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Partner Selection in Tourism Supply Chain Networks: Concepts, Decision Model and Managerial Implications

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by

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Abstract

The current situation of tourism organizations, in particular tour operators have to deal with several challenges. First, the consumers' variety of preferences. Second, the competition of direct service from accommodations. Last, the short-term relationships between tour operators and service providers. Since the service quality depends on the performances of partners, the management committees have realized the importance of partnerships is crucial for not only overcoming these difficulties, but also sustaining competitive advantages. The partnership has already recognized the benefits of helping firms to have better performances. However, most firms in fact fail in practical implementations causing huge unrecoverable and unavoidable sunk costs. Existing literature has suggested that the suitable candidate for collaboration can be initiated at a beginning of selection process. The question is how to evaluate which partner is the most favorable for collaboration make tourism partner selection problem critically very important. Nevertheless, there is no evaluation framework that is appropriately available for tourism firms.

In this study, we focus on the partner selection problem in tourism networks. The purpose is to develop the new evaluation model to advance the tourism supply chain literature. In the process of making a decision, as we have observed the literature in relevance contexts, the main characteristic of partner selection problem is generally dependent on not only the characteristics of multi-dimensional data and evidence available, but also the backgrounds of decision-makers involved. Additionally, due to the qualitative nature of most evaluation criteria, the data available are mostly qualitative and may be expressed solely by means of linguistic terms. These traits cause a difficulty for tourism firms to makes a effective decision under impreciseness, vagueness and uncertainty.

To assist the firms in making better decision, literature has suggested the usefulness of applying fuzzy-based-computation approach when dealing with linguistic assessments. Given its advantages; however, the fuzzy-based approaches have some unavoidable limitations by several reasons. First, a difficulty of precise assigning and mapping linguistic assessments to fuzzy number representation. There are many types of fuzzy membership

functions such as triangular, trapezoidal and so on. The different definitions of membership functions assigned lead different results. Second, most of available models assume that the linguistic judgments expressed by experts are precisely completeness. In practicality, however, due to human' s ability limitations, experts may express a partially preferences. Furthermore, limited by background knowledge and experience as well as evidence available, the linguistic assessments of experts regarding the same alternative are totally conflict. With regard to these mentioned obstacle, existing approaches cannot effectively capture the uncertain and vague information. This limitation effects on the preference orders of alternative in some situations. Last, by applying fuzzy-based computation scheme, the necessity of utilizing an linguistic approximation process to translate value back to the original ones causes the loss of information, which hence implies a lack of precision in the final result. These disadvantages as mentioned earlier would be especially and critically important in partner selection for collaboration contexts.

To avoid the limitation mentioned above, we present an evaluation model for tourism partner selection problem, which is formulated as multi-expert multi-attribute decision problem with uncertain linguistic assessments. The proposed evaluation model consists of two phases. Firstly, we model multi-expert linguistic assessments on single attribute by means of mass function and then makes use of Dempster's rule of combination for attribute aggregation. Secondly, the combined mass function is transformed into corresponding probability distribution via Smets's pignistic transformation and finally defined a linguistic choice function based on the so-called satisfactory principle for ranking and selection.

The main contribution of this research are as follows. Firstly, we propose an alternative evaluation model for linguistic partner selection problem, which is can effectively capture the uncertain linguistic information and random preferences while maintaining the flexibility for managers in freely making decisions using uncertain linguistic assessments. Secondly, by computation solely based on the order-based semantics of the linguistic terms, the difficulty of quantifying a qualitative concept can be eliminated. Lastly, the illustrated practical case study is the first empirical research in contexts of partner selection for collaboration in tourism supply chain networks.

The dissertation is organized as follows. In Chapter 1, we review the research backgrounds and statement of the problem as well as purpose of the study. Chapter 2 begins

with a brief of tourism supply chain concept. Then, a state-of-the-art decision model and method for partner selection are critically reviewed. In Chapter 2 we also explain the basic concept of fuzzy multiple attribute decision making and follows by re-formulating a general scheme of ME-MADM problems with uncertain linguistic assessments as well as briefly introduce the Dempster-Shafer theory of evidence and Dempster's rule of combination using in this research. Chapter 3 introduces research framework and strategy for data collection Next, Chapter 4 explains a process of developing evaluation criteria for partner selection in tourism industry. Later, Chapter 5 describes a process of developing a tourism partner evaluation model and approach. In addition, the proposed method is illustrated with a real partner selection problem in tourism supply chain networks. Further, the performance evaluation of proposed method is also conducted. Finally, Chapter 6 concludes the paper with some discussions and concluding remarks as well as suggestions for future research.

Keywords: Multi-expert multi-attribute decision making, uncertain linguistic assessment, satisfactory principle, partner selection, tourism supply chain management

Acknowledgments

Aut viam inveniam aut faciam.

(I will either find a way, or make.) - Hannibal (247 BC - 182 BC)

First of all, I would like to express my sincere deepest respect and profound gratitude to my superb supervisor, Associate Professor Van-Nam Huynh from Japan Advanced Institute of Science and Technology (JAIST), for his vision and supreme encouragement as well as thoughtful guidance in every discussion and suggestion during conducting the research. He has always provided me with insightful explanations to guide me to understand how beautiful mathematics is. I have learned a lot when working with him. Without his valuable advice, I might be not complete this dissertation.

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Glossary and Terminology

Glossary	Terminology
Alternatives	Objects or options to be evaluated. An alternative may be evaluated based on its attributes.
Criteria	A property, quality or feature of an alternative. The word attributes and criteria are used interchangeably.
Criteria Hierarchy	A criteria hierarchy illustrates the multi-level structure of criteria.
MCDM	An acronyms for Multiple Criteria Decision making.
ME-MCDM	An acronyms for Multiple Experts Multiple Criteria Decision making.
Decision Matrix	A decision table to illustrate the assessments of each alternative regarding each criterion.
Belief Matrix	A transformation of original decision matrix to belief (mass) decision table.
Linguistic Assessment	A result of assigning evaluations and the associated degrees of belief in term of linguistic terms to an attribute based on guidelines and evidence.
Subjective Uncertainty	Subjective uncertainty refers to degrees of belief associated with linguistic assessments
Criteria Aggregation	A main task of MACM is the process of aggregating assessments from lower level criteria to higher level criteria to obtain the overall assessments.
Sensitivity Analysis	Investigation of how sensitive the ranking of alternatives is to changes in weights for certain attributes.

Chapter 1

Introduction

In introductory chapter, we will first review and discuss importance of the partner selection for collaboration problem in tourism supply chain networks. Then, a review of existing decision models and approaches are also intensively described. Next, to address research gaps, we state the research motivation and research questions as well as purpose of the study.

1.1 Importance of research

This section will first explain research background and context that we choose to research. The next is the explanation of importance of research and its challenges in context of partner selection problem in tourism supply chain networks.

1.1.1 Research backgrounds, contexts and its challenges

Over a decade, it is highly clear that manufacturing and production based industries have influenced to the world economy [1]. Nevertheless, a trend of the global economy has been changing from traditional production to service-oriented industry. In a recent years, service industry is the most rapid growth industry around the world [5]. In service-oriented business, tourism sector plays significant contributions.

In tourism business transactions, the main characteristic is a process of delivering services regarding a combination of tourism products such as package tours [1, 5]. These products which can actually be purchased individually are put together by a tour operator

Figure 1.1: A tourist who has different preference.

who uses the advantage of scale economy to offer the mix product for a lower price than purchased separately [6]. The fashion of tourism product arises by several reasons. First, it is convenience for tourists. Second, tourists always are looking for the guarantee for security and safety. In the popularity of package tours, the targeting of so-called "in-locations" where a majority of tourist are going is the third reason [5, 6]. Forth, an affordable price is in comparison to separately purchased products [7]. Last, the most significant advantage is time-saving process [5].

Even though package tours have several advantages, there are some additional challenges that nowadays tour operators have to overcome these issues. First, a dynamic personal preference of tourist [1, 8]. Figure 1.1 illustrates a tourist who has different preference. A traditional tour package cannot deal with such situation effectively because a traditional package tour is rigid, standardized and leave very little space for tourists' personal interests [9]. Regarding the limitation, package tours have less fashionable. This disadvantage mentioned is becoming more and more obvious as the society is developing [5]. Evans and Stabler [10] have suggested that if package tour are less flexible and customized, tour operators are not able to maintain their popularity in the future. Second, a direct competition from accommodations. Usually, tour operator design a package tour by selecting and combining services offered by service provider. However, nowadays many on-line sources such as e-business are available and easy to access that can help and support service provider to provide direct service to the target customers. Figure On-line tourism phenomena may lead to delete tour operator and travel agency out of the

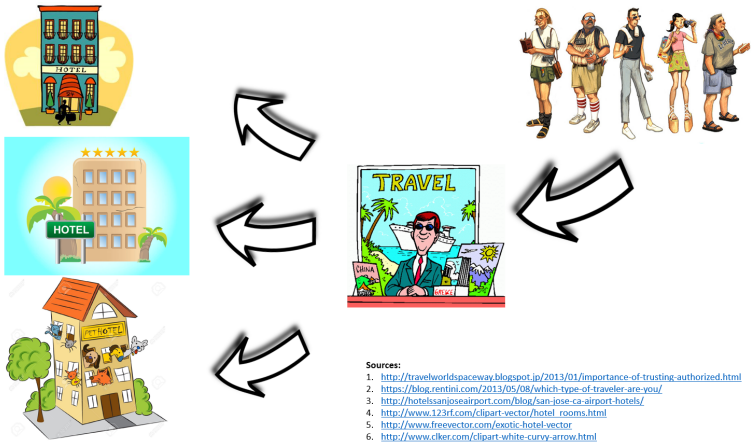

Figure 1.2: An illustration of seamless entity.

whole system in the near future [1]. Third, a short-term relationship and commission. On the one hand, commission is very important for tour operator for survival. On the other hand, commission leads a short-term relationship. Most tourism organizations can easily change partner(s) if a proposed commission is satisfied. This difficulty significantly affect to small and medium tourism company sizes when competing with big companies. Last, service quality and seamless entity. A quality of service is the most critical issue for tour operator and travel agency. Zhange *et al.* (2009) suggests that a difficulty in successfully designing and delivering services to desired tourist (customers), who usually have complex expectations and often view tourism products as *seamless entity*. Hence, the service performance of tour operators depend on the service quality of service providers, which are selected for offering a tour package. Figure 1.2 illustrates a difficulty of seamless entity problem.

To overcome these problems mentioned, tourism research during the last two decades had modernized considerably. The main issue is to investigate on how tourism firms in particular tour operator and travel agency can survive and enhance their competitive advantage dynamically under fierce competition environment. In the main stream research, many tourism researchers have studied using a systematic approach regarding the marketing perspective aiming to expand and to increase tourism distribution channels [11, 12, 13, 14]. For example, to implement the new information technology and to develop new commercial formats such as new marketing campaigns. However, there is another important strategies for survival. That is the effective tourism supply chain man-

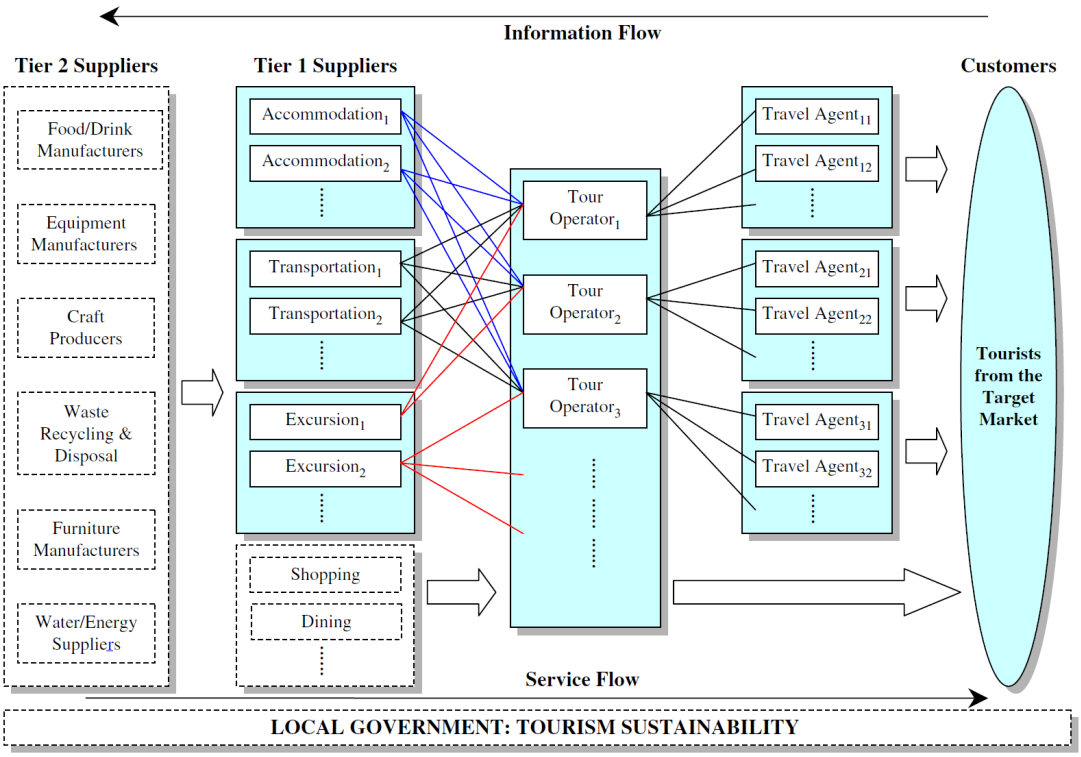

Figure 1.3: A typical TSC within a destination.[1]

agement ($TSCM$) [1, 15]. Literature has suggested that when tourism organizations can efficiently manage the unit operations in tourism supply chain within a specific tourism destination, can then gain advantages and also can easily accomplish business objectives over competitors [16, 17]. Nevertheless, there is little theoretical and empirical research within the context of tourism supply chain management.

In order to effectively analyze and manage tourism supply chain, previous research has suggested that it is necessary to understand the network structure of tourism supply chain (TSC) [1]. In this study, we adopted the tourism network structure, proposed by Zhang *et al* [1] due to the generalization of its structure. The typical TSC within a destination is shown in Figure 1.3.

In structure of tourism networks, the downstream side is tourists, who usually have random demands. Travel agency are the retail branches of tourism products, and dealing with tourists and tour operators. Sometimes travel agents and tour operators can be the same or separate business entities [1]. Tour operators is the main player who are an assembler of tourism product by buying single travel services such as transport and

accommodation from their suppliers. The finished products will be sold by travel agency as distributor. There are two mains supply chain players in upstream side: direct suppliers and sub-suppliers (supplier's supplier). In the first-tier supplier, direct suppliers such as transportation operators, accommodation operators and theme parks are the main service providers, whereas the second-tier suppliers, who are the supporters, supply raw-services (materials) and raw-products to the first-tier suppliers.

Regarding the comprehensive structure above, a concept of tourism supply chain using in this research is defined as "*a network of tourism organizations engaged in different activities ranging from the supply of different components of tourism products/services such as flights and accommodation to the distribution and marketing of the final tourism product at a specific tourism destination, and involves a wide range of participants in both the private and public sectors.*" [1, 15]

There are five important characteristics of tourism industry that distinguish it from not only primary sectors, but also service sector.

1. Tourism industry is a **coordination-intensive** industry in which different products/servcies including transportation, accommodation, and so on, are bundled together to form a final product.

2. Tourism product is **perishable** in nature since services cannot be stored as inventory for future operation.

3. Since tourism product cannot be examined prior to tourists' purchase, the tourism industry is therefore a very **information-intensive**, or **information-dependent**, industry because most of successful transaction are dependent on the presentation and interpretation of the products.

4. Tourism product is generally **complex** since it consists of many service components.

5. Tourism industry is **dynamic** in nature because of intensive competition among service providers.

Based on these characteristics, Zhang et al. [1] have proposed seven potential issues in tourism supply chain management: demand management, two-party relationships, supply management, inventory management, product development, TSC coordination and

information technology. In this study, we only focus on supply management issue. The details explanation is described in the next following section.

1.1.2 Necessity of partnership in tourism networks

Supply management have been of great interest among supply chain management scholars. The supply management focus on how to effectively manage buyer-supplier relationship [18]. This is because suppliers have strong influenced on costs, profits and service qualities of the buyers. Although supply management issue is important, research investigating this issue in tourism supply chain is scattered and lack of a clear direction [1].

The importance process in supply management is to assemble tourism products such as holidays package tour. In designing the package tour successfully, partnership is crucial for most tourism organizations, especially for tour operators to complete this utmost important supply chain activities because tourists often view a tourism product as a seamless entity [1]. If tour operators fail to satisfy tourists' expectations, then they will loss a huge profit and opportunity costs [19]. Since tourism supply chain activity is a cross-functional activity, literature also has suggested that the success rate of designing tourism services for tour operators depends on the supply relationship performance between a focal tour operator and its suppliers [1, 20, 21, 22, 23].

In tourism supply management research, there have focused on the relationship between tour operator and accommodation. March [24] have found that Australian travel suppliers extremely depend on travel buyers. Next, in empirical study of Garcia-Falcon and Medina-Munoz [25], the results show that having good relationships with travel agents is an important element for the success of hotel. Later, Buhalis [11] found that hotels operating in Mediterranean consider the power of tour operator in the target market. Even though successful partnerships is necessary, most of tourism enterprises however fail in implementing long-time collaborative relationships.

More interestingly, there are few studies investigating on what are the critical factors orienting successful relationships between tourism supply chain members. Medina-Munoz and Garcia-Falcon [20] was the first researchers exploring what are factors leading tourism firms to form a successful relationships using a sample in America. They found that trust, commitment, coordination, communication quality, information exchange, participation,

usage of constructive resolution techniques, and similar relative dependence have a positive effect on long-term partnerships. Later, Pansiri [26] has suggested that the effects relationships between characteristics of alliance partner have a positive influenced on alliance performance. However, her study has limitation on how to evaluate which alliance is best partner for successful collaboration.

Regarding the necessity of partnerships as discussed above, tourism organizations are recognizing the importance of selecting suitable partners for collaboration. However, there is no evaluation model and framework for evaluating a potential partner in the context of tourism supply chain management. Motivated by addressing a research gap, this study aims at developing an evaluation model for partner collaboration in tourism supply chain context.

1.2 Research motivations and problem statements

In effectively managing tourism supply side, there are several issues for tourism stakeholders having to deal with not only adversarial relationships as the norm in tourism industry, but also to manage the coordination linkage across organizations from arm-length relationships towards tight links [16]. In addition, there is a difficulty in successfully designing and delivering services to desired customers who usually have complex expectations and often view tourism product as seamless entity [1]. To overcome these challenge, tourism firms have realized that they cannot provide effective services by solely utilizing their internal resources due to its limitations. The necessity of collaboration with suitable supply chain partner becomes an essential approach in order to sustain competitive advantages. The significant benefits of supply chain partnerships have already suggested in the literature. By effective collaboration, a focal organization can gain critical resources as well as surplus core competency that lead positive performance outcomes such as reduce costs and improve service performance [20, 21]. Nevertheless, the unrecoverable sunk costs are inevitable when working with the wrong candidate. Existing literature has suggested that the suitable candidate for collaboration can be initiated at a beginning of selection process. The question is how to evaluate which partner is the most favorable for collaboration make tourism partner selection problem critically very important. These make tourism partner evaluation process critically very important. However, there is no ap-

propriate evaluation framework that can direct apply for tourism partner selection as we have already observed.

Although the suitable tourism partner for collaboration is an important issue in effective tourism supply chain management, there is no theoretical and empirical research addressing research gaps. Hence, this study have focused on developing an evaluation model for tourism partner selection problem. Limited by tourism partner selection research, the existing studies in other contexts are hence indirectly reviewed. The nature of partner selection problem, as we already have witnessed, is formally formulated as multiexpert multiattribute decision-making ($ME - MADM$) problem. The main characteristics of ME-MADM problem are usually dependent on the nature of various attribute information and evidence available as well as the background knowledge of experts/ decision-makers [27, 28, 29]. In the context of partner selection for collaboration, the decision of a firm for selecting suitable partner to start working with is often relying on not only the firm' s operational competency but also depending on the characteristics of potential partner [30, 31]. In addition, due to the qualitative nature of evaluation criteria, the data available are mostly qualitative and may be expressed solely by means of linguistic terms [32]. Furthermore, in the multiple functional groups, each expert who has different background knowledge and perspective may be judged and evaluated only in subjective assessments. These traits cause complexity and uncertainty as well as vagueness in partner selection processes.

To assist firms in making better decisions, numerous techniques and approaches have been developed. In the current literature, it can be summarized that when dealing with uncertain information, a fuzzy-based-computation approach is realistic and necessary. In shipping industry, Ding and Liang [33] have applied a fuzzy multi-criteria decision model to address the strategic alliances selection problem. Buyukozkan et al. [28] have later proposed an integrated approach based on fuzzy logic to deal with multi-criteria decision problem under subjective assessments for strategic alliance partner in logistic value chain. Chen et al. [30] have developed a fuzzy analytic hierarchy process to deal with linguistic variables in R&D strategic alliance partner. Feng et al. [29] have introduced a fuzzy multi-criteria decision model to deal with individual and collaborative utilities data in co-development partner selection environment. Liou [31] have developed an integrated

model by combining a Decision-Making Trial and Evaluation Laboratory (DEMATEL) and Analytic Network Process (ANP) to address the strategic alliance partner selection in the airline industry. Recently, Li and Wan [34] have proposed a fuzzy multi-attribute group decision making approach to deal with inhomogeneous assessments and incomplete weight information in outsourcing provider selection problem.

The aforementioned models and methods appear to be effective and be useful methodology. Nevertheless, they have some unavoidable limitations by several reasons. First, there is a difficulty of precise assigning and mapping linguistic assessments to fuzzy number representation [35]. In many real decision situations, due to human' s ability limitations, experts may express a partially preferences [36, 34]. However, most of available models assume that the linguistic judgments expressed by experts are precisely completeness. Further, limited by background knowledge and experience as well as evidence available, the linguistic assessments of experts regarding the same alternative are totally conflict and semantically overlap [32]. These mentioned obstacle sensitively influences to a consistency of the final decision and also cannot well capture the uncertain and vague information. In particular, the different definitions of membership functions assigned lead different results. Second, the existing partner election models are not permitted the attribute to have different weights assigned by experts. This limitation effects on the preference orders of alternative in some situations. Last, by applying fuzzy-based computation scheme, the necessity of utilizing an linguistic approximation process to translate value back to the original ones causes the loss of information [37], which hence implies a lack of precision in the final result. These disadvantages as mentioned earlier would be especially and critically important in partner selection for collaboration contexts.

Hence, in pursuing the problem mentioned above, this research has posed three major research questions that will guide this research. These research questions will be answered in the concluding remarks chapter of this dissertation.

RQ 1: What are the critical criteria in partner selection and evaluation for collaboration in tourism supply chain networks?

RQ 2: What is the suitable decision model and technique that can apply appropriately for partner selection for collaboration in the context of tourism supply chain networks?

RQ 3: How to avoid and eliminate the complexity and limitation of applying and using

fuzzy-based-computation, while maintaining the flexibility for managers in freely making decisions using uncertain linguistic assessments?

1.3 Research goals and purposes

To answer the proposed three research questions, we specify the research goals and purposes in the following.

1. To purpose a new set of evaluation criteria of partner selection for collaboration in context of tourism supply chain networks.

2. To develop a new evaluation framework and a new decision model for partner collaboration in tourism supply chain networks.

3. To propose a new decision approach that can deal with uncertain linguistic assessments effectively.

4. To provide a managerial guide for tourism organizations in particular to effectively manage partnerships.

1.4 Research strategies and activities

The aim of this research is to develop an evaluation model for collaboration in tourism supply chain networks. To reach the goal, we divide research into three main stages.

Stage I: Research formulation and gather information. In this stage, after critically reviewing literature, we formulate research questions and research problem. Then, we conduct a qualitative research by in-depth interviewing with experts in order to better understand the partner selection problem in tourism supply chain networks. The further explanation describes in the section 1.1.

Stage II: Develop evaluation criteria for partner selection in tourism supply chain context. Since there is no previous research on partner selection for collaboration in tourism supply chain. We aim at developing a set of evaluation criteria. A research method in this stage is a mixed research including interview and survey. The detailed explanation is described in Chapter 3.

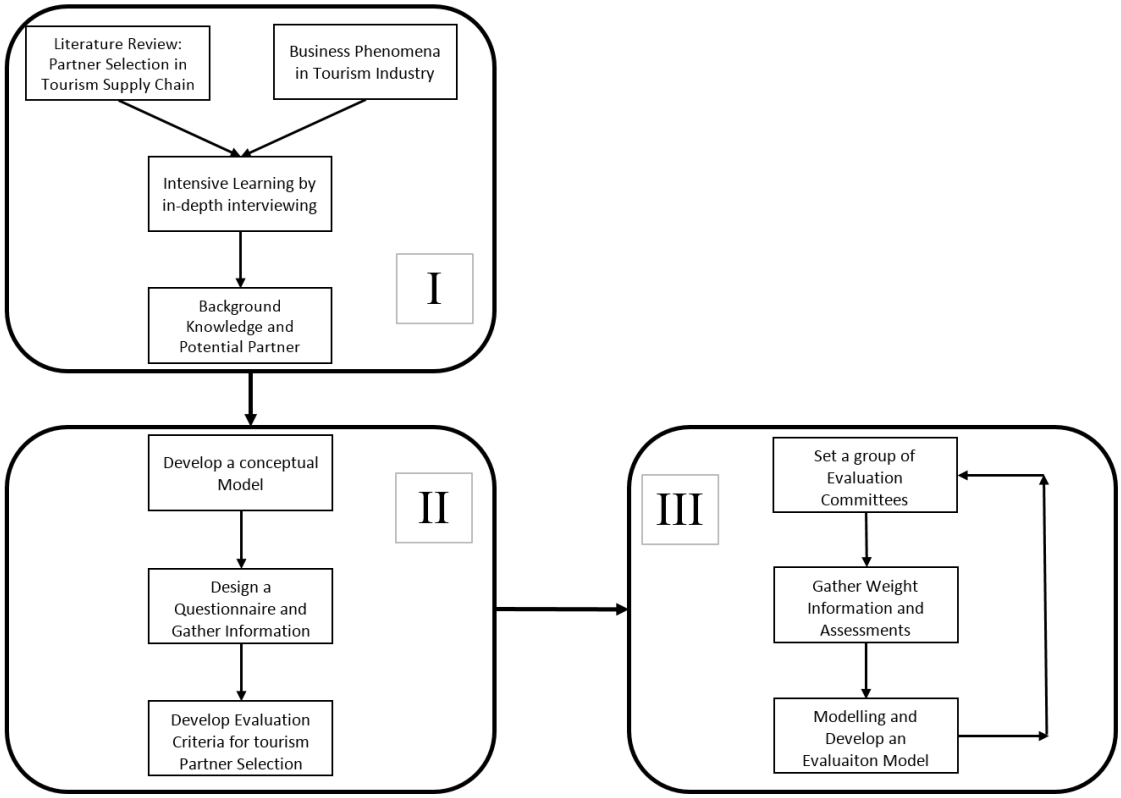

Figure 1.4: A research framework and flow in this study.

Stage III: Develop evaluation model and approach for tourism partner selection for collaboration. This research phase is the main stage of conducting this study. Once the evaluation criteria are ready, we invite an experts, who are having experience more than ten-years of working experience in tour operator industry to form a group of committees. Then, experts are expressed their assessments on a set of candidates. Thanks to the information collected, we develop an evaluation model in order to rank the candidates. Chapter 4 will be described the developing process. In addition, Chapter 5 show the usefulness and validation of the proposed decision model.

1.5 Contributions and originalities of research

The main contribution of this research are summarized as follows.

First, we propose the new critical evaluation criteria for partner selection in tourism supply chain networks. The evaluation criteria proposing in this study are empirically

verified by applying appropriate statistical techniques. It can be concluded that the proposed evaluation criteria for collaborative partner selection can be used in real practical situation. This contribution can help tourism firms to effectively manage partnerships with supply chain partners.

Second, we present a new hybrid evaluation model for tourism partner selection problem, which is formulated as multi-expert multi-attribute decision problem with uncertain linguistic assessments. The proposed evaluation model consists of two phases. First we model muti-expert linguistic assessments on single attribute by means of mass function and then makes use of Dempster's rule of combination for attribute aggregation. Second, the combined mass function is transformed into corresponsing probability distribution via Smets's pignistic transformation and finally defined a linguistic choice function based on the so-called satisfactory principle for ranking and selection. Based on the proposed decision model, the second contribution is that the alternative evaluation model for linguistic partner selection problem can effectively capture the uncertain linguistic information and random preferences while maintaining the flexibility for managers in freely making decisions using uncertain linguistic assessments. Further, by computation solely based on the order-based semantics of the linguistic terms proposing in this study, the difficulty of quantifying a qualitative concept can be eliminated.

Third, we develop the first evaluation model in contexts of partner selection for collaboration in tourism networks. Our contribution is that tourism firms espe cially tour operators and travel agencies can adopt our partner evaluation framework for real implementation in practical situation such as to design a dynamic tour package effectively.

1.6 Chapter organization

This dissertation is composed of six chapters. The detailed explanation is depicted in the following.

Chapter 1 describes the research background of partner selection in tourism supply chain networks. After critically reviewing the literature, we state the research problem and motivation. Then, research purposes are proposed to capture the direction of this research.

Chapter 2 first describes a general framework for addressing partner selection problem.

Since there is no appropriate decision mode for tourism partner selection, the related decision models and approaches for partner selection in other contexts are critically reviewed. Next, the limitations and drawbacks of existing models are intensively discussed. In the last section, the comprehensive summarization is described to justify the contribution of this research.

Chapter 3 intensively explains the development and establish a set of evaluation criteria for tourism partner selection. An analysis and verification of the proposed evaluation criteria are also discussed in this chapter.

Chapter 4 demonstrates an evaluation framework model for partner selection in tourism supply chain networks. This chapter also describes the development of proposed hybrid evaluation model, which is developed to deal with uncertain linguistic assessments.

Chapter 5 shows the usefulness of our proposed evaluation framework and approach using a real case study. In addition, this chapter also conducts an evaluation and validation as well as justification to show the performance that can overcome the limitations of existing decision model.

Chapter 6 contains a concluding remarks and practical implications. Likewise, the main contributions of the study including academic contribution, social impact and contribution to knowledge science as well as suggestions for future research are also discussed in this chapter.

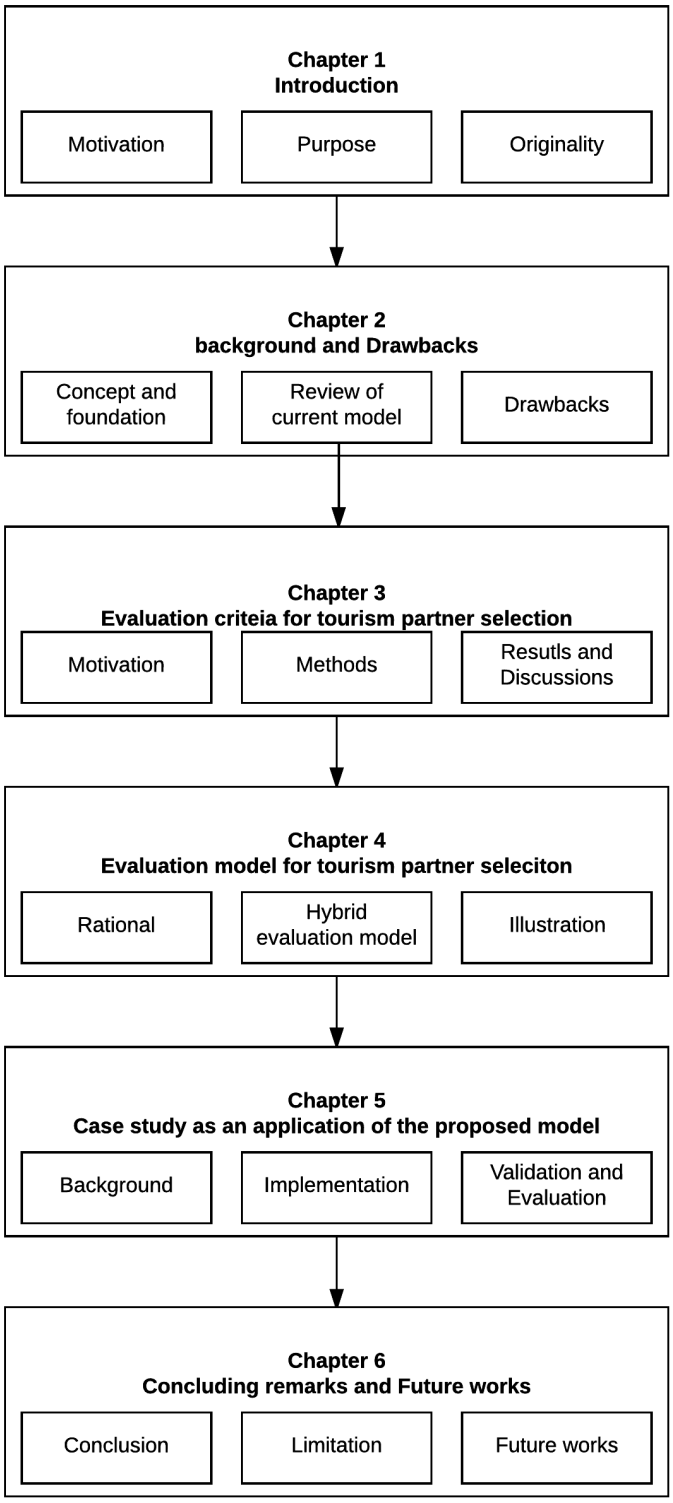

Figure 1.5: Thesis organization.

Chapter 2

Background and literature review of decision models for partner selection problem

This chapter first introduces background knowledge of partner selection problem. Next, previous literature is intensively reviewed and discussed on available evaluation approaches. Since the partner selection problem is closely related to human perceptions, the background of fuzzy multiple attribute decision making problem is thoughtfully described in order to show the advantages and disadvantages. Last, the research activities are depicted to answer the research questions.

2.1 Background and foundation of partner selection problem

There has been growing recognition of the necessity for a firm to work closely with its supply chain partners in order to better the operational performances [2]. Literature suggests a key step in the successful formation of any supply chain is that of selecting and evaluating supply chain partner [38]. The pioneer work, which can be referred to De Boer *et al.* (2001) is a comprehensive review on partner decision-making methods that classifies the existing methods to different stage of partner selection process. The classical model consists of three stages: formulation of criteria, sorting and final selection.

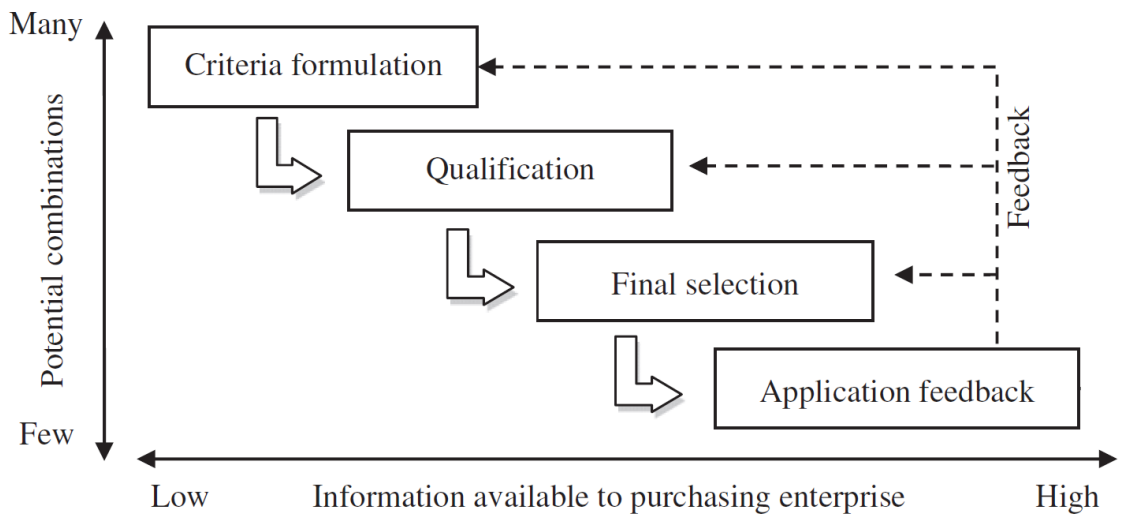

Figure 2.1: The phase of typical partner selection framework.[2]

However, We and Barnes (2010) argue that the traditional framework cannot capture the present situation. Therefore, the new partner selection framework has proposed by adding one phase, so-called application feedback. The further discussions are described in-details in the following section.

The partner selection framework basically consists of four phases: criteria formulation, qualification, final selection and application feedback [2]. Figure 2.1 depicts the typical partner selection framework.

Figure 2.1 illustrates the complexity and degree of uncertainty of partner selection phases. The level of complexity in partner selection increases when information available in each stage is limited. In addition, the development of decision model depends on the purpose of each partner selection process. In the next following, we will discuss in-details.

1). ***Formulation of criteria***. The purpose of criteria formulation is that of determining what criteria to use in subsequent decision-making [2]. It can be emphasized that decision criteria depends on specific decision problem. In traditional research, cost attribute is the most important decision variable. However, to consider only cost criterion is not enough for overall partner consideration. Dickson [39] has argued that vendor selection and evaluation process is multi-objective decision problem in nature. Currently, there is now widespread agreement that partner selection and evaluation problem have to consider multi-dimension of decision variables such as quality, delivery and flexibility

[2]. It can be observed that the nature of partner selection problem is multi-criteria decision making problem usually involves both tangible and intangible criteria. The main characteristic is the conflict between objectives of evaluation criteria.

In sum, it is necessary to evaluate the appropriate evaluation criteria for tourism partner selection since there is no research investigating on such research issue. We hence aim to propose the decision variables for partner selection for collaboration in the context of tourism supply chain networks.

2). ***Qualification***. In qualification stage, it aims to reduce the set of all possible candidates (partners) to a smaller set of acceptable ones [2]. Literature also suggests that the qualification stage is a prerequisite for initiating long-tern relationships between supply chain partners [40].

There have several approaches that are available in the current literature. For the reason of simplicity but without loss of generality, we adopted the a summary of methods and models for qualification stage in selection partner. Figure 2.2 shows the summary of representative studies on qualification stage. Further information is available in a comprehensive review paper of Wu and Barnes [41].

In conclusion, qualification process is a sorting scheme rather than a ranking process. However, in this research we solely focus on developing a ranking method (the detailed explanation will be discussed in the Chapter 3 and 5). Therefore, we apply a simple technique for information on attribute given, so-called Conjunctive method or Satisficing method, which is developed by Simon [42] to reduce a set of possible candidates [27].

The idea is due to the fact of basic concept of partnerships, literature suggests that long-term working relationships can initiate successful collaboration. Hence, we use a year of relationship (more than 5 years) and hotel star rating (more than 3 star) as minimal attribute criteria. In conjunctive method, alternative $\mathbf{A}_i$ as an acceptable alternative only if $\mathbf{x}_{ij} \geqslant \mathbf{x}_j^0$ where $\mathbf{j}$ = 1,2,...,n, and $\mathbf{x}_j^0$ is the standard level of $\mathbf{x}_j$. Please note that the conjunctive method is not usually used for selection of alternatives but rather for dichotomizing them into acceptable/not acceptable categories [27].

3). ***Final Selection***. This final selection step is the most important for selecting a partner. Proposed models in final selection usually involve selecting which of the qualified candidates to start working with for specific services [2].

Methods/ models	Key concept	Representative works	Strong/weakness points
DEA	Efficiency = the ratio of the weighted sum of its outputs to the weighted sum of its inputs	Weber et al. (1991, 1998), Wu and Olson (2008), Saen (2009), Wu (2009), Wu and Blackhurst (2009), Azadeh and Alem (2010), Wu and Olson (2010), Saen (2010), Zeydan et al. (2011)	Te weight constraints are used to reduce the possibility of having inappropriate input and output factor weights
Cluster analysis	Differences between items within a cluster are minimal; Differences between items from different clusters are maximal	Hinkle et al. (1969), Ha and Krishnan (2008), Che (2010)	Only global-scaled clusters have been verified. Relationship between global-local perspectives on cluster detection has not been explored
Categorical models	Potential partners are sorted into "positive", "neutral" or "negative" categories	None found	Cannot be applied to a complex problem, such as that represented by a hierarchical structure of decision attributes
Artificial intelligence	"Trained" computer-aided systems which do not require formalization of the decision-making process	Humphreys et al. (2003), Choy et al. (2002, 2004), Yigin et al. (2007), Guo et al. (2009), Faez et al. (2009), Lee and Ou-Yang (2009), Luo et al. (2009), Montazer et al. (2009), Aksoy and Ozturk (2011), Zhao and Yu (2011)	Can cope better with complexity and uncertainty than traditional models as it designed to operate in a similar way to human judgement

Figure 2.2: A summary of approaches for partner qualification .[2]

In the early research, the decision model is proposed to deal with single attribute. Nowadays, it is necessary to develop decision models dealing with multi-criteria decision problem which is complex and difficult for decision-makers. There have numerous techniques and approaches that propose for dealing with partner selection. For further information, is can be referred to Wu and Barnes [2].

Proposed techniques and approaches can be categorized into two main concepts: multi-attribute decision-making (MADM) and multi-objective decision making (MODM). The difference between MADM and MODM is that MODM involve designing of alternatives which optimize or "best satisfy" the objective functions proposed by decision-makers [43], while MADM focus on selecting of the "best alternative" from a set pf pre-selected candidates described by the objective meanings of multiple attributes [27]. In other word, it can be simply concluded that MADM problems are optimization problems which is continuous MADM, whereas MADM problems are discrete approaches for selection problems.

In this study, we use Multiple Attribute Decision Making (MADM) problem as theoretical background to deal with partner selection for collaboration in tourism supply chain networks. The basic concepts and foundations as well as current approaches will be discussed in the next section.

4). ***Application feedback***. Most of previous studies have developed partner selection models based on three mentioned processes. However, Luo *at al.* [44] and Wu and Barnes [2] have argued that in order to manage long-term partnerships, it should be added a further process, namely that of application feedback. Regarding principles of continuous improvement and organization learning, this process aims at making a partner selection process more robust for firms under dynamic environments. By applying this process, firms can be ensured that the most appropriate partners are selected at all times [2].

In sum, as discussed above, the main stage is final selection. At this stage, final selection models involves selecting which of the qualified partners (candidates). Previous research suggests this stage is mainly dealt with single business process and single objective problem. However, the current business is under complex environments. It is necessary to consider "multiple business process and multiple objectives problem. These characteristics mentioned refers to a decision making with multiple criteria, so-called multiple criteria

decision making problem. The next section introduces the state of the art of decision models and approaches for dealing with partner selection problem.

2.2 Literature review of decision models and approaches

Decision making process can be defined as the final outcomes of some cognitive processes leading the final selection of an alternative among several potential ones [45, 46]. Herrera *et al.* [32] also mentioned that "decision making is an inherent human ability which is not necessarily rationally guided, which can be based on explicit ot tacit assumptions about the set of feasible alternatives". In practical situation, decision making problem is usually involving multiple criteria and multiple objectives simultaneously. This can be referred to multiple attribute/criteria decision making.

2.2.1 Multiple criteria decision making: Basic concepts and foundations

Multiple criteria decision making (MCDM) refers to making decisions in the presences of multiple, usually conflicting, criteria [27, 47]. The main task of MCDM is to help human having a better decision using a rational methodology. With regard to its advantage and usefulness, multiple criteria decision making has grown as a part of operation research, concerning with designing computational and mathematical tools for supporting evaluation assessment expressed by decision-makers [3].

The nature of MCDM problem can be described using a decision matrix. Suppose that there are $\mathbf{m}$ alternatives which is assessed regarding $\mathbf{n}$ attributes, a decision matrix is a $\mathbf{m} \times \mathbf{n}$ matrix with each element $\mathbf{X}_{ij}$ being the $\mathbf{j}$-th attribute value of the $\mathbf{i}$-th alternatives. In other way we can simply represent a MADM problem in a decision table. Table 2.1 illustrates a typical decision table for multiple attribute decision making problem.

The different contexts is the different MADM problems. However, they share the common characteristics which are described in the next following.

1. *Multiple attribute often form a hierarchy.* An attribute is a property, quality or feature of alternatives in evaluation question. Some attribute may break down

Table 2.1: A typical decision table for multiple attribute decision making problem

Alternatives	**Attributes : Weights**			
	$n_1 : w_1$	$n_2 : w_2$	...	$n_m : w_m$
m_1	x_{11}	x_{12}	...	x_{1m}
m_2	x_{21}	x_{22}	...	x_{2m}
...	...	...	...	...
m_n	x_{n1}	x_{n2}	...	x_{nm}

further into lower levels of attributes, so-called sub-attributes [47, 48]. Generally, a criteria is set up for evaluation of alternatives.

2. *Conflict among criteria.* Basically, multiple criteria conflict with one another since each has a different objective [27].

3. *A variety nature of information on attributes.* The varieties of attribute consist of incommensurable unit, mixture of qualitative and quantitative attributes and mixture of deterministic and probabilistic attributes. This feature reflects on developing a decision model and approach for dealing with MADM problem.

4. *Uncertainty.* Based on the nature of attributes, decision-makers may not be 100% sure when dealing with qualitative attributes and sometimes data or information is not fully available. Hence, they usually express their evaluation in subjective forms (judgments).

Due to nature of attributes and information available, decision making problems are generally uncertain. In the early research, researcher have addressed uncertainty by using the probability theory and statistics. However, Mardani *et al.* [3] have mentioned that in daily life human usually use a natural language to articulate our subjective perceptions. In our natural languages, words might not have a clear and well-defined meanings [3, 49, 50]. It means that if the word is used as a label for a set, the boundaries of the set to which

objects do or do not belong will become fuzzy [49, 50]. In addition, due to different subjective perception and background knowledge, when persons are judging an event, even using the same word, they may have a different semantic meanings [36].

Therefore, fuzzy number [50] are introduced in order to help decision-makers to effectively deal with subjective information by representing linguistic variable with appropriate means of fuzzy number. Given its effectiveness, various researchers have extended fuzzy concept into multiple attribute decision making, so-called Fuzzy Multi-Attribute Decision making (FMADM). Currently, FMADM is one of the most widely used decision methodologies in engineering, technology, science, management and business than classical MADM [3, 51, 52, 53].

The scope of the review in this study is under the multi-criteria decision making discipline. Numerous FMADM methods have been proposed to deal with multiple attribute decision making, which are different in practical applications such as theoretical background and types of question asked [3]. It is of interest to emphasize here that a method for MADM problem is designed for a particular problem. Hence, it is inapplicable to other problems. As mentioned earlier, there can be categorized approaches to MADM problems into two main groups: *classical MADM* and *Fuzzy MADM*. Regarding real-life situation, Fuzzy based MADM is the most popular since it can effectively deal with the uncertainty situation. In the fuzzy multiple criteria decision making, the process of selecting alternatives from among a set of possible alternatives is illustrated in Figure 2.2.

In multiple criteria decision problem, a methodological issue is to select the best alternative from a predefined set of alternatives regarding their performance values that satisfies the objectives of evaluation criteria simultaneously. Hence, the central MADM problem is to aggregate or combine assessments regarding each attributes on order to get the rational overall assessments. To deal with MADM problem, there are various approaches that have been proposed in the literature [3]. In this study, we classify multiple attribute decision making methods regarding aggregation model into two main groups in the following.

The first proposal is complete aggregation model. In this method, Simple Additive Weighting (SAW) [54, 55], Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) [43] are the representative approaches, which is applied in various appli-

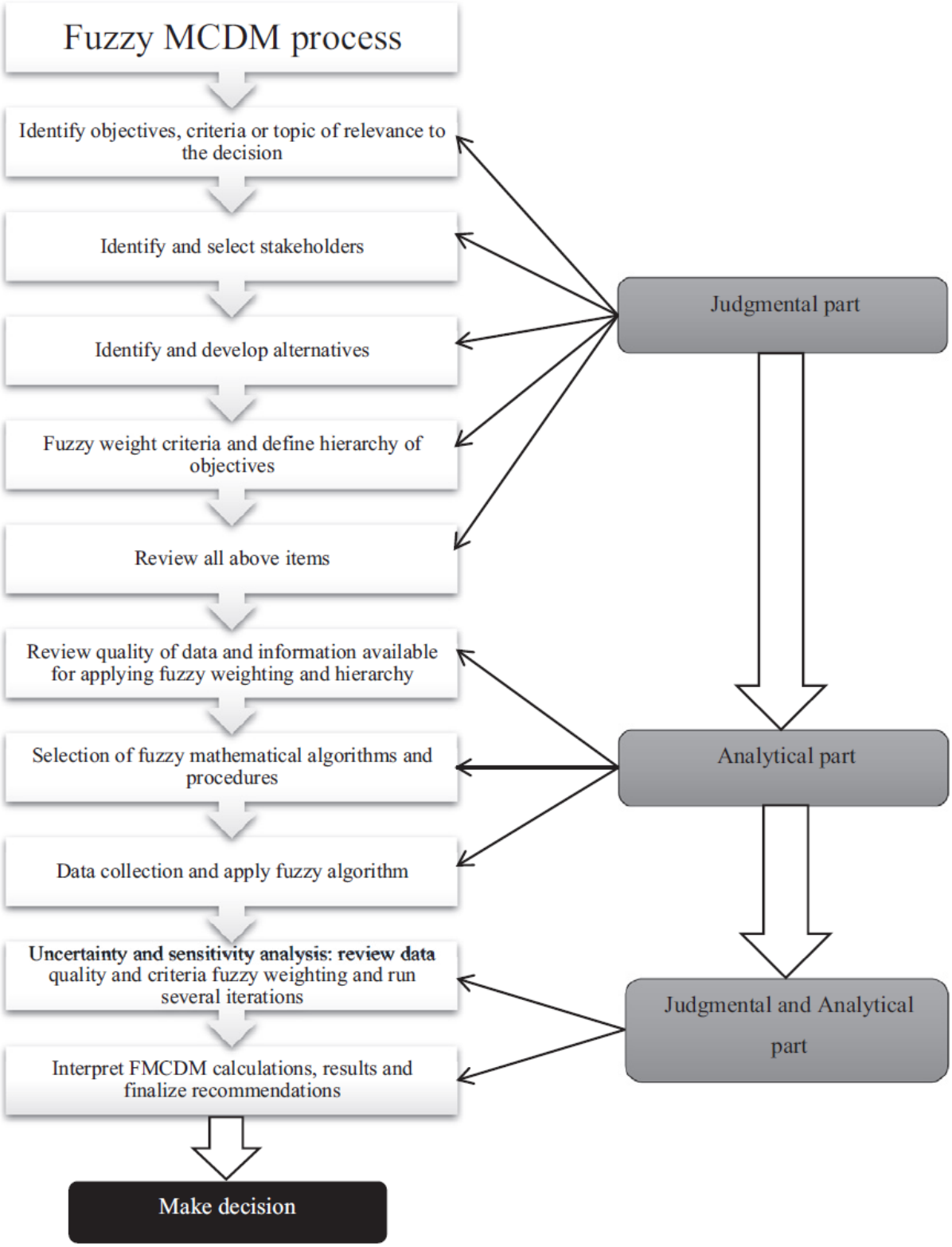

Figure 2.3: A typical fuzzy multiple criteria decision process [3].

cations.

The second proposal is partial aggregation model. The significant idea in this proposal is to compare alternatives by means of pair-wise comparison (binary) based approaches. There are three main techniques that are very popular in the literature because of dealing with uncertain situation effectively: Analytic Hierarchy Process (AHP) [56, 57, 58, 59], ELECTRE [60], and PROMETHEE [61].

In a recent time, TOPSIS and AHP have been applied in various applications such as engineering discipline [62, 63], business and management field [64, 65] as well as science and technology [3]. Currently, literature have suggested a hint on applying a fuzzy set and its related concepts to deal with multiple attribute decision problem for example Fuzzy-TOPSIS and Fuzzy-AHP since as Mardani *et al.* [3] state that hesitancy and uncertainty are generally considered as unavoidable problems. However, although these MADM techniques mentioned are suitable to deal with decision making under uncertainty, ambiguity and vagueness, they have some drawbacks by several reasons. First, there are many types of information in real world situation, the transformation method to unify information when facing with non-homogeneous information is necessary. Most of previous research have applied fuzzy number space to transform non-homogeneous information to homogeneous one. It leads problematic of information loss [62]. Figure 2.4 illustrates the typical process of computation when applying a Fuzzy-AHP or a Fuzzy-TOPSIS. As shown in Figure 2.4, the necessity of employing a approximation process in fuzzy-based-computation scheme causes the loss of information. Second, most of studies assume that decision makers have made an assessment under static environment. However, with regard to practical decision process, the decision techniques should be robust enough to deal with the inclusion and exclusion of both supply alternatives and decision criteria [66]. Third, as for computational complexity, Fuzzy-AHP is very dependent on information given on alternatives. Therefore, this technique cannot add or remove alternatives independently since its mathematical foundation is based on pair-wise comparison. In addition, the level of computational complexity increases when increasing a number of decision criteria. Last, AHP is restricted for users to use AHP scale (9-reciprocal scale) when they are willing to use AHP-based methodology. Junior *et al.* (2014) have recent investigated the performance between Fuzzy AHP and Fuzzy TOPSIS methods. The comparison

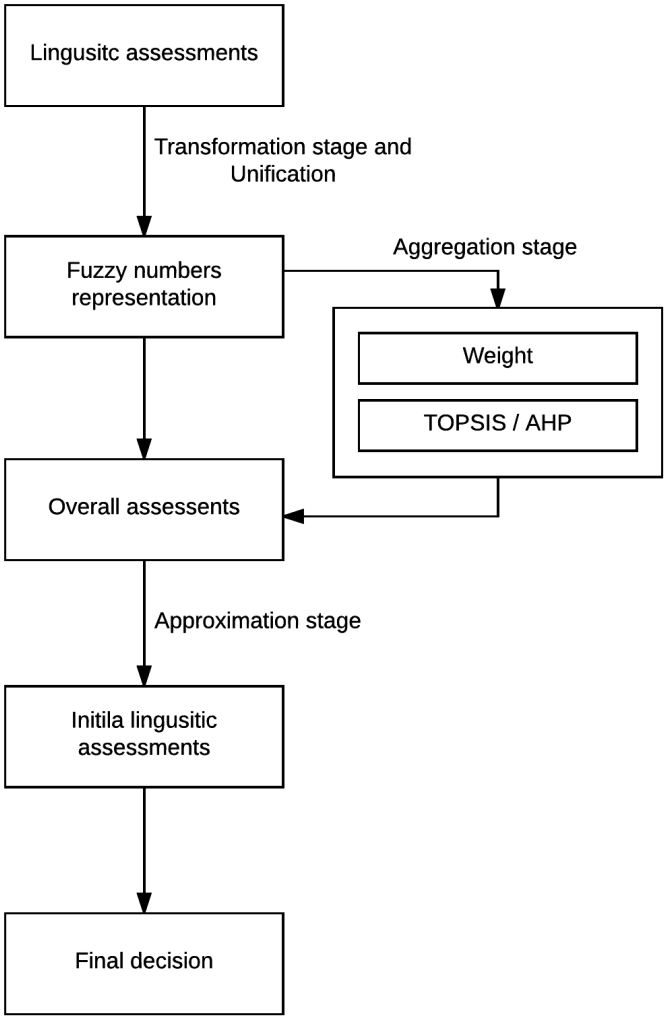

Figure 2.4: A typical scheme on employing Fuzzy-AHP/Fuzzy-TOPSIS.

was made based on six factors: adequacy to changes of alternatives or criteria, agility in the decision process, computational complexity and modeling of uncertainty. The results indicates that both methods are suitable to supporting group decision making and also modeling of uncertainty. However, Fuzzy TOPSIS performs better than Fuzzy AHP in regard to changes of alternatives and criteria, agility and number of criteria and alternative. These drawbacks guides us for further research and investigation. In the next section, we will review and discuss decision approaches that propose to address partner selection in different contexts.

2.2.2 A review of decision methods in context of partner selection

The literature on partner selection issue in tourism supply chain contexts as we have observed so far is very limited. There are only three related researches of supplier selection in tourism industry [22, 67, 68]. In addition, these were conducted in qualitative research methodology. Therefore, the studies of partner selection in other contexts are indirectly reviewed. Since the importance of collaborative partnership is important in operating business under dynamic environment, the research is highly increasing during the last decade [69, 64, 65, 70].

The existing studies mainly focus on partner selection in traditional supply chain management contexts. Buyukozkan *et al.* [28] have proposed the integrated based fuzzy logic approaches to deal with multi-criteria decision making under subjective assessments for strategic alliance partner in logistic value chain. Chen *et al.* [30] have proposed the analytic hierarchy process to deal with linguistic variable in R&D strategic alliance partner. Feng *et al.* [29] have developed the fuzzy multi-criteria decision method to deal with individual and collaborative utilities data in co-development partner selection environment. Verdecho *et al.* [71] have recently introduced the multi-criteria approach to manage the quality of inter-firm collaborative relationship. There are the studies of partner selection in virtual enterprise as well. Ye and Li [72] have developed group multi-attribute decision model to deal with partner selection in virtual firm under the incompleteness of information. Yue [73] have proposed the intuitionistic fuzzy projection-based approach for selecting the partner in virtual firm circumstance without the need of using approximation function.

Taking in the different tracks, there are some researches in service value chain. Chang [65] have proposed the integrated approach using fuzzy set and VIKOR to assess the service evacuation in Taiwan hospital. Tsaur *et al.* [74] have proposed the fuzzy-MCDM evaluation method to evaluate the quality of service of airline industry. Akincilar and Dagdeviren [69] have recently developed the hybrid multi-criteria decision model to evaluate the quality of hotel website. Chou et al. [75] have introduced the fuzzy multi-attribute decision model for helping international tourists to selection the hotel effectively. However, in tourism supply chain context is quite limited. March [22] have explored the

buyer-supplier relationship problem in servicing international tourism. Cobanoglu *et al.* [67] have empirically examined the main components of hotel selection using a large-scale survey in Turkey. Pearce [68] have recently investigated the factor affecting successful inbound supplier selection in New Zealand. Table 2.2 illustrates the summarization of approaches and applications in related contexts of partner selection problem.

In conclusion, as we observed, while fuzzy-computation-based approach can efficiently deal with uncertain judgments and ambiguity assessments; however, it has some inevitability limitations by several reasons.

1. The result of final linguistic evaluation depends on the fuzzy number representation. Therefore, the subjective definition of membership functions and their associated semantics can also sensitively influence the solution.

2. Regarding the fuzzy-based computation scheme, the need of making use the approximation techniques is required to return the fuzzy values to the initial linguistic term set. This unavoidable process causes the information loss problem leading the inconsistent final decision making result.

3. When a situation involves high granularity of uncertainty; for instance, in multi-expert decision setting, multiple experts may express their different linguistic assessments due to their preferences and knowledge in random linguistic assessment values such as interval forms, even in the same alternative since experts do not know for sure about the states of natures. Hence, it is very difficult to assign the subjective judgments to the precise crisp value. These disadvantages as mentioned earlier would be especially and critically important in partner selection contexts.

Motivated by the above observations, in this study we will develop alternative approach to deal with multiple attribute decision making problem under fuzzy environment. The proposed alternative approach can deal with uncertainty effectively by providing a flexible method for decision-makers. The detailed explanation is described in the next following section.

Table 2.2: A summarization of the related studies in partner selection context

Main study area	Relevant studies	Methods	Data Formats	Applications
Traditional supply chain	Buyukozkan *et al.* [28]	Fuzzy MCDM	Linguistic terms	Logistic value chain
	Chen *et al.* [30]	Fuzzy ANP	Linguistic terms	R&D alliance
	Ding and Liang [33]	Fuzzy MCDM	Linguistic terms	Shipping alliance
	Feng *et al.* [29]	Fuzzy MCDM	Linguistic terms	Co-development alliance
	Verdeho et al. [71]	ANP	Linguistic terms	Inter-firm collaboration
	Ye and Li [72]	Group MADM	Linguistic terms	Virtual enterprise
	Yue [73]	Intuitionistic fuzzy-based projection	Linguistic terms	Virtual enterprise
Service supply chain	Akincilar and Degdevien [69]	Hybrid MCDM	Linguistic terms	Hotel website selection
	Chang [70]	Fuzzy VIKOR	Linguistic terms	Hospital sector
	Chou *at al.*	Fuzzy MCDM	Linguistic terms	Hotel location selection
	Liou [31]	Integrated MADM	Linguistic terms	Airline alliance selection
	Tsaur et al. [74]	Fuzzy MCDM	Linguistic terms	Airline service quality evaluation

2.3 Summary

In this chapter, we review current available approaches in different contexts. We summarize several drawbacks and then conclude our research direction in this study after critically reviewing literature.

When developing a decision model for partner selection problem, basically we have to consider four aspects: particular decision problem, decision-makers involved, decision environments and decision approaches. In this study we have dealt with partner selection for collaboration in tourism supply chains. The partner selection problem is formulated as multi-expert multi-attribute decision-making under fuzzy assessments. Two main important processes are therefore

1. To purpose a set of decision criteria that can appropriately describe tourism partner selection in tourism supply chain context.

   In multiple criteria decision contexts, the performance of decision model depends on the quality of decision and evaluation criteria. In addition, the decision criteria should reflect the situation. Hence, it is necessary to carefully establish and verify the suitable evaluation criteria for partner selection for collaboration in tourism supply chain contexts. As discussed in this chapter, there is no appropriate decision and evaluation criteria for dealing with tourism partner selection for collaboration. In this study, we aims to purpose the decision criteria for tourism partner selection. The in-details methodology, discussion and verification are described in Chapter 3.

2. To develop a new evaluation model and approaches that can effectively overcome drawbacks and limitations of existing decision models and methods as well as that can appropriate and applicable for tourism partner selection.

   The decision method relies on the characteristics of the decision problem domain. As mentioned in the last section, most situations have to deal with various degrees of uncertainty, which are caused by subjective evaluation of qualitative criteria, by different assessments from multiple decision-makers, by dealing with no previous data and information as well as incomplete information to rely on [66]. Numerous methods have been widely employing fuzzy-based approaches. However, it has some inevitability limitations. Furthermore, the existing decision methods

in other contexts cannot appropriately apply to partner selection in tourism supply chain contexts. Motivated by the above observations, we will develop an evaluation framework to address this research gap. The in-details methodology of developing an evaluation method for partner selection for collaboration in tourism networks are introduced and discussed in Chapter 4.

Chapter 3

Evaluation criteria for partner selection in tourism supply chain networks

In this chapter, the first research question will be addressed. We first state a research motivation and research objective, followed by related work has reviewed. Next, a research methodology is explained step-by-step. Results and discussion as well as concluding remarks will be described in the last section.

3.1 Motivation

Over a decade the manufacturing sector has influenced to the world economy [1, 76]. However, a recent trend in the global economy has been changing from traditional productions to the service sector [16]. Evidence has shown that the impact of service industry is significantly improved not only the global economy [77], but the economy in South-East Asia, especially in Thailand as well [78]. In economic climate of Thailand, the service sector contributes the most to the Gross Domestic Product (GDP) of Thailand comparing to other sectors. As of structure of Thailand's GDP, the tertiary (service) sector contributes with 49.9%. Regarding the service industry, tourism industry plays a crucial role that can efficiently generate better incomes the most. That is because Thailand has a lot of useful and valuable attractions; for example the historical resources, and the ancient tradition

and cultures. Thanks to these valuable natural resources, the major inbound markets are international tourists that travel to Thailand has been rising up to almost 15 million tourists [79].

In tourism business transactions, the main characteristic is a process of delivering services regarding a combination of tourism products such as package tours [1, 5]. These products which could actually be purchased individually are put together by a tour operator who uses the advantage of scale economy to offer the mix product for a lower price than purchased separately [6]. The popularity of tourism product arises by several reasons. First, it is convenience for tourists. Second, tourists always are looking for the guarantee for security and safety. In the popularity of package tours, the targeting of so-called "in-locations" where a majority of tourist are going is the third reason [5, 6]. Forth, an affordable price is in comparison to separately purchased products [7]. Last, the most significant advantage is time-saving process [5].

Although package tours have several advantages, in the current market tour operators still have some issues to face due to a dynamic and complex personal preference of tourist [1, 8]. A traditional tour package cannot deal with such situation effectively because a traditional package tour is rigid, standardized and leave very little space for tourists' personal interests [9]. This disadvantage mentioned is becoming more and more obvious as the society is developing [5]. Evans and Stabler [10] suggests that if package tour are less flexible and customized, tour operators are not able to maintain their popularity in the future.

Furthermore, the successful service process depends on the necessity of involving various supply chain members and different operational functions in order to design and form as well as bundle tourism products that can satisfy customers (tourists) preferences successfully. It is worth to mention that tourism operation has to deal with the demand uncertainty [80] and also the complexity of managing the supply chain networks [81]. That is because customers always view the tourism product as a seamless entity [1, 16]. Likewise, the modern customers have more power to change their demand as they preferred [80]. Further, tourism organizations can easily change from one company to another ones if profit proposal are well satisfied [17]. Currently, tourism industry have changed to new evolution from traditional or mass tourism to the modern one. The effective buyer-

supplier relationship management with the appropriate partners is therefore necessary for tourism firms to gain more profits [82], increase market share [83] and sustain long-term competitive advantage [84].

The benefits of collaborative working have suggested in the current supply chain management literature [85, 86]. Cao and Zhang [85] suggests that collaboration is the key success in the global competitions. Nevertheless, most of tourism organizations fail in implementing partnerships. Researchers have suggested some common factors leading the short relationships such as incompatibility of partners [29], culture distance [20, 23], lack of trust [84], and lack of alliance experience [87]. Likewise, literature has also suggested that the good collaboration can be initiated at the beginning by selecting the good candidate to start working with [29]. However, there is no research in the tourism supply chain literature on investigating how to select and evaluate potential partner to start working with, and also what are the critical determinant factors that influence successful partnerships.

To help tourism firms have better effective supply chain management, literature in other contexts has suggested that there are two main important research issues that need to be carefully considered. The first issue is to consider critical evaluation factors (criteria) and the latter issue is to develop the decision model regarding the nature of evaluation criteria and data available. It is worth to mention that the quality of decision model relies on the evaluation criteria. In this study, motivated by limitations above, we aim at developing evaluation criteria for partner selection problems in tourism supply chain networks by answering two research questions:

1. What are suitable evaluation criteria for partner selection problem in the context of tourism supply chain?

2. What are the relationships between criteria that influence the successful strategic alliance partnership performance?

The results will yield the valuable knowledge on the partner evaluation as well as how to manage buyer-seller relationships effectively in the tourism literature.

The rest of this chapter is organized as follows. The next section is a review of theoretical background and developing the conceptual model. Next, the research method

of this study is presented followed by a discussion of the results. The last section provides the concluding remarks, managerial implications, and possible question for future research.

3.2 Theoretical background and conceptual model

In this section, we discuss briefly the importance of supply chain collaboration in the tourism industry. Based on critically reviewing the literatures, we then develop the conceptual research model.

3.2.1 Research background

Theoretically, the typical tourism supply chain consists of five main supply chain members: customers (tourists), travel agencies, tour operators, service providers, and the suppliers service providers [1]. In the supply chain scheme, the tour operators play a crucial role in the tourism supply chain networks because they stand as intermediary's role for initiating demand from customers (tourists) and transfer their requirements to the service providers who play as the first-tier main suppliers; for example, accommodation and transportation [78]. Likewise, in the supply side, the tour operators deliver the services which is offered form the related-suppliers to the end-customer at particular destination [16]. Furthermore, the tour operators are acting as architects to design the tour package (tourism product), sometimes so-called tourism product assemblers. In the perspective of buyers-sellers relationships, the tourism product is a linkage point between tour operators and service providers that interact among supply chain members dynamically for making a tour package more attractive that can satisfy the customers preference [88].

In the process of designing the package tour, partnership is crucial for most tourism organizations. That is because tourists often view a tourism product as a seamless entity [1]. Zhang *et al.* [1] stated that supply chain relationship performance has a direct impact on financial and operational performances. Likewise, Sigala [88] have founded that tourism is a cross-functional activity. Therefore, tour operators duty depends on the performance of suppliers as well as linking within the tourism supply chain networks.

The benefits of successful partnerships are mentioned intensively in the literature. However, most of the tourism enterprises in fact fail in implementing the long-time col-

laborative relationships. As reported, since the most critical criteria is the incompatibility, researchers have suggested that the good relationship can be initiated at the beginning by carefully selecting the suitable candidate to start working with. More interestingly, there are few studies investigating on such issues in the context of tourism supply chain management. Medina-Munoz and Garcia-Falcon [20] are the first researchers exploring what factors that lead to form a success relationships between hotels and travel agency in America. They found that trust, commitment, coordination, communication quality, information exchange, participation, usage of constructive resolution techniques, and similar relative dependence have a positive effect on long-term partnerships. Later, Pansiri [26] has found that the effects relationships between characteristics of alliance partner have a positive influenced on alliance performance. However, her study has limitation on how to evaluate which alliance is best partner to start working with.

It can be noted that in the area of partner selection and evaluation is still lack of the common determinants leading to better making a decision [1]. Furthermore, most of the proposed criteria did not consider the importance of collaborative relationships as well as risk-oriented factors, which are already mentioned intensively. Motivated by the limitations, this study aims at developing evaluation criteria with considering the importance of collaborative relationship as well as uncertainty and risk-oriented factors.

3.2.2 Related work on evaluation criteria

The literature on partner selection issue in tourism supply chain networks as we have observed so far is very limited. There are only three direct related research of supplier selection in tourism industry. Cobanoglu et al. (2003) have determined the importance of travelers that place on hotel selection attributes using surveying of 612 Turkish business travelers. March (2000) have examined the purchasing attitudes of tour operators regarding three types of tourism products: hotels, coach companies, and restaurants. The 26 inbound tour operators in Asia who deal with inbound tourists to Australia has asked to answer the questionnaire. Recently, Pearce (2007) investigates supplier selection in the New Zealand inbound tourism market, especially the factors that lead tour operators to change their suppliers. The author founds that product-related and people-related factor are the most critical factors for leading wholesalers to choose and to change their suppliers.

Table 3.1: A summarization of evaluation criteria regarding selected authors

Evaluation criteria	Proposed by							
	Buyukozkan *et al.* [28]	Chan and Kumar [64]	Ding and Liang [33]	Feng *et al.* [29]	Tsaur *et al.* [74]	Liou [31]	Medina-Munoz and Garcia-Falcon [20]	Pearce [14]
Cost	X							X
Product quality	X							X
Human resources								X
trust							X	
Commitment	X	X			X		X	
Coordination					X		X	
Communication		X					X	
Goal correspondence				X		X	X	
Compatibility								
Organizational culture				X		X		
Reputation		X						
Performance and relationship quality		X	X	X		X		
Conflict resolution							X	
Economy		X						
Political stability								
Location		X	X					
flexibility		X			X			
Capacity	X	X	X	X				
Service mind-oriented service					X			
Novelty								

Therefore, the studies of partner selection in other contexts are indirectly reviewed.

There are various studies in traditional supply chain as well as in service value chain on how firm form and select the strategic partnerships. In partner selection for forming strategic alliances in shipping industry, Ding and Liang [33] have proposed five evaluation criteria with considering of Wider and deeper geographical scope, Managerial capabilities of lines, Service channels or places, Increase in frequency of service, Net handling performance at container terminal, and Increase in local or regional market. Likewise, Buyukozkan *et al.* [28] have proposed evaluation criteria regarding strategic dimension and business excellence dimension. According to Feng *et al.* [29], they have recently suggested that only individual evaluation criteria are not sufficient to evaluate the partner candidate to start working with. Hence, they proposed the collaborative factors regarding concept of resources and competency sharing. It consists of Resource complementarity, Overlapping knowledge bases, Motivation correspondence, Goal correspondence, and compatible cultures. Further, collaborative evaluation criteria are proposed to assess the partners in forming strategic alliances for R&D collaborations. It consists of Corporation compatibility Technology capability Resource for R&D Financial condition [30]. For the purpose of uncertainty consideration, Chan and Kumar [64, 65] have proposed risk-oriented factors to evaluate global supplier in the context of manufacturing industry.

Taking in the different tracks, Tsaur *et al.* [74] have proposed the multi criteria assessment for evaluating the service quality in airline industry. There are five main categories: Tangibility, Reliability, Responsiveness, Assurance and Empathy. Later, in the airlines partner evaluation, Liou [31] have suggested the main and sub-main evaluation criteria. As for evaluation criteria, he proposed four dimensions: Organization, Strategy, Finance and Services. In the organization factor, it is defined as how firm have collaborative behavior by measuring organization relation, cooperative culture and leaning ability.

Thanks to the knowledge of evaluation criteria above, we can summarize that in order to effectively evaluate partner, it must consider not only internal (individual) factors inside firm boundary but also collaborative attributes. Further, when the main criteria are not sufficient to reflect the meaning for better evaluation, it must divide the criteria to the sub-criteria. Based on the critically reviewed, we propose the conceptual model about evaluation criteria for partner selection in tourism supply chain networks as shown

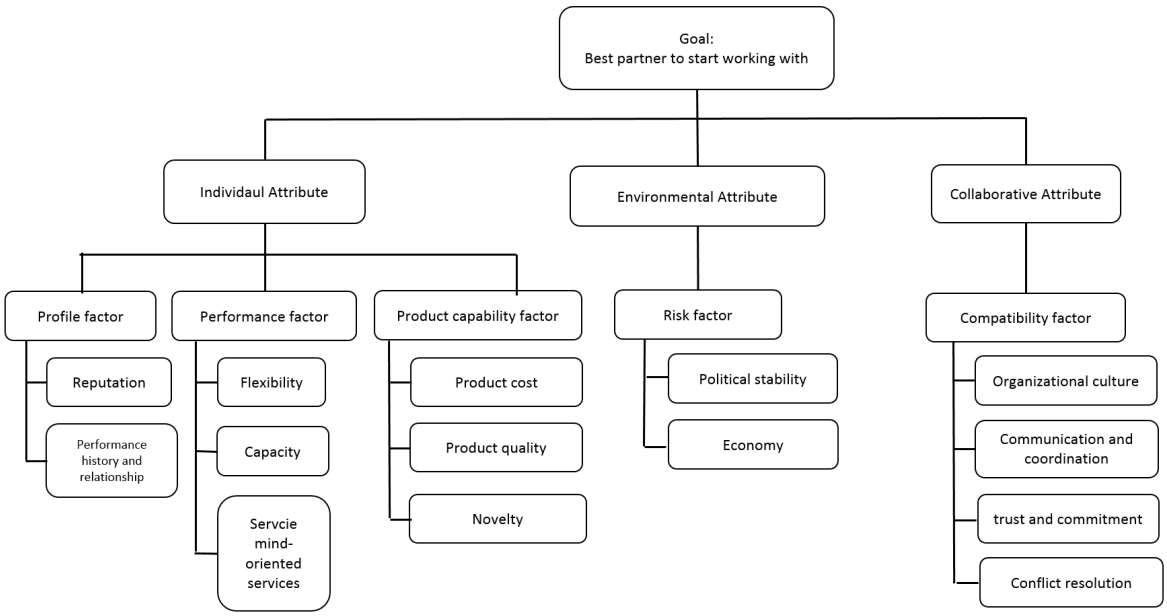

Figure 3.1: A conceptual model and and evaluation hierarchy for partner selection for collaboration.

in Figure 3.1. As for construct operationalizations, the measurement items are described in Table 3.2.

3.3 Methodology for verifying evaluation criteria for tourism partner selection

To answer proposed research questions, case study is chosen in this study because it enables a researcher to closely examine the data within a specific context [89]. In order to conduct an effective case study, Yin [90] have suggested three necessary conditions for the design of case study: a) the type of research question posed, b) the extent of control an investigator has over actual behavioral events, and c) the degree of focus on contemporary events.

3.3.1 Samples and data collection

The unit of analysis in this study is tourism firms between tour operators and hotel sectors in Thailand. This sector was chosen as our case study background and empirical

Table 3.2: The proposed criteria of Tourism partner selection using in this study

Criteria	**Sub-Criteria**	**Brief Description**
Supplier's Performance (C_1)	Flexibility (c_{11})	Ability to respond to a requirement rapidly
	Capacity(c_{12})	Ability to effectively support the buyers' requirement
	Service Mind-oriented (c_{13})	Perceived ability to deliver a good services
Supplier's Profile (C_2)	Reputation(c_{21})	The preferred supplier has a good point-of-view from customers.
	Performance history and Relationship closeness (c_{22})	Ability to sustain the best performances.
Risk Factor (C_3)	Political stability (c_{31})	The political status at destination.
	Economy (c_{32})	The economic status such as currency exchange rate at destination.
Product's characteristics(C_4)	Product Cost(c_{41})	Our suppliers can provide a services at the lowest cost for your company.
	Product Quality (c_{42})	Our suppliers can provide the best products/services for your company.
	Novelty (c_{43})	Suppliers can frequently support and design the innovative product for your company.
Supplier's Compatibility (C_5)	Organizational culture (c_{51})	Our suppliers can understand well about the different cultures.
	Communication and Coordination(c_{52})	Our suppliers can work and well communicate together effectively.
	Symmetry in organizational size(c_{53})	Our suppliers have an equivalence size in business units with your company.
	Trust and Commitment (c_{54})	Our suppliers and your company have mutual trust and commitment in working together.
	Strategic goals fitting(c_{55})	Our suppliers and your company have similar in strategic directions such as win-win strategy.
	Conflict resolution(c_{56})	Our suppliers and your company are well working together when solving conflict problems.

grounding for several reasons.

First, partnership is critically very important for tourism organizations, especially for tour operators and travel agencies as already mentioned in Chapter 1 and also Section 3.2.1. Since the nature of operating business is easy to provide the service operations, the numbers of operating tour operators travel agencies including the registered and non-registered firms are then gradually growth over the past five years [79]. To offer the basic services to customers are neither not sufficient for the registered firms to satisfy customers,

nor not adequate to compete with the others. Therefore, the tourism firms have to keep maintaining advantages by improving provided services continuously. Second, among types of tourism business units, the tour operators and/or travel agencies in Thailand are the main contributor to service industries generating the higher revenues to the GDP of Thailand in the last ten years. Last, given a good location and destinations, many tourists always come to take a vacation, to transit, and also to have a business meeting in Thailand. Thanks to the benefits as discussed, the study of tourism supply chain will yield the valuable knowledge to the current literature.

In order to collect the desired data, we set the plan for data collection into three stages regarding the case study procedure suggested by Eisenhardt [89]. The first stage is to conduct qualitative research by in-depth interviewing with scholars and experts who are working in tourism industry. The purpose of this stage is that we would like to better background knowledge about partner selection problem and also to collect related evaluation factors as well as preliminary verification on evaluation for partner selection factors. The proposed evaluation criteria can be referred to Figure **??** in Section **??**.

In order for examining proposed hypothesized evaluation criteria, we have developed evaluation criteria according to the operationalization in Section **??**. The sampling technique using in this study is snowball method [91]. Snowball technique is a non-probability sampling technique where existing respondent regarding study subjects recruit future subjects of respondents based on their acquaintances [91]. The mail survey and walk-in survey were favored as our instrument because it provides several advantages such as simply and easy to access to target respondents, more efficient distribution and data evaluation as well as lower costs [4]. In the designed questionnaire, a cross-sectional questionnaire includes three main parts. It consists of demographic questions, the questions related on supply chain supply chain partnerships and additional information. Prior to implementation, the pilot test was conducted by in-depth interviewing with three selected tour operator managers and top management positions in order to ensure that the instrument has under specifications of reliability and validity [92, 93]. The target groups were senior-level employees of tour operator companies who are working in the field of supply chain management, designing packages, or with direct involvement in company decision making processes [20]. the survey was conducted in Bangkok, Thailand and data were collected

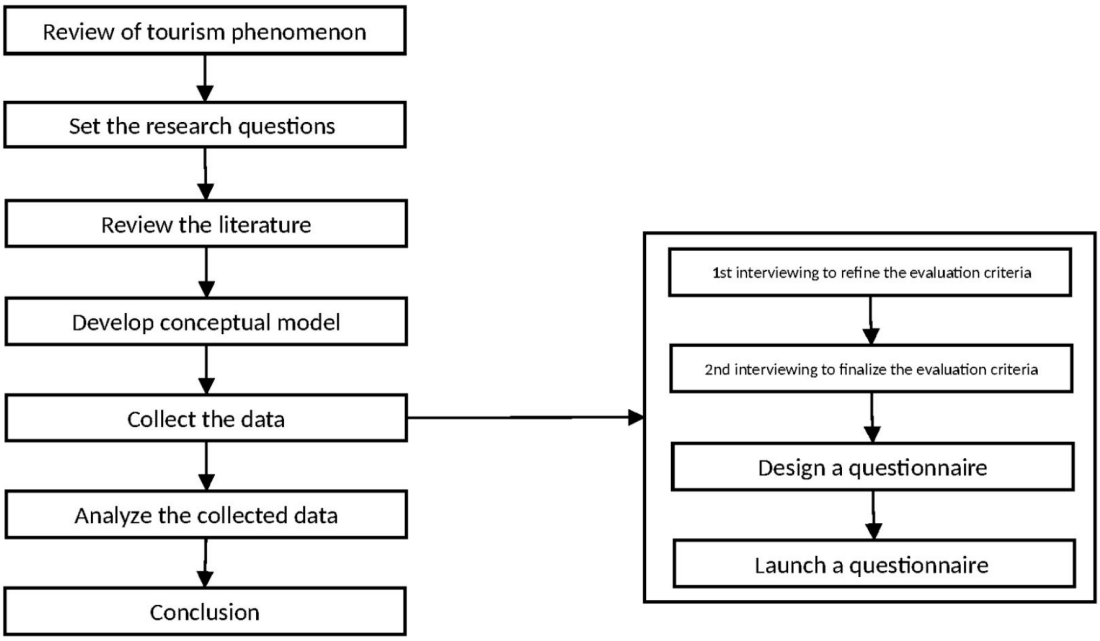

Figure 3.2: A research methodology designed and data collection processes.

for two months between April to May in 2014. The sample size of our case study is ten respondents who are working in tour operators and travel agencies, and have experience more than 10 years working experience.

3.3.2 Measure of variables and goodness of measurement

Once the interview processes have finished and the proposed evaluation criteria are ready, we have asked the experts to express their opinions on each criterion by using the seven-point Likert scales [94] as measurement scale. For the main criteria and sub-criteria, please refer to Table 3.2. In order to make data gathered more solid, all instruments were adapted from the literature and were modified to measure the performances appropriately as discussed in Chapter 3 and also the previous section (Section 3.3).

In this study, we conceptualize measurement constructs into three dimensions: individual attribute, collaborative attribute and risk attribute. As for individual attribute, Performances' suppliers was modifying a scale proposed by Feng *et al.* [29], Tsaur *et al.* [74], and Buyukozkan *et al.* [28]. The performance was newly measured by three dimensions: Flexibility, Capacity and Service mind-oriented Services. Suppliers' profiles have been adapted from Su *et al.* [95] and Chen *et al* [96] was constructed to measure

Reputation, and Performance history and relationship closeness. Product's characteristics have been adapted from Lee *et al.* [5], Chang [70], and Emden *et al* [97]. The measurement for risk factor, including Political stability and Economy was newly developed upon suggestions from adapted from Chan and Kumar [64], and Chan *et al.* [65], respectively. In collaborative attribute, we measure compatibility as collaborative attribute into six dimensions: Organizational culture, Communication, Symmetry in organizational size, Trust and commitment, Strategic goal fitting, and Conflict resolution. This measurement was adapted from Chen *et al.* [30], Ding and Liang [33], Medina-Munoz and Garcia-Falcon [20] and Ramayah *et al* [84]. Further information and discussion is in Chapter 3.

In order to test the measurement consistency, both validity and reliability analysis are used for testing the goodness of our proposed items [92, 93]. The principle component analysis (PCA) and VARIMAX rotation [98] were applied to confirm the factors. Likewise, the Cronbach's alpha coefficient (α) was assessed the inter-item consistency of our measurement items [99]. Furthermore, the Pearson correlation [100] have adopted to test their relationship for the verification processes.

3.4 Analysis, results and discussions

The purpose of using the statistical analysis is to robustly confirm and to verify the proposed evaluation criteria proposed since these evaluation criteria are qualitatively only conceptualized and constructed based on case study research approach by in-depth interviewing with experts.

In the analysis, the principle component analysis (PCA) with VARIMAX was first used to robustly confirm the proposed evaluation criteria whether these criteria are related with their categories. The results show that all sampling adequacy values are ranging between 0.60 - 0.80. It means that the factors are appropriately valid [92, 101] as shown in Table 3.3. In the Table 3.3, the factor loadings of each measurement criterion are all significantly supports ($P < 0.05$). Further, all Cronbach's alpha (α) values of all constructs are above 0.70 as minimal requirement [102]. As such we can conclude that the measurement criteria are valid and reliability [92].

As seen from the overall mean, the profiles of partner is the most concern (6.5), followed by compatibility (6.1) and performance (6.1). The results indicates that the

Table 3.3: A result of measurement properties of proposed evaluation criteria

Main criteria	Sub-criteria	Statistical Results			
		Mean	S.D.	KMO	Factor Loading
Performances	Flexibility	5.6	1.20	0.70	0.794
	Capability	6.1	1.14		0.838
	Service mind-oriented services	**6.5**	0.92		0.871
Profiles	Reputation	**6.7**	0.64	0.65	0.954
	Performance history	6.3	1.19		0.954
Risk factor	Political stability	6.1	1.45	0.65	0.913
	Economy	**6.3**	0.90		0.913
Characteristics	Product cost	6.0	1.10	0.65	0.876
	Product quality	6.1	1.14		0.970
	Novelty	**6.3**	0.90		0.898
Compatibility	Organizational culture	6.0	1.34	0.65	0.898
	Communication	6.0	1.34		0.964
	Symmetry in size	6.1	1.04		0.825
	Trust and commitment	**6.4**	1.02		0.930
	Goal fitting	6.0	1.18		0.872
	Conflict resolution	5.8	1.47		0.731

profile is the main criteria when tourism firm have to evaluate which partner is good enough to start working with. In the profile, we conceptualized this construct with two sub-criteria: reputation and the history of relationship performance. The reputation is the most important factor because achieving the good reputation, firms may have a long -term business operation with good point-of-views evaluated by the users [103]. Regarding the result, our result consistent with the literature that reputation can support tourism firms gaining competitive advantage because tourists usually evaluate and judge tourism products based on the reputation of the organization [5]. By utilizing partner's reputation, tour operators can be sure that they can rely on the performance of that partner [20, 96]. Based on empirical evidence, partnership can be success in the future collaboration.

In a recent year, the limitation of internal resources and competencies is the most con-

cern issue. To overcome such limitation, literature suggests the benefits of collaboration can enhance competitive advantage of firms by using a surplus resource and capacity from supply chain partners [85, 86]. Tourism firms have recognizing that compatibility between a focal firm and partner firms is very important. In this study, our result support an assumption mentioned. The most critical factor in comparability is trust and commitment (6.4). This empirical evidence consistent with the literature that trust and commitment is the most critical success factor that enhances and fosters the successful partnerships in tourism supply chain context [20, 21]. Furthermore, this construct was newly measured compatibility. Based on our analysis, tourism firms can adopt this criteria for effectively evaluating potential partners in practical situation.

The performance of providing services form partners is also important. In maintaining the good performance in tourism industry is service mind-oriented operation (6.5). Committed by service-mind operations, the focal tourism firm can reap the benefits from the partnerships such as quick response and small cooperation. Regarding the results, firms will gain the better effective decision in selecting partners using these criteria proposed.

The last section we discuss the results solely on one main criteria of each group based on simple statistics. In order to make our proposed evaluation criteria sounds empirical grounding, we apply Pearson's Correlation analysis to robustly confirm the results. In the Table 3.4, there are positive inter-play relationships between flexibility, capability and service mind-oriented. Interestingly, as for the performance of partners, there is high correlation between capacity and service-mind oriented (0.621). Based on the result, it can be interpreted that when tourism firms have more service mind orienting their company operations, they are willing to deliver and provide the best services even they have less capabilities. Likewise, as reported in the literature, if tourism firms have a good record in providing services, they will then gain the better reputation [80]. In sum, we can conclude that the performance and profile criteria are valid for partner selection processes based on a grounding of this casual relationship.

The correlation analysis of characteristics of products also indicates that the high positive correlation between product quality and novelty (0.851) indicates how tourism firms can stimulate successful innovation to sustain their competitive advantage. If partner firms have more capable of generating new products, the focal firms will reap the direct

Table 3.4: A result of correlation analysis of individual evaluation criteria

Main criteria	Sub-criteria	(1)	(2)	(4)	(6)	(7)
Performances	(1) Flexibility					
	(2) Capability	0.470*				
	(3) Service mind-oriented services	0.542*	0.621*			
Profiles	(4) Reputation					
	(5) Performance history			0.908*		
Characteristics	(6) Product cost					
	(7) Product quality				0.804*	
	(8) Novelty				0.906*	0.851*

benefits on designing the new innovative tourism products successfully [5, 104, 5].

For risk factor, the positive relationship of correlation analysis indicates that political stability and economy have a strong positive influence to the risk oriented factor (0.669) as shown in the Table 3.5. This criteria benefit to the tourism organizations for dealing with not only local firm evaluations but also global partner selection problems.

As discussed earlier, this study we advance the literature by proposing the collaboration criteria to help firms having better decision. In the analysis of collaborative attributes proposed, the inter-play positive relationships of correlation analysis indicate that these criteria are valid for using in the evaluating partners in tourism supply chain networks. The strongest result in correlation analysis is the relationship between communication and coordination, and strategic goals fitting (0.882), followed by organizational culture, and trust and commitment (0.877). The results strongly indicate that the inter-play effects between communication and coordination, strategic goals fitting, organizational culture, and trust and commitment have a positive impact on how tourism firms can sustain their long-time collaborative relationships by selecting the suitable candidates at the beginning.

Table 3.5: A result of correlation analysis of risk evaluation criteria

Main criteria	Sub-criteria	(1)
Risk factor	(1) Political stability	
	(2) Economy	0.669*

Table 3.6: A result of correlation analysis of collaborative evaluation criteria

Main criteria	Sub-criteria	(1)	(2)	(3)	(4)	(5)
Compatibility	(1) Organizational culture					
	(2) Communication	0.833*				
	(3) Symmetry in size	0.714*	0.714*			
	(4) Trust and commitment	0.877*	0.877*	0.808*		
	(5) Goal fitting	0.630*	0.882*	0.761*	0.826*	
	(6) Conflict resolution	0.659*	0.761*	0.534	0.454	0.518

3.5 Summary

In this paper, we have addressed the current research question in the tourism literature regarding the partner selection problem. The objective is to develop the evaluation criteria for partner selection problem in tourism supply chain networks. In developing processes, we have proposed the conceptualize partner evaluation criteria. After statistically verifications, the proposed evaluation criteria consist of five main categories: performances of partners, profiles of partners, risk oriented factors, characteristics of products, and compatibility. Furthermore, we also have proposed the sub-criteria in order to better measure each criterion.

For practical perspectives and managerial implications, regarding the proposed evaluation criteria, tour operator and travel agency managers can adopted the proposed evaluation criteria in effectively managing the buyer-seller relationships. For example, when tour operator firms have to evaluate new partners to start working with, one criterion such as reputation is not enough. Therefore, they need to consider from multiple criteria for example reputation, trust and commitment, and service mind-oriented services as well as novelty of tourism products. Based on these evaluation criteria, tourism firms can better have a suitable to start working with. Likewise, tourism firms may overcome the short-term partnerships by carefully evaluate the candidate at the beginning and can dynamically gain better competitive advantage. Therefore, we hope that the advantages of proposed evaluation criteria in terms of generalization would convincingly encourage those managers to use these criteria in the daily business working. The examples of managerial implications are useful not only for tour operators and accommodation industries, but also the whole tourism industry.

While our study contributes considerably to the tourism supply chain management and buyer-seller management literature, especially for Southeast Asia, there are some limitations by several reasons. First, the most important limitation is the small sample size for empirically verification. In addition, our sample is confined to only tour-operators and accommodation industries in Thailand. These may lead the weak results and the bias of our analysis. Hence, we will use a bigger sample sizes to re-examine our conceptual model and also to compare with other countries in the further investigations; for example utilizing multiple linear regression is to confirm relationships between basic criteria and sub-criteria. This future research will provide more useful knowledge in tourism partner selection. Despite this limitation, our results can be sufficiently accepted regarding the important requirements of statistical verifications. Second, we only explore the key impacts relationship between tour operators and accommodation. However, there are other tourism businesses such as transportation, and theme parks as well as food and beverage as second-tier service provider that must need further investigation to provide more in-depth knowledge and understanding. Last, this study relies solely on the conceptual analysis and qualitative study. Therefore, for making the proposed evaluation criteria more general, the real case study in partner selection for collaboration in tourism supply chain is strongly necessary to investigate whether these evaluation criteria for partner selection problem in tourism context working appropriately in the practical perspectives. These mentioned limitations are the promising opportunities for future investigation.

Chapter 4

Decision model and evaluation process for partner selection in tourism supply chain networks

This chapter first recalls background and motivation on developing a new partner evaluation model for tourism supply chain networks. With regard to some drawbacks of existing decision methods, this chapter then intensively describes a process of developing an evaluation model. In the last section, discussion and concluding remarks is discussed the advantages of the proposed method.

4.1 Introduction

In this section, the author would like to recall the importance of partner selection for collaboration in tourism supply chain networks. The successful collaboration with suitable supply chain partners enhances the success rate of designing and delivering services such as package tours. Tourism firms, in particular tour operators are recognizing that the unrecoverable sunk costs of working with wrong candidates are inevitable. Therefore, the question about how to evaluate which partner(s) is suitable for successful collaboration makes tourism partner evaluation process critically very important. However, there is no research on investigating evaluation model and decision approach.

This study focuses on developing the first evaluation model for tourism partner se-

lection problem. Partner selection and evaluation is a decision process with the aim of choosing the best partner from a set of potential partner [66]; [2]. The partner selection problem, as we already have witnessed is based on evaluation under multiple decision-makers involved and multiple evaluation criteria. We can refer to multiple expert multiple criteria decision making problem (***ME-MCDM***). The basic concept and foundation can be found in Chapter 2. The quality of evaluation are usually dependent on the nature of various criteria information and evidence available as well as the background knowledge of experts/ decision-makers [27]. Junior *et al.* [66] suggests that the performances and relative advantages of various decision models and methods depend on the characteristics of the particular problem and situation domain.

In the context of tourism partner selection, the decision of a firm for selecting suitable partner for collaboration often relies on not only the firm' s operational competency but also depending on the characteristics of potential partners [2]. In addition, due to the qualitative nature of evaluation criteria, the data available are mostly qualitative and may be expressed solely by means of linguistic terms [32, 37]. Furthermore, in the multiple functional groups, each expert who has different background knowledge and perspective may be judged and evaluated only in subjective assessments [36, 109]. These traits cause uncertainty as well as vagueness in partner evaluation processes. Motivated by discussion above, this study will purpose a new decision model and evaluation approach for tourism partner selection and evaluation.

4.2 Literature review of partner evaluation approach

This section reviews the existing decision approaches that propose to address the partner selection problem in different contexts. Additionally, the drawbacks and limitation of existing researches are also discussed and emphasized in this section.

4.2.1 Approaches to partner evaluation

Several studies have been developed to cope with partner selection problem. Most approaches have developed based on the mathematical foundation of multiple criteria decision-making problem. Typically, there are two types of approaches to partner selection: *Single*

approach and *Hybrid approach*. Table 4.1 summaries decision making approaches applied to partner selection problem in other contexts.

As shown in Table 4.1, the combination between fuzzy set as well as fuzzy logic and MCDM techniques is mostly adopted and applied to address the partner selection problem when involving a degree of uncertainty. Uncertainty in partner decision making is caused by subjective evaluation of qualitative (linguistic) criteria, by different opinions from multiple decision makers, and with no previous information as well as incomplete data [66]. The benefits of fuzzy set can help firms in better decision under uncertainty and ambiguity and can enhance the performance of MCDM techniques. There are several representative studies that successfully apply a fuzzy-based computational scheme to partner selection problem in different contexts.

- Ding and Liang [33] have applied a fuzzy multi-criteria decision model to address the strategic alliances selection problem in shipping industry.
- Buyukozkan *et al.* [28] have later proposed an integrated approach based on fuzzy logic to deal with multi-criteria decision problem under subjective assessments for strategic alliance partner in logistic value chain.
- Chen *et al.* [30] have developed a fuzzy analytic hierarchy process to deal with linguistic variables in R&D strategic alliance partner.
- Feng *et al.* [29, 52] have introduced a fuzzy multi-criteria decision model to deal with individual and collaborative utilities data in co-development partner selection environment.
- Liou [31] have developed an integrated model by combining a Decision-Making Trial and Evaluation Laboratory (DEMATEL) and Analytic Network Process (ANP) to address the strategic alliance partner selection in the airline industry.
- Li and Wan [34] have proposed a fuzzy multi-attribute group decision making approach to deal with inhomogeneous assessments and incomplete weight information in outsourcing provider selection problem.

It can be summarized from the related studies that when dealing with uncertain and vague information such as judgment of experts/decision-makers, a fuzzy-based-computation

Table 4.1: Decision making approaches applied to partner selection problem

Approach	Relevant studies	Methods	Data Formats	Applications
Single method	Verdeho et al. [71]	ANP	Linguistic terms	Inter-firm collaboration
	Ye and Li [72]	MADM	Linguistic terms	Virtual enterprise
Hybrid method	Akincilar and Degdevien [69]	Hybrid MCDM	Linguistic terms	Hotel website selection
	Buyukozkan *et al.* [28]	Fuzzy MCDM	Linguistic terms	Logistic value chain
	Chen *et al.* [30]	Fuzzy ANP	Linguistic terms	R&D alliance
	Chang [70]	Fuzzy VIKOR	Linguistic terms	Hospital sector
	Chou *at al.*	Fuzzy MCDM	Linguistic terms	Hotel location selection
	Ding and Liang [33]	Fuzzy MCDM	Linguistic terms	Shipping alliance
	Feng *et al.* [29]	Fuzzy MCDM	Linguistic terms	Co-development alliance
	Liou [31]	Integrated MADM	Linguistic terms	Airline alliance selection
	Tsaur et al. [74]	Fuzzy MCDM	Linguistic terms	Airline service quality evaluation
	Yue [73]	Intuitionistic fuzzy-based projection	Linguistic terms	Virtual enterprise

approach is realistic and necessary [3]. However, it should be emphasized here that the use of appropriate techniques can bring some effectiveness and efficiency to the selection process [66]. Likewise, Wu and Barnes [2] suggests that when deciding which techniques can be adopted and applied to use, it must take into account the alignment between the natures of particular problem at hand and the characteristics of techniques. For example, Junior *et al.* [66] have investigated the performance between Fuzzy-AHP and Fuzzy-TOPSIS by conducting a comparative study using a supplier selection problem in manufacturing sector. The result shows that Fuzzy-TOPSIS is better than Fuzzy-AHP in term of changing alternatives and criteria, agility and number of criteria and alternative candidates. Further information and in-detail discussion cab be referred to Chapter 2.

4.2.2 Drawbacks

The aforementioned methods and techniques appear to be effective and be useful methodology. Nevertheless, existing approaches have some unavoidable limitations by several reasons.

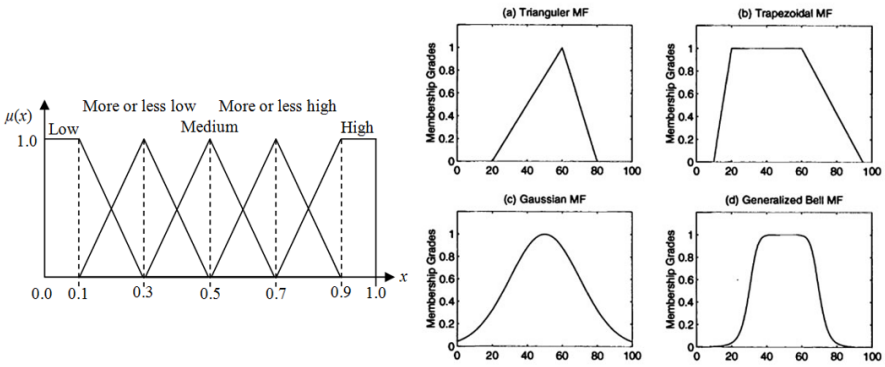

Figure 4.1: A example of different types of fuzzy membership function.

1. A difficulty of precise assigning and mapping linguistic assessments to fuzzy number representation.

   Limited by background knowledge and experience as well as evidence available, the linguistic assessments of experts regarding the same alternative are totally conflict and semantically overlap. These mentioned obstacle sensitively influences to a consistency of the final decision and also cannot well capture the uncertain and

vague information. In particular, the different definitions of membership functions assigned lead different results. Figure 4.1 shows the different types of fuzzy membership function.

2. The existing partner election models are not permitted the attribute to have different weights assigned by experts. This limitation effects on the preference orders of alternative in some situations.

3. Most available models assume that the linguistic judgments expresses by experts/decision-makers are precisely completeness. However, practically, due to human's ability limitations, experts may express a partially expression in order to represent their belief confidences. Figure 4.2 illustrates the different individual expressions regarding their level of belief confidences.

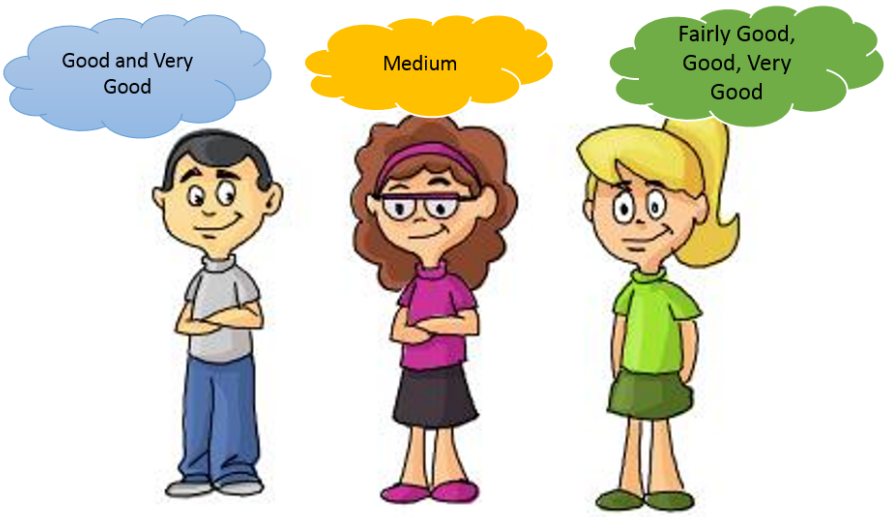

Figure 4.2: A example of different individual preferences representing level of belief confidences.

4. Loss of information.

   By applying fuzzy-based computation scheme, the necessity of utilizing an linguistic approximation process to translate value back to the original ones causes the loss of information [32, 35, 37], which hence implies a lack of precision in the final result. Figure 4.3 depicts the need of re-translation process in fuzzy-based computational scheme causes loss of information.

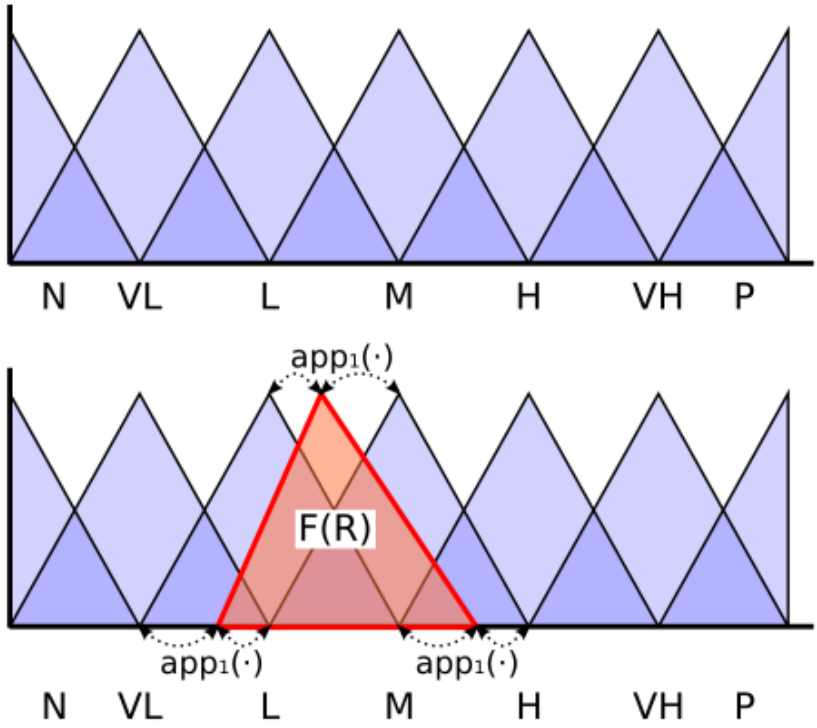

Figure 4.3: A translation process leads information loss (Herrera *et al.* [32]).

In sum, we can conclude that existing approaches cannot apply directly to solve partner selection for collaboration in tourism networks. In addition, there are some drawbacks that need to overcome limitations of exiting approaches on partner selection problem.

To do so, we present an evaluation model for tourism partner selection problem, which is formulated as multi-expert multi-attribute decision problem with uncertain linguistic assessments. The proposed evaluation model consists of two phases. First we model multiple-expert linguistic assessments on single attribute by means of mass function and then makes use of Dempster's rule of combination for attribute aggregation. Second, the combined mass function is transformed into corresponding probability distribution via Smets's pignistic transformation and finally defined a linguistic choice function based on the so-called satisfactory principle for ranking and selection. Figure 4.4 shows the difference between traditional framework and our proposed framework.

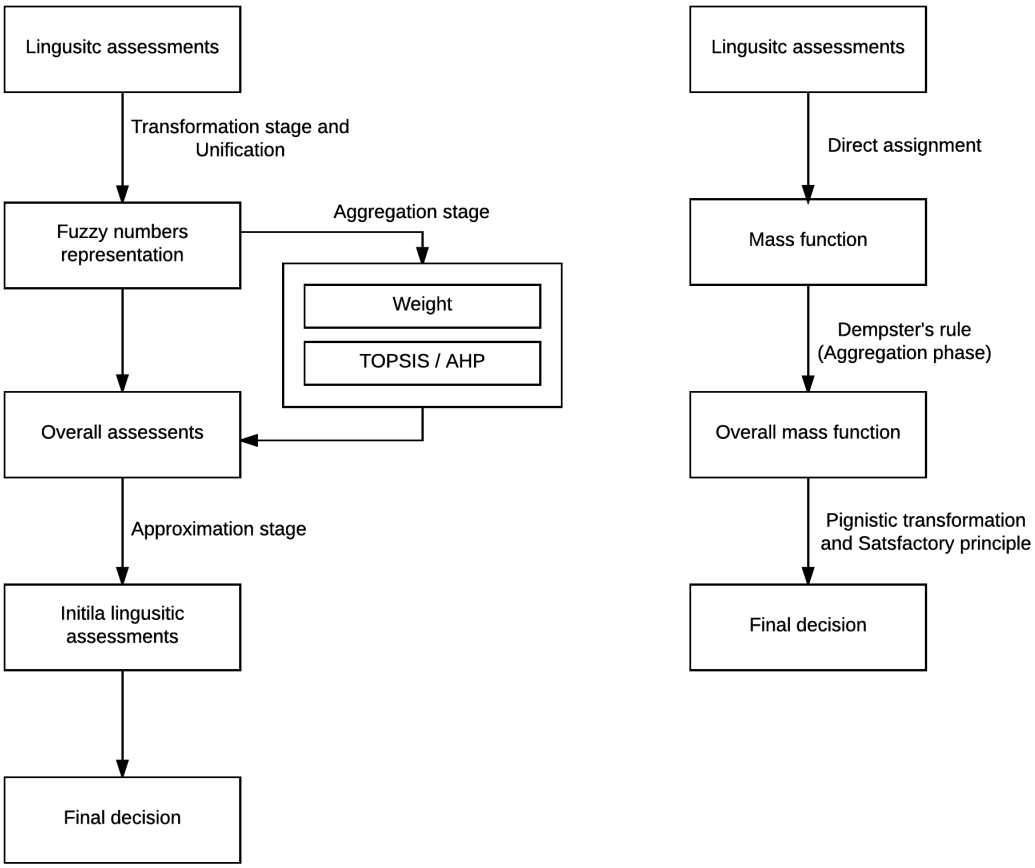

Figure 4.4: The difference between traditional framework and our proposed method.

4.3 Preliminaries

This section shall propose a new hybrid evaluation model for tourism partner selection problem. Before describing in-details, we first briefly describe a fundamental concept of linguistic term set, and mathematical background, so-called Demspter-Shafer theory of evidence using in this study.

4.3.1 Description of the linguistic term set in linguistic decision making

The foundation of linguistic concept was first proposed by Zadeh [49, 50]. Zadeh [50] defines term linguistic variable as "variable whose values are not numbers but words or sentences in a natural or artificial language". Up to date, a linguistic variable provides

a tool as theoretical background for human to approximately express their evaluation in decision making activity [32].

Formally, a linguistic variable is a 5-tuple $(L, T(L), U, S, M)$ [50] in which

- L is the name of the variable,
- $T(L)$ is a finite term set of labels or words (a set of linguistic values),
- U is a universe of discourse,
- S is the syntactic rule which generate the terms in $T(L)$, and
- M is a semantic rule which associates with each linguistic value X its meaning $M(X)$, where $M(X)$ denotes a fuzzy subset of U.

The importance of linguistic variable by means of linguistic term set has already recognized in practical situation, including group decision making [110, 111], multicriteria decision making [69] and consensus [32]. The necessity of utilizing linguistic variables arises for several reasons. First, when attempting to quantify phenomenon related to human perception, we often prefer to use words in natural language instead of numerical values due to the facts that humans have a capability limitation to precisely express their preferences and personal judgments with confidence [50]. Regarding this situation, the linguistic terms can simply help to deal with qualitative information which is difficult to measure directly such as "comfort" or "design" [112] of a designed item, terms like "good", "medium", "bad" would be used [32]. Second, precise quantitative information in some situations may not be fully available ot the cost of its computation is too high, so an "approximate value" may be tolerated (for example, when evaluating the speed of service provided, linguistic terms like "fast", "very fast", "slow" may be used instead of numerical value) [35]. Last, in any decision process under time constraint, only incomplete information and little evidence are available. It is very difficult for decision-makers to provide a concise assessment that can explicitly capture their opinions effectively. These mentioned situation, a linguistic approach is necessary and helpful.

Essentially, as for any linguistic based approach, the term set of a linguistic variable and its associated semantics must be defined first to supply the decision-makers as an instrument by which they can naturally express their information by choosing from the

provided linguistic term set [37]. Further, it is also worth to note here that the cardinality of linguistic term set must be small and rich enough in order to allow a discrimination of uncertainty. In this study, the linguistic term set is directly supply a finite term set and consider all terms as primary ones, distributed on a scale on which a total order is defined [35].

To determine the semantics aspect, it must be defined according to its linguistic term set. As suggested in the literature, there are three main possibilities for defining the semantics of the linguistic term set: semantics based on membership functions and a semantic rule, semantics based on the ordered structure of the term set, and mixed semantics . In this study, we adopt the ordered structure based semantics of the linguistic term set; for instance, a set of five terms L could be given as follows:

$$L = \left\{ \begin{array}{r} s_1 = (Worst), s_2 = (Bad), s_3 = (Fair), \\ s_4 = (Good), s_5 = (Best) \end{array} \right\}$$

in which $s_i < s_j$ if and only if $i < j$.

4.3.2 Problem formulation

In this section we shall re-formulate scheme on Multi-Experts Multi-Attribute Decision Making problem with linguistic assessments.

The common characteristic of ME-MADM problem is characterized by a finite set of experts, denoted by $E = \{e_1, ..., e_p\}$, who are asked to access another finite set of alternatives (or candidates) $A = \{a_1, ...a_n\}$ against multiple attributes, denoted by $\{x_1, ..., x_m\}$, associating with a weighting vector $W = (w_1, ..., w_m)$, where w_j is the relative weight of the jth basic attribute (x_i) with $0 \leq w_j \leq 1$.

Assume that

$$L = \{s_0, ..., s_g\}$$

is the linguistic term set accompanied with the ordered structure such that $s_l < s_{l'}$ if and only if $l < l'$.

Let us denote

$$\mathcal{I}^L = \{[s_l, s_{l'}] \mid s_l, s_{l'} \in L \text{ and } s_l \leq s_l'\}$$

Table 4.2: Expert e_k's assessment on alternatives

Alternatives	Attributes : Weights			
	$x_1 : w_1$	$x_2 : w_2$	...	$x_m : w_m$
a_1	x_{11}^k	x_{12}^k	...	x_{1m}^k
a_2	x_{21}^k	x_{22}^k	...	x_{2m}^k
...	...	...	...	...
a_n	x_{n1}^k	x_{n2}^k	...	x_{nm}^k

The $\mathcal{I}^L$ can be referred to the assessment set of all intervals in L.

With regard to assumption above, the general scheme of ME-MADM problems considered in this paper can be then reformulated as in Table 4.2, which defines the linguistic assessment from expert $e_k(k = 1, ..., p)$ on the alternatives a_i, for $i = 1, ..., n$ at attributes x_j, for $j = 1, ..., m$. More specifically, x_{ij}^k stand for the assessment of expert e_k on the alternative a_i at attribute x_j, and $x_{ij}^k \in \mathcal{I}^L$.

4.4 Dempster-Shafer theory of evidence

This section we shall briefly the fundamental concept of Dempster-Shafer (D-S) theory using in this study. Although fuzzy concept can effectively deal with uncertainty situation, there is another mathematical framework that can deal with uncertainty and complexity as well, so-called Dempster-Shafer theory of evidence. Given its advantage, this theory can overcome the mentioned limitations when applying fuzzy concepts.

4.4.1 Basic concepts and foundations

Helton [113] has suggested that there are two types of uncertainty: Aleatory uncertainty and Epistemic one. In epistemic uncertainty, it results from the lack of knowledge about a system and is a property of the analysts performing the analysis [114]. Sometimes epistemic uncertainty is also known as subjective uncertainty and ignorance. Examples of this uncertainty type of situation include when there is little information on which to

evaluate a probability or when that information is ambiguous in nature.

Dempster-Shafer theory was developed based on the motivation that the traditional probability theory has limitation when dealing with epistemic uncertainty. This theory allows us to consider a measure of uncertainty in an interval or a set instead of a precise measure [114, 115].

The basic concept of the theory is that a problem domain is represented by a finite set Θ of mutually exclusive and exhausive hypotheses, called *the frame of discernment* [115]. In a finite discrete space, Dempster-Shafer theory can be interpreted as a generalization of probability theory [114]. The difference between D-S theory and traditional probability theory is that by applying the standard probability framework, all elements in Θ are assigned a probability. And when the degree of support for an event is known, the reminder of the support is automatically assigned to the negation of the event.

In D-S theory, on the other hand, mass assignments are carried put for events as they know, and committing support for an event does not necessarily imply that remaining support is committed to its negation. There are three important functions in Dempster-Shafer theory: the *basic probability assignment* (bpa or m), the *belief function* (Bel), and the *Plausibility function* (Pl)

In basic probability assignment (bpa) is a primitive of evidence theory. The bpa terms does not refer to probability in the classical sense [114]. Formally, a basic probabilistic assignment (BPA), also called mass function, is a function $m : 2^{\Theta} \longrightarrow [0, 1]$ verifying

$$m(\emptyset) = 0, \text{ and } \sum_{A \in 2^{\Theta}} m(A) = 1$$

The quantity $m(A)$ can be interpreted as a measure of the belief that is committed exactly to A, given the available evidence. A subset $A \in 2^{\Theta}$ with $m(A) > 0$ is called a focal element of m. A BPA m is called to be *vacuous* if $m(\Theta) = 1$ and $m(A) = 0$ for all $A \neq \Theta$.

Two evidential functions derived from the basic probability assignment are the belief function Bel and the plausibility function Pl defined as

$$Bel(A) = \sum_{\emptyset \neq B \subseteq A} m(B), \text{ and } Pl(A) = \sum_{B \cap A \neq \emptyset} m(B)$$

The difference between $m(A)$ and $Bel(A)$ is that while $m(A)$ is our belief committed to the subset A excluding any of its proper subsets, $Bel(A)$ is our degree of belief in A as

well as all of its subsets. Consequently, $Pl(A)$ represents the degree to which the evidence fails to refuse A. Note that all the three functions are in an one-to-one correspondence with each other.

4.4.2 Rules for combining the evidence

The purpose of aggregation of information is "to meaningfully summarize and simplify a corpus of data whether the data is coming from a single source ot multiple sources" [114]. There are several aggregation techniques such as arithmetic averages, geometric averages, harmonic averages, maximum and minimum values.

Literature suggests that combination rules in Dempster-Shafer theory are the special types of aggregation methods for data obtained from *multiple* sources that provide different assessments for the same frame of discernment and the important assumption in the theory is that these sources are *independent* [114, 116].

Two useful operations that play a central role in the manipulation of belief functions are *discounting* and *Dempsters rule of combination* [115]. The discounting operation is used when a source of information provides a BPA m, but one knows that this source has probability α of reliability. Then one may adopt $(1-\alpha)$ as ones *discount rate*, which results in a new BPA m^{α} defined by

$$m^{\alpha}(A) = \alpha \mathrm{m}(A), \text{for any} A \subset \Theta \tag{4.1}$$

$$m^{\Theta} = (1-\alpha) + \alpha m(\Theta) \tag{4.2}$$

Consider now two pieces of evidence on the same frame Θ represented by two BPAs m_1 and m_2. Dempsters rule of combination is then used to generate a new BPA, denoted by $(m_1 \oplus m_2)$ (also called the orthogonal sum of m_1 and m_2), denoted as follows

$$(m_1 \oplus m_2)(\emptyset) = 0, \tag{4.3}$$

$$(m_1 \oplus m_2)(A) = \frac{1}{1-k} \sum_{B \cap C = A} m_1(B) m_2(C) \tag{4.4}$$

where

$$k = \sum_{B \cap C = \emptyset} m_1(B) m_2(C)$$

Note that the orthogonal sum combination is only applicable to such two BPAs that meet the condition $k < 1$.

Given a convenient framework for modeling imperfect data and for combining information, Dempster-Shafer theory or belief functions theory has been widely used in various fields classification and data mining as well as multicriteria decision analysis [116]. In multicriteria contexts, as of a comprehensive review of Boujelben *et al.* [116], the authors have distinguished current approaches into three main proposals regarding its ranking procedures: Utkin's approach [117, 118], the DS-AHP method [119, 120, 121] and the evidential reasoning (ER) algorithm [48, 122].

The idea of ranking of alternatives in first approach is based on the computation of belief and plausibility of each alternative, while in second approach the authors extend the concepts of AHP by utilizing evidence theory to capture verbal judgment expressed by decision-makers. A procedure of third approach is modeling imperfect evaluations regarding a set of ordinal criteria before making a ranking. Nevertheless, although an ER approach can effectively imperfect assessments, it has a drawback because the belief structure is defined basically on single assessment grade under the same set of assessment grades. These cannot be possible in some situations such as in a problem of partner selection, a decision-maker or an expert may hesitate between two or more successive assessments grades when evaluating potential candidates. It is naturally that he/her will express his/her evaluation in interval form such as "good" and "very good" without being able to refine his/her judgment [116].

4.5 Partner Evaluation: The Linguistic Assessment-Based Framework

In this section, the proposed partner evaluation framework is graphically described in Fig 4.5.

The evaluation framework consists of three main parts. The first part is to set the selection objectives related to company's plan and policy, the dynamically changes of

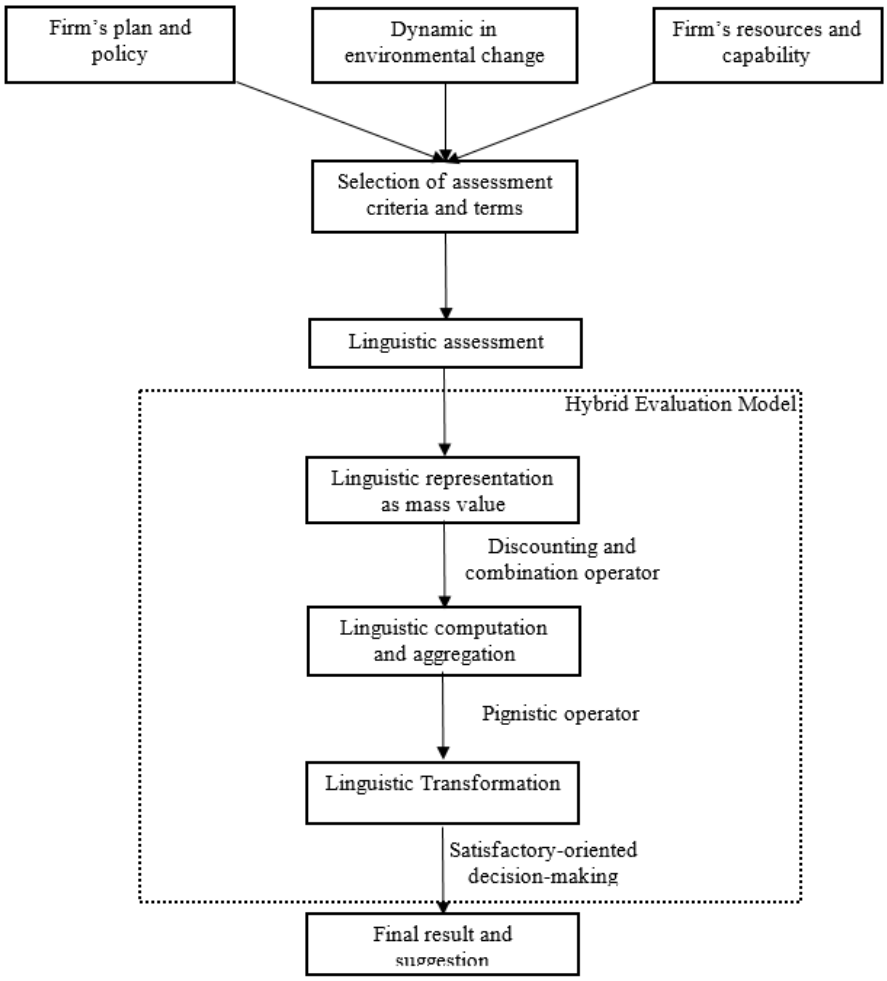

Figure 4.5: A partner selection and evaluation framework

business environments as well as the firm's limitation of resources and capabilities that need to fulfill in order to better gain competitive advantages than rivals. Regarding the goals, the second step is to synthesize and derive the evaluation criteria. Then, asking the managers/experts to express their evaluation assessment with regard to generated evaluation criteria using appropriate linguistic term set. The last part is to make a computation based on collected linguistic assessments in order to obtain a final decision. In the selection process, each major step is illustrated in the following.

4.5.1 Selecting Criteria for Evaluation

Prior to solve the partner selection problem, it should be emphasized here that the evaluation criteria and decision model are specific for particular decision situations [27, 37, 123].

Likewise, as suggested in the literature, criteria should be essentially reflected not only the the partner's characteristics, but also a firm's business objective, operational competency and marketing competition.

4.5.2 Selecting Linguistic Term Sets and Their Associated Semantics

Since the proposed evaluation criteria are qualitative, it is necessary to design and select the linguistic terms and their associated semantics in order to not only appropriately measure each proposed criterion, but also supply decision-makers as an instrument by which they can naturally express their information [37].

The summarization of proposed model is described in the next section.

4.5.3 Hybrid Evaluation Model Based on Dempster-Shafer Theory and Satisfactory Principle

In this section, we present the proposed evaluation model. In the model, there are two schemes: a modeling and aggregation phase and an evaluation and selection phase.

Phase I: Modeling and Aggregation Phase

1) ***Modeling Uncertain Linguistic Assessment***: Let us consider alternative (or candidate) a_i $(i = 1, ..., n)$ according to each attribute $x_{i,j}$ $(j = 1, ..., m)$, we then can define a mass function $\mathbf{m}_{i,j} : 2^L \longrightarrow [0, 1]$ as follows:

$$\mathbf{m}_{i,j}(X) \quad = \quad \frac{|e_k \in E \mid x_{ij}^k = X|}{|E|} \tag{4.5}$$

for any $X \in 2^L$. Note that the focal elements of $\mathbf{m}_{i,j}$ are elements of $\mathcal{I}^L$.

As such, having derived mass function for each alternative (a_i) regarding criterion c_j, we can obtain the decision matrix as shown in Table 4.3. In the belief decision table, $\mathbf{m}_{ij}$ $(i = 1, ..., n; j = 1, ...m)$ is the mass value of linguistic rating of all experts E_k $(k = 1, ..., 4)$ regarding criterion c_j. Further, w_{ij} $(i = 1, ..., n; j = 1, ...m)$ is the linguistic weight, which

Table 4.3: The Belief Decision Matrix

Alternatives	Attributes : Weights			
	$x_1 : w_1$	$x_2 : w_2$	...	$x_m : w_m$
a_1	$\mathbf{m}_{11}$	$\mathbf{m}_{12}$	...	$\mathbf{m}_{1m}$
a_2	$\mathbf{m}_{21}$	$\mathbf{m}_{22}$	...	$\mathbf{m}_{2m}$
...	...	...	...	...
a_n	$\mathbf{m}_{n1}$	$\mathbf{m}_{n2}$	...	$\mathbf{m}_{nm}$

experts E_i assigns to criterion c_j.

2) ***Attribute Aggregation***: Formally, in any linguistic decision analysis, the importance scheme is to aggregate linguistic assessment in order to obtain the overall linguistic assessment. In this study, by employing the evidential reasoning approach [48], we can obtain its overall mass function for each alternative a_i $(i = 1, ..., n)$ via a discounting-and-combination scheme as follows:

$$\mathbf{m}_i = \bigoplus_{j=1}^{m} w_j \odot \mathbf{m}_{i,j} \tag{4.6}$$

where $\odot$ and $\oplus$ are, respectively, the discounting operation and Dempsters combination operator.

In particular, we have

$$w_j \odot \mathbf{m}_{i,j} \triangleq \mathbf{m}_{i,j}^{w_j} : 2^L \longrightarrow [0, 1]$$

where

$$\mathbf{m}_{i,j}^{w_j}(X) = w_j \times \mathbf{m}_{i,j}(X), \quad \text{for any } X \subseteq L \tag{4.7}$$

$$\mathbf{m}_{i,j}^{w_j}(L) = (1 - w_j) + w_j \times \mathbf{m}_{i,j}(L) \tag{4.8}$$

Then, the overall mass function of a_i is

$$\mathbf{m}_i = \bigoplus_{j=1}^{m} \mathbf{m}_{i,j}^{w_j}$$

where $\oplus$ is Dempster's combination operator.

Phase II: Evaluation and Selection Phase

3) ***Transformation and Generation of Probabilistic Distribution***: For the purpose of making decisions, guided by the *Generalized Insufficient Reason Principle*, we are able to define a probability function $\mathbf{p}_i$ on L for each alternative a_i $(i = 1, ..., n)$, derived from $\mathbf{m}_i$ via the *pignistic transformation* [125]. Namely,

$$\mathbf{p}_i(s_l) \quad = \quad \sum_{s_l \in X, X \subseteq L} \frac{\mathbf{m}_i(X)}{|X|} \; for \; l = 0, ..., g \tag{4.9}$$

That is, as in the two-level language of the so-called transferable belief model [125], the aggregated mass function m itself representing the belief is entertained based on the available evidence at the *credal level*, and when a decision must be made, the belief at the credal level induces the probability function $\mathbf{p}_i$ defined by (9) for decision making purpose.

Quite importantly, as mentioned in [126], the procedure of asking each expert to linguistically evaluate each alternative in terms of its performance adopts an absolute evaluation and is based on the assumption that the alternatives are independent.

4) ***Evaluation and Selection***: Therefore, regarding the assumption mentioned above, if we view the derived probability function of alternatives as their random performances $\mathbf{p}_i, i = 1, ..., n$, we have for each $i, \mathbf{p}_i$ which is stochastically independent of all the others.

This assumption allows us to easily compute the probabilities of comparisons of two independent probability distributions of the two random performances. That is, we can work out the probability that one of the associated random preferences is *less than or equal* to the other. More particularly, for any $\mathbf{p}_i, \mathbf{p}_j$ such that $i \neq j$, we have

$$P(\mathbf{p}_i \succeq \mathbf{p}_j) = \sum_{s \in L} \mathbf{p}_i(s) P(s \succeq \mathbf{p}_j) \tag{4.10}$$

where $P(s \succeq \mathbf{p}_j)$ is the cumulative probability function defined by

$$P(s \succeq \mathbf{p}_j) = \sum_{\substack{x \in L \\ s \geq x}} \mathbf{p}_j(x) \tag{4.11}$$

The quantity $P(\mathbf{p}_i \succeq \mathbf{p}_j)$ could be interpreted as the probability of the performance of a_i is as at least good as that of a_j under the evaluation scheme. Intuitively, *it is perfectly satisfactory to select an alternative as the best if its performance is as at least good as all the others under the same evaluation scheme* [35]. We have called this the *satisfactory principle.*

Now we are ready, based on the satisfactory principle, to propose a choice function defined as follows

$$V(a_i) = \sum_{j \neq i} P(\mathbf{p}_i \succeq \mathbf{p}_j) \tag{4.12}$$

$$= \sum_{j \neq i} \sum_{s \in L} \left[\mathbf{p}_i(s) \sum_{\substack{x \in L \\ s \geq x}} \mathbf{p}_j(x) \right] \tag{4.13}$$

Then the satisfactory-oriented linguistic decision model for the ME-MADM problem is defined by

$$a_{best} = argmax_{a_i \in A} V(a_i) \tag{4.14}$$

4.6 An illustrative numerical example

This section we will illustrate how the proposed technique performs by giving a simple and clear example for the reason of easy to understand.

4.6.1 Problem description

Assume that the hotel operator want to increase a sale margin by increasing the marketing and distribution channels. Therefore, accommodation have to find a potential company as effective outsourcing supplier. To do so, the hotel operator have set a group of evaluation committees, who are from different departments for expressing some opinions.

After finalizing a set of evaluation criteria and a set of final potential suppliers, assume that two experts are asked to express their evaluation assessments regarding the performance criteria: service quality and reputation using five scale of linguistic term set L.

$$L = \left\{ \begin{array}{r} s_1 = (Worst), s_2 = (Bad), s_3 = (Fair), \\ s_4 = (Good), s_5 = (Perfect) \end{array} \right\}$$

in which $s_i < s_j$ if and only if $i < j$.

The performance rating is shown in Table 4.4. It is worth to note here that the linguistic assessments expressed by expert $\mathbf{e}_1$, which is S_2, S_3 on alternative $\mathbf{a}_1$ regarding Reputation as criterion is the uncertain information usually representing their level of belief or confidence under circumstance. For the sake of simplicity, we assume that a weighting vector of two experts and two attributes is equally importances.

Table 4.4: The performance rating on alternative retarding criteria.

Suppliers	Experts	Attributes	
		Service quality	Reputation
a_1	$\mathbf{e}_1$	S_4	S_2, S_3
	$\mathbf{e}_2$	S_2, S_3	S_3
a_2	$\mathbf{e}_1$	S_2	S_4
	$\mathbf{e}_2$	S_3, S_4	S_3

4.6.2 Result of numerical computation

Now, let us apply the proposed evaluation method developed in the previous section.

1. We model the uncertain linguistic assessments by direct assigning them into mass function representing experts judgments on each alternative per criteria, defined by (4.5).

2. For criteria aggregation, using a discounting-and-combination scheme defined by (4.6-4.8), we can easily obtain overall mass function as shown in Table 4.5.

Table 4.5: The belief assessments on alternatives.

Suppliers	Attributes : Weights	
	Service quality (0.5)	Reputation (0.5)
a_1	$\{S_2, S_3\}(0.5); \{S_4\}(0.5)$	$\{S_2, S_3\}(0.5); \{S_3\}(0.5)$
a_2	$\{S_2\}(0.5); \{S_3, S_4\}(0.5)$	$\{S_3\}(0.5); \{S_4\}(0.5)$

3. Utilizing *Smet*'s Pignistic transformation and Satisfactory principle, we can then compute the choice function of the alternatives defined by (4.9) and (4.13) as shown in Table 4.6.

Table 4.6: The belief assessments on alternatives.

Overall mass function	a_1	a_2
$m\{S_2\}$	0.214	
$m\{S_3\}$		0.267
$m\{S_4\}$	0.143	0.200
$m\{S_2, S_3\}$	0.357	0.133
$m\{S_3, S_4\}$		0.133
$m\{S_\theta\}$	0.286	0.267

Table 4.7: The choice function of the alternatives.

Alternative	$V(a_i)$
a_1	0.239
a_2	0.442

The choice function value of each alternative is illustrated in the Table 4.7. Based on the satisfactory-oriented linguistic decision rule defined by (4.14), we can easily select the best alternative. The ranking order is $a_2 \succ a_1$.

Therefore, the most preferable alternative is $\mathbf{a}_2$.

4.7 Discussion and Concluding Remarks

As mentioned, the decision model depends on the particular situation and problem. Since there is no research on developing partner evaluation model, this study proposes a new hybrid evaluation model for tourism partner selection.

The new evaluation model for tourism partner selection problem is formulated as multi-expert multi-attribute decision problem with uncertain linguistic assessments. The proposed evaluation processes consists of two phases.

1. A modeling and aggregation phase. We first model multiple-expert linguistic assessments on single attribute by means of mass function and then makes use of Dempster's rule of combination for attribute aggregation.

2. An evaluation and selection phase. We transform the combined mass function is transformed into corresponding probability distribution via Smets's *pignistic transformation* and finally defined a linguistic choice function based on the so-called *satisfactory principle* for ranking and selection.

With regard to the drawbacks and limitations we have witnessed, we can justify that the proposed evaluation model contributes to not only decision science and tourism supply chain literature, but also practical situation. Specifically, using our proposed hybrid evaluation model instead of utilizing a traditional fuzzy-based computational scheme, the burden of qualifying a subjective evaluation can be eliminated, while maintaining a flexible way for practical users to freely express their subjective evaluations regarding their level of confidence.

However, the main limitation of the proposed evaluation approach is the usefulness and validity. Therefore, it is much interesting to employ our proposed technique to address the real practical problem. In the next chapter, we shall conduct a case study in order to illustrate how the proposed partner evaluation model works in practice.

Chapter 5

Case study: Tourism partner evaluation for collaboration in Thailand

"*Coming together is a beginning, staying together is progress, and working together is success*" - Henry Ford (1863-1947).

This chapter shows and demonstrates the usefulness of the proposed hybrid evaluation framework, which is developed in the Chapter 4. Case study of tourism partner evaluation for collaboration in Thailand is used for validation and evaluation. For the reasons of confidentiality, the name of the related firms using in this study is not revealed. First the research problem was conceptually illustrated the partner selection situation in Thailand. Then, the numerical analysis and results of computation demonstrate how the proposed technique is applicable in practical problem. From the result of case study, our proposed evaluation method shows the performance in consistent result when dealing with uncertain assessments while maintaining a flexibility approach for tourism managers to express their assessments freely.

5.1 Partner as a key to success in tourism networks

In this section, we shall first briefly recall the necessity of partner selection for collaboration in tourism networks.

Currently, tourism firms have a difficulty in successfully designing and delivering services to desired customers who usually have complex expectations [1, 87, 105]. To overcome this challenge, firms have realized that they cannot provide effective services by solely utilizing their internal resource due to its limitation [106, 107]. Therefore, the necessity of collaboration with suitable supply chain partner becomes an essential approach in order to sustain competitive advantages. The significant benefits of partnerships have already suggested in the literature [97, 85, 108]. By effective collaboration, a focal organization can gain critical resource as well as surplus core competency that lead positive performance outcomes such as reduce costs and improve service performances. However, the unrecoverable sunk costs are inevitable when working with the wrong candidates [28, 34]. These make tourism partner evaluation process critically very important; however, there is no evaluation model for tourism partner selection problem.

5.2 Background of tourism partner evaluation for collaboration in Thailand

Thailand is one of the top three most popular tourist destination in Asia [128]. This reason leads many tourists around the world come to explore and to travel in Thailand. Tourist organizations in various roles and functions are therefore willing to gain and to reap such benefits by proposing the designed services i.e. tour packages. In tourism supply chain networks, the tour operators play important roles in order to bridge the willingness between demand and supply sides by merging and organizing it together into the designed package tours [1, 78].

It should be emphasized here that a successful designed package tour strongly rely on the collaborative relationships between the service providers (suppliers) such as accommodation and transportation, and tour operators. This is because tour operators itself cannot successfully assemble a piece of services satisfying the unpredictable expectation of prospected customers, who often view the tourism product as an end-to-end seamless entity [1, 17]. With regard to the complex relationships, tourism firms/organizations can easily change suppliers from one to another if profit proposal is well satisfied. In addition, the service providers such as accommodation companies are sometimes willing to

provide services by using their internal services, says in high seasoning. These difficulties arise tour operators have a problem with designing tour packages successfully causing not only huge loss of profits, but also reputation and reliability of customers' point-of-views. Based on these reasons, tour operator firms have to find the suitable partner to start working with in order to dynamically gain the long-term competitive advantage over the competitors together.

To answer proposed research questions, case study is chosen in this study because it enables a researcher to closely examine the data within a specific context [89]. In order to conduct an effective case study, Yin [90] have suggested three necessary conditions for the design of case study: a) the type of research question posed, b) the extent of control an investigator has over actual behavioral events, and c) the degree of focus on contemporary events.

In this study, we have chosen a medium tour operator located in Bangkok, Thailand as our scope and unit of analysis for investigation and for answering research question appropriately. For the reason of confidentially, the name of tour operator and hotel operators using in this study are not revealed. Figure 5.1 shows that unit of our analysis and also activities in generating tourism products between tour operators and hotel operators. Tour operator and accommodation where are located in Bangkok, Thailand were chosen as our empirical background for several reasons. Figure 5.2 illustrates the contributions of tourism industry in the Thai economy.

1). In the economic climate of Thailand, the service sector has a significant impact in the first rank among three sectors: manufacturing and agriculture to the GDP (Gross Domestic Product) of Thailand. The tertiary (service) sector contributes to the country with 49.9%. In this sector, apart from other service-oriented industries that contribute to the economy of Thailand such as wholesale and retail industry as well as financial industry, tourism industry including accommodation and transportation is the most highest growth industry that generates huge revenues. The importance of tourism industry is due to the fact that there have several contributions and advantages to the economy of Thailand.

- The direct contribution of tourism was USD2,364.8bn (3.1% of total GDP) in 2014.
- Tourism industry contributes directly to global employment. The total contribution was 9.4% of total employment (276,845,000 jobs) in 2014.

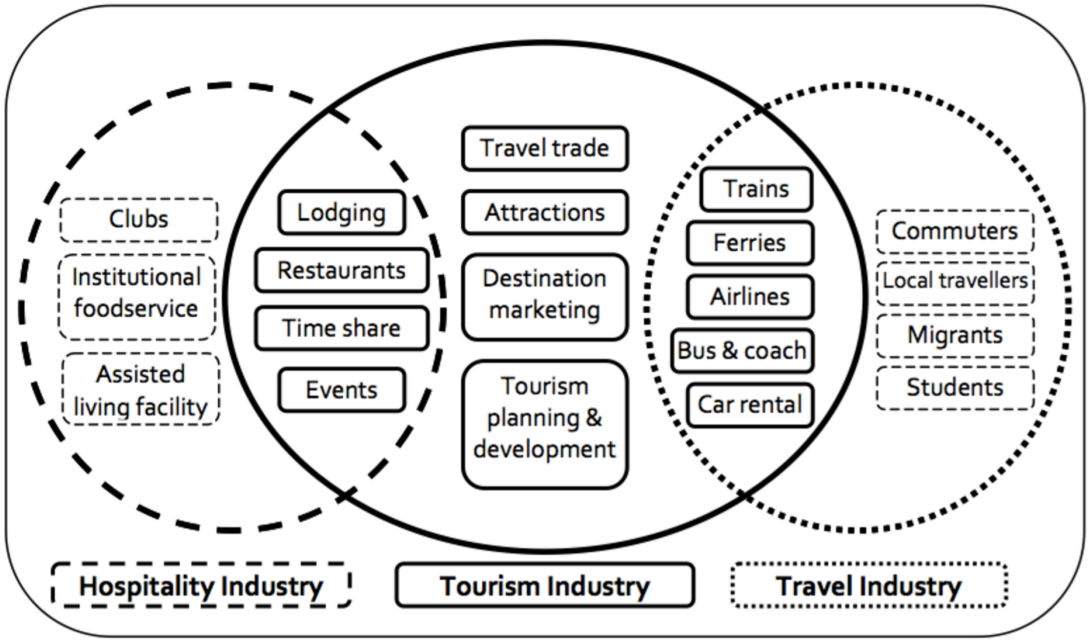

Figure 5.1: A scope of this study in tour operators and hotel operators relationship.[4]

- Tourism industry leads a high investment. In 2014, the total investment was USD814.4bn (4.3%) from investment in tourism sector.

It can be concluded that tourism industry plays a crucial role that can efficiently generate the income for the country. Thanks to a lot of useful and valuable attractions in Thailand for example the historical resources, and the ancient traditions as well as unique cultures, the major inbound markets of international tourists that travel to Thailand have been rising up to almost 15 million of tourists [79] in 2010. However, due to political issue, the number of tourists is decreasing around 10%. Figure 5.3 shows the tourism statistics of Thailand supporting several reasons as mentioned above.

In tourism supply chain, hotel operator and tour operator are the most well-known business and very popular in Thailand [79]. This is because these businesses can start-up to do a business with a small investment. Figure 5.4 shows the number of SMEs enterprises which do business in hotel and and Travel agency compare with the large companies in Thailand during 2007-2009. It can be summarized that the number of SMEs enterprises are larger than of 100% of large companies Furthermore, the trend are also indicates that the number of SMEs are dramatically increasing during this time. Nakwa *et al.* [79] have suggested that small and medium businesses are playing an important role to not only

2015 ANNUAL RESEARCH: KEY FACTS[1]

2015 forecast

GDP: DIRECT CONTRIBUTION

The direct contribution of Travel & Tourism to GDP was USD2,364.8bn (3.1% of total GDP) in 2014, and is forecast to rise by 3.7% in 2015, and to rise by 3.9% pa, from 2015-2025, to USD3,593.2bn (3.3% of total GDP) in 2025.

GDP: TOTAL CONTRIBUTION

The total contribution of Travel & Tourism to GDP was USD7,580.9bn (9.8% of GDP) in 2014, and is forecast to rise by 3.7% in 2015, and to rise by 3.8% pa to USD11,381.9bn (10.5% of GDP) in 2025.

EMPLOYMENT: DIRECT CONTRIBUTION

In 2014 Travel & Tourism directly supported 105,408,000 jobs (3.6% of total employment). This is expected to rise by 2.0% in 2015 and rise by 2.0% pa to 130,694,000 jobs (3.9% of total employment) in 2025.

EMPLOYMENT: TOTAL CONTRIBUTION

In 2014, the total contribution of Travel & Tourism to employment, including jobs indirectly supported by the industry, was 9.4% of total employment (276,845,000 jobs). This is expected to rise by 2.6% in 2015 to 283,983,000 jobs and rise by 2.3% pa to 356,911,000 jobs in 2025 (10.7% of total).

VISITOR EXPORTS

Visitor exports generated USD1,383.8bn (5.7% of total exports) in 2014. This is forecast to grow by 2.8% in 2015, and grow by 4.2% pa, from 2015-2025, to USD2,140.1bn in 2025 (5.6% of total).

INVESTMENT

Travel & Tourism investment in 2014 was USD814.4bn, or 4.3% of total investment. It should rise by 4.8% in 2015, and rise by 4.6% pa over the next ten years to USD1,336.4bn in 2025 (4.9% of total).

[1]All values are in constant 2014 prices & exchange rates

Figure 5.2: A fact sheet of tourism industry's contributions. (Source: www.wttc.org)

the economy of Thailand, but also the global economy.

2). As mentioned about the numbers of SME leading a strong competition in tourism supply chain, it will cause decreasing on number of business operations where cannot individually survive under severe competition [78]. Because of limitations of resources and capabilities, tour operators really need an effective collaborative strategy with the appropriate supply chain partners as collaborative advantage on order to gain and reap higher profits and better market share [88]. However, most of collaboration between tour operator and accommodation are not success. Furthermore, there is little research investigating such issue in context of neither Southeast Asia, especially Thailand, nor global

Tourism Statistics

Number of Tourists (Q3/2014): 5.8 mil (-10.1% y-o-y)

Awards and Honors:

Huffington Post: Thailand is one of "The World's 7 Most Retiree-friendly Nations."
HSBC Expat Explorer 2014: Thailand is 7th top destination for expats.
Frommers: Bangkok is one of the 11 worl'ds best shopping destinations.
TripAdvisor: Ao Nang among top 10 Destinations on the Rise in the World.
CondeNast Reader's Choice Awards 2014: Bangkok and Chiangmai are Top 25 Cities in the World.
Business Traveller Asia Pacific: Bangkok is "Best Leisure Destination in the Asia-Pacific."

Figure 5.3: A fact sheet of tourism statistics of Thailand. (Source: www.mfa.go.th)

tourism supply chain. Hence, it is worth to investigate the problem using this sample characteristics. Referring the benefits as discussed, this study will yield the valuable knowledge to the current literature.

5.3 A preparative study

In this section, we shall conduct a case study of partner evaluation for collaboration in Thailand to illustrate and validate the partner evaluation model developed in Chapter 4. In addition, we aim to provide a managerial guidelines and practical implications for tourism organizations in particular tour operator.

5.3.1 Identification of evaluation criteria

A qualitative study was conducted at the early stage in order to effectively select the most related evaluation criteria that can explicitly capture the problem (Chapter 3). For the purpose of validity, the proposed criteria are adopted based on the related partner

Type of Business	Hotel and Restaurant				Travel & Tour Agency			
	2007	2008	2009	Change 08/09	2007	2008	2009	Change 08/09
Number of Enterprises	184,147	188,286	185,938	(1.25)	11,097	10,928	10,334	(5.43)
SMEs	183,892	188,029	185,678	(1.25)	11,092	10,923	10,330	(5.43)
Large Companies	242	244	246	1.01	3	3	3	0.00
Number of Employment (Person)	774,909	781,823	706,855	(9.59)	34,418	32,892	28,664	(12.85)
SMEs	646,944	648,432	587,084	(9.46)	34,005	32,505	28,320	(12.87)
Large Companies	127,965	133,391	119,771	(10.21)	413	387	344	(11.12)
Total Revenue (Million Baht)	66,871	66,444	61,231	(7.85)	16,019	12,621	10,224	(18.99)
SMEs	28,476	28,668	28,538	(0.45)	15,989	12,570	10,183	(18.99)
Large Companies	38,395	37,776	32,693	(13.46)	30	51	41	(18.69)
Net Profit (Million Baht)	7,810	5,807	2,805	(51.69)	76	(34)	(57)	(64.34)
SMEs	(162)	(138)	(152)	(9.77)	14	(76)	(96)	(26.90)
Large Companies	7,972	5,946	2,957	(50.27)	61	41	40	(4.27)
Labor Productivity (Baht/Person)	41,551	39,423	39,362	(0.15)	50,846	53,349	51,922	(2.67)
SMEs	10,486	9,877	9,999	1.24	48,313	49,585	48,078	(3.04)
Large Companies	212,313	183,047	189,364	3.45	185,161	369,478	381,907	3.36
Capital Productivity (Times)	0.21	0.18	0.18	0.47	0.20	0.15	0.14	(7.62)
SMEs	0.17	0.14	0.14	0.71	0.20	0.14	0.13	(7.98)
Large Companies	0.22	0.20	0.20	0.64	0.50	0.46	0.44	(2.52)

Source: Office of Small and Medium Enterprises Promotion

Figure 5.4: A number of SMEs enterprises compare with large companies in Thailand. (Source: eng.sme.go.th)

selection literature. Then, discussing by in-depth interviewing with experts, who are the tourism professionalisms having work experience more than 10 years and also tourism academicians, in order to confirm whether the proposed criteria are enough specific with the situation. The detailed information of final proposed criteria are shown in Table 5.1.

5.3.2 Identification of linguistic term sets and their associated semantics

Since the proposed evaluation criteria are qualitative, it is necessary to design and select the linguistic terms and their associated semantics in order to not only appropriately measure each proposed criterion, but also supply decision-makers as an instrument by which they can naturally express their information [37]. In this study, we defined two linguistic term sets and their associated semantics in totally ordering representations for evaluation as follows.

Table 5.1: The proposed criteria of Tourism partner selection using in this study

Criteria	**Sub-Criteria**
Performance (C_1)	Flexibility (c_{11}) Capacity(c_{12}) Service Mind-oriented (c_{13})
Profile (C_2)	Reputation(c_{21}) Performance history and Relationship closeness (c_{22})
Risk Factor (C_3)	Political stability (c_{31}) Economy (c_{32})
Product's characteristics(C_4)	Product Cost(c_{41}) Product Quality (c_{42}) Novelty (c_{43})
Compatibility (C_5)	Organizational culture (c_{51}) Communication and Coordination(c_{52}) Symmetry in organizational size(c_{53}) Trust and Commitment (c_{54}) Strategic goals fitting(c_{55}) Conflict resolution(c_{56})

The term set for evaluating the relative importance of different criteria

The different evaluation criteria have different degrees of importance. It is dependent on not only the situations that firms have faced, but also the background and experience of decision-makers [124]. Therefore, it should be carefully considered when making any decision. In this study, the linguistic term set of measuring the relative importance is chosen in the following.

$$\boldsymbol{S_1} = \left\{ \begin{array}{r} s_1^1(\text{Very Low}), s_2^1(\text{Low}), s_3^1(\text{Slightly Low}), \\ s_4^1(\text{Medium}), s_5^1(\text{Slightly High}), s_6^1(\text{High}), \\ s_7^1(\text{Very High}) \end{array} \right\}$$

The term set for assessing the rating performance of different alternatives

The importance of rating performance is to help decision-makers to evaluate how well each alternative (candidate) quantify the objectives of proposed multiple criteria. The linguistic term set using in this study is chosen as follows.

$$\boldsymbol{S_2} = \left\{ \begin{array}{r} s_0^2(\text{Very Poor}), s_1^2(\text{Poor}), s_2^2(\text{Slightly Poor}), \\ s_3^2(\text{Medium}), s_4^2(\text{Slightly Good}), s_5^2(\text{Good}), \\ s_6^2(\text{Very Good}) \end{array} \right\}$$

5.3.3 Gathering Data and Developing Computational Model for Making a Decision

Once the criteria for evaluation and also measurement scales are ready, the group of decision-makers (or experts) from different departments is invited to express their preferences and opinions under their consideration with the chosen linguistic terms sets. In addition, the experts is also asked to give their evaluation on the relative importances on each criterion. It is worth to emphasize here that when facing with the qualitative nature of criteria and the uncertainty of predicting future, experts might not know for sure about the outcomes. Hence, they may only express assessments in linguistic forms. In this study, we allowed experts can freely express their preference evaluations in uncertain linguistic interval values. Form the collected rating performance, we then employing our proposed hybrid evaluation model to deal with uncertain linguistic assessment.

5.4 Reformulation of Dempster-Shafer theory

Before employing the proposed approach, we shall reformulate Dempstr-Shafer theory as our mathematical background for analysis and evaluation.

In the theory, a problem domain is represented by a finite set Θ of mutually exclusive and exhausive hypotheses, called *the frame of discernment* [115]. The difference between D-S theory and traditional probability theory is that by applying the standard probability framework, all elements in Θ are assigned a probability. And when the degree of support for an event is known, the reminder of the support is automatically assigned to the

negation of the event. In D-S theory, on the other hand, mass assignments are carried put for events as they know, and committing support for an event does not necessarily imply that remaining support is committed to its negation. Formally, a basic probabilistic assignment (BPA), also called mass function, is a function $m : 2^{\Theta} \longrightarrow [0, 1]$ verifying

$$m(\emptyset) = 0, \text{ and } \sum_{A \in 2^{\Theta}} m(A) = 1$$

The quantity $m(A)$ can be interpreted as a measure of the belief that is committed exactly to A, given the available evidence. A subset $A \in 2^{\Theta}$ with $m(A) > 0$ is called a focal element of m. A BPA m is called to be *vacuous* if $m(\Theta) = 1$ and $m(A) = 0$ for all $A \neq \Theta$.

Two evidential functions derived from the basic probability assignment are the belief function Bel and the plausibility function Pl defined as

$$Bel(A) = \sum_{\emptyset \neq B \subseteq A} m(B), and Pl(A) = \sum_{B \cap A \neq \emptyset} m(B)$$

The difference between $m(A)$ and $Bel(A)$ is that while $m(A)$ is our belief committed to the subset A excluding any of its proper subsets, $Bel(A)$ is our degree of belief in A as well as all of its subsets. Consequently, $Pl(A)$ represents the degree to which the evidence fails to refuse A. Note that all the three functions are in an one-to-one correspondence with each other.

Most importantly, two useful operations that play a central role in the manipulation of belief functions are *discounting* and *Dempsters rule of combination* [114, 115]. The discounting operation is used when a source of information provides a BPA m, but one knows that this source has probability α of reliability. Then one may adopt $(1 - \alpha)$ as ones *discount rate*, which results in a new BPA m^{α} defined by

$$m^{\alpha}(A) = \alpha \mathrm{m}(A), \text{for any} A \subset \Theta \tag{5.1}$$

$$m^{\Theta} = (1 - \alpha) + \alpha m(\Theta) \tag{5.2}$$

Consider now two pieces of evidence on the same frame Θ represented by two BPAs m_1 and m_2. Dempsters rule of combination is then used to generate a new BPA, denoted by $(m_1 \oplus m_2)$ (also called the orthogonal sum of m_1 and m_2), denoted as follows

$$(m_1 \oplus m_2)(\emptyset) = 0, \tag{5.3}$$

$$(m_1 \oplus m_2)(A) = \frac{1}{1-k} \sum_{B \cap C = A} m_1(B) m_2(C) \tag{5.4}$$

where

$$k = \sum_{B \cap C = \emptyset} m_1(B) m_2(C)$$

Note that the orthogonal sum combination is only applicable to such two BPAs that meet the condition $k < 1$.

5.5 Employing a hybrid evaluation model based on Dempster-Shafer Theory and Satisfactory principle

5.5.1 The proposed evaluation process

In this section, we present the proposed evaluation model. In the model, there are two schemes: a modeling and aggregation phase and an evaluation and selection phase.

Phase I: Modeling and Aggregation Phase

1) Modeling Uncertain Linguistic Assessment: Let us consider alternative (or candidate) a_i $(i = 1, ..., n)$ according to each attribute $x_{i,j}$ $(j = 1, ..., m)$, we then can define a mass function $\mathbf{m}_{i,j} : 2^L \longrightarrow [0, 1]$ as follows:

$$\mathbf{m}_{i,j}(X) = \frac{|e_k \in E \mid x_{ij}^k = X|}{|E|} \tag{5.5}$$

for any $X \in 2^L$. Note that the focal elements of $\mathbf{m}_{i,j}$ are elements of $\mathcal{I}^L$.

As such, having derived mass function for each alternative (a_i) regarding criterion c_j, we can obtain the decision matrix as shown in Table 5.2. In the belief decision table, $\mathbf{m}_{ij}$

Table 5.2: The Belief Decision Matrix

Alternatives	Attributes : Weights			
	$x_1 : w_1$	$x_2 : w_2$	...	$x_m : w_m$
a_1	$\mathbf{m}_{11}$	$\mathbf{m}_{12}$	...	$\mathbf{m}_{1m}$
a_2	$\mathbf{m}_{21}$	$\mathbf{m}_{22}$	...	$\mathbf{m}_{2m}$
...	...	...	...	...
a_n	$\mathbf{m}_{n1}$	$\mathbf{m}_{n2}$	...	$\mathbf{m}_{nm}$

$(i = 1, ..., n; j = 1, ...m)$ is the mass value of linguistic rating of all experts E_k $(k = 1, ..., 4)$ regarding criterion c_j. Further, w_{ij} $(i = 1, ..., n; j = 1, ...m)$ is the linguistic weight, which experts E_i assigns to criterion c_j.

2) Attribute Aggregation: Formally, in any linguistic decision analysis, the importance scheme is to aggregate linguistic assessment in order to obtain the overall linguistic assessment. In this study, by employing the evidential reasoning approach [48], we can obtain its overall mass function for each alternative a_i $(i = 1, ..., n)$ via a discounting-and-combination scheme as follows:

$$\mathbf{m}_i = \bigoplus_{j=1}^{m} w_j \odot \mathbf{m}_{i,j} \tag{5.6}$$

where $\odot$ and $\oplus$ are, respectively, the discounting operation and Dempsters combination operator.

In particular, we have

$$w_j \odot \mathbf{m}_{i,j} \triangleq \mathbf{m}_{i,j}^{w_j} : 2^L \longrightarrow [0, 1]$$

where

$$\mathbf{m}_{i,j}^{w_j}(X) = w_j \times \mathbf{m}_{i,j}(X), \quad \text{for any } X \subseteq L \tag{5.7}$$

$$\mathbf{m}_{i,j}^{w_j}(L) = (1 - w_j) + w_j \times \mathbf{m}_{i,j}(L) \tag{5.8}$$

Then, the overall mass function of a_i is

$$\mathbf{m}_i = \bigoplus_{j=1}^{m} \mathbf{m}_{i,j}^{w_j}$$

where $\oplus$ is Dempster's combination operator.

Phase II: Evaluation and Selection Phase

3) Transformation and Generation of Probabilistic Distribution: For the purpose of making decisions, guided by the *Generalized Insufficient Reason Principle*, we are able to define a probability function $\mathbf{p}_i$ on L for each alternative a_i $(i = 1, ..., n)$, derived from $\mathbf{m}_i$ via the *pignistic transformation* [125]. Namely,

$$\mathbf{p}_i(s_l) \quad = \quad \sum_{s_l \in X, X \subseteq L} \frac{\mathbf{m}_i(X)}{|X|} \; for \; l = 0, ..., g \tag{5.9}$$

That is, as in the two-level language of the so-called transferable belief model [125], the aggregated mass function m itself representing the belief is entertained based on the available evidence at the *credal level*, and when a decision must be made, the belief at the credal level induces the probability function $\mathbf{p}_i$ defined by (9) for decision making purpose.

Quite importantly, as mentioned in [126], the procedure of asking each expert to linguistically evaluate each alternative in terms of its performance adopts an absolute evaluation and is based on the assumption that the alternatives are independent.

4) Evaluation and Selection: Therefore, regarding the assumption mentioned above, if we view the derived probability function of alternatives as their random performances $\mathbf{p}_i, i = 1, ..., n$, we have for each $i, \mathbf{p}_i$ which is stochastically independent of all the others.

This assumption allows us to easily compute the probabilities of comparisons of two independent probability distributions of the two random performances. That is, we can work out the probability that one of the associated random preferences is *less than or equal* to the other. More particularly, for any $\mathbf{p}_i, \mathbf{p}_j$ such that $i \neq j$, we have

$$P(\mathbf{p}_i \succeq \mathbf{p}_j) = \sum_{s \in L} \mathbf{p}_i(s) P(s \succeq \mathbf{p}_j) \tag{5.10}$$

where $P(s \succeq \mathbf{p}_j)$ is the cumulative probability function defined by

$$P(s \succeq \mathbf{p}_j) = \sum_{\substack{x \in L \\ s \geq x}} \mathbf{p}_j(x) \tag{5.11}$$

The quantity $P(\mathbf{p}_i \succeq \mathbf{p}_j)$ could be interpreted as the probability of the performance of a_i is as at least good as that of a_j under the evaluation scheme. Intuitively, *it is perfectly satisfactory to select an alternative as the best if its performance is as at least good as all the others under the same evaluation scheme* [35]. We have called this the *satisfactory principle.*

Now we are ready, based on the satisfactory principle, to propose a choice function defined as follows

$$V(a_i) = \sum_{j \neq i} P(\mathbf{p}_i \succeq \mathbf{p}_j) \tag{5.12}$$

$$= \sum_{j \neq i} \sum_{s \in L} \left[\mathbf{p}_i(s) \sum_{\substack{x \in L \\ s \geq x}} \mathbf{p}_j(x) \right] \tag{5.13}$$

Then the satisfactory-oriented linguistic decision model for the ME-MADM problem is defined by

$$a_{best} = argmax_{a_i \in A} V(a_i) \tag{5.14}$$

5.5.2 Result of Linguistic Assessment-Based Partner Evaluation Model

In this section, we shall briefly recall the preparative study first. Prior to solve the partner selection problem, the qualitative research was carefully conducted to refine the evaluation criteria as well as to collect the data. Once the evaluation criteria was ready, we

Table 5.3: The Linguistic Weights of Criteria Assessed by Experts

Criteria	Experts									
	E_1	E_2	E_3	E_4	E_5	E_6	E_7	E_8	E_9	E_{10}
c_{11}	s_5, s_6, s_7	s_4, s_5	s_5, s_6, s_7	s_5, s_6, s_7	s_4	s_7	s_4	s_7	s_4	s_6, s_7
c_{12}	s_5, s_6, s_7	s_3, s_4	s_6, s_7	s_6, s_7	s_5, s_6, s_7	s_7	s_4	s_7	s_5, s_6, s_7	s_5, s_6, s_7
c_{13}	s_5, s_6, s_7	s_6, s_7	s_6, s_7	s_7	s_7	s_7	s_4	s_7	s_5, s_6, s_7	s_6, s_7
c_{21}	s_7	s_4, s_5, s_6	s_7	s_7	s_7	s_7	s_5, s_6, s_7	s_7	s_6, s_7	s_6, s_7
c_{22}	s_7	s_3, s_4, s_5	s_6, s_7	s_6, s_7	s_7	s_7	s_4	s_7	s_5, s_6, s_7	s_6, s_7
c_{31}	s_3	s_6, s_7	s_4, s_5	s_7	s_7	s_7	s_7	s_7	s_6, s_7	s_3, s_4
c_{32}	s_5, s_6	s_5, s_6	s_5, s_6, s_7	s_7	s_6, s_7	s_6, s_7	s_5, s_6, s_7	s_7	s_6, s_7	s_4
c_{41}	s_7	s_6, s_7	s_5, s_6, s_7	s_5, s_6, s_7	s_5, s_6, s_7	s_6, s_7	s_3, s_4	s_7	s_5, s_6, s_7	s_4
c_{42}	s_5, s_6, s_7	s_5, s_6, s_7	s_6, s_7	s_7	s_6, s_7	s_7	s_4	s_7	s_5, s_6, s_7	s_4
c_{43}	s_5, s_6, s_7	s_5, s_6, s_7	s_6, s_7	s_7	s_6, s_7	s_7	s_5, s_6, s_7	s_7	s_5, s_6, s_7	s_4
c_{51}	s_6, s_7	s_1, s_2, s_3	s_7	s_7	s_5, s_6, s_7	s_6, s_7	s_4	s_7	s_5, s_6, s_7	s_5, s_6, s_7
c_{52}	s_6, s_7	s_3, s_4	s_7	s_6, s_7	s_6, s_7	s_6, s_7	s_4	s_7	s_5, s_6, s_7	s_4
c_{53}	s_7	s_4, s_5, s_6	s_4, s_5, s_6	s_6, s_7	s_5, s_6, s_7	s_5, s_6, s_7	s_4	s_7	s_5, s_6, s_7	s_5, s_6, s_7
c_{54}	s_7	s_3, s_4, s_5	s_5, s_6, s_7	s_6, s_7	s_7	s_6, s_7	s_4	s_7	s_6, s_7	s_5, s_6, s_7
c_{55}	s_7	s_4, s_5, s_6	s_5, s_6, s_7	s_5, s_6, s_7	s_6, s_7	s_6, s_7	s_4	s_7	s_6, s_7	s_4
c_{56}	s_7	s_1, s_2, s_3	s_5, s_6, s_7	s_6, s_7	s_7	s_7	s_5, s_6, s_7	s_7	s_4	s_4

had invited the experts to form the evaluation committees. There are four experts, who have more than ten-years experience and work in different functions in the tour operator organization.

In the selection process, there are two main steps. The first step is to refine the set of hotel candidates from 10 hotel firms to the last four ones. The criteria are year of operations and also hotel star by employing disjunctive and conjunctive techniques [27] respectively. The underlying idea is that this is because no consensus in tourism literature whether the hotel star and years of operations have influenced to the potential of firm performances [108]. In the second step, the experts are asked to express their evaluations freely, regarding their knowledge background and experience by using the chosen linguistic term set as shown in the section IV. The uncertain linguistic weights evaluated and assessed by 10 experts are depicted in the Table 5.3. Likewise, the uncertain linguistic assessments of each expert are illustrated in the Table 5.4 and Table 5.5.

Regarding the uncertain linguistic assessment collected, now let us apply the proposed hybrid decision method, developed in the previous section to the partner selection problem in tourism networks.

Table 5.4: The Linguistic Assessment of the Alternatives by Experts e_1 and e_2

		Alternatives							
		Expert e_1				Expert e_2			
		a_1^1	a_2^1	a_3^1	a_4^1	a_1^2	a_2^2	a_3^2	a_4^2
Criteria	c_{11}	s_4	s_6	s_4, s_5, s_6	s_4, s_5	s_6	s_5, s_6	s_3, s_4	s_3
	c_{12}	s_5	s_6	s_5, s_6	s_3	s_6	s_4, s_5, s_6	s_2, s_3	s_3
	c_{13}	s_6	s_5	s_5, s_6	s_3	s_6	s_5, s_6	s_5, s_6	s_3
	c_{21}	s_6	s_6	s_6	s_3	s_6	s_5, s_6	s_3, s_4, s_5	s_4, s_5, s_6
	c_{22}	s_5	s_6	s_5, s_6	s_4	s_6	s_5, s_6	s_2, s_3, s_4	s_3
	c_{31}	s_3	s_6	s_3, s_4	s_4	s_6	s_2, s_3	s_5, s_6	s_6
	c_{32}	s_4	s_5, s_6	s_4, s_5, s_6	s_6	s_6	s_3	s_4, s_5	s_4, s_5, s_6
	c_{41}	s_4	s_5, s_6	s_4, s_5, s_6	s_3	s_6	s_3	s_5, s_6	s_2, s_3
	c_{42}	s_5	s_6	s_5, s_6	s_2	s_6	s_3	s_4, s_5, s_6	s_3
	c_{43}	s_5	s_6	s_5, s_6	s_4	s_6	s_3	s_4, s_5, s_6	s_4, s_5, s_6
	c_{51}	s_6	s_5, s_6	s_6	s_3	s_6	s_4, s_5, s_6	s_0, s_1, s_2	s_3
	c_{52}	s_6	s_5, s_6	s_6	s_5	s_6	s_3	s_2, s_3	s_3
	c_{53}	s_3	s_4, s_5, s_6	s_3, s_4, s_5	s_0	s_6	s_4, s_5, s_6	s_3, s_4, s_5	s_3
	c_{54}	s_4	s_5, s_6	s_4, s_5, s_6	s_4	s_6	s_4, s_5, s_6	s_2, s_3, s_4	s_3
	c_{55}	s_4	s_5, s_6	s_4, s_5, s_6	s_4	s_6	s_3	s_3, s_4, s_5	s_3
	c_{56}	s_4	s_6	s_4, s_5, s_6	s_0	s_6	s_3	s_0, s_1, s_2	s_4, s_5, s_6

Table 5.5: The Linguistic Assessment of the Alternatives by Experts e_3 and e_4

		Alternatives							
		Expert e_3				Expert e_4			
		a_1^3	a_2^3	a_3^3	a_4^3	a_1^4	a_2^4	a_3^4	a_4^4
Criteria	c_{11}	s_4, s_5	s_4, s_5	s_5, s_6	s_4	s_6	s_3	s_3, s_4	s_4
	c_{12}	s_3, s_4	s_5, s_6	s_4, s_5	s_2	s_6	s_4, s_5, s_6	s_2, s_3, s_4	s_5
	c_{13}	s_3, s_4	s_6	s_5, s_6	s_5	s_6	s_6	s_5, s_6	s_5
	c_{21}	s_3, s_4	s_6	s_5, s_6	s_3, s_4	s_6	s_6	s_4, s_5	s_6
	c_{22}	s_4, s_5	s_5, s_6	s_5, s_6	s_2, s_3	s_6	s_6	s_3, s_4	s_5
	c_{31}	s_4, s_5	s_6	s_3	s_5	s_6	s_6	s_5, s_6	s_3
	c_{32}	s_6	s_6	s_4	s_4, s_5	s_5, s_6	s_5, s_6	s_4, s_5	s_4
	c_{41}	s_3, s_4	s_4, s_5	s_4	s_3	s_5, s_6	s_4, s_5, s_6	s_6	s_4
	c_{42}	s_2, s_3	s_6	s_4	s_5, s_6	s_6	s_5, s_6	s_4, s_5	s_5
	c_{43}	s_4, s_5	s_6	s_4	s_5, s_6	s_6	s_5, s_6	s_4, s_5	s_5
	c_{51}	s_3	s_6, s_5	s_0	s_3	s_5, s_6	s_4, s_5, s_6	s_1, s_2	s_6
	c_{52}	s_5	s_5, s_6	s_3, s_4	s_2, s_3	s_5, s_6	s_5, s_6	s_2, s_3	s_6
	c_{53}	s_0	s_5, s_6	s_4, s_5	s_5	s_4, s_5, s_6	s_4, s_5	s_4, s_5	s_3
	c_{54}	s_4	s_5, s_6	s_5, s_6	s_4	s_5, s_6	s_6	s_3, s_4	s_4
	c_{55}	s_4	s_4, s_5	s_3, s_4	s_3, s_4	s_5, s_6	s_5, s_6	s_4, s_5	s_4
	c_{56}	s_0	s_5, s_6	s_2, s_3	s_1, s_2	s_6	s_6	s_1, s_2	s_4

1) The original uncertain linguistic assessments of each expert, as shown in Table 5.4 and Table 5.5 are modeled by means of mass values defined by (5.5). The results of mass value for each alternative regarding criterion are shown in the Table 5.6 and Table 5.7. For example, the uncertain linguistic evaluations of alternative a_1 regarding the criterion c_{11} provided by four experts are $\boldsymbol{e_1} = s_4$; $\boldsymbol{e_2} = s_6$; $\boldsymbol{e_3} = s_4, s_5, s_6$; $\boldsymbol{e_4} = s_4, s_5$. Using (5), the mass value can be derived as $\mathbf{m}_{11} = \{s_4\} : 0.25; \{s_6\} : 0.5; \{s_4, s_5\} : 0.25$.

We can observe that the linguistic assessments provided by Expert e_3 and e_4 are in interval forms representing the high vagueness of information. Furthermore, the associated semantic of its linguistic assessment may be overlapped. As suggested in the multi-criteria aggregation literature, the linguistic assessment is therefore needed to be unified before performing any aggregation process by means of unification and transformation methods due to the impreciseness nature manipulation [35, 127].

Most of the current work has been dealt with such processes by employing the linguistic terms with the space of fuzzy number by means of membership functions. It should be emphasized here that the subjective definition can be sensitively influence to

Table 5.6: The Belief Assessment of the Alternatives a_1 with respect to each criteria

		Mass Function									
		$m\{s_0\}$	$m\{s_3\}$	$m\{s_4\}$	$m\{s_5\}$	$m\{s_6\}$	$m\{s_{2,3}\}$	$m\{s_{3,4}\}$	$m\{\{s_{4,5}\}$	$m\{s_{5,6}\}$	$m\{s_{4,5,6}\}$
Criteria	c_{11}			0.25		0.50			0.25		
	c_{12}				0.25	0.50		0.25			
	c_{13}				0.25	0.50		0.25			
	c_{21}					0.75		0.25			
	c_{22}				0.25	0.50			0.25		
	c_{31}		0.25			0.50			0.25		
	c_{32}			0.25		0.50				0.25	
	c_{41}			0.25		0.25		0.25		0.25	
	c_{42}				0.25	0.50	0.25				
	c_{43}				0.25	0.50			0.25		
	c_{51}		0.25			0.50				0.25	
	c_{52}				0.25	0.50				0.25	
	c_{53}	0.25	0.25			0.25					0.25
	c_{54}			0.50		0.25				0.25	
	c_{55}			0.50		0.25				0.25	
	c_{56}	0.25		0.25		0.50					

Table 5.7: The Belief Assessment of the Alternatives a_2 with respect to each criteria

		Mass Function					
		$m\{s_3\}$	$m\{s_6\}$	$m\{s_{2,3}\}$	$m\{s_{4,5}\}$	$m\{s_{5,6}\}$	$m\{s_{4,5,6}\}$
Criteria	c_{11}	0.25	0.25		0.25	0.25	
	c_{12}		0.25			0.25	0.5
	c_{13}		0.75			0.25	
	c_{21}		0.75			0.25	
	c_{22}		0.50			0.50	
	c_{31}		0.75	0.25			
	c_{32}	0.25	0.25			0.50	
	c_{41}	0.25			0.25	0.25	0.25
	c_{42}	0.25	0.5			0.25	
	c_{43}	0.25	0.5			0.25	
	c_{51}		0.25			0.25	0.5
	c_{52}	0.25				0.75	
	c_{53}				0.25	0.25	0.5
	c_{54}		0.25			0.50	0.25
	c_{55}	0.25			0.25	0.50	
	c_{56}	0.25	0.50			0.25	

the transformation processes. In particular, we also observed that it cannot well represent the knowledge and preference of each expert which is usually conflicting and overlapping. Therefore, the advantage of applying the proposed technique is that we can deal with the uncertain linguistic assessment with semantic overlapping by direct assigning the linguistic expressions into the mass function spaces regarding the occurrences of linguistic assessments.

2) By applying a discounting-and-combination scheme defined by (5.6) - (5.8), we can discount the coefficient degrees of importances on mass values regarding the criteria. The interpretation of coefficient degrees is the weight importances on each criterion representing the preferences on criteria. It should be emphasized here that in the current literature on multi-criteria evaluations, the issue of uncertain linguistic weight is very important on how uncertain weight can be precisely assigned [34]. Although in the following discussion we only deal with the simple case for simplicity but without loss of generality, other new techniques would be interesting to consider and this is left for further research.

In this study, we simple assign wighting vector w_j by means of average operator. For example, the uncertain linguistic weight of criterion c_{11} is $w_j^{11} = [s_5, s_6, s_7;\ s_4, s_5;$

Table 5.8: The Belief Assessment of the Alternatives a_3 with respect to each criteria

Criteria	Mass Function												
	$m\{s_3\}$	$m\{s_4\}$	$m\{s_5\}$	$m\{s_6\}$	$m\{s_{1,2}\}$	$m\{s_{2,3}\}$	$m\{s_{3,4}\}$	$m\{\{s_{4,5}\}$	$m\{s_{5,6}\}$	$m\{s_{0,1,2}\}$	$m\{s_{2,3,4}\}$	$m\{s_{3,4,5}\}$	$m\{s_{4,5,6}\}$
c_{11}							0.50		0.25				0.25
c_{12}						0.25		0.25	0.25		0.25		
c_{13}								1.00					
c_{21}				0.25				0.25	0.25			0.25	
c_{22}							0.25		0.5		0.25		
c_{31}	0.25						0.25		0.5				
c_{32}		0.25							0.50				0.25
c_{41}		0.25		0.25					0.25				0.25
c_{42}		0.25						0.25	0.25				0.25
c_{43}		0.25						0.25	0.25				0.25
c_{51}			0.25	0.25	0.25					0.25			
c_{52}				0.25		0.50	0.25						
c_{53}								0.50				0.50	
c_{54}							0.25		0.25		0.25		0.25
c_{55}							0.25	0.25				0.25	0.25
c_{56}					0.25	0.25				0.25			0.25

Table 5.9: The Belief Assessment of the Alternatives a_4 with respect to each criteria

Criteria	Mass Function											
	$m\{s_0\}$	$m\{s_2\}$	$m\{s_3\}$	$m\{s_4\}$	$m\{s_5\}$	$m\{s_6\}$	$m\{s_{1,2}\}$	$m\{s_{2,3}\}$	$m\{\{s_{3,4}\}$	$m\{s_{4,5}\}$	$m\{s_{5,6}\}$	$m\{s_{4,5,6}\}$
c_{11}			0.25	0.50						0.25		
c_{12}		0.25	0.50		0.25							
c_{13}			0.50		0.50							
c_{21}			0.25			0.25			0.25			0.25
c_{22}			0.25	0.25	0.25			0.25				
c_{31}			0.25	0.25	0.25	0.25						
c_{32}				0.25		0.25			0.25			0.25
c_{41}			0.25	0.25				0.25			0.25	
c_{42}		0.25	0.25		0.25						0.25	
c_{43}				0.25	0.25						0.25	0.25
c_{51}	0.25		0.50			0.25						
c_{52}			0.25		0.25	0.25		0.25				
c_{53}	0.25		0.50		0.25							
c_{54}			0.25	0.75								
c_{55}			0.25	0.50					0.25			
c_{56}	0.25			0.25			0.25					0.25

$s_5, s_6, s_7;\ s_5, s_6, s_7;\ s_4;\ s_7;\ s_4;\ s_7\ ;\ s_4;\ s_6, s_7]$. We first take an average on the uncertain ones such as the uncertain linguistic weight of Expert E_1 is $s_5, s_6, s_7 = s_6 = w_j^1$, and then take the overall average on each criteria. After normalization process, the proportion of overall average weight of criterion c_{11} is 0.3107. The normalization weighting vectors of sub-criteria using in this study are

$$\begin{bmatrix} w_{1j} \\ w_{2j} \\ w_{3j} \\ w_{4j} \\ w_{5j} \end{bmatrix} = \begin{bmatrix} 0.3107 & 0.3305 & 0.3588 & & & \\ 0.5176 & 0.4824 & & & & \\ 0.4958 & 0.5042 & & & & \\ 0.3241 & 0.3324 & 0.3435 & & & \\ 0.1664 & 0.1650 & 0.1679 & 0.1707 & 0.1679 & 0.1621 \end{bmatrix}$$

Likewise, as for the weight importance of main evaluation criteria, we assume that they have an equally importances. Therefore, the weighting vectors for main criteria are [0.2 0.2 0.2 0.2 0.2].

Then, based on the Dempster's rule of combination as an aggregation operator, we can aggregate the attribute from basic values to super-scale ones. The result of overall aggregated mass values on each alternative are shown in Table 5.10.

Table 5.10: The Overall Aggregated Belief Assessments of the Alternatives

		Alternatives			
		a_1	a_2	a_3	a_4
Overall Aggregated Belief Values	m_{s_0}	0.0002	0.0000	0.0000	0.0032
	m_{s_2}	0.0000	0.0000	0.0040	0.0057
	m_{s_3}	0.0153	0.0078	0.0020	0.1840
	m_{s_4}	0.0534	0.0000	0.1838	0.1695
	m_{s_5}	0.0717	0.0208	0.6319	0.4997
	m_{s_6}	0.7788	0.8919	0.0150	0.0532
	m_{s_1,s_2}	0.0000	0.0000	0.0001	0.0010
	m_{s_2,s_3}	0.0031	0.0012	0.0015	0.0092
	m_{s_3,s_4}	0.0199	0.0000	0.0020	0.0068
	m_{s_4,s_5}	0.0277	0.0031	0.1730	0.0125
	m_{s_5,s_6}	0.0104	0.0667	0.0211	0.0150
	m_{s_0,s_1,s_2}	0.0000	0.0000	0.0001	0.0000
	m_{s_2,s_3,s_4}	0.0000	0.0000	0.0003	0.0000
	m_{s_3,s_4,s_5}	0.0000	0.0000	0.0004	0.0000
	m_{s_4,s_5,s_6}	0.0001	0.0038	0.0037	0.0164

Table 5.11: The Pignisitc Probability Transformation of Random Preferences for the Alternatives

		Random Preferences			
		p_1	p_2	p_3	p_4
Probability Function on L	s_0	0.0002	0.0000	0.0000	0.0032
	s_1	0.0000	0.0000	0.0001	0.0005
	s_2	0.0016	0.0006	0.0049	0.0138
	s_3	0.0268	0.0084	0.0040	0.1920
	s_4	0.0772	0.0028	0.2548	0.1846
	s_5	0.0908	0.0570	0.7123	0.5189
	s_6	0.7840	0.9265	0.0268	0.0661

Table 5.12: The Choice Function of the Alternatives

	Alternatives			
	a_1	a_2	a_3	a_4
$V(a_i)$	2.570	**2.868**	1.050	0.921

3) In order to obtain the final ranking, the pignistic transformation, defined by (5.9) is applied to derive a probability function p_i of alternative a_i on L. The obtained result is shown in Table 5.11. Then, applying the notion of satisfactory principle, defined by (5.10) - (5.11), we can obtain the choice function $V(a_i)$ of the alternative by computing from the equation (5.12) - (5.13). The result of the choice function is shown in Table 5.12.

4) As for ranking the alternatives, we employ the satisfaction-oriented linguistic decision rule, defined by (5.14), the ordered ranking options is

$$a_2 \succ a_1 \succ a_3 \succ a_4$$

Referring to the ranking result, the alternative a_2 is the best of the four alternatives, followed by alternative a_1, a_3 and a_4, respectively.

Interestingly, we can see that the proposed evaluation model can not only deal with the subjective evaluations, but also the uncertain information effectively. Additionally,

it also provide the flexibility for managers in making their decisions by allowing them to express any linguistic assessments freely.

5.5.3 Performance evaluation and verification

For verifying and ascertaining the efficiency of this proposed method, a numerical analysis was conducted to evaluate the performance.

As can be observed the probability α in equation (5.6)- (5.8), the final ranking result strongly relies on the reliability values interpreting as degrees of importances ($\mathbf{w}_j$) of criteria. In the experiment, two scenarios are hence studied. The scenario **1** illustrated the case where the weighting vector of criteria are equally importance as shown in the following.

- The weight importance for sub-evaluation criteria.

$$\begin{bmatrix} w_{1j} \\ w_{2j} \\ w_{3j} \\ w_{4j} \\ w_{5j} \end{bmatrix} = \begin{bmatrix} 0.33 & 0.33 & 0.33 & & & \\ 0.50 & 0.50 & & & & \\ 0.50 & 0.50 & & & & \\ 0.33 & 0.33 & 0.33 & & & \\ 0.17 & 0.17 & 0.17 & 0.17 & 0.17 & 0.17 \end{bmatrix}$$

- The weight importance for main evaluation criteria.

$$\begin{bmatrix} w_j \end{bmatrix} = \begin{bmatrix} 0.20 & 0.20 & 0.20 & 0.20 & 0.20 \end{bmatrix}$$

After computing using the same scheme, the experimental result indicates that the final ranking is still the same order and the alternative a_2 is the most preferable.

Since the weights in scenario **1** has changed in the overall perspective, it is necessary to further conduct in order to observe the effect of weight importance with high degrees in scenario **2**. As suggested in the multi-criteria decision analysis literature, the most important criteria is the most high degrees of importances. Therefore, based on the original degrees of importances given by the evaluation committees, the most important criteria are the criteria $\mathbf{c}_4$ and $\mathbf{c}_5$ respectively. The rest of weight impregnation are fixed in every scenario. For the experiment setting, there are seven sub-scenarios conducted

Table 5.13: Performance Analysis

Case	w_1	w_2	w_3	$\mathbf{w}_4$	$\mathbf{w}_5$	Ranking order of all candidates
1	0.20	0.10	0.10	**0.00**	**0.60**	$a_2 \succ a_1 \succ a_3 \succ a_4$
2	0.20	0.10	0.10	**0.10**	**0.50**	$a_2 \succ a_1 \succ a_3 \succ a_4$
3	0.20	0.10	0.10	**0.20**	**0.40**	$a_2 \succ a_1 \succ a_3 \succ a_4$
4	0.20	0.10	0.10	**0.30**	**0.30**	$a_2 \succ a_1 \succ a_3 \succ a_4$
5	0.20	0.10	0.10	**0.40**	**0.20**	$a_2 \succ a_1 \succ a_3 \succ a_4$
6	0.20	0.10	0.10	**0.50**	**0.10**	$a_2 \succ a_1 \succ a_3 \succ a_4$
7	0.20	0.10	0.10	**0.60**	**0.00**	$a_2 \succ a_1 \succ a_3 \succ a_4$

by varying weight importances. the results of ranking as well as the case of analysis are shown in Table 5.13.

In the table 5.13, the result also indicate that the entire ranking order of four alternative remains the same as $a_2 \succ a_1 \succ a_3 \succ a_4$ in all scenarios generated. In sum, regarding the numerical analysis, it is clear that our proposed evaluation method performs effectively in dealing with ambiguity of uncertain linguistic assessments by providing a consistent evaluation result.

5.6 Discussion

In this study, the validation of the proposed hybrid evaluation model has examined by using a empirical case study of partner selection for collaboration in Thailand. We can conclude that our proposed partner evaluation model can effectively work and apply to the practical situation. As for the comparative study, it would be worth to emphasize here that our partner evaluation model is the first tourism partner evaluation model. Therefore, there is no comparative study in this context. However, we can discuss the advantages of our techniques that can overcome the existing partner evaluation approach in the related contexts.

The advantages of our proposed approach comparing with the related studies can be discussed and examined in the following.

1. Our proposed hybrid decision method can overcome the limitations of using a fuzzy-

based computation. By applying the Dempster-Shafer theory of evidence, we can easily direct assign the uncertain linguistic information into mass function. Such that we can avoid a traditional fuzzy-based computation scheme which is difficult to assign and define fuzzy membership functions. In particular, the final result obtained by our proposed method is more consistent and robustness that is conducted in the previous section. Furthermore, we can conclude that our proposed method can effectively capture the uncertain and vague information, while maintaining a sound flexibility for users to express their any uncertain linguistic assessment.

2. The necessity of re-translation process in traditional fuzzy scheme causes information loss which strongly affects to the final result. Our proposed method can also overcome this drawback by direct computing on uncertain linguistic information. By applying Satisfactory principle, we can easily obtain the final result by making a pair-wise comparison. It can be concluded that our proposed technique is an effective alternative framework for partner selection problem that can provide more flexible method than Fuzzy-AHP which is usually restricted to be used 1-9 AHP scales when applying a Fuzzy-AHP.

3. Our proposed method provides a flexible framework by allowing different weight importance assigned to each criterion. The verification and performance analysis, which is conducted in section 5.5.3 indicates that our final ranking result is strongly consistent and is not sensitive to different weight importance assigned. Based on this fact, we can also conclude that our proposed technique is an effective alternative framework for partner selection problem that can provide a stable method like Fuzzy-TOPSIS. However, by eliminating a traditional fuzzy-based computational scheme, our proposed technique is sound effective better than Fuzzy-TOPSIS which is cannot directly apply to tourism partner selection.

4. The main contribution of our proposed technique is that our hybrid evaluation approach can deal with a partially expression witch expressed by experts/decision-makers while the existing techniques cannot. Given this advantage, experts and/or decision-makers can freely express their evaluation assessments that better represent their belief and their level of confidence.

With regard to the advantages discussed above, we can conclude that our proposed evaluation model for tourism partner selection provides a better solution to not only partner selection literature, but also multiple expert multiple criteria decision making problem with linguistic information.

5.7 Concluding Remarks

In this chapter, we have proposed a hybrid evaluation model by applying the Dempster-Shafer theory of evidence and satisfactory principle as an alternative framework. Given the advantages of proposed approach, we can deal the uncertain linguistic assessments effectively in not only the partner selection in tourism networks, but also the multiple experts multiple attribute decision making with uncertain linguistic assessments context. Since this approach performs directly computing based on the total order-based semantic structures of linguistic term sets, the burden of quantifying the qualitative concept can be eliminated. In addition, instead of utilizing the traditional fuzzy-set-based approach as well as linguistic approximation processes, we can avoid the information loss, while maintaining the flexibility for managers in making their decision freely with random linguistic values. Furthermore, the proposed approach can deal with the vagueness and ambiguity of information, provided by the multiple sources by representing and capturing their individual knowledges and preferences efficiency.

In practical perspective and managerial implementation, our proposed evaluation model provides more flexible framework for top managements and managers who are working in the tourism organizations to making their decisions freely in evaluating the suitable partners for successful collaboration. The ranking result inducing by the real-valued choice function is in numerical value not a linguistic evaluation. It is thus easily to interpret the final outcomes as well as to decrease the complexity in performing computations with subjective judgments. Furthermore, tourism firm can also adopt our established decision criteria such as their compatible features to address their selection and evaluation of partner problem at different situations. Therefore, we really hope that the advantages over the previous approaches in terms of not only the unified evaluation model, but also the simplicity of interpreting the final evaluation result would convincingly stimulate the eagerness of those managers to accept our solution proposal and adopt to solve their

practical business settings.

While the proposed approach provides the significant contributions; however, there are some limitations by several reasons. First, it is much interesting to extend and to verify the evaluation result by empirically investigating with other criteria and also sub-criteria in order to cover all of aspects using a difference view from other tourism supply chain units. This is because the proposed evaluation criteria using in this study are suggested to reflect only the one-side of tour operators' viewpoints. It is worth emphasizing that to carry on the successful collaboration, the tour operator firms have to view from the aspect of accommodations and other service providers such as transportation as well as theme park. Second, as for robustness and validation, a comparative study of the proposed hybrid method and the existing ones such as fuzzy multi-criteria decision making is necessary to be further conducted in order to ascertain the efficiency of this evaluation method. Last, in real-world decision making there are many different types of linguistic information representing vagueness and uncertainty in subjective judgments; for example, multi-granularity linguistic term sets and linguistic hierarchies contexts, which is really worth to explore how well the proposed evaluation method can be appropriately applied. These are left for the further research.

Chapter 6

Conclusion

This chapter provides a brief introduction, answer of three major research questions, theoretical and practical implications, limitations and directions for future research.

6.1 Introduction

The final chapter summarizes the overall findings of this research and also sheds light on the major findings in this study by answering research questions proposed and formulated in the Chapter 1. The structure of this chapter is as follows. The second section answers three main research questions. Next, the managerial implication is elucidated for tourism organization in order to better manage partnerships in the third section. Then, limitations of the research will be discussed in the forth section. Last, the final presents directions for future research.

6.2 Answers to research questions

We are now recalling research questions and provide answers for that three questions.

RQ 1: What are the critical criteria in partner selection and evaluation for collaboration in tourism supply chain networks?

Although partner selection is an important supply chain activity in tourism networks, there is no research investigating on this issue. In selecting partner to start working with, tourism organizations have to deal with two important issues: *evaluation criteria* and

appropriate decision model. The results of this study indicate that there are two main groups of evaluation criteria that are important for effective evaluation. One is individual attributes and another is collaborative ones. Further, we also propose a risk-oriented factors for global partner selection as well.

In individual attributes, tourism firms have to consider performances and profiles of potential partner. Table in Chapter 4 indicates that **service mind-oriented services** is the most concern in performance of partner (6.5 0f 7.0). Further, **reputation** is the most important factor in evaluating profile of possible partner (6.7 of 7.0). This study also suggests that the **novelty** of services/tourism product is strongly necessary (6.3 of 7.0). Regarding these individual attributes, tourism firms can gain competitive advantages over competitors.

As mentioned in Chapter 1, partnerships is necessary to dynamically sustain competitive advantages. However, most of tourism firms have little knowledge on which factor should be considered. This study indicates that compatibility is the most necessary for initiating long-term collaboration. In compatibility factor, **trust and commitment** (6.4 of 7.0) is the most important factor when selecting potential partner to start working with. Combining with individual attributes mentioned above, enterprise where is operating in tourism industry can reap collaborative advantage over the rivals.

In addition, this study also suggests the importance of risk-oriented factor in global partner selection which is no evidence in current tourism supply chain literature. Our result indicates that the **economy** such as currency rate in destination is very important for designing a successful tourism product. It contributes 6.3 of 7.0.

In sum, we have answered this question by conducting an empirical study (Chapter 3). Regarding a statistical requirement, it can be concluded that service mind-oriented services, reputation, novelty, economy, and trust and commitment are the main critical criteria for evaluating and selecting partner for collaboration in context of tourism supply chain networks.

RQ 2: What is the suitable decision model and technique that can apply appropriately for partner selection for collaboration in the context of tourism supply chain networks?

In developing a decision model, it is of interest to mention that it depends on a particular situation and data available we have faced. In this study, the data we have to deal with are in term of linguistic value. In addition, the complexity of these data is that they are uncertain linguistic information. Further, the current available approaches are not inappropriate. This study hence develop a suitable decision model and approaches to overcome a difficult as mentioned.

In this study, we formulate a partner selection problem for collaboration as multi-expert multi-attribute decision making problem with uncertain linguistic information. Basically, the proposed evaluation model consists of two phases: *a modeling and aggregation phase* that first models multi-expert linguistic assessments on a single attribute by means of mass functions and then makes use of Dempster's rule of combination for attribute aggregation; and an *evaluation and selection phase* that transforms the combined mass functions into corresponding probability distributions via Smets' *pignistic transportation* and finally defines a linguistic choice function based on the so-called *satisfactory principle* for ranking and selection. The decision model and evaluation framework we have developed can deal with uncertain linguistic assessment effectively by providing a consistent final ranking result when varying weight important on main critical criteria. In conclusion, this question has already answered in Chapter 4.

RQ 3: How to avoid and eliminate the complexity and limitation of applying and using fuzzy-based-computation, while maintaining the flexibility for managers in freely making decisions using uncertain linguistic assessments?

In the last answered question, we have already mentioned about the complexity of dealing with uncertain linguistic assessments. Most of current approaches have suggested the necessity of unification method to unify uncertain linguistic assessment. Hence, the fuzzy-based-computation is the most effective method to handle uncertainty and vagueness. However, it has an unavoidable limitations that sensitively effect to the final result.

We have developed an alternative approach in this study to overcome such limitations. The proposed approach is applied *Dempster-Shafer theory of evidence* and *Satisfactory principle*. The key concept of proposed approach is making a direct computation solely on uncertain linguistic assessments by viewing uncertain linguistic assessments in ordering-

based semantics of the linguistic terms. The result of proposed approach shows that by performing direct computation on linguistic terms, the burden of quantifying a qualitative concept is eliminated. Furthermore, our proposed approach can allows tourism managers to freely express their linguistic evaluations in interval forms representing a level of their confident. To sum up, this question has also already answered in Chapter 5.

6.3 Managerial implications

Basically, this study we develop an evaluation model for partner selection in tourism supply chain networks based on a case study. Regarding our findings, we can illustrate managerial implications for tourism organizations.

As mentioned the importance of partnerships in Chapter 1, most of tourism firms however fail in practical implementation. For effective partnership management, this study identifies a number of way that can manage an effective long-term partnerships by selecting a potential partner at the beginning.

To overcome, this study develop evaluation criteria for tourism firms. In managing effective partnership, tourism firms have to consider not only individual criteria but also collaborative attribute. As for individual attribute, reputation and service-mind oriented services are the most important for finding some partners to start collaboration. Likewise, since current customers have complex and uncertain preferences, tour operators have to on the one hand stimulate a new tour packages quite often in order to sustain their competitive advantages. On the other hand, they also have to search for accommodations where are recognizing the importance of novelty of providing services. Another important factor is trust and commitment in enhancing compatibility. Since the nature of tourism is strongly coordination-oriented activity, tour operators have to select partner based on the level of trust they have in order to make sure that partner such as accommodation they have selected is the best one to start collaboration.

Regarding the proposed evaluation criteria, managers can adopt our proposed evaluation criteria in effectively managing the buyer-seller relationships. In addition, based on these criteria, tourism firms can overcome the short-term partnerships by carefully evaluate the candidate at the beginning. Therefore, we hope that the advantages of proposed evaluation criteria in terms of generalization would convincingly encourage those

managers to use these criteria in the daily business working. The examples of managerial implications are useful not only for tour operators and accommodation industries, but also the whole tourism industry.

Furthermore, our proposed evaluation model provides more flexible framework for top managements and managers who are working in the tourism organizations to making their decisions freely in evaluating the suitable partners to start working with. The ranking result inducing by the real-valued choice function is in numerical value not a linguistic evaluation. It is thus easily to interpret the final outcomes as well as to decrease the complexity in performing computations with subjective judgments. In addition, tourism firm can also adopt our established decision criteria such as their compatible features to address their selection and evaluation of partner problem at different situations. Therefore, we really hope that the advantages over the previous approaches in terms of not only the unified evaluation model, but also the simplicity of interpreting the final evaluation result would convincingly stimulate the eagerness of those managers to accept our solution proposal and adopt to solve their practical business settings.

6.4 Thesis contributions

The main contribution of this research are summarized as follows.

First, we propose the critical evaluation criteria for partner selection in tourism supply chain networks. The evaluation criteria proposed in this study are empirically verified by applying appropriate statistical techniques. It can be concluded that the proposed evaluation criteria for collaborative partner selection can be used in real practical situation. This contribution can help tourism firms to effectively manage partnerships with supply chain partners.

Second, we present an evaluation model for tourism partner selection problem, which is formulated as multi-expert multi-attribute decision problem with uncertain linguistic assessments. The proposed evaluation model consists of two phases. First we model muti-expert linguistic assessments on single attribute by means of mass function and then makes use of Dempster's rule of combination for attribute aggregation. Second, the combined mass function is transformed into corresponding probability distribution via Smets's pignistic transformation and finally defined a linguistic choice function based on

the so-called satisfactory principle for ranking and selection. Based on the proposed decision model, the second contribution is that the alternative evaluation model for linguistic partner selection problem can effectively capture the uncertain linguistic information and random preferences while maintaining the flexibility for managers in freely making decisions using uncertain linguistic assessments. Further, by computation solely based on the order-based semantics of the linguistic terms proposing in this study, the difficulty of quantifying a qualitative concept can be eliminated.

Third, partner evaluation framework for collaboration which is developed in this study is the first selection and evaluation model in contexts of partner selection in tourism supply chain networks. Our contribution is that tourism firms especially tour operators and travel agencies can adopt our partner evaluation framework for real implementation in practical situation effectively.

Forth, the contribution to Knowledge Science. The proposed decision model for partner selection in tourism industry developed in this study supply a new way of modeling decision makers/evaluators knowledge. As of tacit knowledge, evaluators cannot precisely express their assessments. Our proposed decision model can support them to represent and handle tacit knowledge in effective way. In addition, a combination rule using in this study can be viewed as an effective tool for fusing and integrating personal knowledge form multiple evaluators. Furthermore, our proposed approach itself can also viewed as knowledge creation and knowledge justification model not only for tourism managers in selecting a partner, but also for fuzzy multiple experts multiple attributes decision making literature.

6.5 Research limitations

Although our contributions benefits to partner selection in tourism supply chain literature, there are limitations by several reasons.

First, the most important limitation is the small sample size for empirically verification. In addition, our sample is confined to only tour-operators and accommodation industries in Thailand. These may lead the weak results and the bias of our analysis, especially in examining evaluation criteria for partner selection in tourism supply chain networks. Consequently, we will use a bigger sample sizes to re-examine our conceptual

model and also to compare with other countries in the further investigations. Despite this limitations, our results can be sufficiently accepted regarding the important requirements of statistical verifications. It means that our proposed evaluation criteria are suitable for practical implementation in tourism partner collaboration.

Second, we only explore the key impacts supply chain members regarding relationship between tour operators and accommodation. However, there are other tourism businesses such as transportation, and theme parks as well as food and beverage as second-tier service provider that must need further investigation. This is because different business is different perspective which can be implied that the proposed evaluation criteria is not suitable under such situation. The further research should be conducted in order to generalize the proposed evaluation criteria for partner selection in tourism supply chain networks. This will provide in-depth knowledge and understanding in tourism supply chain contexts.

Last, the proposed evaluation model is focusing solely on uncertain linguistic assessments. Although, in this study we prove already that it provides a consistent final ranking result, the uncertain linguistic weight is not taking into account while developing a decision model. It will decrease the performance reliability of our proposed decision model since the criteria weight representing decision-makers' preferences is very important in multiple criteria decision making literature. Therefore, it is very necessary to develop new technique that can capture and compute uncertain linguistic weight effectively. This will made our proposed decision model for partner selection in tourism networks more general in practical situation.

6.6 Directions for future research

In this section, the open questions are discussed for possible further research.

First, although the proposed evaluation criteria are suitable for tourism partner selection, it is much interesting to conduct a further study by developing new evaluation criteria for partner selection for collaboration in tourism supply chain contexts in order to cover all of aspects using a difference point-of-views from other tourism supply chain units. This is because evaluation criteria proposed in this study have developed based on solely the one-side perspective of tour operators. To foster successful collaboration, it

is worth emphasizing that the tour operators have to continuously manage partnerships based on information from accommodation's aspects and also other service providers such as transportation as well as theme park.

Second, regarding natures of evaluation criteria in practical situation, there are many types of attribute such as objective attributes. It is worth to extend our proposed decision approach to cope with such kind of information in order to make our proposed decision model more applicable in real practical decision making.

Third, as for robustness and validation, a comparative study between proposed hybrid method and the existing ones such as fuzzy multi-criteria decision making is necessary to be further conducted in order to ascertain the efficiency of this evaluation method.

Forth, in real-world decision making it is not effective to define a unique linguistic term set to be used by all decision-makers [111]. Due to the fact that each decision-maker have different point-of-view and different knowledge about the same problem. It seems natural to allow decision makers to express their assessments using different linguistic term sets under the same problem [129]. For example, in a grading system a decsion maker could choose to use a linguistic term set $S_1 =$ {Low, Medium, High} and another may prefer a linguistic term set with higher granularity as $s_2 =$ {Very Low, Low, Medium, High, Very High} [32]. Under such circumstance, we refer to *multi-granular linguistic assessment*. Therefore, it is really worth to extend our proposed evaluation model to deal with multi-granular linguistic information. This will made the proposed method more general and application in practical situation.

Fifth, although this study provide a suitable decision model for final selection stage in partner selection framework mentioned in Chapter 2, it is necessary to extend a further study by developing a so-called application feedback stage in order for continuous improvement [130]. Likewise, in this feedback stage tourism firms can continuous track to check and inspect whether selected partner is still good enough for collaboration at all time [44]. The holistic (four phases) decision model for partner collaboration will provide a huge impact for tourism partner supply chain literature. Last, a software-based decision support system (DSS) could help users and managers in tourism supply chains implementing our proposed approach easily and expeditiously. Hence, a computer-based decision support system should be developed in order to assist users not only for tourism

organizations, but also other sectors in practical applications. The stage will help tourism firms to foster their competitive advantage under dynamic market.

Appendix A

Questionnaire on evaluation criteria for partner selection in tourism supply chain networks

In this section we will show a questionnaire designed using in this study. The questionnaire consists of three main parts: demographics, evaluation criteria for partner selection and additional information.

A.1 General information and demographics.

แบบสอบถามข้อมูลวิจัย

การศึกษาขั้นตอนและวิธีในการตัดสินใจเลือกและประเมินซัพพลายเออร์ในอุตสาหกรรมการท่องเที่ยวไทย

"A study of decision method for supplier evaluation and selection in Thai tourism supply chain"

ข้อมูลผู้ตอบแบบสอบถาม

ชื่อบริษัท		ลักษณะธุรกิจ (ทัวร์/อเจนซี่)	
ที่อยู่บริษัท			
ชื่อผู้ตอบแบบสอบถาม		ตำแหน่ง	
เบอร์ติดต่อ		อีเมล์ล (Email)	

<u>ส่วนที่ 1 ข้อมูลทั่วไปของทางบริษัทท่าน (General Information)</u>

กรุณาทำเครื่องหมาย ✓ ในช่อง ☐ ที่ตรงกลับข้อมูลของท่าน

ข้อ 1. บริษัทของท่านมีการบริหารจัดการแบบใด (The management type of company)

บริหารโดยเครือข่ายของบริษัทแม่ โปรด ระบุ.....	บริหารงานโดยอิสระ
บริหารงานอิสระภายใต้ข้อตกลงของแฟรนไชด์ โปรด ระบุ.....	อื่นๆ โปรด ระบุ.....

ข้อ 2. โครงสร้างทุนของบริษัทท่านมีลักษณะใด (Type of Investment)

สัดส่วนผู้ถือหุ้นเป็นคนไทย 100%	สัดส่วนผู้ถือหุ้นมีนักลงทุนต่างชาติร่วมด้วย
อื่นๆ (โปรดระบุ):.....	

ข้อ 3. โปรดระบุระดับหรือขนาดของบริษัทของท่าน (The size of your company)

ขนาดเล็ก (Small)	ขนาดกลาง (Medium)	ขนาดใหญ่ (Large)

Figure A.1: A questionnaire for evaluation criteria (Part I).

A.2 Evaluation criteria for partner selection in tourism supply chain networks.

This is a question for asking how long a focal firm have been working with suppliers.

There are the questions for asking respondents to express their evaluation using 7-point Likert scale.

ส่วนที่ 2 ปัจจัยที่ส่งผลต่อการเลือกซัพพลายเออร์สำหรับการออกแบบแพ็คเกจทัวร์และความร่วมมือในระยะยาว

ข้อ 4. บริษัทของท่านติดต่อกับซัพพลายเออร์มานานเท่าใด

(How long have your company been working with your supplier?)

บริษัททัวร์/ซัพพลายเออร์/โรงแรม/สายการบิน	
น้อยกว่า 1 ปี	1 – 5 ปี
6 – 10 ปี	มากกว่า 10 ปี

Figure A.2: A questionnaire for evaluation criteria (Part II).

ข้อ 5. บริษัทของท่านมีหลักเกณฑ์ใดในการเลือกหรือถูกเลือกโดยคู่ค้า (เลือกตอบได้มากกว่า 1 คำตอบขึ้นไป) (กรุณาทำเครื่องหมาย ✓ ในช่องคะแนน โดย 1 = น้อยที่สุด, 2 = น้อย, 3 = ค่อนข้างน้อย, 4 = ปานกลาง, 5 = ค่อนข้างมาก, 6 = มาก, 7 = มากที่สุด) **(Rating of scale: 1= Very low, 2 = Low, 3 = Slightly low, 4 = Medium, 5 = Slightly high, 6 = High, 7 = Very high) ***Noted: Please feel free to give your opinion as much as possible, says, you can express more than one ratings in case you are not sure about the particular factors*****

ปัจจัยและเงื่อนไขที่เกี่ยวข้องในการเลือกซัพพลายเออร์	คะแนน						
	1	2	3	4	5	6	7
5.1 ประสิทธิภาพของซัพพลายเออร์ (Supplier's performance)							
5.1.1 ความยืดหยุ่นในการติดต่อสื่อสารและเปลี่ยนแปลงข้อมูล **(Flexibility)**							
5.1.2 ความสามารถของซัพพลายเออร์ในการดำเนินธุรกิจ เช่น ความสามารถในการรองรับลูกค้าและให้บริการบริษัทของท่าน **(Capability)**							
5.1.3 การให้บริการด้วยใจรักบริการเป็นหลัก **(Service mind oriented)**							
5.2 ข้อมูลโดยรวมของซัพพลายเออร์ (Supplier's profile)							
5.2.1 ความน่าเชื่อถือจากมุมมองของลูกค้า **(Reputation)**							
5.2.2 ประสิทธิภาพการทำงานในอดีตและความสัมพันธ์กับซัพพลายเออร์ **(Performance history & relationship closeness)**							
5.3 ปัจจัยเสี่ยง (Risk factors)							
5.3.1 สถานการณ์และเสถียรภาพทางการเมือง **(Political stability)**							
5.3.2 สถานการณ์และเสถียรภาพทางเศรษฐกิจ เช่น อัตราการแลกเปลี่ยนเงิน **(Economy)**							
5.4 ราคาและต้นทุนของสินค้าและบริการ (Product/Service of tour package price)							
5.4.1 ซัพพลายเออร์เสนอราคาต้นทุนต่ำสุดให้กับทางบริษัท **(Product cost)**							
5.4.2 ซัพพลายเออร์สามารถให้บริการที่มีคุณภาพกับทางบริษัทอย่างสูงที่สุดที่ทางซัพพลายเออร์สามารถให้บริการได้ **(Quality of Product)**							
5.4.3 ซัพพลายเออร์สามารถนำเสนอผลิตภัณฑ์และบริการที่ใหม่และแตกต่างจากคู่แข่งรายอื่นๆ **(Novelty)**							
5.5 ความเข้ากันได้กับทางซัพพลายเออร์ (Supplier's compatibility)							
5.5.1 วัฒนธรรมขององค์กร **(Organizational Culture)**							
5.5.2 การติดต่อสื่อสารและประสานงานร่วมกัน **(Communication and Coordination)**							
5.5.3 ความสมมาตรของขนาดองค์กร **(Symmetry in organizational size)**							
5.5.4 ความเชื่อใจและพันธะสัญญาในการดำเนินธุรกิจ **(Trust and commitment)**							
5.5.5 ความเข้ากันได้ของกลยุทธ์ทางธุรกิจ **(Strategic goals fitting)**							
5.5.6 แนวทางในการแก้ปัญหาร่วมกันเมื่อเกิดความขัดแย้ง **(Conflict Resolution)**							

Figure A.3: A questionnaire for evaluation criteria (Part II (con't)).

ส่วนที่ 3 ข้อมูลเสนอแนะเพิ่มเติม (Additional Information)

.....

.....

.....

.....

.....

**********ขอขอบพระคุณในความร่วมมือเป็นอย่างสูงครับ **********

หากพบปัญหาในการกรอกแบบสอบถามกรุณาติดต่อ

1. ชื่อ : ณรงค์ศักดิ์ พงศธรวิวัฒน์
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2. ชื่อ : Assoc. Prof. Huynh Van-Nam
   Email: Huynh@jaist.ac.jp

Figure A.4: A questionnaire for evaluation criteria (Part II (con't)).

Appendix B

A code for hybrid evaluation approach.

This section will provide a programing code for future utilization. The designed codes consist of two main parts: *Mass assignment and Attribute aggregation, and Satisfactory principle.*

B.1 A code for mass assignment and mass combination in MATLAB language.

Algorithm 1 Compute overall mass values

```
procedure
    clear all;
    m = [linguistic assessment];
    l = [mass assignment value];
    t1 = findtarget (m);
    target = zeros (1,length(t1));
    for i = 1:length (t1) do
        tmp=vec2num(t1i);
        target(i)=tmp;
    end for
    comput_new (m, l, target);
    Return  overall mass
end procedure
```

B.1.1 A supplementary code.

Algorithm 2 Function **tagt= findtarget(m)**

```
procedure
    tagt=m1, 1
    [rows,cols]=size(m)
    j = 1:rows
    k = 1:cols
    flag=1;
    for i = 1:length(tagt) go through all existing targets do
        if isequal(mj,k,tagti) compare
        flag=0;
        break;
    end for
    end
    end
    if flag==1
    tagt = [tagt,mj,k];
    end
    end
    end
    end
    Return m
end procedure
```

Algorithm 3 Function [**s,table**] = **multip2(m1,l1,m2,l2)**

```
procedure
    l2=l2(:);
    table = zeros(length(l2),length(l1));
    m2=m2(:);
    s=cell(length(m2),length(m1));
    for i = 1:length(l1) do
        for j = 1:length(l2) do
            table(j,i) = l2(j)*l1(i);
            sj,i = intersect(m2j,m1i);
        end for
    end for
end procedure
```

Algorithm 4 Function [**s,t**] = **divd3(m,l)**

```
procedure
    d = size (m,1);
    if d==2
    for [s,t] = multip2(m(1,:),l(1,:),m(2,:),l(2,:)); do
        else
        for [tm,tl] = divd3(m(2:end,:),l(2:end,:)); do
            for [s,t]=multip2(m(1,:),l(1,:),tm,tl); do
            end for
        end for
    end for
end procedure
```

Algorithm 5 Function **result= vec2num(v)**

```
procedure
    for n=''; do
        start=1;
        flag=0;
        if v(1)==0
        start=2;
        flag=1;
    end for
    for i=start:length(v); do
        n=strcat(n,num2str(v(i)));
    end for
    if flag==1;
    for n=strcat(n,'0'); do
    end for
    result = str2double(n);
end procedure
```

B.2 A code for Satisfactory-oriented decision making in MATLAB language.

Algorithm 6 Function **v = compute (v)**

```
procedure
    M = [Transformed probability value];
    [a,b] = size(M);
    for i = 1:a; do
        v(i) = compute_v a(M, i);;
    end for
    End;
    End;
end procedure
```

B.2.1 A supplementary code for Satisfactory principle.

Algorithm 7 Function sum1 = $compute_{va}$ (M,m)

```
procedure
    sum1 = 0;
    for j = 1:4; do
        if j==m;
        else
        sum2 = 0;
        for s = 1:7; do
            sum3 = 0;
            for x = 1:s; do
                sum3 = sum3 + M(j,x);
            end for
            sum2 = sum2 + sum3*M(m,s);
        end for
        sum1 = sum1 + sum2;
    end for
    End
    End
end procedure
```

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