Abstract: In order to gain competitive advantage, container port operators have begun to apply partnering strategies to the integration of the resources of their vertical allies, especially the container carriers. Intelligent management of the involved risk is the core issue in determining an effective partnering strategy. This paper aims to establish a risk analysis model to examine the potential partnership paradigms between a port operator and container carriers. This study explores three types of possible partnerships, identified by the resource allocation and ownership methodology of each, and concludes four risk factors. The partnering risk is defined as the difference between presetting and expected revenue for the port operator. The quantitative model is designated to be a two phase stochastic process, and is measured through Monte Carlo simulations using the computer software program @RISK. The study finds that higher risks occur in ‘cross-involved resources’ partnering than with other partnership scenarios. Empirically, the variation of risk incurred to small-scale partnered carriers, whose market share is less than 20%, was found to be smaller than that to the large-scale carriers, whose market share is greater than 40%. Finally risk mitigation measures are recommended for future partnership decisions.

Key Words: port, partnering relationship, risk, simulation

1. INTRODUCTION

Nowadays, container ports face fierce competition from a growing number of global players. Levels of service, economies of scale and port location have all become core competencies for port operators (Chen, 1997). In order to gain competitive advantage, the port operators not only provide import/export and transit cargo handling, engage in multiple-country consolidation, provide value-added warehousing and other integrated logistic services, but must also apply an effective partnering strategy to integrate the resources of their vertical allies, especially the container carriers. In recent decades, various and more effective buyer-seller partnerships have been applied in accordance with the theories of supply chain management (SCM). Partnering has improved the levels of service, increased market share and decreased the variances of demand and inventory (Lambert et al., 1996; Ryoo & Thanopoulou, 1999; Slack et al. 1996; Gudmundsson & Rhoades, 2001). Logistics activity has long assumed a strategic role in the organization market and supply chain integration (Meade & Sarkis, 1998). Now, however, there is an increasing recognition that the port itself is a key element of the logistics chain in container transportation (Heaver et al., 2000). If the container port operators could meet the requirements of customer relationship management through SCM, i.e. via partnerships with the container carriers, they would thereby also gain improved performance and efficiency.

The current trend in firm competition is a movement from a “market competition” paradigm to a “supply chain competition” paradigm. Many firms are reviewing their logistic processes, distributions and information flows in order to improve their performances, to reduce their total costs, and to re-create their core competencies. Logistics activity plays a critical strategic role in the supply chain integration. From the viewpoint of the port operator, there are many types of cooperative relationships with shipping carriers, such as conferences, strategic alliances, joint ventures, et cetera (Ryoo & Thanopoulou, 1999; Slack et al., 2002; Soog & Panayides, 2002). The container carriers also participate in terminal operations by means of
partnering or vertical integration. Such business partnering is clearly the trend of the future (Sheppard & Seidman, 2001). However, what kind of partnering model between port operators and container carriers is most suitable? What key factors of such partnering can be identified? How much relative risk must the port operator assume in each type of partnership? These issues will clearly affect the potential for success of any of the possible partnership paradigms. Certainly, the amount of assumed risk is the core issue in the determination of an effective partnering strategy. But there has been little quantitative research to examine this specific topic. Therefore, this study attempts to establish a risk analysis model, and to further examine the partnering risk between port operators and container carriers.

This paper is organized as follows: Section 2 reviews the partnering practices and theories developed in shipping and other industries. The analytical risk model for the port operator and shipping carriers is described in section 3. In section 4 we demonstrate a brief case study through simulation. Section 5 is dedicated to the discussion of the risk analysis model. Finally, section 6 summarizes the conclusions and recommendations.

2. DEVELOPING AN UNDERSTANDING OF THE PARTNERING RISK BETWEEN PORT OPERATORS AND CONTAINER CARRIERS

There are many types of partnership in the shipping industry, such as conferences, joint ventures, and strategic alliances (Ryoo & Thanopoulou, 1999; Slack et al., 2002). Previous studies concerning partnering have focused mainly on three aspects: partnership classifications or typologies (Das & Teng, 1998a; Gibbs, 1998; Gudmundsson, & Rhoades, 2001; Kumar & Steenkamp, 1995; Tretheway & Oum, 1992), partnership establishments (Christopher & Jüttner, 2000; Das & Teng, 1998b; Kumar & Steenkamo, 1995; Lambert et al., 1996; Lambert et al., 1999), and factor analysis towards successful partnering (Anderson et al., 1990; Boddy et al., 1998; Cullen et al., 2000; Doney & Cannon, 1997; Geyskens et al., 1996; Gundlach et al., 1995; Morgan & Hunt, 1994; Ruyter & Wetzels, 1999). However, what is partnership? What is the difference between a partnership and a strategic alliance? Before this study can discuss the partnership risk, we must first define the partnership itself, the type of partnering, the life cycle of the partnership and the inherent risk factors of partnering. All of these factors must be identified. We will express them as follows:

2.1 Partnership in the Container Carrier and Port Operator Industry

For container port business, the container handling volume is highly dependent on number of callings. Cuganesan et al. (1999) emphasizes that competition alone is not a survival mechanism. Cooperation is also a common and important survival strategy. In the ocean shipping context, an alliance is defined as a cooperative operational arrangement between two or more carriers that lies anywhere between a traditional arms-length relationship and an integrated strategic relationship that amounts to a virtual merger (Sheppard & Seidman, 2001). The formation of strategic alliances was defined as a voluntary inter-firm cooperative arrangement (Das & Teng, 2001). Ellram & Hendrick (1995) defined partnership as a continuous relationship between firms that contains mutual trust for a certain time period, sharing risk information and profit. The relationship also considered as a long-duration commitment between firms. Every partner shares information, risk and profit. Lambert et al. (1996) stated that a partnership is a tailored business relationship based on mutual trust, openness, shared risk and shared rewards that yields a competitive advantage, resulting in business performance greater than would be achieved by the firms individually. From the logistics view, a supply chain partnership is a relationship formed between two independent entities in supply channels to achieve specific objectives and benefits (Maloni & Benton, 1997).

There is a systematic definition for partnering types by Lambert et al. (1996). They described that there are many types of partnering, such as arm’s-length, type I, type II, type III, joint venture and vertical integration, that will be dependent on the degree of closeness of the relationship between the involved partners. Therefore, this study synthesized other related studies and generalized the partnership as a resources dependences relationship. Each partner will own and need each other partner’s resources. The involved partners each gain their respective profits by building cooperative relationships with the other constituent partners and sharing the available resources. Further, this study identifies three types of partnership depending on the resource allocation methodology utilized, i.e., the ‘no resource-involving’
partnership, the ‘resources-involving’ partnership, and the ‘resources crossly-involved’ partnership.

(1) ‘No resource-involving’ partnership: In a typical ‘no resource-involving’ partnership, each partner holds independent ownership and control of its own resources. There are no additional resources exchanged under the cooperative agreements between the partnered entities. Relationships such as incentive rate agreements and collaboration memoranda between port operators and container carriers are included in this type or paradigm.

(2) ‘Resources-involving’ partnership: The ‘resources-involving’ partnership allows each partner’s independent character to remain intact. But each partner provides some resource or resources, such as land, facilities, crews or capital, to their partners. There are some formal long-term contracts between or among the involved partners. In this paradigm, one party will partially control another party’s resources.

(3) ‘Resources crossly-involved’ partnership: The formation of a group organization, instead of individual firms, is the hallmark of the ‘resources crossly-involved’ partnership paradigm. Each party may hold stock, there may be an exchange of equity, and/or a joint company may be formed. All resources are pooled in the partnership through coordination of the individual partners. The B.O.T. (Build, Operate and Transfer) model is a typical case for this type of partnership.

The difference between a ‘resources-involving’ and ‘no resource-involving’ partnership is strictly the resource allocation methodology inherent to each. The ‘resources crossly-involved’ partnership usually has a both a longer relationship duration and a more complicated ownership structure than the former two types.

2.2 The Life Cycle and Risk Factors of Partnership

Past studies pointed out that strategic alliances or partnering is very unstable and has high failure percentage (Bruner & Spekman, 1998; Rhoades & Lush, 1997; Soog & Panayides, 2002). Midoro & Pitto (2000) found that the factors driving such cooperation are risk and investment sharing, economies of scales and a capability to increase service frequencies. However, partnership retains several inherent risks that can be potentially damaging to the participants (Maloni & Benton, 1997).

Relationships between business partners do not just emerge or exist; instead they evolve through a process over time. This process can be characterized by five principal phases: the awareness, exploration, expansion, commitment, and dissolution phases (Scanzoni, 1979). Each phase represents a significant transition in how partners in a relationship perceive one another. Alternatively, in certain exchange processes two or more phases may be compressed into one, or the relationship may leap-frog from the first phase to the third phase (Dwyer et al., 1987). This study concludes that the life cycle of partnership is fundamentally as follows:

(1) **Construction phase:** The construction phase is to confirm the market opportunities. In the event that the firms do not have sufficient resources to take advantage of the extant opportunities, they would search for the potential partners with whom to cooperate. Firms should, therefore, be aware of, or at least able to recognize, their potential partners, so as to ensure a mutually-compatible set of goals, and thereby judge the potential for conducting a cooperative endeavor.

(2) **Maintenance phase:** After the partnering is confirmed, the relationship would enter the maintenance phase of operation or commitment, in which each partner would provide relatively high levels of input, on issues such as design, marketing, financial management, manufacturing and distribution, to the mutual association in order to achieve partnership goals.

Finally, during the phase of operation or commitment, if the market opportunity has elapsed, or dissatisfaction has emerged from one or more parties, the termination phase can be activated. Premature dissolution of the relationship is caused by risk factors; there is a discrete failure probability composed of various combinations of these risk factors. No matter in what phase the partnership fails, the partnership expense will occur. Only if both of the above two phases are successful can the partnership begin to flourish and potentially see a profit. This study uses conditional probability analysis to explain the operation of the partnership life cycle.
Since the theories of Strader et al. (1998) are more complete and clearer than those of Scanzoni (1979), this study then applies the theories of Strader for the transportation partnering life cycle. Figure 1 shows the life cycle of partnership:

Figure 1. The Life Cycle of Partnership

After reviewing the relevant literature, we conclude that the core risk factors are expressed by four concrete concepts: interdependence level, objectives consensus, information sharing, and speculation behavior. The ways they lead to partnering risk are briefly illustrated as follows:

(1) **Interdependence level**: 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 (Beier & Stern, 1969; Frazier & May, 1983). Research concluded the existence of a positive relationship between interdependence and commitment through empirical evidence (Kumar & Steenkamp, 1995; Ruyter & Wetzel, 1999).

(2) **Objectives consensus**: Objectives consensus is 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 (Morgan & Hunt, 1994). 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 (Lambert et al., 1996). The objectives consensus has a positive relationship with commitment. That is, the higher the degree of the objectives consensus, the higher the commitment.

(3) **Information sharing**: Information sharing is broadly defined as the willingness to engage in 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 and EDI (Anderson et al., 1990; Lambert et al., 1996; Lambert et al., 1999; Leverick & Cooper; 1998). Ineffective information sharing would easily lead to errors in policy, strategy and operation levels, so as to affect the degree of commitment.

(4) **Speculation behavior**: Speculation behavior refers to lack of honesty in transactions to include “seeking self-interest with guile” (Williamson, 1975). 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 (Moore, 1998). When a party believes that a partner engages in speculation behavior, such perceptions will lead to decreased trust and eventually to depressed commitment.
3. RISK ANALYSIS MODEL FOR PARTNERING

Based on port operators’ and container carriers’ business extension needs, they can cooperate by partnering to take advantage of their respective core competencies. The partnership is achieved by means of resources and information sharing, procedure reengineering, economies of scale and minimization of forecast errors. Therefore, this study assumes that there is least a container carrier who will build a partnership with a port operator. The port volume must be increased and assured because of the partnering. On the other side, container carriers can get a lower port charge, decreasing their operation cost and allowing them to develop their efficiency. It is impossible that the partnership will always be successful. This study is discussing the partnering risk between two parties from the port operator’s viewpoint. If the container carrier fails the partnership for any reason, this will cause some risk to the port operator.

As defined, the partnering risk is the gap between presetting profit and expected net revenue of partnering. The presetting profit ($EV_k$) is giving by the port operator before partnering. It may be arbitrated and roughly estimated by the decision marker. On the contrary, the expected net revenue ($NR_k$) is an objective and well-advised value derived through analytical process. Therefore, the risk for each partnering types is written as Equation (1):

$$RISK_k = \begin{cases} 0, & EV_k \leq NR_k \\ EV_k - NR_k, & EV_k > NR_k \end{cases}$$  \hspace{1cm} (1)

There will be no risk when the presetting profit is smaller than the expected net revenue. Otherwise, the risk of partnering will occur.

The expected net revenue of partnering is termed as profit (gain) or loss resulting from partnering. The quantitative risk expression is thus written as indicated in Equation (2):

$$NR_k = G_k - L_k$$  \hspace{1cm} (2)

where

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

$NR_k$: expected net revenue of partnership type $k$;

$G_k$: expected gain for partnership type $k$;

$L_k$: expected loss for partnership type $k$.

In Equation (2), $G_k$ 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 (3). 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 (4):

$$G_k = \sum_{i=1}^{2} (1 - p_{ik}) \times q_k$$  \hspace{1cm} (3)

$$L_k = p_{1k} \times q_{1k}' + (1 - p_{1k}) \times p_{2k} \times q_{2k}'$$  \hspace{1cm} (4)

where

$i$: phase of partnering (construction 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 success for partnership type $k$ in partnering phase $i$.

While substituting Equations (3) and (4) to Equation (2), the expected net revenue is rewritten as Equation (5):
\[ NR_k = \prod_{j=1}^{2} \left( 1 - p_{ik} \right) \times q - p'_{1k} \times q'_{ik} + (1 - p_{1k}) \times p_{2k} \times q_{2k}' \]  \hspace{1cm} (5)

As illustrated, the termination probability is determined by the core risk factor of lack of commitment that is associated with four identified 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 risk factor \( \delta_{ijk} \), as shown in Equation (6):

\[ p_{ik} = \sum_{j=1}^{n} \left( w_{ijk} \times \delta_{ijk} \right) \] \hspace{1cm} (6)

where
\[ w_{ijk} : \text{weight of importance of risk factor } j \text{ for partnership type } k \text{ in the partnering phase } i; \]
\[ \delta_{ijk} : \text{probability of occurrence of risk factor } j \text{ for partnership type } k \text{ in the partnering phase } i. \]

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 (Al-Harbi, 2000; Huser & Tadikamalla, 1996; Saaty, 1980). First, we established one comparison matrix of weight of importance of risk factor \( j \) for partnership type \( k \) and phase \( i \). The matrices, as indicated in Equation (7), 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.

\[
A = \begin{bmatrix}
1 & w_{1j} & w_{1j} & w_{1j} \\
\frac{w_2}{w_1} & 1 & w_{2j} & w_{2j} \\
\frac{w_3}{w_2} & \frac{w_3}{w_1} & 1 & w_{3j} \\
\frac{w_4}{w_3} & \frac{w_4}{w_2} & \frac{w_4}{w_1} & 1 \\
\end{bmatrix} \hspace{1cm} (7)
\]

As for partnering consequences, they are divided into two categories: 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 (8). They differ by both partnership type and termination phase.

\[ q'_{ik} = \sum_{j=1}^{i} C_{rk} + c_{ik} \] \hspace{1cm} (8)
where
\( c_{rk} \) : relation cost for partnership type \( k \) in partnering phase \( r \), (construction phase: \( r = 1 \) and maintenance phase: \( r = 2 \));
\( c_{ik} \) : 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 (9) and (10):

\[
q_k = rev_k - \sum_{i=1}^{2} c_{ik}
\]

\[
rev_k = orev_k + crev_k
\]

where
\( rev_k \) : 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 incurs 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 (11). In addition, the capital return \( (crev_k) \) of partnership is measured as the product of capital amount \( (\Phi_k) \) and the expected return rate \( (\sigma_k) \), as indicated in Equation (12):

\[
orev_k = pri_k \times vol_k
\]

\[
crev_k = \Phi_k \times (\sigma_k - 1)
\]

where
\( pri_k \) : negotiated service charge by partnership type \( k \);
\( vol_k \) : additional transportation demand incurred by partnership type \( k \);
\( \Phi_k \) : capital amount spent for partnership type \( k \), it only occurs when \( k=3 \);
\( \sigma_k \) : expected return rate from capital investment for partnership type \( k \), it only occurs when \( k=3 \).

While substituting Equations (10), (11), and (12) into Equation (9), the expression of the consequences of partnering success is rewritten as Equation (13).

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

The additional demand volume is measured as overall market volume \( (m) \) multiplied by the difference of market share \( (\lambda_k) \), as indicated in Equation (14):

\[
vol_k = m \times (\lambda_k - \lambda_0)
\]

where
\( m \) : the overall market demand volume;
\( \lambda_k \) : the market share resulting from partnership type \( k \);
\( \lambda_0 \) : the original market share.
4. MODEL APPLICATION AND SIMULATIONS

Considering the uncertainties which inevitably emerge in any complicated partnering activity, we designate the partnering risk models as a stochastic process, rather than a deterministic one. 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-making and environmental ambiguities inherent in such a complex process. However, the model calibrations and calculations thus become difficult to solve; as a result, simulations are chosen as an effective method of dealing with the resultant complications.

4.1 Parameter Setting

The parameters of simulation, including relation cost, termination cost, capital return rate and additional transportation demand, are gained from interview. We selected eight main container carriers in the port of Keelung in Taiwan for the case study. We enlisted the cooperation of high-level managers in those shipping companies, and asked them to provide us with the information we needed as data for variables in our model. According to the supplied maximum, median and minimum values, we composed the triangle probabilities distribution for each variable in order to describe the uncertainty situation as input data for the risk analysis model. Furthermore, we assumed certain scenarios, as outlined below. All of the parameters are shown in Table 1.

(A) Port annual container handling volume: 1,800,000TEU, It is used to illustrate the market volume in the port. Within the study period, the size of market is unchanged.

(B) Basic port tariff: NTD 2,500/TEU. It assumes that the port charge is a flat structure.

(C) Discounted port tariff: According to the type of partnership, the port operator gives container carriers 5%, 10% and 20% discounts to attract their ship calling and container handling. It also provides for some differences for market sharing and value sharing between each partnering.

4.2 Weight of Risk Factors

Moreover, we asked for and were provided with termination probabilities and weights of risk factors for partnering with the selected eight companies. The relative weight values are calculated by using AHP technique through pairwise comparison. The weights of risk factor, such as interdependence level, objectives consensus, information sharing and speculation behavior, in two different phases are shown in Table 2. The consistency ratios of two phases are 0.04 and 0.08. All of them meet the consistency requirement (C.R. <0.1) of AHP.

4.3 Result of Simulation

The quantitative model is designated to be a stochastic process and is measured through Monte Carlo simulations using the computer software program @RISK 4.5. The case study was conducted through interviewing eight high-ranking officers of container carriers to obtain required parameters as specified in Table 1. Triangle distributions and 1,000 iterations are justified to simulate the risks of different partnering scenarios. Figure 2 to Figure 7 shows the result of these simulations.

First, the port operator is assumed to be partnered with a container carrier who has 20% market share. We compared the different types of partnership and presented the results as Figure 2 to Figure 4. Because there is no relation cost and termination cost in a 'no resources-involving' partnership, as Figure 2 shows, there is low and concentrated expected revenue in the simulation. When the relation cost is included, the Figure 3 shows that there may be some losses after the partnership is terminated. The partnering revenue will increase when the port operator and container carrier invest their resources in cooperation. Because of the capital return, the revenue will increase obviously in the Figure 4 scenario.
Table 1. The parameters for simulation

<table>
<thead>
<tr>
<th>No Resources-Involving</th>
<th>Resources-Involving</th>
<th>Resources Crossly-Involved</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Relationship Cost (NT$10K)</strong></td>
<td>0</td>
<td>Tri(3000,6000,10000)</td>
</tr>
<tr>
<td><strong>Termination Cost (NT$10K)</strong></td>
<td>0</td>
<td>Tri(120,160,200)</td>
</tr>
<tr>
<td><strong>Rate of Return</strong></td>
<td>0</td>
<td>Tri(1.2,1.35,1.5)</td>
</tr>
<tr>
<td><strong>Additional Volume</strong></td>
<td>Tri(-0.05,0.1,0.15)</td>
<td>Tri(-0.1,0.1,0.8)</td>
</tr>
<tr>
<td><strong>Port Charge Discount</strong></td>
<td>95%</td>
<td>90%</td>
</tr>
<tr>
<td><strong>Port Tariff Base (NT$10K)</strong></td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td><strong>Annual Volume (TEU)</strong></td>
<td>1,800,000</td>
<td>1,800,000</td>
</tr>
</tbody>
</table>

Note: Tri(a, b, c) denotes triangle distribution with maximum value (a), medium value (b), and minimum value (c).

Table 2. Weights of Risk Factors in Two Different Phases

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>Construction phase</th>
<th>Maintenance phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interdependence level</td>
<td>0.143</td>
<td>0.383</td>
</tr>
<tr>
<td>Objectives Consensus</td>
<td>0.511</td>
<td>0.328</td>
</tr>
<tr>
<td>Information sharing</td>
<td>0.290</td>
<td>0.168</td>
</tr>
<tr>
<td>Speculation behavior</td>
<td>0.055</td>
<td>0.120</td>
</tr>
<tr>
<td>C. R.</td>
<td>0.04</td>
<td>0.08</td>
</tr>
</tbody>
</table>

Second, this study examines the revenue distribution by accumulating probability distribution as Figure 5 shows. The port operator is assumed to have a partnership with a container carrier who has 40% market share. We compare the ‘resources-involving’ or ‘no resource-involving’ partnership. Figure 6 shows that the distribution curve of the ‘resources-involving’ partnering is more disperse than the ‘no resource-involving’ one. The spikes of two probability distribution curves both are close to zero. Furthermore, Figure 7 shows that we found that the distribution curve of partnering with 40% market share is more disperse than 20% market share partnership.

The study found that higher risks would occur in ‘crossly-involved resource’ partnering than with the other two partnering types. Empirically, the variation of risk incurred to small-scale partnered carriers, whose market share is less than 20%, was found to be smaller than that incurred to the large-scale carriers, whose market share was greater than 40%.

The parameter sensitivity analysis of this model using rank correlations is based on the Spearman rank correlation coefficient calculations by @RISK. With this analysis, correlation coefficients are calculated between the output values and each set of sampled input values. (Palisade Corporation, 2002) Three important parameters (value greater than 0.4) are selected for sensitivity analysis.

The results of sensitivity analysis (in table 3) showed that there is no difference on input parameters for 20% or 40% market share. The ‘additional volume’ is the most sensitive parameter in ‘no resources-involving’ partnership. Similarly, the ‘rate of return’ is the most sensitive one in ‘resources crossly-involved’ partnership. In the ‘resources-involving’ partnership, especially, two parameters are significantly sensitive in the sensitivity analysis. The ‘additional volume’ is positively correlation to the input value and more sensitive than the ‘relationship cost’ at 40% market share. On the contrary, the ‘relationship cost’ is negatively correlation to the input value and more sensitive than the ‘additional volume’ at 20% market share.
Table 3 Sensitivity analysis for simulation parameters

At 20% market share

<table>
<thead>
<tr>
<th>parameter</th>
<th>No Resources-Involving</th>
<th>Resources-Involving</th>
<th>Resources Crossly-Involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Volume</td>
<td>0.9275 (0.9905)</td>
<td>0.5865 (0.5718)</td>
<td></td>
</tr>
<tr>
<td>Relationship Cost (NT$10K)</td>
<td>-0.8015 (-0.8073)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate of Return</td>
<td>1.0000 (0.9999)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

At 40% market share

<table>
<thead>
<tr>
<th>parameter</th>
<th>No Resources-Involving</th>
<th>Resources-Involving</th>
<th>Resources Crossly-Involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Volume</td>
<td>0.9283 (0.9894)</td>
<td>0.9089 (0.9163)</td>
<td></td>
</tr>
<tr>
<td>Relationship Cost (NT$10K)</td>
<td>-0.3922 (-0.4098)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate of Return</td>
<td>1.0000 (0.9999)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: ( ) denotes correlation coefficient.

Figure 2. The Probability Distribution of No Resources Involving (NRI) Partnering for Expected Revenue, with 20% Market Share Carrier

Figure 3. Probability Distribution of Resources Involving (RI) Partnering for Expected Revenue, with 20% Market Share Carrier

Figure 4. The Probability Distribution of Resources Crossly-Involved (RCI) Partnering for Expected Revenue, with 20% market share carrier

Figure 5. Cumulate Probability Distribution of NRI Partnering for Expected Revenue, with 20% market share carrier
5. MODEL EXPANSIONS AND DISCUSSIONS

By means of our risk analysis model simulation, demonstration of port operator decision-making and risk-consideration is tested feasibly and practically; on the other hand, through methods of triangular probability distribution and Monte Carlo simulation, we also offer a depiction of the effect on the partnering relationship by whatever uncertain risk factors might cause a divergence of partnership. Yet, it is clear that there remains much to be done in order to model theoretical development and its employment, listed as follows:

(1) This model focuses on port operators’ benefits and reflects its measurements of correlative risk factors in terms of business operation surplus, which is further commuted into monetary value only. Obviously, a more complete analysis of the construction of a partnership should not just emphasize the port operators’ interests, but should also take into consideration the allies’ concerns for balance, as this happens to be a prime prerequisite factor in deciding the duration and cooperation of the relationship. Therefore, this study suggests that a complete and balanced partner relationship framework should contain equal risk evaluations based on model simulation for both sides; this relationship structure is shown as Figure 9(A). Whenever conflicts between two sides emerge, it is worthwhile to either adopt conventional multi-objectives theories to generate an optimum solution, or to employ game theory to describe a mutual decision-making process.
This model derives partnership success and termination probability from in-depth interviews of container shipping decision-makers as to what factors of partnership could divert decisions of cooperation, that is, by analyzing ways of comprehending how interdependence level, objectives consensus, information sharing and speculation behaviors contribute to the possibilities of deterioration or break-up of relations, and evaluating risk conditions for the duration of partnership between container shipping liner and port operator. But, scenarios change when assessing the subjects from either the port operator’s or container carrier’s viewpoint, or extending the single partner to plural numbers of container carriers, the relationship structure shown as Figure 9(B), or even constructing a multi-sided relationship network. All these scenarios result in various combinations which increase the complexity of this model and its operation. Therefore, on the first phase, we merely focus only on a single party’s objective to evaluate its ally combination, but expect further and more-developed descriptions of the partnership decision-making process when different scenarios can all be included in the future, as in the relationship structure shown in Figures 9(C) and 9(D).

Figure 9. The Further Expansions of This Study

In this model, we include parameters of specific uncertain factors by triangular probability function and Monte Carlo simulation to generate expected revenue. However, the actual distribution status of parameters and their reciprocal relations leave more fields to be explored. In other words, the inherent limitations of this risk simulation model constitute another ‘risk’ assessment issue.

In contrast to assessing appraisals of figures in this model, which merely evaluates on the basis of monetary units, we find, through some other assessing techniques, a structure of partnership in light of non-monetary factors to obtain values of relative risks can be an effective alternative for decision-makers to be informed about risk differentiations.

The additional transportation demands incurred are associated with two service attributes provided, i.e. service charge and travel time (Cullinane & Toy, 2000). In theory, the lower the service charge, or the shorter the travel time, the greater the additional demand volumes, and vice versa. For purposes of condensing and simplifying the operational
procedures of the simulation, we put aside Tsai et al.’s disaggregate demand Logit model, which includes extra transportation volume as one of the considering parameters, owing to high frequencies of freightage fluctuation and flexible marketing strategy on which fares, services and volumes can not be fully controlled. Hence, we use a triangular probability function to fix the uncertainty of transportation volumes and assume market scales are stable all the time. Nevertheless, whenever this model is reinforced to grasp factors beyond the previously-mentioned ones adopted here, (interdependence level, objectives consensus, information sharing, and speculation behavior), it is certainly time for making use of Logit model’s conception of disaggregate demand so as to extend and fortify our model.

6. CONCLUSIONS AND RECOMMENDATIONS

The core concept of this study is based on integrating for supply chain management. It also explored the partnership building between port operators and carrier in the container business. This reduced total cost and increased core competency in the shipping market. Risk is seen as the core issue in partnering. The partnering risk is defined as the difference between presetting and expected revenue for the port operator. The gain or loss of partnering is computed by weighting the sum of each event of probability and consequence. This study identifies three types of partnership depending on the resources spent, i.e., ‘no resource-involving’ partnership, ‘resources–involving’ partnership, and ‘resources crossly-involved’ partnership.

There are different risk levels due to relationship costs, partnering gain or termination loss in each type of partnership. This study concluded interdependence level, objectives consensus, information sharing, and speculation behavior are the principal factors affecting partnership risk. This study also follows the life cycle of partnering through two phases, the construction and relationship maintenance phases. Each of the construction and maintenance phase will be terminated by risk factors. There are termination costs associated with the termination phase. The partnering risk models are designated to be stochastic processes and measured through simulations using the computer software program @RISK. By means of our risk analysis model simulation, a demonstration of port operation decision-making and risk-consideration is tested feasibly and practically. The study found that higher risks would occur in ‘crossly-involved resource’ partnering than in other partnering scenarios. Empirically, the variation of risk incurred to small-scale partnered carriers, whose market share is less than 20%, was found to be smaller than that incurred to the large-scale ones, whose market share is greater than 40%.

Further research is recommended to take risk mitigation strategies into account as decision variables for the extension of partnering risk issues. Therefore, we suggest that a complete and balanced partner relationship framework should contain equal risk evaluations based on model simulation of both sides and taking into consideration every relevant party.

REFERENCES


