussions and Conclusion

The developing of the new performance measurement model of the Thai's frozen shrimp supply chain is recommended to provide the effectiveness and efficiency in the area of Thai frozen shrimp chain. The impact of the new model significantly improves the performance measurement indicators in terms of cost, quality, flexibility and other essential factors in the supply chain. In order to response to the companies's needs and the suggestions from literature reviews of previous studies including lacking of the support evidences of causal impacts on the model, in-considering between an environmental aspect and indicators, unable to verify of validity and reliability of the research instrument, (which can affect the bias of the results) and lacking of specific methods to manage with the qualitative and quantitative data. The results from developing the comprehensive performance measurement model therefore cannot only integrate the new model but also able to prioritize the important key performance measurement indicators by providing the strong research methodology to analyze and combine the evaluation methods for improvement of the specific PM model of Thai frozen shrimp supply chain.

Therefore, this Chapter 6 will be discussed on how the results of the study can achieve the research objectives. In addition, the chapter will conclude about the overall of the research, contributions, limitations and recommendations for further research. Therefore, the body of this chapter is practically organized for the coherent of contents in the chapter, which the research results are critiqued and discussions in section 6.1. Section 6.2 is continuous to explore the benefit of the findings in terms of the contribution of the study. Finally, Section 6.4 describes the limitations and recommendations for future works.

6.1 Discussion of Results

The results of the study is significantly answered with the research objectives including; 1) explaining the impact of the performance measurement aspects and the key performance measurement indicators on the frozen shrimp supply, 2) testing the validity and reliability of the performance measurement model for evaluating the effectiveness of the frozen shrimp supply chain in Thailand, 3) analyzing the importance and integrate the key performance measurement indicators for assessing the efficiency of the frozen shrimp supply chain in Thailand, 4) indicating the adequacy and feasibility of the performance measurement model for assessing the effectiveness of the frozen shrimp supply chain in Thailand by comparing the results of this study with the outcome of the pilot companies and 5) developing a new performance measurement model for evaluating the effectiveness of the frozen shrimp supply chain in Thailand. The discussions are presented based on the two main results (Chapter 4 and Chapter 5). From the results, the researcher describes and discusses to provide research questions above as below.

6.1.1 To explain the impact of the performance measurement aspects and the key performance measurement indicators

The result showed KPIs can provide the effects to the Thai frozen shrimp supply chain. This result can be explained in each main criteria as below,

1) Efficiency

Aramyan (2007) pointed out that the financial dimension is significantly importance to performance measurement supply chain orientation. The efficiency is embedded in profitability, and it is linked to the performance measurement chain (Chan, 2003). Manufacturing cost is consisted of the labor, maintenance and re-working costs, purchased materials, equipment charges, and the supply's margin.Manufacturing cost has the most impact on the frozen shrimp supply chain performance because the cost is one of traditional performance indicators that classically and clearly represent the performance's organization. Every organization tries to reduce the waste cost in the manufacturing such as the raw material cost and the labor cost. Therefore, the manufacturing cost is popularly applied as the essential indicator to measure performances (Aramyan, 2007); Shephed and Gunter (2005); Brawat and Shama,

(2007); Bond, (1999). According to Wiwattanapornchai, & Chaveesuk (2011).stated that the manufacturing cost is shown the highest percentage (60%) of total cost in the shrimp culture. It therefore should be considered. In contrast, Aramyan (2007) pointed out the profits and the returns of investment (ROI) which provided more impacts than the manufacturing cost in the agri-food chain. However, it is up to condition and scope of a supply chain performance measurement. Bhawat and Shama (2007) explained that the ROI may impact to the performance strategic but the manufacturing cost has impact on the performance operation. According to Zhang and Aramyan (2009) the profit and return of investment (ROI) were used to classify performance indicators and can be represented clearly on the financial supply chain performance. Profit, which was supported by Chan and Qi (2003), was included the positive returns from a business investment after the subtracting of all expenses. Return on investments (ROI) was a measurement of a firm's profitability and used to measure the effectiveness of the firm by using its capital to generate profit (Bigliaridi & Bottani, 2010). A profit indicator, which used to introduce the new measurement, is currently needed because the majority of performance measurements are related to costs, while the reducing costs and making more profit are the key success of doing businesses.

2) Flexibility

Beamon (1998) defined the flexibility as the degree of choice in responding to random fluctuations in the demand pattern. It was used to measure the supply chain's capacity to cope with the volume and to schedule variations of productions from customers as well as suppliers. Volume flexibility, defined as the ability to respond to the changing in the demand, could be calculated in terms of the demand variance together with maximum and minimum profitable output volumes during any period of time (Lohman et al., 2004; Zhang & Aramyan, 2009). In the agri-food supply chain, the volume delivery can directly impact to all members (Aramyan, 2007) since agri products depend on the season and make fluctuation on the product demand. Then, it reduces ability to operate and fails to meet with business's goal of the company. Moreover, the information from the interviewees of this study concerned on the volume flexibility indicators that were relied on the shrimp disease outbreak and the unstable situations of the shrimp price. In contrast, the backorders and losing of sale rate

are does not provide the impact on the Thai frozen shrimp chain because these events do not happen and do not be found in the Thai frozen shrimp chain before.

3) Responsiveness

Zhang and Aramyan, (2009) stated that the customer response time, customer complaints customers, and lead time impact to the chain process with the high score. These can be applied to all chain members because the client response time has greatly impacted on the distribution network design of the company. As similarly, the customer complaints reflect the problem of products, processes, and/or services. Finally, lead time can set up queuing time, process time, batching time, handle time, and transport time (Chan, 2003). In the agri-food chain, the lead-time helps to manage and cultivate the planning. From the interviews, interviewees informed that the lead time decreased the product quality and product safety.

4) Quality

The three indicators are considering being high important aspects that are product safety, traceability and storage and transport aspects. According to Zhang and Aramyan, (2009) quality is composed of the product quality and the process quality. Product safety is defined as a product that does not surpass an agreeable level of risk associated with pathogen or chemical and physical hazards such as microbiological or chemical contaminants in products, and micro-organisms. Traceability is an ability to trace the production's history, application or location of products by using recorded identifications. Storage and transport conditions are described as the transportation and storage of products that suited with the good quality. These indicators involve to customer’s satisfactions, and it is very strictly used to control the food quality. Moreover, in agri-food supply chains, quality is an important measurement, especially in the cases of non-financial measures of specific products and the characteristics of production. It can cause hazardous infections in raw materials, especially through the insufficient application of the Hazard Analysis and the Critical Control Points (HACCP), which can lead to hazardous infection in final products (Loc, 2006).

5) Innovativeness

The use of new technology is impacting on this chain. Chan (2003) revealed that the innovativeness is the paramount factor to the changing of the environment. It helps to complete with the strong competitors with advantage condition and it can be recognized by the customers. In the Thai frozen shrimp chain, the innovation can help farmers to manage farms such as feeder machines that are used to reduce the labor cost, feed time scheduling and contribute to manage a planning to cultivation.

6.1.2 To test the validity and reliability of the performance measurement model

The results showed the Average Variance Extracted (AVE) estimate range from 36 % to 52.5%. The AVE value of efficiency and innovativeness is found more than 0.5.Moreover, the construct reliability (CR) value is range from 0.276 to 0.86, which it means the flexibility indicator and the quality indicator do not provide enough value of the internal consistency. For this issue, the research consulted with the statistics specialist about the CFA results, the suggestion was that it is still potentially used as a tool to measure the supply chain performance. Supporting by the study of Punniyamoorty et al., (2012), SEM and AHP were applied as instruments in the supplier selection. However, the research did not test validity and reliability of the model; the study only tested on the strongly theoretical foundation to develop the model for determining supplier. In addition, the sample size is small that it could not be represented to the validity and reliability of the model. In summary, the model fitting degree of the PM is therefore proved that it can potentially apply to use in the Thai frozen shrimp supply chain.

6.1.3 To analyzing the importance and integrate the KPIs

The result of Section 5.3: Chapter 5 showed five main criteria had important to the Thai frozen shrimp supply chain in BSC perspective. The efficiency criteria were the most important to the financial perspective. According to Bigliardi and Bottani (2010), the BSC could serve as a reference for the food industry and financial efficiency was the most important in this BSC perspective. Supported by Widyaningrum and Masruroh (2012), they pointed out sea fishery supply chain should be concerned with

financial efficiency for supply chain evaluating in small and medium enterprises (SME). Moreover, Bhawat and Shama (2007) integrated BSC in SCM evaluation, financial efficiency such as cost, profit, and ROI should be addressed in a financial perspective. However, the flexibility criteria did not be directly in the financial standpoint, some flexible measure indicators such as numbers of backorders and numbers of stock outs were in cost criteria (Shepherd & Gunter, 2005). The third criteria, the responsiveness, was addressed and was the most important in the customer perspective. According to lead time, customer response time, and customer complaints, which were an indicator in the responsiveness, help to meet the high customer satisfaction which has became a major preoccupation for organizations Moreover, Bigliardi and Bottani (2010) informed responsiveness to urgently was addressed in customer perspective. In addition, Theeranuphattana and Tang (2008) strongly supported the responsiveness were important criteria in customer-facing. The forth, the food quality criteria were the most important in customer perspective because it was concerned directly to consumers. According to Loc (2006) quality was the very strict market standards on safety and hygiene to consumers. Therefore, the quality criteria are a standard of products, processes, and services that were related to the customer satisfaction (Chan, 2003). Finally, Innovativeness criteria, this criterion can help the company to advantage competition over other competitors (Chan, 2003). According to Bhawat and Shama (2007) this criterion was important because innovation can bring about efficiency in the operation management of the business. Moreover, it guarantees the cost will be reduced.

In addition on BSC perspectives, financial and customer perspective were an important perspective and were efficiency and effectiveness to supply chain performance. According to Theeranuphattana & Tang (2008), supply chain performance was grouped into two important aspects that were customer-facing and internal-facing. Two aspects were composed of 10 KPIs that all KPIs were conducted from the SCOR model. The results showed it had effectiveness to SCM.

6.1.4 To develop a new performance measurement model

The result of Section 5.4: Chapter 5 showed the new performance measurement model for evaluating the Thai frozen shrimp supply chain. The new PM model is developed by using integrated method between CFA and AHP. According to

Punniyamoorty et al. (2012) the relative weightage from CFA is considered more valid than another approach because the CFA method could take measurement error into account when data was analyzed by statistics method. For this reason, this new performance measurement model was synthesized by using data from concerned people. It is very advantage than another approach as MCDM which collected data from less number of people to arrive the weight score. Moreover, Byrne (1998) pointed out the factor loading can be used to consider the important variables in 2nd CFA that it was applied to prioritizing important KPIs in Table 5.4.

6.1.5 Implement with others food chain

The research performance model were specific to the shrimp supply chain study in Thailand and analyzed with combination methods. However, these shrimp chains were also general in the many parts of the word such as China, Vietnam, and Bangladesh. The specific impacts would be differently in each system to differences in supply chain system boundaries, food standard, functional units but general supply chain would be similar (Gao et al, 2010).). As well, this performance measurement model not only can adopt in the shrimp aquaculture supply chain but also can apply in seafood supply chains such as Seabass, Scylla, Oyster, and Green mussel. Because of Thai GAP standard is applied and would be a similar process to marine culture.

Furthermore, the research model adapted from Aramyan (2007) who created a model for an agricultural base on BSC and applied his model in Netherland. For the reason, this model can also use to measure performance of agricultural supply chain. For example adapted into Thai rice, crops, and poultry. However, observe variables in the main quality criteria should be change follow the Thai Agricultural Standard (National Bureau of Agricultural Commodity and Food Standards, 2014). Additionally, this model can drive into a performance measurement model that towards typology, economic and social sustainability in a future research.

6.2 Conclusion

To meet the global market, performance measurement is critical to the success of organizations because it can understand organization behavior and situation. Moreover, performance measurement can help organizations to improve competitiveness. This research aims to develop the new performance measurement model that contained financial and non-financial indicators and the specific characteristics of indicators in agri-food supply chains.

In the research process, the sample size of this study is 120 participants by using a convenience sampling method. There are five latent variables; 1) financial efficiency, 2) flexibility, 3) responsiveness, 4) quality, and 5) innovativeness. Moreover, there are 27 observe variables. Questionnaire of the performance measurement in the Thai frozen shrimp supply chain was applied to collect the data. The descriptive statistics was used to analyze data in term of mean, standard deviation, skewness and kurtosis and CFA was applied to find out the validity and the reliability the model and to test the model fits to empirical data. The new performance measurement model was synthesized from the integrated method between the CFA and The AHP method. The new performance measurement model was proved it was very strongly theoretical performance measurement concept with the right fits values. Although, the validity and the reliability have not insufficient by AVE and CR value in some KPIs with the limitation of this research. However, this model can be conceptualized as a 2nd multidimensional construct consisting of Efficiency, Flexibility, Responsiveness, Quality, and innovativeness.

The new performance measurement model is therefore created by consisted with 25 KPIs. The KPIs were grouped into five criteria that are efficiency, flexibility, responsiveness, quality (product and process) and were grouped into the financial and customer perspective of BSC. Therefore, the results are clearly answered to both research objectives on the prioritizing important KPIs, main criteria, and BSC perspectives.

6.3 Research Contributions

6.3.1 The integrating of PM in Thai frozen shrimp supply chain

The contribution of this research is the developing of the new performance measurement model based on the integrated conceptual ideas and the synthesizing methods for evaluating the supply chain in Thailand. The direction of the research contribution can be explained as follows;

1) The new model has firstly contributed to the performance measurement aspects integration (The qualitative and quantitative aspects of the traditional SCPM were integrated with an environmental dimension in which it could be evaluated into carbon footprint value). The integration of the new model had never provided within other Thai Frozen Shrimp Chain performance measurement models before. The new model is composed of all aspects of the performance measurement in the supply chain, and it is still maintained importance aspects similarly with other chains. The performance measurement aspects of the new performance measurement in supply chain model are developed and based on literature reviews. The model is combined with the five dimensions; Efficiency, Flexibility Responsiveness, Quality with including environmental aspects and Innovativeness. In addition, the new model is integrated with the necessary dimensions in each aspect for the effective performance evaluation since the important data were informed by the members or participants in the chain. Customers or users are expected to be able to save their time and the cost when they apply the model. Because, the model is measured once, but it provides the two dimension results including the performance information of supply chain management and the environmental management dimensions. Therefore, the first contribution can answer the first sub research question, regarding identify the necessary aspects of the Thai frozen shrimp chain and to use as the standard model for evaluating of this chain.

2) The second contribution of the model, the model is constructed from the integrating of conceptual ideas by using the methods of a combination between the confirming and the testing of the model. This integration is also based on the multiple decisions making. It could be said that the integration model has never been developed in other Thai frozen shrimp chains before. This is because many research studies usually use only the multiple decision making (MCDM) methods for evaluating a

supply chain performance in SPCM. In this new integrating model, it is not only prioritized the KPIs by using the effective model by using the multiple decision making but also analyzed the effective model by explaining the casual relationship between them. The results show the sufficiency of the direct effect and indirect impact among factors (KPIs) while the MCDM cannot. The second contribution also answers the second and third sub research questions.

6.3.2 The benefit on the Thai Frozen Shrimp Supply Chain Business

The researcher expects that the results of this study will benefit to provide the new knowledge about the development of the new key performance measurement groups and the effective supply chain performance measurement models for the Thai Frozen Shrimp Supply Chain. For application of the results, the new integrating model will enhance the importance of the new key performance measurements and could help Thai's frozen shrimp supply chain companies to reduce the time of diagnostics, the cost of the SCM developing, and the man-hours of the supply chain management.

6.4 Limitations

The restriction of this study is composed of 3 limitations, which are

1. Small sample size to collect data, the Small sample size in ratio 4:1 has an effected on the AVE and the CR value. Although Shah & Goldstein (2006) suggested, this ratio was sufficient. However, the researcher should use fit indices that are least biased. For instance, X^2, GFI, NNFI and NFI. For nonnormality data, they also recommended about estimation methods that should be ML Robust or another method that do not assume multivariate normality such as GLS or ADF (Shah & Goldstein, 2006).

2. The combination method between SEM and AHP, although this integrated method can be tested, estimated causal relationships; arrived weight scores for prioritizing the important KPIs in AHP process, the bias of the points of view from fewer people in AHP have impact to weight score.

3. The new performance measurement model did not implement in the Thai frozen shrimp supply chain because it is out of this research scope. Therefore, further

research should be used the new performance measurement model as a tool to evaluate supply chain performance in this chain and another agri-food chain to achieve a validity and reliability of this model.

6.5 Recommendations

From limitation, the research proposed the future study to eliminate their limitations, which are

1. The sample size should be added to meet a standard of validity and reliability of the CFA method. Hence, further study is needed to add participants at the ratio 20:1. The participant groups should be a concern all member in the chain such as breeder, grower, manufacturer, retailer, wholesaler, distributor and supermarket. Moreover, a bootstrapping method as an aid to nonnormal data. The key point of this technique is that it help the researcher to create multiple subsamples from an original data. In generally, an advantage of the bootstrapping is that it permits the researcher to evaluate the stability parameter estimates and whereby report their values with a degree accuracy (Byrne, 2010).

2. The evaluated method, the future research should be applied the several techniques, such as fuzzy set theory with AHP for manage the subjective and bias from the point of views of participants, multi-attribute theory (MAUT) to determine an overall performance function for aquaculture supply chains. In additions, to generate efficiency score, data envelopment analysis (DEA) is needed to represent this performance model can be applied to test with factual data.

3. The new performance measurement model should be implemented in concerned farm, companies and also should be implemented in other chain of agri-food chain to achieve the effectiveness of the new performance measurement model and arrive to validity and reliability standard.