運輸計劃季刊
第三十二卷　第二期
民國九十二年六月
頁 199 ～ 頁 218

Transportation Planning Journal
Vo1. 32　No. 2
June 2003
PP. 199 ～ 218

A RISK ANALYSIS MODEL FOR TRANSPORTATION PARTNERING IN SUPPLY CHAIN MANAGEMENT[1]

蔡明志 Ming-Chih Tsai[2]
曹至宏 Chih-Hong Tsao[3]
康傑民 Chieh-Min Kang[4]

(90 年 10 月 11 日收稿，91 年 5 月 3 日修改，92 年 3 月 25 日定稿)

ABSTRACT

Partnering is becoming a common practice in supply chain management (SCM). However, there has been very little systematic and in-depth examination of the nature, efficacy and feasibility of a partnering approach. Considering that risk is the core issue in partnering, this paper aims to establish a theoretical risk analysis model for transportation partnering where partnership types, partnering risk factors, and risk consequences are pertinently justified and quantitatively structured. Meanwhile, the express delivery (ED) service initiated by a hypothetical railway system is applied as a case study for demonstration purposes.

Transportation partnership types are classified into three categories, termed as Types I, II and III, depending on the resources spent. Partnering risk is defined as the expected consequences, which is measured as the product of the probability and the consequences of a successful (or failed) partnering. The successful partnering is justified to be dependent on the core risk factor of commitment that are associated with four sub risk factors of interdependence, shared values, communications, and opportunistic behavior. The consequences

1. We are indebted to TRA for providing us with valuable information and grant for this study.

2. Associate Professor of Department of Marketing, National Chung Hsing University, 250 Kuo-Kuang Rd., Taichung City 402, Taiwan, Tel.: 04-22840392 ext. 21, E-mail: mctsai@ dragon.nchu.edu.tw.
3. PhD. Student of Institute of Traffic and Transportation, National Chao Tung University, 4 F, 114 Chung Hsiao W. Rd., Sec. 1, Taipei 100, Taiwan, Tel.: 02-24206575, Fax: 02-24242495, E-mail: u8836802@cc.nctu.edu.tw.
4. Master of Institute of Transportation, Warehousing and Logistics, National Kaohsiung First University of Science and Technology, 1 University Rd., Yuanchau, Kaohsiung 824, Taiwan.

of partnering involve revenues, relation costs and termination costs generated from partnering activity. Partnering risk models are designated to be stochastic processes and measured through simulations using the computer software of @RISK. The results in this case study demonstrate rational risk scenario analysis upon partnership type selection, based on the calculated partnering risks.

Key Words: *Transportation; Partnering; Risk analysis; Simulation; Supply chain management*

I. INTRODUCTION

Supply chain management (SCM) emphasizes on resource integrations within or between the organizations to exhibit the enterprise synergies for increased customer values and decreased operation cost. To do so, partnering is regarded as the direct and common practices in SCM. Previous studies concerning partnering have focused mainly on three aspects: of partnership classifications or typologies [1-7], partnership establishments [4,5,8-10], and factor analysis towards successful partnering [11-18]. However, a systematic and quantitative researches that examine the nature, efficacy and feasibility of a partnering approach have not been substantially carried out [19]. In addition, partnerships were frequently explored on the issues of buyer-vender, production-distribution, or inventory-distribution coordination. Literature on transportation or distribution, customer coordination has been very rare so far [20].

Partnering risk is at the core of partnering issues, yet very little study has been carried out [21,22]. In the past, partnering risk was mainly investigated on separated issues, e.g. factors of a successful (failure) partnering or the successful (failure) partnering costs [9,10,12,17,23-25]. An integrated partnering risk analysis has not yet been appropriately described [21,22]. Consequently, this paper has three purposes: firstly, to justify risk components of transportation partnering, including partnership types, partnering risk factors, and partnering risk consequences; secondly, to establish a quantitative risk analysis model for transportation partnering selections; and finally, to conduct a brief case study on an express delivery (ED) business initiated by a hypothetic railway system for demonstration purposes.

Following this introduction, Section 2 justifies the analytical structure of transportation partnering. Section 3 describes issues on partnering risks. Section 4 develops analytical risk models for transportation partnering. Section 5 demonstrates a brief case study. Finally, Section 6 summarizes the conclusions and recommendations.

II. JUSTIFICATIONS OF ANALYTICAL STRUCTURE FOR TRANSPORT PARTNERING

2.1 Types of Transportation Partnership

Partnership is seen as inter-firm cooperative agreements in supply channels to achieve specific objectives and benefits, so the agreements should base on mutual trust, openness, shared risk and shared rewards that yield a competitive advantage [5,20,22]. Within the partnership context, there can be a varying degree of integration. Lambert *et al.* [5] indicated three types of partnerships in accordance with degree of activity cooperation. They are Type I, which addresses on a limited coordinated activity and planning; Type II, which involves progress beyond coordination of activities to integration of activities; and Type III, which shares a significant level of operational integration [5]. Apart from this classification, partnership types are also categorized in accordance with resources spent, such as finances, technology, physical, and managerial resources [3,9,26]. The latter one has so far been broadly adopted due to its clear subjects pointed out. Thus, if we regard resources spent as the degree of activity cooperation, these two general classification theories may be reasonably integrated. In other words, partnership types are classified by what resources are spent that are treated as the degree of activity coordination.

Based on this classification, transportation partnerships are justified using the terms of Types I, II and III, but they depend on the resources spent. Meanwhile, the resources involved between these three types are designed to be additive to illuminate the integration degree. That is, the resource integration of partnership Type I is included by partnership Type II which is included by partnership Type III.

Type I is defined as a short-term contractual relationship that coordinates managerial human resources between the transportation organizations for transportation operation integrations, such as human intellectuals and labors utilized to engage in pricing, scheduling or route coordination and operation activities. Type II is viewed as long-term contractual relationships that coordinate not only the human resources spent for Type I, but also the physical resources for installing and maintaining transportation infrastructure and equipment, such as the vehicles, terminals, information infrastructures, between partners. Finally, Type III is viewed as an extension of their own firm by buying out the stock of others. Therefore, the transportation company is equipped with the coordination powers not only in human, infrastructure (as described for Type II), but also in capital resources. This type of partnership maintains highest degree of resource involvements.

2.2 Life Cycle of Transportation Partnering

Partnerships between business partners evolve through a process over time. Life cycle of transportation partnering is characterized into three sequential phases, i.e. initiation, maintenance, and termination phases. For transportation partnering, initiation phase consists of the stages of opportunity identification and relationship formation. In this phase, transportation firms should search and recognize its market opportunities. If opportunities are present but firms cannot engage them, they would then identify and evaluate another partnership with favorable companies [27]. In maintenance phase, partners maintain and operate partnership by providing relatively high levels of inputs, notably human, information infrastructure, or even capital resources to the association to achieve partnership goals. In termination phase, the sequence begins with an intra-psychic stage in which one transportation firm privately evaluates his or her dissatisfaction with the counterpart. Thereafter, the partnering enters an interactive phase in which the parties negotiate their unbonding, and present their termination publicly [28].

In the life cycle of transportation partnering, each phase represents a significant transition in how partners in a relationship perceive one another. And the development of a relationship may involve moving back and forth through the phases when parties are not ready for extending interdependence.

III. DESCRIPTIONS ON TRANSPORTATION PARTNERING RISK

3.1 Definition of Partnering Risk

An increasing number of companies subscribe to the idea that developing partnering can take significant wastes out of the supply chain and provide a route to securing the best commercial advantages. Over the past decade, a number of supply chain partnering practices were known to undergo. The cases of well-known world-class company alliances ranged from the fast food giant of McDonalds with Coca-Cola [29], Rover with Honda, British Aerospace with Daimler-Benz, and Acron with Oracle [30] that were more on manufacturing-oriented base, to the marine carrier giant of Sea-Land with AlliedSignal and CSX for intermodal operations [5], liner alliances [31,32], airline alliances [3], and tourism alliance [33] that were more on transport service base.

Nonetheless, referring to those partnering practices, researches concluded that, it is difficult to justify whether partnering is a predominating supply chain strategy, because some practices were celebrated for their fruitful outcomes, whereas some were driven to a dire financial consequences. But it was commonly found that meticulous partnering analysis was generally lacking in partnering decision-making process [19,30,34-36]. Notably, they were concerned with the deficiency of a systematic process in determining a partnering type, a lack of addressing key failure and mitigation factors of partnering; and an absence of the assessment of the degree to which they should get involved with partnering activity. The outcome of an unconvincing decision-making was found to greatly increase the chance leading to a disoriented partnering, and thus an unpleasant result. As a consequence, partnering risk analysis is emphasized in the recent partnering studies [21,22,37].

Still, there have been very few literatures on partnering risk so far. Partnering risk refers to the negative potentials resulting from uncertainties during partnering. If partnering is handled properly, the mutual benefits may arise by achieving its expected mutual goals. On the contrary, if, for any reason, the partnering is obstructed or even dissolved, both sides face negative consequences. Essentially, partnering risk is attributed to the so-called speculative risk. That is, there is a chance of gain as well as a chance of loss for partnering risk.

Risk is defined as the product of the probability of occurrence and the consequences of unwanted events. Nonetheless, some researchers have defined the relational risk merely as the probability of partnership failure [9,21,22] with disregard to the other critical element of risk, i.e. the consequences of the partnering failure. The inappropriate definitions have virtually led to biased risk analysis. Evidently, the profit gain or loss is the ultimate concern of every partnering. Therefore, partnering risk is defined as the profit gain or loss resulting from partnering activity. Mathematically, it is measured as the product of the probability of success (or termination) and the consequences of success (or termination) of partnering.

3.2 Risk Factors and Consequences of Partnering

3.2.1 Risk Factors

As for the risk factors of partnering, trust and commitment have been frequently been identified as the core risk factors [9,10,13,15,17,22,38]. Trust indicates that, in an exchange, one party has confidence in the other's reliability and integrity, whereas commitment indicates that an exchange partner has devoted efforts at maintaining partnership [17]. Despite that, it is argued that the commitment should uniquely exist in the core because the trust also contributes to commitment [15,17].

In broadly reviewing the relevant literatures, we conclude the essences of commitment being expressed by four concrete concepts: interdependence, shared values, communication, and opportunistic behavior. The ways they lead to partnering risk are briefly illustrated as follows:

Lack of Interdependence

Interdependence, which indicates a firm's dependence on a partner, has been traditionally defined in channels as the firm's need to maintain a partnership with the partner to achieve its goals [39,40]. Researches concluded a positive relationship between interdependence and commitment through the empirical evidences [4,18].

Lack of Shared Values

Shared values are the extent to which partners have beliefs in common about what behaviors, goals, and policies are important or unimportant, appropriate or inappropriate, and right or wrong [17]. For a successful integrated partnership, partners must share compatible values. For instance, the value placed on strategic planning and the approaches used for planning should be similar [5]. The shared value has a positive relationship with commitment. That is, the higher the degree of the values shared, the higher the commitment.

Lack of Communication

Communication is broadly defined as the willingness to formal as well as informal sharing of meaningful and timely information between firms through, for example, integrated E-mail systems, regularly scheduled meetings, phone calls, EDI [5,10,11,36]. Bad communication would easily lead to errors in policy, strategy and operation levels, so as to affect commitment degree.

Opportunistic Behavior

Opportunistic behavior refers to lack of honesty in transactions to include "seeking self-interest with guile" [41]. Opportunism involves a subtle form of deceit and is manifested in such acts as withholding or distorting information with the intent to mislead and shirking or failing to fulfill promises or obligations [42]. When a party believes that a partner engages in opportunistic behavior, such perceptions will lead to decreased trust and eventually to depressed commitment.

Structurally, we identify these four elements as sub-factors of commitment and construct a partnering risk factor domain as shown in Figure 1.

3.2.2 Consequences of Partnering

As defined, profit losses or gains that are associated with whether the partnering succeeds or not are the possible consequences of partnering. The partnering consequences implicate the costs and revenues generated from partnering activities. In the event that the partnering is terminated, the partnering consequences would be to bear partnering costs, which include relation costs (costs spent in initiation or/and maintenance phases) and termination costs, without any substantial benefits gained. On the other hand, if the partnering is maintained successfully, the partnering consequence would indicate incurred partnering revenues extracted by relation costs spent throughout two preceding phases. Further, the details of initiation, maintenance and termination costs and expected revenue are illustrated as follows.

Initiation Cost

The initiation cost mainly includes the investigation expenses for perceiving the potential partners and market opportunities, as well as, research expenses for determining the partnership types and partnering conditions. If a transportation company regards the partnering as infeasible, it would terminate the partnering in this phase with the initiation cost spent as relation cost.

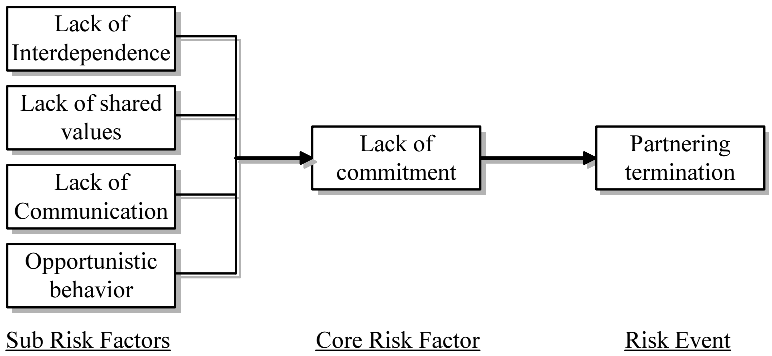

Figure 1 Relationship between Sub Risk Factors, Core Risk Factor and Risk Event

Maintenance Cost

The expenses incurred in the phase vary with partnership types. As the partnering classification defined earlier, maintenance costs for partnership Type I indicate human resources, such as expenses for labors or intellectuals spent in integrating transportation operations, while those for partnership Type II include the expenses for partnership Type I plus the expenses for establishing physical transportation infrastructures and equipments, and those for partnership Type III, comprise the expenses for partnership Type II plus the expenses for capital investments.

Termination Cost

Termination cost is incurred when partnering is terminated. Termination cost indicates all expected losses resulting from partnering termination. Mainly, they include potential market loss expenses, partnering dissolution expenses, and substantial switching expenses [17]. Potential market loss expenses indicate the expenses of market share loss resulting from the lowering of service quality, such as inconvenient transferring and prolonged transit time. Partnering dissolution expenses indicate the indemnity or compensation expenses on legal contract or lawsuit expenses, and, finally, switching expenses refer to the costs incurred from resource switching, such as trading loss of transportation facility and shiftless cost.

As for the partnering revenues incurred from a successful partnering, it consists of operating revenue and capital return. Mathematically, operating revenue is measured as the arithmetic product of two components: the service charge agreed and the additional quantity served. Between them, the service charge is negotiable as an important niche for maintaining partnering and marketing incentives. And, the additional demand quantity is associated with transportation service levels provided, which are different by the extent to which the resources are integrated. In theory, the more deeply the resources are involved, the higher the operation efficiency, so the higher the service levels provided. As for capital return that is merely incurred under the Type III circumstances, it is dependent on the expected return rate and the capital amount in which the firm invested.

IV.　DEVELOPMENT OF ANALYTICAL RISK MODELS

4.1　Model Structure for Risk Analysis of Transportation Partnering

Based on the risk-related issues that have been previously justified, we establish a partnering risk analysis model. As shown in Figure 2, three partnership types are treated as the partnering alternatives to be analyzed. For each type of partnership, the probability of termination in initiation or/and maintenance phase is determined by lack of commitment, which is regarded as core risk factor involving four sub factors, i.e. lack of interdependence, lack of communication, lack of shared value, and opportunistic behavior. The expected risks, termed as profit gain or loss, are measured by combining partnering success (or termination) probabilities and their corresponding consequences.

4.2　Quantitative Risk Analysis Model

As defined, the partnering risk is termed as profit gain or loss resulting from partnering. The quantitative risk expression is thus written as indicated in Equation (1):

G_k : expected gain for partnership type k;

L_k : expected loss for partnership type k.

$$r_k = G_k - L_k \tag{1}$$

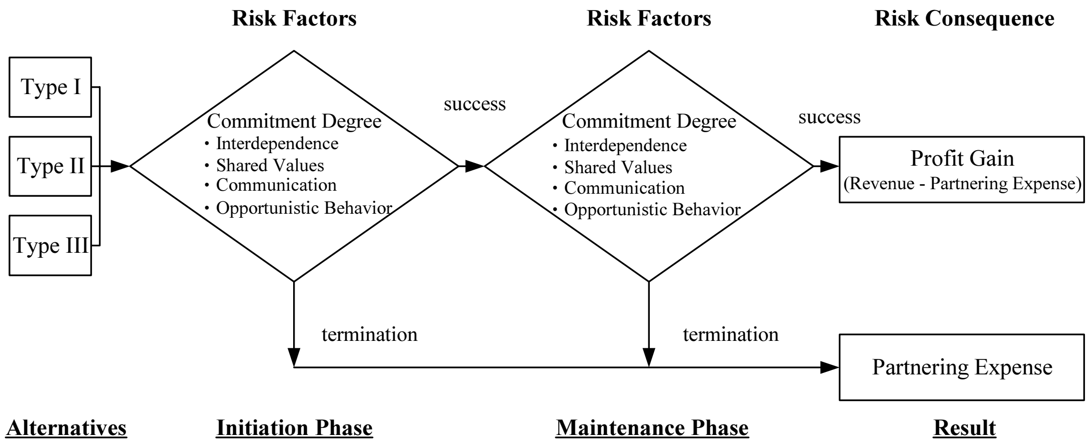

Figure 2 Structure for Transportation Partnering Risk Analysis

in which

k : partnership types, $k = 1,2,3$;

r_k : expected risk consequence for partnership type k;

In Equation (1), G_k indicates the expected consequence resulting from a successful partnering. It is measured as the product of the probabilities of success through two partnering phases ($1 - p_{ik}$) and the consequence of success (q_k), as indicated in Equation (2). On the contrary, L_k indicates the expected consequence resulting from a terminated partnering. It is measured as the sum of the product of the probabilities of termination (p_{ik}) and the consequence of partnering termination (q'_{ik}) for each of two phases, as shown in Equation (3):

$$G_k = \prod_{i=1}^{2} (1 - p_{ik}) \times q_k \tag{2}$$

$$L_k = p_{1k} \times q'_{1k} + (1 - p_{1k}) \times p_{2k} \times q'_{2k} \tag{3}$$

in which

i : phase of partnering (initiation phase: $i = 1$ and maintenance phase: $i = 2$);

q_k : consequence of partnering success for partnership type k;

q'_{ik} : consequence of termination for partnership type k in partnering phase i;

p_{ik} : probability of partnering termination for partnership type k in partnering phase i.

While substituting Equations (2) and (3) to Equation (1), the expected risk consequence is rewritten as Equation (4):

$$r_k = \prod_{i=1}^{2} (1 - p_{ik}) \times q_k - p_{1k} \times q'_{1k} - (1 - p_{1k}) \times p_{2k} \times q'_{2k} \tag{4}$$

As illustrated, the termination probability is determined by the core risk factor of lack of commitment that is associated with four identified sub risk factors. Accordingly, the termination probability is measured as the sum of product of the weight of importance (w_{ijk}) and the probability of occurrence of the sub risk factor (δ_{ijk}), as shown in Equation (5):

$$p_{ik} = \sum_{j=1}^{n} (w_{ijk} \times \delta_{ijk}) \tag{5}$$

in which

w_{ijk} : weight of importance of sub risk factor j for partnership type k in the partnering phase i;

δ_{ijk} : probability of occurrence of sub risk factor j for partnership type k in the partnering phase i.

We designated w_{ijk} to be calibrated by using AHP through pairwise comparison. The nominal scale is used to achieve a concise pair-wise comparison evaluation. The division of the nominal scale consists of equally important, slightly important, important, very important, and absolutely important, which are given the weights 1,3,5,7, and 9.

In accordance with AHP techniques, we derived the comparison matrix of AHP through three steps [43-45]: First, we established one comparison matrix of weight of importance of sub risk factor j, w_j ,given a partnership type k and phase i. The matrices, as indicated in Equation (6), signify the degree to which one factor dominates the other using pairwise comparisons. Next, we derived relative weights for the various factors in each matrix. The relative weights were computed as the components of the normalized eigenvector associated with the largest eigenvalue of their comparison matrix. The weights explained the relative importance of the various factors in each matrix. Finally, we computed the consistency index (CI) and examine the interviewees' consistency by taking the consistency ratio (CR) of CI with the appropriate value in a developed table.

$$A = \begin{bmatrix} 1 & \frac{w_1}{w_2} & \frac{w_1}{w_3} & \frac{w_1}{w_4} \\ \frac{w_2}{w_1} & 1 & \frac{w_2}{w_3} & \frac{w_2}{w_4} \\ \frac{w_3}{w_1} & \frac{w_3}{w_2} & 1 & \frac{w_3}{w_4} \\ \frac{w_4}{w_1} & \frac{w_4}{w_2} & \frac{w_4}{w_3} & 1 \end{bmatrix} \tag{6}$$

As for partnering consequences, they are divided into two categorizes: the consequences of partnering termination and those of success. As defined, the consequences of termination are the sum of relation cost and termination costs, as shown in Equation (7). They are different by both partnership types and termination phases.

$$q'_{ik} = \sum_{r=1}^{i} c_{rk} + c_{tk} \tag{7}$$

in which

c_{rk} : relation cost for partnership type *k* in partnering phase *r*, (initiation phase: $r = 1$ and maintenance phase: $r = 2$);

c_{tk} : termination cost for partnership type *k*.

On the other hand, the consequences of partnering success are measured by the partnering revenues (rev_k) subtracted by the relation costs of two phases (c_{ik}), as indicated in Equation (8) and (9):

$$q_k = rev_k - \sum_{i=1}^{2} c_{ik} \tag{8}$$

$$rev_k = orev_k + crev_k \tag{9}$$

in which

rev_k : partnering revenue resulting from partnering for partnership type *k*;

$orev_k$: operating revenue resulting from operation for partnership type *k*;

$crev_k$: capital return resulting from capital investment for partnership type *k*; it only incur when $k = 3$.

As for operating revenue ($orev_k$), it is measured as the product of negotiated service charge (pri_k) and additional transportation demand (vol_k), as shown in Equation (10). In addition, the capital return ($crev_k$) of partnership is measured as the product of capital amount (Φ_k) and the expected return rate (σ_k), as indicated in Equation (11):

$$orev_k = pri_k \times vol_k \tag{10}$$

$$crev_k = \Phi_k \times (\sigma_k - 1) \tag{11}$$

in which

pri_k :negotiated service charge by partnership type *k*;

vol_k : additional transportation demand incurred by partnership type *k*;

Φ_k : capital amount spent for partnership type k, it only incurs when $k = 3$;

σ_k : expected return rate from capital investment for partnership type k, it only incurs when $k = 3$.

While substituting Equations (9), (10), and (11) into Equation (8), the expression of the consequences of partnering success is rewritten as Equation (12).

$$q_k = pri_k \times vol_k + [\Phi_k \times (\sigma_k - 1)] - \sum_{i=1}^{2} c_{ik} \tag{12}$$

The additional transportation demands incurred are associated with two service attributes provided, i.e. service charge and travel time [46]. In theory, the lower the service charge, or the shorter the travel time, the greater the additional demand volumes, and vice versa. The additional demand volume is measured as overall market volume (m) multiplied by the difference of market share (λ_k), as indicated in Equation (13):

$$vol_k = m \times (\lambda_k - \lambda_0) \tag{13}$$

in which

m : the overall market demand volume;

λ_k : the market share resulting from partnership type k;

λ_0 : the original market share.

The market share (λ_k) is calculated by using Logit model and is expressed as Equation (14), inside which the consumer utility functions (u) are constituted by two service attributes of negotiated service charge and travel time that are expressed in Equation (15). The design of the Logit model is to quantitatively analyze the changes of market share due to the changes of demand attributes in service charge and travel time resulting from partnering. Negotiated service charge is thought to be a representative outcome of a very fundamental relationship pattern, whereas, travel time is designated to express the outcomes of a more deeply initiated partnering, such as transport operation integrations, transport facility/infrastructure establishments.

$$\lambda_{ak} = \frac{e^{u_{ak}}}{\sum e^{u_A}} \tag{14}$$

$$u_{ak} = \beta_0 + \beta_1 \times pri'_k + \beta_2 \times tim_k \tag{15}$$

in which

a : company conducting partnering;

A : company set of similar service provided in market;

u : utility function;

$\beta_0, \beta_1, \beta_2$: parameters of utility function of Logit model;

pri'_k : service charge for partnership type k;

tim_k : travel time for partnership type k.

4.3 Model Calculations and Simulations

Considering uncertainties emerging in the complicated partnering activity, we designate the partnering risk models as stochastic process rather than deterministic. That is, the values of model parameters and variables are set or calibrated as a range of numbers with a distribution rather than a specific figure to reflect the decision and environment ambiguity. However, the model calibrations and calculations would thus become difficult to solve. Simulations are thus chosen to deal with the complications.

Figure 3 indicates the simulation processes in which parameter calibrations and model calculations are logically structured into three levels. In the first level, the model parameters that are categorized into four groups: risk perceptions, service attributes, partnering revenues factors, and partnering costs are calibrated by surveying and are finalized through simulations. In the following level, intermediate variables are calculated using corresponding equations stated in the previous section. The variables include termination probabilities (p_{ik}), utility function (u), market share (λ_k), demand volume (vol_k), operating revenue ($orev_k$), capital return ($crev_k$), partnering revenue (rev_k), consequence for partnering termination (q'_{ik}), consequence for partnering success (q_k), expected consequence of a successful partnering (G_k), and expected consequence of a termination partnering (L_k). Finally, the third level is to calculate the dependent variable, the expected risk consequence (r_k) that is in the form of a range with distribution.

V. A BRIEF DEMONSTRATION

5.1 Description on Hypothetical Partnering System

The model is applicable in principle to any transportation partnering. However, for demonstration purposes, we conducted a brief case study of Express Delivery (ED) business initiated by a hypothetical railway system, say TRA (Taiwan Railway Administration). The relevant parameters that are calibrated from TRA and existing road freightliners are to make the model realistic. It must be stated that the conclusion are not intended to be policy recommendations because practical conclusions would need to sustain detailed information and sophisticated design.

To simplify the case study, the demonstration is engaged under the following assumptions:

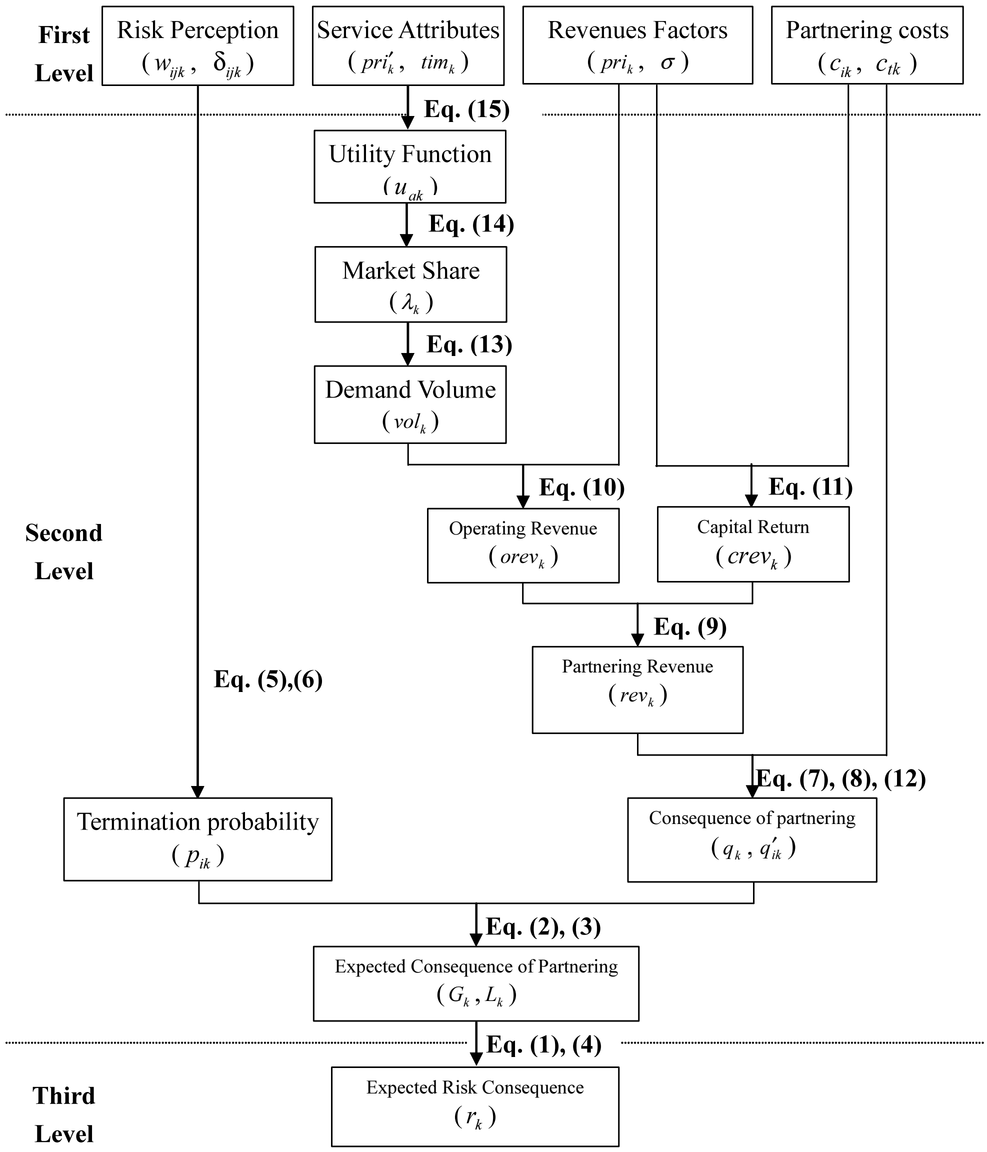

Figure 3　Simulation Processes

1. There exists at least one potential inland freightliner for TRA's partnering.
2. A constant domestic ED market, i.e. new entry would not stimulate the new demand.
3. The provided ED service is confined to the origin and destination between two major

metropolitans in Taiwan — Taipei and Kaohsiung.

4. Service charge is on flat rate basis.
5. Parameters are set and calibrated following uniform distribution.

An interview plan was thus conducted to collect the information needed. The interviewees comprised six high-ranking administrators in charge of ED business on TRA, and five managers from domestic road liners. The calibration results are summarized in Table 1 where figures are in the form of range as designed. The consistency ratio, which was measured as 0.006 (far below a ratio of 0.1 justified in the theory), concluded that there was a satisfactory degree of the comparison consistency. They are finalized through simulations upon the parameters given by each individual interviewee at the confidence level of 90%.

5.2 Partnering Risk Analysis

The partnering risks are calculated using the computer simulation software of @RISK. The dependent variables of partnership risks by types are calculated and presented in Figure 4. The means of annul expected consequences associated with partnership Types I, II and III are 92 million, 270 million, 470 million, respectively. Partnership Type III appears to be the most profitable type among three types. At the 90% of confidence interval, Type III is all in the profitable range, while partnership types I and II are vacillating ranging from positive to negative. The results conclude that partnering involving more resources would naturally increase the mutual commitment, and thus, not only improve the operation efficiency but also prevent partnering from termination from which dire consequences would occur. The same phenomenon have been previously observed and justified in several practical partnering studies [13-15,40, 47].

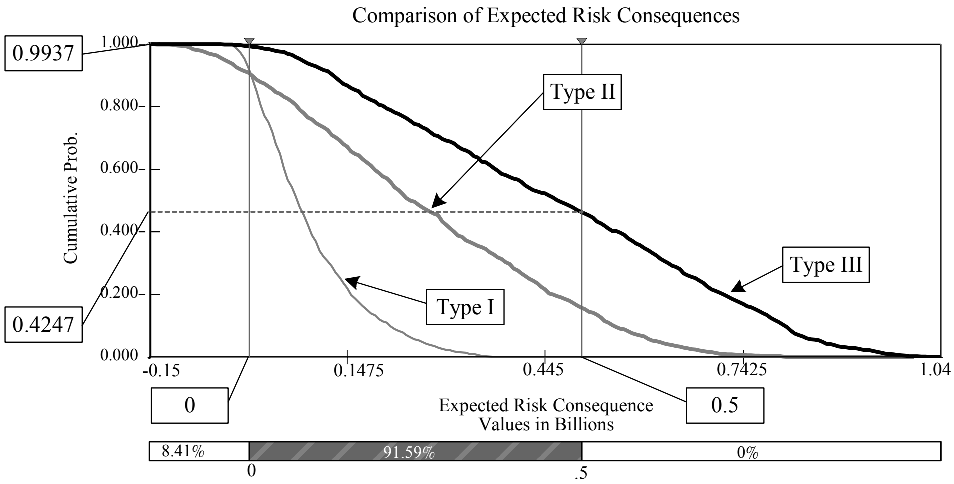

Figure 4 Comparison of Partnering Risks by Types

Nonetheless, although Type III seems to be the ideal decision in the hypothetical example, we must state again that, because the perspectives of partnering example was not sophisticatedly designed and described, to a greater extent, the interviewees might be over-optimistic (or pessimistic) onwards their risk perceptions and risk consequences estimations. This brief demonstration merely illuminates our theoretical ideas on the specified issues.

Table 1　Parameters

Parameters	Type I	Type II	Type III
Duration of contract (years)	[1,3]	[2,5]	[5,10]
Total initiation expenses (million)	[3,5]	[3,5]	[3,5]
Human resource expenses/year (million)	[20,30]	[30,50]	[30,50]
Total facility installation expenses (million)	—	[50,100]	[50,100]
Construction and maintenance expenses for facility per year (million)	—	[120,200]	[120,200]
Total capital investment (million)	—	—	[30,50]
Capital return rate (%)	—	—	[20,25]
Partnering dissolution expenses	15% of labor cost	15% of labor and facility installation costs	15% of labor and facility installation costs
Service charge of studied company (dollars)	[120,133]	[145,171]	[162,173]
Capital return rate (%)	—	—	[20,25]
Travel times (hours)	[13,16] *[15,19]	[11,13] *[15,19]	[11,12] *[15,19]
Service charges (dollars)	[220,253] *[233.4, 25.06]	[245,291] *[233.4, 25.06]	[262,293] *[233.4, 25.06]
Total market demand (million)	15	15	15
Parameter of Logit model β_0	–3.245 * (0)	–3.245 * (0)	–3.245 * (0)
Parameter of Logit model β_1	–0.0003 * (–0.0003)	–0.0003 * (–0.0003)	–0.0003 * (–0.0003)
Parameter of Logit model β_2	–0.0095 * (–0.0095)	–0.009 * (–0.0095)	–0.0095 * (–0.0095)

[a,b]: refers to the range of a to b.
* : indicates the data of competitor.
Source：[48,49].

VI.　CONCLUSIONS AND RECOMMENDATIONS

Transportation partnership types are classified into three categories, termed as Types I, II and III, depending on the resources spent. Partnering risk is defined as the expected consequences resulting from partnering activities, which is measured as the product of the probability and the consequences of a successful (or failed) partnering. The successful partnering is justified to be dependent on the core risk factor of commitment that are associated with four sub risk factors of interdependence, shared values, communications, and opportunistic behavior. The consequences of partnering involve revenues, relation costs and termination costs generated from partnering activity. Considering the complexity of partnering environments, partnering risk models are designated to be stochastic processes and measured through simulations using the computer software of @RISK. The brief case demonstration is engaged in a hypothetical ED services provided through a partnering between a railway and a road freightliner. The results demonstrate rational risk scenario analysis upon partnership type selection, based on the calculated partnering risks.

It is recommended that future research should take risk mitigation strategies into account as decision variables for the extension of partnering risk issues.

REFERENCES

1. Das, T. K. and Teng, B., “Resource and Risk Management in the Strategic Alliance Making Process”, *Journal of Management*, Vol. 24, No. 1, 1998, pp. 21-42.
2. Gibbs, J. E., “Effective Relationships for Supply – Attributes and Definitions”, *European Journal of Purchasing and Supply Management*, Vol. 4, No. 1, 1998, pp. 43-50.
3. Gudmundsson, S. V. and Rhoades, D. L., “Airline Alliance Survival Analysis: Typology, Strategy and Duration”, *Transport Policy*, Vol. 8, No. 2, 2001, pp. 209-218.
4. Kumar, N. L. K. S. and Steenkamp, J. E. M., “The Effects of Perceived Interdependence on Dealer Attitudes”, *Journal of Marketing Research*, Vol. 32, No. 3, 1995, pp. 348-356.
5. Lambert, D. M., Emmelhainz, M. A., and Gardner, J. T., “Developing and Implementing Supply Chain Partnerships”, *The International Journal of Logistics Management*, Vol. 7, No. 2, 1996, pp. 1-17.
6. Tretheway, M. W. and Oum, T. H., “Airline Economics: Foundation for Strategy and Policy”, The Centre for Transportation Studies, University of British Columbia, 1992.
7. Zinn, W. and Parasuraman, A., “Scope and Intensity of Logistics-Based Strategic Alliances”, *Industrial Marketing Management*, Vol. 26, No. 2, 1997, pp. 137-147.
8. Christopher, M. and Jüttner, U., “Development Strategic Partnerships in the Supply Chain: A Practitioner Perspective”, *European Journal of Purchasing & Supply Management*, Vol. 6, No. 2, 2000, pp. 117-127.
9. Das, T. K. and Teng, B., “Between Trust and Control: Developing Confidence in Partner Cooperation in Alliances”, *Academy of Management Review*, Vol. 23, No. 3, 1998, pp. 491-512.

10. Lambert, D. M., Emmelhainz, M A., and Gardner, J. T., “Building Successful Logistics Partnerships”, *Journal of Business Logistics*, Vol. 20, No. 1, 1999, pp. 165-181.
11. Anderson, J. C. and Narus, J. A., “A Model of Distributor Firm and Manufacturer Firm Working Partnerships”, *Journal of Marketing*, Vol. 54, No. 1, January 1990, pp. 42-58.
12. Boddy, D., Cahill, C., Charles, M., Fraser-Kraus, H., and Macbeth, D., “Success and Failure in Implementing Supply Chain Partnering: An Empirical Study”, *European Journal of Purchasing & Supply Management*, Vol. 4, No. 2-3, 1998, pp. 143-151.
13. Cullen, J. B., Johnson, J. L., and Sakano, T., “Success through Commitment and Trust: The Soft Side of Strategic Alliance Management”, *Journal of World Business*, Vol. 35, No. 3, 2000, pp. 223-240.
14. Doney, P. M. and Cannon, J. P., “An Examination of the Nature of Trust in Buyer-Seller Relationships”, *Journal of Marketing*, Vol. 61, No. 2, April 1997, pp. 35-51.
15. Geyskens, I. J. E. M., Steenkamp, L. K. S., and Kumar, N., “The Effects of Trust and Interdependence on Relationship Commitment: A Trans-Atlantic Study”, *International Journal of Research in Marketing*, Vol. 13, No. 4, 1996, pp. 303-317.
16. Gundlach, G. T., Achrol, R. S., and Mentzer, J. T., “The Structure of Commitment in Exchange”, *Journal of Marketing*, Vol. 59, No. 1, January 1995, pp. 78-92.
17. Morgan, R. M. and Hunt, S. D., “The Commitment-Trust Theory of Relationship Marketing”, *Journal of Marketing*, Vol. 58, No. 3, 1994, pp. 20-38.
18. Ruyter, K. and Wetzels, M., “Commitment in Auditor-Client Relationships: Antecedents and Consequences”, *Accounting, Organizations and Society*, Vol. 24, No. 1, 1999, pp. 57-75.
19. Bresnen, M. and Marshall, N., “Partnership in Construction: A Critical Review of Issues, Problems and Dilemmas”, *Construction Management and Economics*, Vol. 18, No. 2, 2000, pp. 229-237.
20. Maloni, M. J. and Benton, W. C., “Supply Chain Partnerships: Opportunities for Operations Research”, *European Journal of Operational Research*, Vol. 101, No. 3, 1997, pp. 419-429.
21. Das, T. K. and Teng, B., “Managing Risks in Strategic Alliance”, *Academy of Management Executive*, Vol. 13, No. 4, 1999, pp. 50-62.
22. Das, T. K. and Teng, B., “A Risk Perception Model of Alliance Structuring”, *Journal of International Management*, Vol. 7, No. 1, 2001, pp. 1-29.
23. Cavinato, J. L., “A Total Cost/Value Model for Supply Chain Competitiveness”, *Journal of Business Logistics*, Vol. 13, No. 2, 1992, pp. 285-301.
24. Gadde, L. and Snehota, I., “Making the Most of Supplier Relationships”, *Industrial Marketing Management*, Vol. 29, No. 4, 2000, pp. 305-316.
25. Maltz, A. B. and Ellram, L. M., “Total Cost of Relationship: An Analytical Framework for the Logistics Outsourcing Decision”, *Journal of Business Logistics*, Vol. 18, No. 1, 1997, pp. 45-66.
26. Grant, R. M., *Contemporary Strategy Analysis: Concepts, Techniques, Applications*, 2nd ed., Cambridge, MA, Blackwell, 1995.

27. Strader, T. J., Lin, F., and Shaw, M. J., "Information Infrastructure for Electronic Virtual Organization Management", *Decision Support Systems*, Vol. 23, No. 1, 1998, pp. 75-94.

28. Scanzoni, J., "Social Exchange and Behavioral Interdependence", in R. R. Burgess and T. L. Houston (Eds), *Social Exchange in Developing Relationships*, New York, Academic Press, 1979.

29. Gundlatch, G. T. and Murphy, P. C., "Ethical and Legal Foundations of Relational Marketing Exchanges", *Journal of Marketing*, Vol. 57, No. 4, Oct. 1993, pp. 36-46.

30. Newman, V. and Chaharbaghi, K., "Strategic Alliances in Fast-Moving Markets", *Long Range Planning*, Vol. 29, No. 6, 1996, pp. 850-856.

31. Ryoo, D. K. and Thanopoulou, H. A., "Liner Alliances in the Globalization Era: A Strategic Tool for Asian Container Carriers", *Maritime Policy and Management*, Vol. 26, No. 4, 1999, pp. 349-367.

32. Slack, B., Comtois, C., and McCalla, R., "Strategic Alliances in the Container Shipping Industry: A Global Perspective", *Maritime Policy and Management*, Vol. 29, No. 1, 2002, pp. 65-76.

33. Augustyn, M. M. and Knowles, T., "Performance of Tourism Partnerships: A Focus on York", *Tourism Management*, Vol. 21, No. 4, 2000, pp. 341-351.

34. Bessant, J., Levy, P., Sang, B., and Lamming, R., "Managing Successful Total Quality Relationships in the Supply Chain", *European Journal of Purchasing and Supply Management*, Vol. 1, No. 1, 1994, pp. 7-17.

35. Ellinger, A. E., Daugherty, P. J., and Gustin, C. M., "The Relationship between Integrated Logistics and Customer Service", *Transportation Research Part E*, Vol. 33, No. 2, 1997, pp. 129-138.

36. Leverick, F. and Cooper, R., "Partnerships in the Motor Industry: Opportunities and Risks for Suppliers", *Long Range Planning*, Vol. 31, No. 1, 1998, pp. 72-81.

37. Ward, S. C., "Assessing and Managing Important Risks", *International Journal of Project Management*, Vol. 17, No. 6, 1999, pp. 331-336.

38. Sherman, S., "Are Strategic Alliances Working?" *Fortune*, September 1992, pp. 77-78.

39. Beier, F. J. and Stern, L. W., *Power in Distribution Channels, in Distribution Channels: Behavioral Dimensions*, Houghton Mifflin Co., Boston, 1969.

40. Frazier, G. L., "On the Measurement of Interfirm Power in Channels of Distribution", *Journal of Marketing Research*, Vol. 20, No. 2, May 1983, pp. 158-166.

41. Williamson, O. E., "Markets and Hierarchies: Analysis and Antitrust Implications", The Free Press, New York, 1975.

42. Moore, K. R., "Trust and Relationship Commitment in Logistics Alliances: A Buyer Perspective", *International Journal of Purchasing and Materials Management*, winter 1998, pp. 24-37.

43. Al-Harbi, K. M. A-S., "Application of the AHP in Project Management", *International Journal of Project Management,* Vol. 19, No. 1, 2001, pp. 19-27.

44. Hauser, D. and Tadikamalla, P., "The Analytic Hierarchy Process in an Uncertain Environment: A Simulation Approach", *European Journal of Operational Research*, Vol. 91, No. 1, 1996, pp.

27-37.

45. Saaty, T. L., *The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation*, McGraw-Hill, Inc., 1980.
46. Cullinane, K. and Toy, N., "Identifying Influential Attributes in Freight Route/Mode Choice Decisions: A Content Analysis", *Transportation Research Part E*, Vol. 36, No. 1, 2000, pp. 41-53.
47. Pinnington, A. and Morris, T., "Power and Control in Professional Partnerships", *Long Range Planning*, Vol. 29, No. 6, 1996, pp. 842-849.
48. IOT (Institute of Transportation), "A Mode Split Study for Freight Transportation System in Taiwan Area", IOT, 1993.
49. Kang, C. M., "Risk Analysis Model for Transportation Partnering in Supply Chain Management", Master Degree Thesis, National Kaohsiung First University of Science and Technology, Taiwan, 2001.