

Chapter 3

Research Designs and Methods

In this research starts from studying of the principles and theories that related with supply chain management, general characteristic of Thailand export frozen food industry and literature to create a primary framework of performance measurement. The expert interview was used in the interview about the suitability of this framework. After the first interview, the performance indexes in the framework were complete. Then the second interview was used to assign the weight of each index according to Balance Scorecard approach by AHP and Fuzzy Set theory. After that the complete performance measurement framework was applied to measure the performance of supply chain management for the frozen food export manufactories in Thailand and indentified their strengths and weaknesses. The framework of this research designs and methods are shown in figure 3.1

3.1 Study related theory to the knowledge base and reference in this research

For supply chain management, the activities which attended in this research are procurement, inventory management, product design and new product development, manufacturing, order process, transportation/distribution, sales, demand management and customer service. The study of supply chain management help in the understanding of this basic principles and dividing the activities in frozen food export industry into the supply chain management activities. Moreover, the BSC was applied to helps in comprehend the overview of the supply chain according to financial perspective, customer perspective, internal process perspective and learning and growth perspective. Fuzzy set theory was studied for conversion from quality value or word into a value that could be calculated to be used in calculating the weight of each factor in the next step. For prioritize the criterion in performance measurement, the Analysis Hierarchy Process [AHP] was utilized. The weight from this step was show which criterion is very important or less important.

3.2 Identify and study supply chain characteristics of export frozen foods

Study the supply chain management in frozen food export industry which activities were related to the performance in supply chain management; the knowledge about the supply chain management of frozen food export industry was derived from the literature review about agricultural supply chain and export industry to find out the specific characteristics of both, the internet about the stage of export situation of Thailand and study about model scheme for food industry of Thailand from National Food Institute [NFI] web page and the attitude of entrepreneurs about food export situation from their web page such as, Thai frozen foods Association.

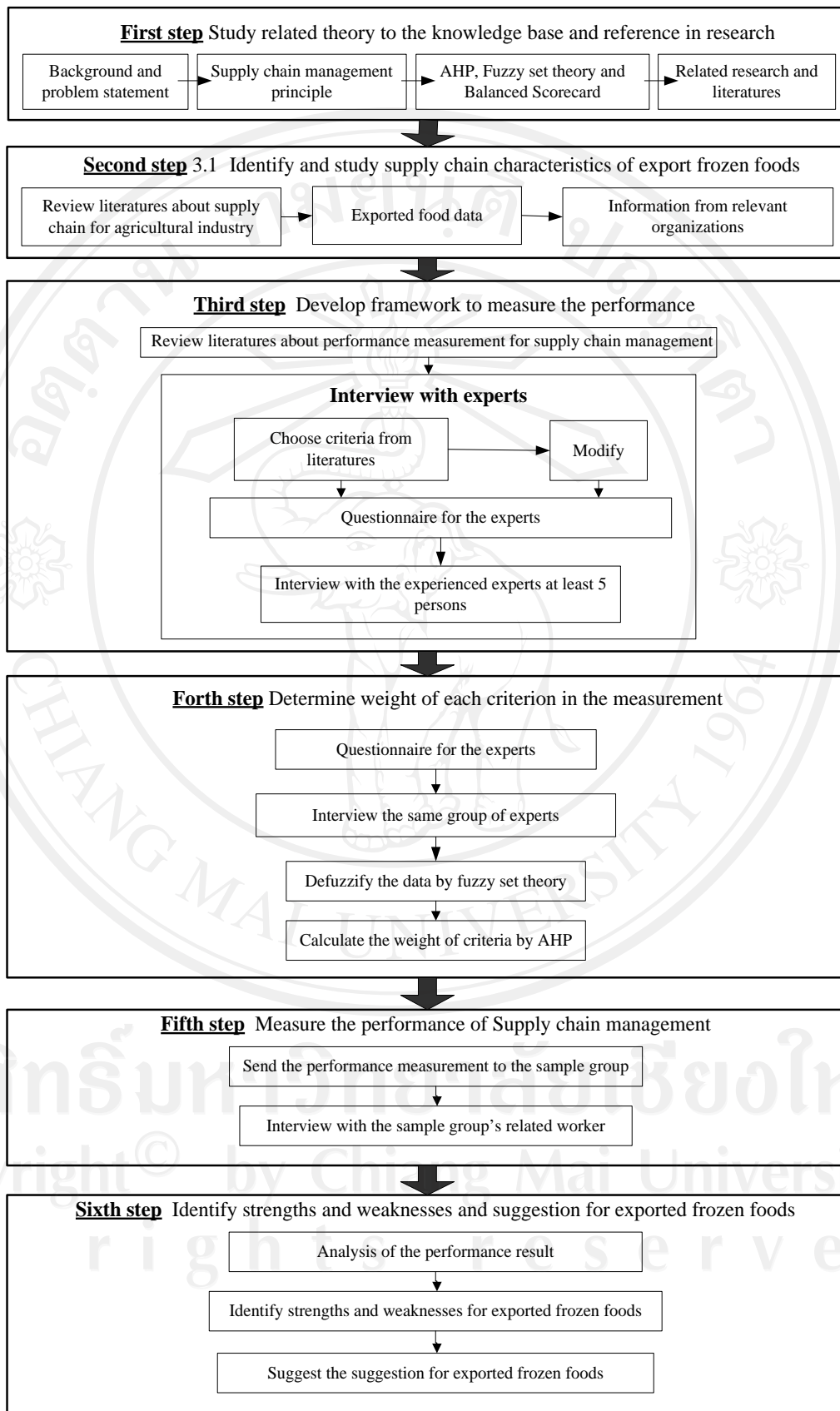


Figure 3.1 The overall research process.

3.3 Develop framework to measure the performance of supply chain management

In this step, process was divided into two sub-processes. The first one was to study the related literature about the performance criteria and choose the primary criteria of framework. Then the expert interview was presented to ensure about the appropriateness of the criteria which used in measurement.

3.3.1. Review related literature

For the study related literatures about the criteria, the literatures included research about supply chain management and its performance measurement of various industries. In this step, the difference of criteria which were used in measurement in different industries and which criteria were widely used were considered especially for food or agricultural supply chain.

3.3.2. Interview with the experts

To structure the framework which was appropriate in using for measuring the performance of supply chain management for exported frozen foods, the experts' opinions are considered. The opinions from experts who have knowledge and related experience would show the overall attitudes which should be emphasized. This research used the interview with at least 5 concerning experts that were divided into 3 categories.

1. Scholars who graduated in directly related disciplines or in supply chain management research for at least 5 years.
2. A worker who has the management or operating decisions related to supply chain management in the frozen food industry with at least 5 years work experience.
3. People who work on planning policy or supply chain management and logistics for manufactory in the government.

In the expert interview, the first questionnaires which represent the framework from a literature review were used. In this questionnaire, the experts opine that agree or disagree for each criterion and recommend developing the measurement framework to be more suitable.

3.4 Determine the weight of each criterion in the measurement

From the previous step, all related criterions were scored by the experts that how much the importance of each criterion by pairwise comparison and the ambiguity that occur from each expert was also considered. The levels of importance and membership value in comparison were derived to 9 levels which shown in table 3.1.

The second questionnaire was used for weighting the importance of each criterion. The experts who weight the criteria were the same group as the first interview. In weighting the priority of criterions, comparing the importance for main-criteria and sub-criteria was used, including rating each criterion into Balance Scorecard's perspectives too. The value from questionnaire was averaged by divided

for each pair then compare this. Details of the questionnaire are shown in the appendix A

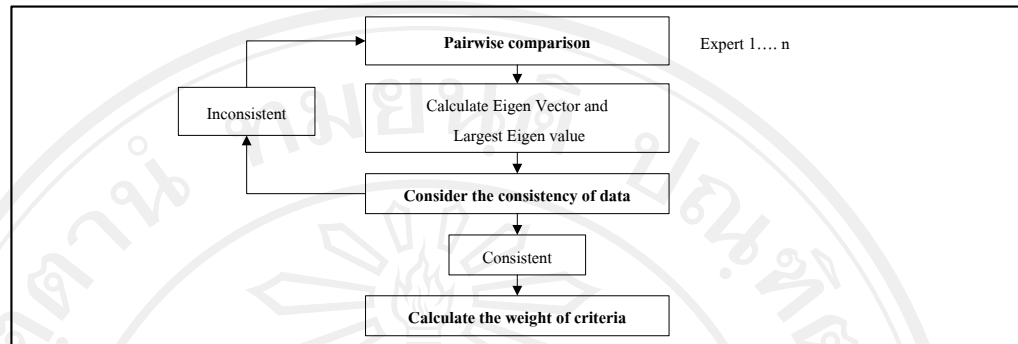


Figure 3.2 The determine weight process

Table 3.1 The level of importance

Preference Level	Fuzzy Number	Triangular Membership Number
Equally Preferred	$\tilde{1}$	(1, 1, 1)
Equally to Moderately Preferred	$\tilde{2}$	(1, 2, 3)
Moderately Preferred	$\tilde{3}$	(2, 3, 4)
Moderately to Strongly Preferred	$\tilde{4}$	(3, 4, 5)
Strongly Preferred	$\tilde{5}$	(4, 5, 6)
Strongly to Very Strongly Preferred	$\tilde{6}$	(5, 6, 7)
Very Strongly Preferred	$\tilde{7}$	(6, 7, 8)
Very Strongly to Extremely Preferred	$\tilde{8}$	(7, 8, 9)
Extremely Preferred	$\tilde{9}$	(8, 9, 9)

The results from the second questionnaire were analyzed for each criterion's priority by AHP method and defuzzify the ambiguity by using triangular membership function as shown in figure 3.4.

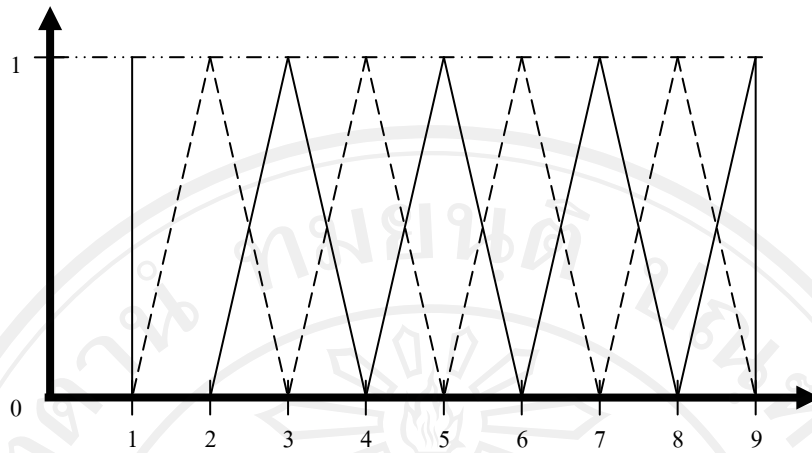


Figure 3.4 The triangular membership functions

The calculations were executed to the theory AHP method using. Maximum Eigen Values (λ_{max}), consistency Index(CI) and consistency Ratio(CR) were calculated.

Because the data obtained by this interview may not always be correct. Therefore, it must be validated by consistency check. The CR must be less than 0.1 to show that the measurement consistency. The CR values can be obtained from the equation as follows;

$$CR = \frac{CI}{RI} \tag{2.3}$$

By CR = Consistency Ratio
 CI = Consistency Index
 RI = Random Index

And Consistency Index (CI) is equal to

$$CI = \frac{\lambda - n}{n - 1} \tag{2.4}$$

By n =the size of the square matrix or the number of criteria

$$\lambda_{max} = \frac{\sum \left(\frac{AW^T}{W^T} \right)}{n} \tag{2.5}$$

Random index is shown in the table 2.1.

Table 2.2 Random Index (RI)

n	1	2	3	4	5	6	7	8	9	10	11	12	13
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56

If $CR \leq 0.10$, the result is considered acceptable but if CR is more than 0.10, the result is considered unacceptable. Decision makers have to review the scale of comparison again until the CR is lower

3.5 Measure the performance of supply chain management

The measurement framework which derives from interview with experts was used in measuring the performance of the sample organizations. The sample organizations of the research are frozen foods manufactories which were the member of department of the export promotion. For the measurement, there were 24 manufactories from 239 manufactories that interviewed with the research and the reliability of statistics as 85 percent interval confidence and 15 percent standard error. In the measurement, researcher communicated with manufactories and sent the framework questionnaire to request information of the person who involved in supply chain management and able to answer the framework questionnaire. Then interview with informants accordingly to the framework was observed to obtain the accurate information.

For data analysis, the research used Quartiles to range the data which received from the organization into 4 ranges. To divide the criteria for rating is defined as follows;

For operations which require the operating results at high (Positive criteria)

The performance which is below the first quartile	1 point
The performance which is between the first quartile and the second quartile	2 point
The performance which is between the second quartile and the third quartile	3 point
The performance which is above the third quartile	4 point

For operations which require the operating results at low (Negative criteria)

The performance which is above the third quartile	1 point
The performance which is between the second quartile and the third quartile	2 point
The performance which is between the first quartile and the second quartile	3 point
The performance which is below the first quartile	4 point

In the scoring of the measurement used SAW method in scoring in each sub-criterion, including the total score for each main criterion.

3.6 Identify strengths ,weaknesses and suggestions for exported frozen foods

The conclusion of data that was gathered from the questionnaire to achieve the objectives of this research can be divided into;

3.6.1. Summary of strengths and weaknesses of the exported frozen food industry accordingly to the measurement by using the SWOT analysis.

3.6.2. Suggest the ways to improve and enhance the efficiency of supply chain management of exported frozen food by using the TOWS analysis.

Table 3.3 Research method and results

No.	Research Method	Reference principle	Results
1.	Study related theory to the knowledge base and a reference in research.	-Supply Chain Management - Balance Scorecard - Fuzzy Set theory - Analytic Hierarchy Process	Knowledge to be applied in research on building performance measurement of the supply chain of exported frozen foods
2.	Study the SCM of the export frozen food industry in Thailand.	- Information from relevant organizations and the supply chain in the exported frozen foods.	Related activities of the action that occurs in the supply chain management of exported frozen foods.
3.	Developing framework	- Theory of supply chain management - Balance Scorecard - Information to the export frozen food industry.	Primary criteria of measurement framework.
4.	Determine the weight of each criterion in the measurement	- Balance Scorecard - Fuzzy Set theory - AHP	Criteria and weight of measurement framework and questionnaire for measurement.
5.	Measuring the performance of SCM	- Theory of supply chain management - Quartiles - The simple additive weighting (SAW)	Result of measurement of supply chain management for the exported frozen foods
6.	Identify strengths, weaknesses and suggestions for exported frozen foods		The analysis result from the using the framework, strengths, weaknesses and the general improvement concept and summary of research results.

The processes which the researcher mentioned in former session could be summarized as a table 3.3 in addition to the details of the operation of each process. The table displays the expected result at each step which was a clear path in the research and in accordance with the prescribed period. The results of each process are shown in chapter 4.