# Discriminate by rough set methodology to Select Compound or Portfolio Relationships Oriented in Taiwan IT Industry

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*Abstract:* - Under the rapid change business environment, the relationships of inter-organization in supply chain will be transformed from single to complex relationships, and complex relationships could be categorized into "Compound Relationships" or "Portfolio Relationships". Theme of this research is to demonstrate how the external/internal resource and maintained flexible volatility of inter-organization will affect the competitive advantage for organization. Most current existed literatures of inter-organization in supply chain are focusing on the kind and features of the simple relationships or portfolio relationships. This study will use Rough set methodology to discriminate nature relations between compound relationships oriented and portfolio relationships oriented the theoretical framework model concerning the influence factors of the different selection between inter-organization in Supply Chain. Our goal is to provide the selection model which is built by discriminate analysis and Rough set methodology; furthermore, to encourage more academic and practical studies interactions.

*Key-Words:* - Relations Oriented Selection model, Compound Relationship, Portfolio Relations, Discriminate Analysis, Rough set.

# **1** Introduction

The most and major current literatures we could found about inter-organizational relationships in supply chain are mainly in the discussions of organization development, history, partnership relations selection, relationship management, relations network formation. or long-term relationship management issues singly. As mentioned before, we found that different types of relation that an organization selects, will cause vary inter-organizational network connection and long-term relations. Furthermore. each inter-organizations supply chain will select its own relationship types which will bring more benefits and synergy in their organizations.

According to current literature, we found that simple relationship between inter-organization exist two types - "Compound Relationship & Portfolio Relationship". Portfolio Relations provide a mechanism for conceptualizing and managing customer, supplier and indirect sets of relationships which surround a firm. The relations linkage may be competitive or cooperation. The effects of each relations linkage will be positive or negative. Compound Relationships defines these complex relationships (see Figure1). Formally, we define a compound relationship as being composed two or more simple relationships between a pair of firms. We define simple relationships as separate and distinct relationships that occurs when two firms in same supplier chain, such as supplier to customer, competitor to competitor, or joint partners. The purpose of this study is that the selected relationship model can help firms to easily to select relationship type to bring more benefits, also helps the firs to have long term relationship with their partners to increase their own advantage.

Fig :	1	Compound	Relationship	and its	component	[8]
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# 2 Literature review

#### 2.1 Basic concepts of rough sets

Rough sets theory was proposed by Pawlak [1]. The central concept of rough sets is a collection of rows that have the same values for one or more attributes. These sets called elementary sets are indiscernible [2]. Rough sets incorporate the use of indiscernible relations to approximate sets of objects by upper and lower set approximations. The upper and lower approximations represent the classes of indiscernible objects that possess sharp descriptions on concepts but without sharp boundaries.

The elementary set forms a basic granule of knowledge about the universe. Any subset of the universe can be expressed either precisely or roughly [3]. A certain subset of the universe can be characterized by two ordinary sets which are called the lower and the upper approximation set. For each subset X of the universe, the lower approximation set consists of all objects which certainly belong to X and the upper approximation contains objects which possibly belong to X.

The focus of initial rough sets applications is mainly placed on medical diagnosis, drug research, and process control. In fact, in recent years there has been a rapid growth of interest in rough sets theory and its applications, worldwide [4].

Decision rules of rough set models constitute a formal language to describe approximations in logical expressions (implications) [5]. Decision rules

are expressed in the form of "If <conditions> Then <decisions>". Certain rules correspond to the lower the uncertain approximation, whereas rules correspond to the boundary region. The certainty and the coverage factors of decision rules are conditional probabilities which describe how exact our knowledge is about the universe. Each decision rule is characterized by the strength of its conclusion, which is indicated by the number of objects satisfying the condition part of the rule and belonging to the decision class [6]. In generating decision rules based on inductive learning principles, the objects are regarded as examples of decisions. To induce decision rules for describing a set of objects, the examples belonging to it are called positive and all the others negative. A decision rule is discriminant if it distinguishes positive examples from negative ones and it is minimal. With the prescription ability of how to make a decision under specific conditions, decision rules derived give pertinent information useful for decision support.

To have the best quality of approximation of classification with a minimal set of decision rules, not all the condition attributes in the information table are to be used. An important step in the rough set approach is to identify the minimal subset of condition attributes (called a reduct), which provide the same quality of classification as the whole set of attributes. Attributes that do not belong to a reduct are superfluous in terms of classification of elements of the universe [7]. If an information table has more than one reduct, the intersection of all reducts is called the core of attributes. The core is a collection of the most significant attributes in the table, without any of which the quality of classification will reduce.

# 2.2 Compound Relationship

A relationship is a connection between two entities (entities can be organizations, people, societies, or even nation-states), such that the entities have explicit roles for which there are expected norms of behavior. Ross & Robinson narrow our thinking to the types of simple relationships that two firms may have with each other—for example, a supplier– customer relationship or a competitor–competitor relationship. [8]

To understand this, consider a given firm and its relationships with another firm. Ross & Robinson categorize the simple relationships that it and the other firm might undertake into four basic types: customer to supplier, in which the firm buys a product or service from the partner firm; supplier to customer, in which the firm sells a product or service to the partner firm; competitor to competitor, in which the two firms compete with each other for some resource (e.g., customers); and partners, in which the two firms work together, formally or informally, to achieve a common goal.[8]

Each simple dyadic relationship that we have discussed can be envisioned as containing a political economy and existing within an environment in other simple relationships is a negligible part of the environment. Each firm must pay attention to its behavior with the other firm. Second, and conversely, performing well in one simple relationship may harm other simple relationships. Third, performing well in one simple relationship may lead to additional relationships.

# 2.3 Portfolio Relationship

This externalization of value activities is dependent on creating strong supplier partnerships in those activities that have high strategic relevance for the customer firm. The externalization process is well led hierarchical documented and structures consisting of several tiers of suppliers forming complex supply chain networks. A relationship may also have an effect on other relationships. The majority of relationship portfolio models are based on customer or supplier relationship portfolio modeling. Moreover, indirect relationships often be analyzed and managed in the purpose for competitors. The best-known models include both two and three dimensional axes along with single, two and three phase analyses [9]. The most often cited relationship portfolio models include the ones by Fiocca, Campbell & Cunningham, Krapfel, Salmond & Spekman, Olsen & Ellram and Turnbull & Zolkiewski [10, 11, 12, 13, 9].

The definition of interconnectedness points out important characteristic another of interconnectedness. Between any two relationships (x) and (y) there can be an affect of (x) on (y): "a relationship affects other relationships." At the same time there can be an effect of (y) on (x): "a relationship is affected by other relationships [14]". Thomas develop six different cases of interconnectedness between any two relationships [14] :

(1) Neutrality Effect: No interconnectedness between two relationships exists when the two relationships are totally independent. (2) Assistance Effect: A one-sided positive effect between two relationships can occur when experiences made in one relationship can be used in the other. (3) Hindrance Effect: If one relationship is hindering the other and there is no impact in the opposite direction, there is a one-sided negative effect. (4) Synergy Effect: Two-way positive effect means that both relationships support or even necessitate or presuppose each other. (5) Lack Effect: Between two relationships a positive and a negative impact can coexist. (6) Competition Effect: Two relationships can also weaken or even exclude each other. Thomas proposed that portfolio relationship have some features. The following examples illustrate interconnectedness of relationships [14]:

# 1) System selling

Within the process of system selling, heterogeneous contributions of more than one company are brought together in order to provide a "complete" or "complex" solution to the customer. Taking computer systems as an example, hardware, software and installation as well as customizations or adaptations will be offered in one package to the customer by different, but cooperating companies.

2) Combination advantages

Combination advantages occur when companies allow access to, or pool, one another's (homogenous) resources.

3) Mediation

Companies mediate inter-organizational can relationships through actively promoting the relationship initiation process between two companies (e.g., the European Commission pays mediators which initiate inter-organizational cooperation's within the SPRINT network).

4) Surety

Like the previous examples, surety can only be understood by analyzing at least three parties. In an industrial setting, a surety can be given by one actor for enabling two other actors to do business together.

# 2.4 The factors interact with Compound Relationships or Portfolio Relationships Selection

1) Dominate relationships

An issue to consider is which of the simple relationships that constitute a compound relationship is likely to be more important than the others. Ross & Robinson expected that the dominant simple relationship between the two firms is the competitor–competitor relationship and that the supplier–customer relationship is less important, though this may change with time and changing market circumstances [8].

The first of these, and we speculate the strongest, is path dependence [15], expressed in this case in the primacy of the original relationship. Two firms that began with a certain relationship (e.g., supplier to customer or competitor to competitor) may find it difficult to introduce norms that are appropriate to other simple relationships into the compound relationship. The other two factors are perhaps more rational; they consider the economic and strategic realities of the various simple relationships. There may be other factors that influence which simple relationship is the dominant relationship, but we believe that these three are especially important ones. H1: The dominant relationships are positively effect the selection of compound relationships and negatively effect selection of portfolio relationships.

#### 2) Relations stability

Relationship stability is a consistent reflection of dyadic favorable relational attitudes in an active working relationship which continues for a period of time.

(1.) Bidirectional Relationship

The two firms might simply be influencing each other in one simple relationship (e.g., a partner relationship in which influence is bidirectional). Anderson & Narus proposed that Bidirectional relationship [16].

(2.) Long-term Relationships

In the present study, two firms build trust to sustain interfirm long-term relationship development. On the other interfirm trust will decrease the partnership to against the opportunism [17]. The literature on trust suggests that confidence on the part of the trusting party results from the firm belief that the trustworthy party is reliable and has high integrity. Essentially, future interaction between exchange partners provides an opportunity to reward good behavior and punish opportunism [18].

#### (3.) Relative Powers

All relationships have power levels; that is, the two firms in the relationship each have some power [8].

H2-1: Bidirectional relationships are positively effect the selection of compound relationships and negatively effect selection of portfolio relationships.

H2-2: Long-term relationships are positively effect the selection of compound relationships and

negatively effect selection of portfolio relationships.

H2-3: Relative powers are positively effect the selection of compound relationships and negatively effect selection of portfolio relationships.

#### 3) Relational Risk

(1.) Opportunistic Behavior

Many scholars posit that when a party believes that a partner engages in opportunistic behavior, such perceptions will lead to decreased trust and increase the competitiveness between each other [19, 20, 21]. Ross & Robinson [8] mentioned that compound relationships can act as a safeguard against opportunism in at least two ways: (1) through the imposition or threat of sanctions from one component simple relationship to another and (2) by reliance on trust and reputation built in one or more of the component simple relationships.

H3-1: Opportunistic behavior is positively effect the selection of compound relationships and negatively effect selection of portfolio relationships.

(2.) Conflict

Conflict is refer to Firat et al. [22] & Etgar [23] marketing channel members to comprehended keeping other channel members from reach goals. Conflict represents the overall level of disagreement in the working partnership [16]. Conflict is between partners' goals, resource share and degree of incompatibility of activities [24].

# H3-2: Conflict is negatively effect the selection of compound relationships and positively effect selection of portfolio relationships.

#### (3.) Uncertainty

Uncertainty is referring to transaction cost theory [18] and somewhat contrary to the transaction efficiency approach, resource dependence theory [26]. Ross & Robinson [8] have raised issues related to how the relationship works both socially and economically. We now turn to the political economy framework [27, 28, 29] and explicitly delineates the internal sociopolitical and economic structures and processes



of an institution and the external environment that influences them.

H3-3: Uncertainty is negatively effect the selection of compound relationships and positively effect selection of portfolio relationships.

#### 4) Intelligence Property

About this topic we interview with some corporate, senior South Asia Business Unit Commissioner, Kenda Rubber, Information Division Section chief, Formosa Plastics Gao Sheng Commissioner. After interview with those corporate, we can sort out that many mature products and technologies had their own patents. Each vendor conduct the business strategy to protect the development of its products and intellectual property, that means patents become one of business strategy. Therefore, at this time, before moving on to the products and technology developers, can significantly reduce its research and development costs, but the risk will stop improvement. For those who follow the products and technologies, wishes to reduce the risk and lower the cost of research and development for product innovation.

H4: Intelligence property is negatively effect selection of compound relationships and positively effect selection of portfolio relationships 5) Allocation of end customer

Mentzer et al. that the Organization for customer orders allocation will be part of the four individuals linked quality, to receive orders to ship the number of quality information and ordering process, the four organizations will become part of the control orders Possession of the main factors [30]. The aim of the customer-oriented and establish a good communication mechanism to avoided the bullwhip effect.

# H5: End customer orders allocation is positively effect selection of compound relationships and negatively effect selection of portfolio relationships.

#### 6) The cost of one-step

In economics and cost accounting, cost of one-stop describes the total economic cost of production and increase variable costs, which vary according to quantity produced such as raw materials, plus fixed costs, which are independent of quantity produced such as expenses for assets like buildings.

H6: The cost of one-stop is positively effect selection of compound relationships and negatively effect selection of portfolio relationships.

# 3 Research method

This study uses the main sample as the firms' production managers of top 2000 manufacturing firms in Taiwan. The scope of research includes all the activities like forwarder got the freight from the owners' cargo, to order the shipping space from marine transportation companies, and to deliver the freight to the destination or receiver.

# 3.1 Contents Validity

All measures of the survey instrument were developed from the literature. The expressions of the items were adjusted. Where appropriate to the context of marine transportation logistics. The items were to be measured on a seven-point Likert scale, ranging from 'Strongly disagree' (1) to 'Strongly agree' (5).

#### 3.2 Pre-test and pilot-test

A pre-test was performed with four managers from different enterprises and four Ph.D. students on a questionnaire consisting of 18 items of the survey instrument for improvement in its content and appearance. Then several large marine transportation firms were contacted to help with the pilot-test of the instrument. The respondents were asked to complete the questionnaire and provide comments on the wording, understandability and clarity of the items, as well as on the overall appearance and content of the instrument. The responses suggested only minor cosmetic changes and no statements were removed. After minor changes being made and further review by two other expert academics, the instrument was deemed ready to be sent to a large sample in order to gather data for testing our research model

# 3.3 Data collection

Two rounds of survey were conducted by distributing the survey instrument in the form of questionnaire to the production managers of top 634 IT industries in Taiwan. These firms were listed in the directories of the top 5000 companies in Chinese Credit 2007 (Taiwan's leading credit company). Therefore, the result of this survey was 64 effective responses with the total response rate of 10.09%. There was no discrepancy from the industry distribution of firms used in this survey when facilitating a chi-square to analyze the industry distribution of respondents. This suggested no non-response bias in the returned questionnaires. Table 1-1 to table 1-5 shows the demographic and characteristic profiles of participating firms.

Table 1-1 Profiles of participating freight cargo-forwarding firms

Professional title	Number of firms	Percentage
Chairman/President	0	0.00%
General Manager	2	0.83%
General Assistant Manager	44	1.66%
Manager	55	22.82%
Assistant Manager	72	29.88%
Raletive Qualification Staff	109	44.81%

Table 1-2 Profiles of participating freight cargo-forwarding firms

Types of operation	Number of firms	Percentage
Taiwan's company	214	88.80%
Foreign company	5	2.07%
Taiwan-Foreign Joint venture	22	9.13%

Table 1-3 Profiles of participating freight cargo-forwarding firms

Years of establishment	Number of firms	Percentage
Less than 5 years	4	1.66%
6-10 years	22	9.13%
11-15 years	29	12.03%
16-20 years	29	12.03%
21-25 years	37	15.35%
26-30 years	28	11.62%
Above 31 years	92	38.17%

Table 1-4 Profiles of participating freight cargo-forwarding firms

Industry type	Number of firms	Percentage
Agricultural/food/beverage	11	4.60%
Textiles/fiber	11	4.60%
Leather/footwear	2	0.84%
Timber/bamboo/rattan	4	1.67%
Printing and related support activities	38	15.90%
Chemical/plastics	6	2.51%
Non-metallic mineral products	30	12.55%
Basic metal industries	21	8.79%
Electrical machinery/Machinery and equipment	76	31.80%

Electronics/communication	15	6.28%
Transport equipment	20	8.37%
Electronic parts and components	5	2.09%
Others	0	0.00%

Years of cooperate with the main company	Number of firms	Percentage
Less than 1 year	1	0.41%
2-5 years	33	13.69%
6-10 years	74	30.71%
11-15 years	48	19.92%
16-20 years	44	18.26%
Above 21 years	41	17.01%

# Table 1-4 Profiles of participating freight cargo-forwarding firms

# 4 Result

# 4.1 Assessment of the discriminate analysis

Cause that this study just confers two groups as compound or portfolio relationship oriented. Means we have just one differentiation function for our study. Per the synchronous estimation, we can have 12 forecast variables and result as table 2 and show the verification on table 3.

Item	Std	Inter-group Std	F Value
History	0.7953	0.0810	0.88* (0.0001)
Economic importance	0.6093	0.0240	$\begin{pmatrix} 0.13 \\ (0.7181) \end{pmatrix}$
Strategic value	0.6013	0.1184	3.32* (0.0001)
Bidirectional Relationships	0.7399	0.0652	$\begin{pmatrix} 0.65 \\ (0.4197) \end{pmatrix}$
Long-term Relationships	0.6659	0.0369	$\begin{pmatrix} 0.26 \\ (0.6114) \end{pmatrix}$
Relative Powers	0.7793	0.0109	$\begin{pmatrix} 0.9 \\ (0.021) \end{pmatrix}$
Conflict	0.9643	0.0497	$\begin{pmatrix} 0.22\\ (0.1373) \end{pmatrix}$
Opportunistic Behaviors	0.7943	0.1315	$2.33^{*}$ (0.0001)
Uncertainty	0.6184	0.0472	$\begin{pmatrix} 0.49 \\ (0.4849) \end{pmatrix}$
Intelligence property	0.6950	0.1034	$1.88^{\circ}$ ( 0.0001 )
End customer order placement	0.637	0.004907	(0.338)
Total cost	0.6870	0.0467	0.39 (0.5340)

Table 2 Wilks' Lambda

IT Industry						
Actual	Portfolio Relationshi P	Compound Relationship	Total			
Portfolio Relationship	19	8	27			
Compound Relationship	7	21	28			
Total	26	29	55			
Correct rate : 72.73% Type I error : 29.63% Type II Error : 25.00% $C = \left(\frac{27}{55}\right)^2 + \left(\frac{28}{55}\right)^2 = 0.499 * 1.25 = 50.02\%$						

# 4.2 Reliability Analysis

Analysis of letters degree (Reliability Analysis) is a test tool for measuring volume of letters degree and stability of the main methods. Due to Davis, et al. study found that reliability differences between the samples and used methods of measuring reliability [31]. As the result show in table 4.

Table 4 Reliability analysis

Item	Error variance	Cronbach's alpha
History	0.59137	0.685
Economic importance	0.61223	0.675
Strategic value	0.72837	0.661
Bidirectional Relationships	0.82008	0.668
Long-term Relationships	0.62514	0.682
Relative Powers	0.79564	0.670
Conflict	0.63640	0.681
Opportunistic Behaviors	0.93900	0.646
Uncertainty	0.56761	0.667
Intelligence property	0.71562	0.664
End customer order placement	0.70780	0.656
Total cost	0.66592	0.667
Cronbach's alpha = $0.678$		

# 4.3 Assessment of the structural model

After using rough set analysis, we can have the result as show in table 5.

Table 5 Results of the model classification

	Industry	Discriminate Analysis	Rough set
	Total	64.88%	97.62%
Hit	Information industry	72.73%	98.71%
Ratio	Chemistry industry	84.62%	88.49%
	Metal Industry	95.24 %	76.82%

# **5** Conclusions

# **5.1 Conclusion**

Under the rapid change business environment, the relationships of inter-organization in supply chain will be transformed from single to complex relationships, and complex relationships could be categorized into "Compound Relationships" or "Portfolio Relationships". Our research has 12 hypothesizes include 4 hypothesizes had been supported. Per empirical result could know that the 4 hypothesizes show as below.

Hypothesis 2-2: Long-term relationships are positively effect the selection of compound relationships and negatively effect selection of portfolio relationships.

Hypothesis 3-2: Conflict is negatively effect the selection of compound relationships and positively effect selection of portfolio relationships.

Hypothesis 4: Intelligence property is negatively effect selection of compound relationships and positively effect selection of portfolio relationships

Hypothesis 5: End customer orders allocation is positively effect selection of compound relationships and negatively effect selection of portfolio relationships.

In this study, our research collect documents and in-depth study to explore the basis of the business to building supply chain relationships between the organization, and selection of development models in an attempt to study the basis for establishment of relations with the complex relationship between the combinations of the integrity. A high degree expectation on changing global economic organizations environment, can provide the implementation of the supply chain for complex and relations inter-organizational portfolios also contribute to inter-organizational business activities and create more competitive. As a result, this study of academic theory and economic development is expected to contribute as follows:

- 1) Composite building relations with the combination of the relationship between the relevant theoretical models, and integrity the structure of the study. Follow this study, the future scholars could do more in-depth discussions on the complex relationship between the portfolio and relation to issues related for research.
- 2) Literature research and interviews with enterprise based, complex relationship with the proposed combination of the relationship

between the selection factors for the industry decision making related to the selection of indicators in order to facilitate the implementation of supply chain relationship between the activities of the organization.

3) This study used statistical methods to analysis and classification methods to predict the value of construction oriented relations between the models selection and upgrade its classification of accuracy and breadth of research.

# **5.2 Suggestion**

Our study also provides some suggest for later researches as below:

- 1) Because compound relationship and portfolio relationships have nature of difference, additional benefits also got different distribute. The additional benefited at less include knowledge storage, knowledge sharing. information sharing, information proliferation, ledge creative...etc. techno Therefore. discussion about the different additional benefits with different types of relationships is really valuable research.
- 2) Because the overall relationships within inter-organization in supply chain would be effected by the major single relationship exit. Therefore, discussion about the exited relationship how to affect the selection in supply chain and compare the different relationships oriented is valuable.
- 3) Because cost limit for this research, the sample size of this research could just focus on IT industry in supply chain. We suggest the further researches to extend the sample size to other industries or manufactures.
- 4) The research design of the study goes by a cross section way, collect the data on the fix time to build up this relationships oriented theoretical framework model. That means this relationships oriented theoretical framework model could just explain the specific time but could not implement to normal situation. We suggest the further researches to using vertical section research design or multiple time data collect to get the sample to build up the dynamic model to discuss about how the different time phase effect the dynamic selection model.
- 5) The data be used in this research is stated data which collected by questionnaire. If using the panel data to evaluate the theoretical model would increase the reliability for the theoretical mode.

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