Chapter IV

Methodology

This chapter identifies the methodology of analysis of this study. The first section introduces the design of research sampling, instrument, and data collection. Next, the response rate is reported. Then, the measurement and the purification of measures are presented. In the last section, the data analysis procedures are described.

Samples

Sampling frame

Samples were selected from the lists of exporters in the Board of Trade of Thailand Directory 1998-1999 and the Thailand's Selected Exporter List 1997-1998 in the categories of electronic, electrical products & parts, and vehicle, parts and accessories, and from the list of members of the Federation of Thai Industries in the sections of electrical and electronics products, and vehicles and vehicle parts. These were the most current information from both public and private sectors. Every attempt was made to append the latest list of firms in order to get the most up-to-date picture of the studied sample.

Selection of industries

This dissertation identified 2 criteria for selection of industries. First, the industry was classified as a major Thai export product by the Business Economics Department, Ministry of Commerce (Bangkok Post, 1998). These products were automatic data processing machines and parts, garments, electronic integrated circuits, rice, canned foods, car parts and accessories, radio and TV receiver and parts, rubber, gems and jewelry, and frozen shrimps and prawn. Second, the industry was one of those that the Thai government established measures to upgrade its production

technology by acquiring foreign technology (Sub-committee on enhancing international competitiveness, 1995). These industries were electronics and parts and vehicle parts.

Two industries that accommodated these two criteria, thus, were chosen. These industries were electronics and car parts. Electronics industry referred to products in the categories of electronics, electrical products, and parts. These products included products such as electronic integrated circuits, air conditioners, refrigerators, washing machines, television receivers, computer, and telephone set. Vehicle parts industry referred to products in the categories of vehicles, car and motorcycle parts, and vehicles accessories.

From the electronics, electrical products and part industry, the number of companies listed in the three publications which were used as the sampling frame were 273, 83, and 187 respectively. From the vehicle, vehicle parts and accessories industry, the number of companies listed in these three publications were 60, 85, and 151 respectively. There were 47, 11, and 5 companies that their names appeared in both industries in these three publications, respectively. Discarding the redundant names from the lists, 478 companies were in the electronics industry, 241 companies were in the vehicle and parts industry, and 59 companies were in both industries. Thus, the whole population of these two industries was 778 companies. Table 4.1 presents the number of population.

Table 4.1 Population

Industry	Population
Electronics and parts	478
Vehicle parts	241
Both industries	59
Total	778

Sample size

Although some kind of sampling plan should be used to identify the appropriate sample size, this study used the entire population in stead. This is due to the nature of the research question of this study which data were to be analyzed by factor analyses and multiple regression analyses. In relation to the factor analysis techniques, Hair,

Anderson, Tatham, and Black (1995: 373) suggest that the researcher generally would not factor analyze a sample of fewer than 50 observations, and preferably the sample size should be 100 or larger. As a general rule, the minimum was to have at least five times as many observations as there were variables to be analyzed, and the more acceptable range would be a ten-to-one ratio. In relation to the multiple regression analysis, a general rule is that there should be five observations for each independent variable in the variate (Hair, Anderson, Tatham, and Black 1995: 105).

Practically, response rate typically achieves at around 20 percent (Powell, 1992; Tootelian and Gaedeke, 1987). In this case, to achieve the sample size of 45-100 or more observations, the sample size should be at the amount of 225-500 or more. It was anticipated that the economic crisis in Thailand would cause a number of firms to dissolve. Moreover, a number of firms might have never experienced any alliance before. In addition, the reliable information on alliances in Thailand was not available. Therefore, the total number of the population was used to ensure that sufficient data were available for the analysis.

Instrument

This study used a questionnaire as the instrument of data collection. The measure development began with a literature review and some field interviews. The in-depth interviews of the top-executive level were conducted to help define the scope and content of the measures. Seven companies were selected from the list of members of the Federation of Thai Industries by two people who were in charge of activities of members in the two industries. To approach some executives, the name of my lecturers and the name of people in the Federation were used as references. Two executives declined to cooperate. Five executives were interviewed. Interviewees agreed that the improvements in production and productivity indicated that learning had occurred. Inquiring about a quantitative information was not suggested since it required too much time and effort of the respondents. Moreover, the quantitative information was considered critical to the competitiveness of the firm. Inquiring about such information would result in reluctant responses.

A self-administrative questionnaire, then, was developed to acquire cross-sectional data. Some measures were newly developed whereas some were adapted or received from previous studies. The questionnaire comprised 2 parts. The first part collected the information about the respondents. The second part collected the information about the focal firm, its partner, and the focal alliance relating to the variables in the proposed conceptual model. The questionnaire was written in Thai. Measures from previous studies, which were originally written in English, were translated into Thai. The translated version was reviewed by three Thai readers who had studied in the United States and were unfamiliar with the research. After the review, all readers did not suggest any further correction of the translated version.

A pre-test study was performed. Thirty executives who were attending an EX-MBA class at the University of the Thai Chamber of Commerce were asked to answer the questionnaire and to suggest for improving the survey instrument. Twelve questionnaires were returned for a 40% response rate. There were comments on several questions. The questionnaire was revised and submitted to three executives and three doctoral candidates whom were asked to answer and comment on it. No further comments among respondents were suggested. A mail survey, then, was conducted.

Data Collection

This study employed a mail survey method. Prior to mailing the questionnaires, I performed an intensive investigation by telephone to identify the name of the key informant and the language of the questionnaire that would be convenient for the respondents. All contacts suggested that the companies preferred the questionnaire to be sent to the managing director in Thai. A reason was given that the managing director knew the best and had the sole authority to give the information about the firm. Therefore, a self-administered questionnaire prepared in Thai was distributed to the managing director of each firm. The key informant approach was validated by John and Reve (1982), and had been successfully employed in a number of studies of inter-organization relationships (e.g. Simonin, 1991; Morgan and Hunt, 1994). These informants are able to provide reliable assessments of organizational phenomenon provided that they hold positions which make them knowledgeable about the issue

under investigation, and be able and willing to participate in the research project (Rindfleisch, 1997).

A mailing package consisted of a cover letter, a questionnaire, and a self-addressed postage-paid reply envelope was sent to each managing director of 778 companies (see Appendix B). The letter requested the managing directors to answer or forward the questionnaire to the executive who had been in charge of an international alliance. The executives included president, vice president, managing director, general manager, and production manager who were responsible for the collaboration between partners in the alliance. The cover letter also explained the purpose of the study as well as promised a copy of the findings to those who had returned the completed questionnaires to entice the participation of companies in the study. Each questionnaire was coded (see Coding Sheet in Appendix C) to allow the follow-up phone calling. To prevent the problem of memory decay and to achieve the accuracy of the information, respondents were asked to select only one international alliance which they were experienced and were particularly familiar during the four-year time frame (1994-1997), regardless of the longevity of the selected alliance. This approach was in line with Simonin's (1991) research method.

Three weeks after the initial mailing, I conducted follow-up phone calls and faxes. The mean number of follow-ups per firm was five. Responses were validated for any inconsistency among answers to different questions. If a discrepancy was detected, the respondent was contacted by telephone with requests for clarification. Thus, the quality of the responses was checked prior to analysis.

Response Rate

Without follow-ups, the response rate was 9.45 percent (67 firms). The surveys for 69 firms were returned as undeliverable. Later, with careful follow-ups, a total of returned questionnaires was 181, resulted in a response rate of 25.53 percent. However, of these, twenty-nine firms declined to participate because they were very busy. Thirty-two companies had never experienced in any alliances whereas five firms were not manufacturers. Two firms had changed their owners. Eleven questionnaires were not usable either due to the non-completion (with more than 6 unanswered

questions and the respondents could not be contacted) or to the firms were not in the selected industries. Finally, a total of completed questionnaires was 102, resulted in a usable response rate of 14.39%. Table 4.2 summarizes the mail survey result.

Table 4.2 Mail survey result

	Amount	%
Questionnaires sent (1)	778	
Undeliverable questionnaires (2)	69	
Total questionnaires (1) – (2)	709	100
No response	528	74.47
Response	181	25.53
No alliance	32	4.51
Not manufacturer	5	0.71
Decline to participate	29	4.09
Change owner	2	0.28
Unusable	11	1.55
Completed questionnaires	102	14.39

Bourque and Clark (1991: 58) suggest that if there is appreciable non-response, investigators should attempt to evaluate how non-response subjects compare with subjects for whom data exist. One common check is to compare the demographic characteristics of the sample with those of the population from which it came. Armstrong and Overton (1977) describe that information received from companies who respond only after repeated contacts resemble that of non-respondents. The potential non-response bias, then, was assessed by comparing early (n_1=67)versus late (n_2=35) respondents as recommended by Armstrong and Overton (1977). The demographic characteristics of the sample included year of experience of the respondents and year of operation of the firm which both of them met the assumption of normal distribution.

A Levene's test for homogeneity of variances and a t-test for equality of means of the two groups were performed by using SPSS 8. Two assumptions underlying this test were that the population variances and means were approximately equal. The null and alternative hypotheses were :

1. $H_0 : \sigma_1^2 = \sigma_2^2$

   $H_a : \sigma_1^2 \neq \sigma_2^2$

2. $H_0 : \mu_1 = \mu_2$

$H_a : \mu_1 \neq \mu_2$

No significant differences in either variances (observed significance levels at 0.136, 0.597 respectively) or mean scores (observed significance levels at 0.652, 0.766, respectively) were found between early (i.e., before follow-up phone calls) and late (i.e., after follow-up phone calls) respondents. The results indicated that non-response bias was a relatively minor concern. This analysis suggested that the responses appeared to be a good representatives of the overall population.

Table 4.3 Characteristics of respondents

Characteristics	Respondents/ Organizations	N	Percent
Titles of respondents	• President and Vice President	100	2
	• Managing Director and Deputy MD		34
	• General Manager		44
	• Others (e.g., section manager)		20
Industry of respondents	• Vehicle and parts	102	44.1
	• Electricity and electronics		47.1
	• Both industries		8.8
Motive of alliance	• Financial assistance	102	34.3
	• Technology assistance		90.2
	• Marketing knowledge		58.8
	• Others (e.g., management, foreign market)		10.8
Status in the alliance	• Still in the alliance	102	85.3
	• No longer in the alliance		14.7
Employees trained by foreign partner	• None	102	5.9
	• 1-10%		61.8
	• 11-20%		22.5
	• 21% or above		9.8
Nationality of foreign partners	• Japanese	102	66.7
	• American		7.8
	• Asian (e.g., China, Korea, Taiwan)		7.8
	• European (e.g., France, Germany)		12.8
	• Australian		4.9
Number of foreign experts presented in the alliance	• None	102	31.4
	• With 1-5 foreign experts		49.0
	• With 6-10 foreign experts		9.8
	• With 11 foreign experts or more		9.8
Proportion of foreign partner in management level in the alliance	• None	102	36.3
	• Less than local firm's		38.2
	• Equal to local firm's		10.8
	• More than local firm's		14.7

The characteristics of the respondents are summarized in table 4.3. Most respondents held executive positions and had an average of 10.28 years of experience with the current firms. The information suggested an appropriate level of awareness and expert knowledge with the collaborative phenomenon of the respondents. The companies had an average of 18.53 years of operation in the industries. The respondents were almost equally from the two industries. The majority (90.2 %) indicated they had participated the alliance for the technology assistance reason. Most respondents were still in the alliance (85.3%). Approximately one to ten percent of employees in most local firms were trained by their foreign partners (61.8%). The majority of foreign partner firms were Japanese (66.7%). Approximately one to five foreign experts presented in almost half (49%) of the alliance. The number of foreign partner's executives in 38.2 percent of the alliances were less than those of local firm. In the meantime, 36.3 percent of the alliances had no foreign partner's executives.

Measurement

This study attempted to employ multiple-item measures to reduce the possibility that a single item might be misinterpreted or otherwise provide a specious result (Tallman, Sutcliffe, and Antonin, 1997). The use of multiple indicators allows researchers to more precisely specify the responses desired and does not place total reliance on a single response but instead on the average or typical response to a set of related responses (Hair, Anderson, Tatham, and Black, 1995: 9). The measures were restricted to 5-point scale, if not otherwise mentioned, since Geringer (1991) found that more numerous response categories exceeded the respondents' ability to discriminate and produced "noise" rather than more precise data.

Dependent Variable: Learning

Learning was operationalized as the upgrading in the production-related operation process of local firms. Learning was measured from the local firm's production process development, product design development, production standard development, partner's knowledge assimilation, and productivity improvement.

To measure the overall production process development, a six-item statement measure was developed. Respondents indicated the extent to which each statement was agreed on a scale of 1 = strongly disagree to 5 = strongly agree. An example of items is "After entering this alliance, we have advanced and improved the efficiency of our production process." The reliability and validity tests suggested the deletion of one item resulted in the Coefficient alpha of .8408. The principal components analysis revealed a single-factor solution with the eigenvalue of 3.07 with the total variance explained at 61.48%. The Kaiser-Meyer-Olkin measure was 0.798.

To measure the productivity improvement, a five-item measure was used. Respondents were asked to identify the percentage improvement of defective rate, product return rate, machine's capacity utilization, number of R&D projects, and man-hour production from a fixed-alternative number of 1 = none, 2 = 1-20%, 3 = 21-40%, 4 = 41-60%, 5 = 61% or more. The Cronbach's alpha was .8389. The factor analysis revealed a single-factor solution with eigenvalue greater than one (3.06) and the total variance explained at 61.14%. The Kaiser-Meyer-Olkin measure was 0.752.

To measure the product design development, respondents were asked to identify the number of new product designs that had been developed after the local firm entered the alliance from a fixed-alternative number of 1 = none, 2 = 1-3, 3 = 4-6, and 4 = 7 designs or more. Because this was a single item measure, estimation of internal consistency and unidimensionality were not applicable.

To measure the production standardization, respondents were asked to identify types of patent and certificate that they had been awarded after entering the alliance. The number of the types of certificate and patent were counted and used in the analysis. Ten types of patent and certificate of standardization were provided, i.e., copyright, invention patent, petty patent, product design patent, Thailand Industrial Standards marks, laboratory accreditation under ISO Guide 25, TIS/ISO 9000, TIS/ISO 14000, TIS 18000, and trademarks. These standard certificates and patents were encouraged as the indicators of production upgrading by the Thai Industrial Standards Institute, Ministry of Industry and the Department of Intellectual Property, Ministry of Commerce, thus, were used in this study. In addition, Rindfleisch (1997) and Olk (1997) use the number of patents, which a firm has received as a result of the participation in a cooperative research venture, as a related measure of venture

performance. Moreover, Bresman, Birkinshaw, and Nobel (1999) use the number of patents as a measure of the transfer of technical knowledge from the acquired unit to the acquirer. This was a formative index, thus, the internal consistency and the unidimensionality were not applicable.

To measure the partner-knowledge assimilation, respondents were asked to identify the average percentage utilization of their partner's technology from a fixed-alternative number of 1= 1-10%, 2=11-20%, 3=21-30%, 4=31-40%, 5= 41% or above. Because this was a single-item measure, the estimation of internal consistency and unidimensionality was not applicable.

Independent Variables

1. Partner attributes

1.1 Cultural similarity

Cultural similarity was defined as the similarity of values and capabilities between a local firm and its partner firm in terms of the congruency in organizational values and social norms, and the compatibility in technological capability, organizational procedures, and philosophies and approaches to business dealings. Cultural similarity was measured by using the 4-item measure of shared norms, developed by Sarkar, Cavusgil, and Evirgen (1997), which its reported reliability based on the coefficient alpha of .794. An example of questions is "Executives from both firms involved in this project had compatible philosophies and approaches to business dealings." Responses were measured on a scale ranging from 1 = strongly disagree to 5 = strongly agree. The sudden drop in the item-to-total correlations and the reliability test suggested the deletion of two items. The deletion resulted in the Cronbach's alpha of .7364, a single factor solution with an eigenvalue greater than one, and the total variance explained at 79.23%. To make a composite scale, the respective items were summed and averaged.

1.2 Receptivity

Receptivity was defined as the behaviors and the resources of a local firm that were available to utilize a new knowledge. Receptivity was measured by the firm's resources strength, knowledge-cultivating activities, and capability of information management and attitude towards learning.

To indicate the capability to manage information and attitude towards learning, a four-item statement was adapted from the nine-item statement of Rindfleisch's (1997) measure of learning capacity. The original items were selected and adapted to suit the interest of this study. The respondents were indicated on a scale of 1 =strongly disagree to 5=strongly agree. An example of the items is "We are capable of managing new information in meaningful ways." The reliability test suggested the deletion of two items. The deletion resulted in the Cronbach's alpha of .7889, a single-factor solution with an eigenvalue greater than one (1.65) and the total variance explained at 82.59%.

To indicate their knowledge-cultivating activities, respondents were asked to identify frequencies of conducting 5 activities that aimed to educate their employees. These activities included in-house training courses, other institutions' training courses, conferences, firm's memo distribution, and other site visits. A space was provided for respondents to supply additional activities, but rarely was any offered. Designed as closed end questions, frequencies were grouped as 1 = none, 2 = 1 to 6 time(s), 3 = 7 to 12 times, and 4 = 13 times or more. The reliability and validity tests suggested the deletion of two items, resulted in the Cronbach's alpha of .7821. The principal components analysis revealed a single-factor solution with eigenvalue greater than one (2.1) and the total variance explained at 69.82%.

To indicate the firms' strength, respondents were asked to assess on a scale of 1 = very low to 5 = very high. A list of nine firm's strengths was provided. These firm's strengths included financial fund for new knowledge development, regulations and government relations, human resources development, management flexibility, manufacturing management, technology development, quality control, ability to use foreign language, and executive's interest in educating employees. The reliability and validity tests suggested the deletion of 4 items because of low correlations and low communalities. After the deletion, the principal components analysis revealed a two-

factor solution with eigenvalues greater than one and the total variance explained at 70.54%. The Cronbach's alpha was .7415.

1.3 Trust

Trust was defined by the credibility and the benevolence that a local firm evaluated its foreign partner's fulfilling obligations in the relationship. The eight-item measure of trust developed by Johnson, Cullen, Sakano, and Takenouchi (1997), which its validity with the variance explained at .70 and reliability with the Cronbach's alphas exceeding .90, was shortened and adapted into a six-item statement. The first four items measured the credibility. The last two statements measured the benevolence. This measure was chosen because it covered the credibility and the benevolence which were relevant to the mutual benefit from exchanging relationship between partner firms. Respondents indicated on a scale of 1 =strongly disagree to 5=strongly agree. An example of statement of credibility was "We know that our partner is capable and competent." An example of statement of benevolence was "In this relationship, we feel like our partner cares what happens to us."

From the estimation for the reliability and validity of the measure, two statements were eliminated because of their low validity in the level of explanation. The Cronbach's alpha of the retained four items was .8621. The principal components analysis revealed a single-factor solution with an eigenvalue greater than one and the total variance explained at 70.83%. The Kaiser-Meyer-Olkin measure was 0.791. After establishing internal consistency and validity of the multiple-item scale, the items were summed and averaged to create a composite scale.

2. Relationship attributes

2.1 Ownership Structure

I define the ownership structure as the possession of capital assets in the alliance of partner firms in terms of equity and non-equity. Equity ownership implies any form of international alliance that the partner firms have equity in it. Non-equity

ownership implies any form of international alliance that the equity of the partner firms is not involved at all in the collaboration. Respondents were asked to characterize their ownership and to identify the amount of equity being held by each partner in the focal alliance. However, the information on the amount of equity was rarely completed, thus, insufficient for the analysis. The ownership structure was a binary variable, value 1 if the ownership structure was equity based alliance, and value 0 if otherwise. Because this was a single-item measure, the estimation of internal consistency and unidimensionality was not applicable.

2.2 Partner complementarity

In this study, complementarity was defined as the degree of balanced contribution of partner firms (Johnson, Cullen, Sakano, and Takenouchi, 1997) in terms of scope and extent. Scope was identified as the number of unique type of resources that partner firms contribute to the alliance (Contractor and Lorange, 1988). Extent was identified as the amount of resources that partner firms contribute to the alliance (Lin, Yu, and Seetoo, 1997). Complementarity was measured by the combination of scope and extent.

Previous studies measured partner complementarity differently. For instance, Johnson, Cullen, Sakano, and Takenouchi (1997) measured the degree of scope and extent of contribution by asking respondents to rate their contributions of seven types of resource to the alliance based on a seven-point scale. To measure the extent of the contribution, the scale was coded +3 (mostly the Japanese partner) to –3 (mostly the foreign partner). The two neutral categories (coded 1 and –1) were labeled "about equal." The sum of zero presented a perfectly balanced contribution to the alliance. To measure the uniqueness of the contribution, the scale was coded 3 (mostly the Japanese partner), 2, 1, 1, 2, and 3 (mostly the foreign partner). The sum of the scale showed the total unique resource contributions of the partners to the alliance. Complementarity was the combination of balance and uniqueness (Complementarity = Balance * Uniqueness). Seven types of resource included technical skills, market knowledge, access to raw materials, and access to labor pools.

Lin, Yu, and Seetoo (1997) measured the contributions of partners by scope (similar or complementary) and degree (equal or unequal). The scope was associated with types of resource that partners brought into the alliance while the degree was associated with the amount of contributed resource. A list of ten types of resources was provided. The gap between the number of total resources and the gap between the number of uniquely contributed resources were computed and compared to their respective means to identify whether the contributions were equal and whether they were complementary.

To develop a measure which is less complicated, I adapt the previous two methods. A list of fifteen resources was provided (some of the resources were derived from previous study, e.g., Erden, 1997). These resources included manufacturing related knowledge, quality control, product R&D, brand name, product related technology, product design, management systems, marketing know-how, financial resources, human resources, training, distribution channels, raw materials, and inventory management. Respondents were asked to identify types of resource that both parties had contributed to the alliance.

The scope of contributions was the percentage unique resources that partners brought to the alliance. The range of the values was from zero to one hundred. The higher the value, the higher the degree of scope of the contribution. The extent of balanced contribution was the percentage gap between partners' contributions. The range of the value, which reflected the gap of the contributions between partners, was from zero to one hundred. The lower the value, the higher degree of the balanced contribution. To reverse the score, the value of one hundred was subtracted by the value of the computed extent of the contributions. The range of the value was also from zero to one hundred. The higher the value, the higher the degree of extent of the contribution. Complementarity was the average sum of scope and extent where higher scores indicated greater complementarity. This measure is formative, involves a checklist approach. With formative measures, traditional validation procedures do not apply (Bollens and Lennox, 1991).

2.3 Prior ties

I defined prior ties as the relationships between partners in prior to the collaboration into the focal alliance in terms of alliance participation or other business relationship. Respondents were asked to identify whether the partners had ever participated in any alliance or other business. Prior ties were counted by the types of participation, value 1 for any type of participation and value 0 for non-participation. The range of the value was from 0 to 2. The more types of tie indicated the stronger degree of prior ties. This measure is formative, thus validation procedures do not applicable.

3. Knowledge Attribute

3.1 Ambiguity

Ambiguity was defined as the degree to which the knowledge lacked its clarity in terms of the transferability, the linkages between elements of the knowledge, the relatedness to the prior knowledge base, and the articulation into a written form. A four-item measure was developed. Respondents were asked to indicate the ambiguity of the knowledge on a scale of 1 = strongly disagree to 5 = strongly agree. An example from the measure is "This technology cannot be incorporated into written form."

The tests for reliability and validity revealed a problematic item in the measure. From the reliability test, the statement "This technology is not related to our knowledge base" had low item-to-total correlation. The inter-item analysis suggested that the deletion of this item would substantially improve the scale alpha. In addition, the principal components analysis revealed that the item had low item-to-item correlation. Deletion of the item resulted in the Cronbach's alpha of .8546, a single factor with eigenvalue greater than one and the total variance explained at 78.34%. The Kaiser-Meyer-Olkin measure was .722. To form a composite scale, the respective items were summed and averaged.

3.2 Trialability

Trialability was defined as the degree to which the knowledge enabled the local firm to gradually apply the knowledge of its foreign partner to the firm's production process by setting up working procedures, test-run schedule, and testing period. A three-item measure was developed. Respondents were asked to indicate the trialability of knowledge on a scale of 1 = strongly disagree to 5 = strongly agree. An example of the items is "The working procedures of this technology are able to be set up and adjusted to our production within a limited time." The reliability and validity tests suggested the deletion of one item, resulted in the Cronbach's alpha of .5950. A principal components analysis revealed a single factor solution with eigenvalue greater than one and the total variance explained at 71.64%. The Kaiser-Meyer-Olkin measure was .50. To form a composite scale, the respective items were summed and averaged.

3.3 Usage advantage

Usage advantage was defined as the degree to which the knowledge benefits its users in terms of being suitable to the market, providing uniqueness, offering appropriate cost and benefit, providing efficiency improvement, and advancing and accrediting the production process. A five–item measure was developed. An example of the items was "This technology improves the efficiency of our production process." Respondents were asked to indicate the usage advantage of the knowledge on a scale of 1 = strongly disagree to 5 = strongly agree.

The analyses of internal consistency and unidimensionality revealed low item-to-total correlation and item-to-item correlation of two items. Deletion of these items resulted in a single factor solution with eigenvalue greater than one and the total variance explained at 69.67%. The Cronbach's alpha was .7684. The Kaiser-Meyer-Olkin measure was .643. To make a composite scale, all items were summed and averaged.

Purification of Measures

As recommended by Churchill (1995: 545), every multiple-item measure was subject to a purification process. The purification involves eliminating items that seem to create confusion among respondents and items that do not discriminate between subjects with fundamentally different position on the construct. The purification of measures is to assess the reliability and the validity of the proposed measures. Reliability concerns the tendency toward consistency of the results given by repeated measurements (Carmines and Zeller, 1982: 12). Validity concerns the extent to which an indicator of some abstract concept measures what it purports to measure (Carmines and Zeller, 1982: 13).

In this study, the unidimensionality and the construct validity of every multiple-item scale used to measure the variables was assessed by subjecting the purified scale items to a principal components factor analysis with a varimax rotation. Factors were rotated to obtain a clear interpretation of the loadings (Kim and Mueller, 1990: 29). The correlation matrix was used since it could be applied to measures which the scales varied substantially (Kim and Mueller, 1990: 76). The SPSS 8 was used to analyze all data. The validity analysis produced a clean factor structure with items loadings on the appropriate factors with the exception of cultural similarity and trust measures. A number of items were deleted because of low loadings. Internal reliability tests showed satisfactory Cronbach alphas ranging from .5950 through 8621. A listing of the items used in these measures are detailed in Appendix A. The reliability of these measures is provided in Table 4.4. The validity is presented in Table 4.5.

Reliability

The reliability of multiple-item scales was assessed by its internal consistency and unidimensionality. The internal consistency of the multiple-item scales was assessed based on coefficient alpha and item-to-total statistics. Following the recommendation of Gerbing and Anderson (1988), a principal components analysis was used to assess the unidimensionality of each set of items. Following Heide and Weiss (1995), this purification process also entailed a series of validity checks.

After dropping the items with low item-to-total correlation and low item-to-item correlation, the multiple-item scales used in this study showed reasonable internal consistency and unidimensionality. All measures except trialability had Cronbach's alpha greater than .70. In addition, each measure had a single-factor solution with eigenvalue greater than one. The total variance explained ranged from 56.34% to 82.59%. Every item had factor loadings and communality over 0.50, indicating its practical significance and sufficient level of explanation, respectively.

Internal Consistency

The internal consistency method assesses the homogeneity of a set of items. The basic rationale for the assessments rests on the fact that items in a scale should behave similarly (Davis and Cosenza, 1993: 177). The internal consistency of a set of items forming the scale is based on the coefficient alpha (Cronbach's alpha). Coefficient alpha provides a summary measure of the inter-correlations that exist among a set of items. This examination offers some initial information on the behavior of measurement models and helps to point to problem prone constructs and questionable measures. The coefficient alpha is expressed as follows:

$$\alpha = N\,\bar{\rho} / [1 + \bar{\rho}\,(N-1)]$$

where N is equal to the number of items and $\bar{\rho}$ is equal to the mean inter-item correlation (Carmines and Zeller, 1982: 44). It implies that if all the items in a measure are drawn from the domain of a single construct, responses to those items should be highly inter-correlated. A high value of alpha supports high reliability (maximum value being 1) and a low value indicates low reliability (minimum value being 0). Nunnally (1967) suggests that reliability measures should exceed .50 for a minimum degree of internal consistency whereas Nunnally (1978) suggests that a coefficient .70 is more appropriate. Churchill (1995: 542) suggests that if alpha is low, items with correlations near zero or items that produce a substantial or sudden drop in the item-to-total correlations would be deleted. It is because those items might not share equally in the common core, then, should be eliminated.

Unidimensionality

A unidimensionality is an assumption underlying the calculation of reliability and is demonstrated when the items of a construct have acceptable fit on a single-factor solution (Hair, Anderson, Tatham, and Black, 1995: 641). The unidimensionality of each multiple-item scale was assessed by using the principal components analyses, extracting factors with eigenvalues greater than one, with the varimax rotation, and the examination of the correlation, factor loadings and communalities for each scale (Rindfleisch, 1997).

The eigenvalues were used both as a criterion of determining the number of factors and a measure of variance accounted for by a given dimension (Kim and Mueller, 1990: 83). Only the factors having eigenvalues greater than 1 were considered significant. All factors with eigenvalues less than 1 were considered insignificant and were disregarded. The rationale for the eigenvalues criterion is that any individual factor should account for the variance of at least a single variable if it is to be retained for interpretation (Hair, Anderson, Tatham, and Black, 1995: 375). Along with the eigenvalues, the cumulative percentage of the variance was also inspected to ensure practical significance for the derived factors (Hair, Anderson, Tatham, and Black, 1995: 378). The cumulative percentage of the variance indicates the linear combination formed by the factor.

Factor loadings are the correlations between the original variables and the factors, and the key to understand the nature of a particular factor (Hair, Anderson, Tatham, and Black, 1995: 366). Factor loadings that were .50 or greater were considered practically significant whereas loadings greater than .3 were considered to meet the minimum level (Hair, Anderson, Tatham, and Black, 1995: 385). Factor loadings that were less than .3 were considered as not substantial (Kim and Mueller, 1990: 70) and were eliminated.

The item-to-item correlation between items in each of the proposed scale was examined. If the correlations between variables were small, it was unlikely that they shared common factors. Items with low correlation, thus, were eliminated.

The communalities which were the amount of variance an original variable shared with all other variables included in the analysis (Hair, Anderson, Tatham, and

Black, 1995: 365) were also investigated. Variables with communalities less than .50 were identified as not having sufficient level of explanation (Hair, Anderson, Tatham, and Black, 1995: 387) and were disregarded.

The degree of empirical reliability was also assessed by using the Kaiser – Meyer-Olkin (KMO) and the Bartlett test of sphericity. KMO is a measure to determine whether the given data are adequate for factor analyses. The index ranges between 0 and 1 where the value 1 implies that every variable can be predicted without error from other variables in the set (Kim and Mueller, 1990: 54). Values above .50 indicate appropriateness (Hair, Anderson, Tatham, and Black, 1995: 366). The Bartlett test of sphericity is a statistical test for the overall significance of all correlations within a correlation matrix (Hair, Anderson, Tatham, and Black, 1995: 365). In this study, the KMO and the Bartlett test of sphericity indicated an adequacy of the data for the analyses and the significance of the correlations for every multiple-item measure.

Table 4.4 Reliability of multiple-item measures

(N=102)

Variables	Indicators	No. of factor	Factor loading	Eigenvalues and % of cumulative variances	Alpha if item deleted	Alpha
Learning	Overall learning	1		3.07 (61.48)		.8408
	Production efficiency improvement		.802		.8043	
	Production technology improvement		.823		.7970	
	Changes in manufacturing, conducts		.834		.7905	
	Changes in understanding		.726		.8235	
	Better environment provision		.729		.8263	
	Productivity development	1		3.06(61.14)		.8389
	Defective rate improvement		.776		.8042	
	Return product improvement		.756		.8178	
	Machine's capacity utilization		.808		.7976	
	Number of R&D project		.766		.8134	
	Man-hour productivity improvement		.802		.7994	

Variables	Indicators	No. of factor	Factor loading	Eigenvalues and % of cumulative variances	Alpha if item deleted	Alpha
Cultural Similarity	Compatible procedures	1	.890	1.59(79.23)	n.a.	.7364
	Compatible philosophy		.890		n.a.	
Receptivity	Capability	1		1.65(82.59)		.7889
	Information management		.909		n.a.	
	Information integration		.909		n.a.	
	Knowledge cultivating activities	1		2.10(69.82)		.7821
	In-house training		.891		.5984	
	Outside training		.836		.7109	
	Company's memo		.776		.7869	
	Firm's strength	2				.7415
	Financial strength	Factor1	.583	2.49(49.82)	.6768	
	Regulations and government relations		.859		.6944	
	Human resource development		.842		.6851	
	Production technology development	Factor2	.904	1.04(70.54)	.7354	
	Plant capacity and quality control		.763		.6859	
Trust	Responsible	1	.890	2.83(70.83)	.7925	.8621
	Qualified		.759		.8651	
	Frank		.873		.8060	
	Thoughtful		.839		.8265	
Ambiguity	Easily transferable (R)	1	.901	2.35(78.34)	.7716	.8546
	Clear association (R)		.902		.7702	
	Unable to be written		.852		.8555	
Trialability	Set up working procedures	1	.846	1.48(71.64)	n.a.	.5950
	Partner's supervision		.846		n.a.	
Usage Advantage	Profitable	1	.736	2.09(69.67)	.8265	.7684
	Efficiency creation		.895		.5795	
	Accrediting		.865		.6570	

Note: (R)= The statement was reverse scored.

Content Validity

Content validity or face validity focuses on the adequacy with which the domain of the concept under study is captured by the measure (Churchill, 1995: 534). The key to content validity lies in the procedures that are used to develop the instrument. These procedures include examining the literature and testing the internal consistency. In this study, careful scrutiny of the literatures and measures used in previous research, in-depth interviews of the top executive level and a pretest were conducted to help ensure that only relevant items were included in the final instrument.

Construct validity

Construct validity deals with the degree to which the scale represents and acts like the concept being measured. A statistical approach to evaluate construct validity is discriminant validity (Davis and Cosenza, 1993: 172). Discirminant validity is the degree to which the measurement scale may be differentiated from other scales purporting to measure different concepts (Davis and Cosenza, 1993: 173). It is required that a measure does not correlate too highly with measures from which it is supposed to differ (Churchill, 1995: 539).

To assess the discriminant validity of measures, all the multiple-item measures were forced into a single principal components analysis with varimax rotation. The factor components and individual item loadings were inspected. Factors emerged consistent with the priori operationalizations, except cultural similarity and trust measures revealed strong loadings on the same factor. In addition, receptivity was discriminated into three factors. However, the result was as expected and designed in the data collection stage. All items in the analysis loaded greater than .50 on their respective factors as indicated in Table 4.5.

Table 4.5 Validity of multiple-item measures

Component	1	2	3	4	5	6	7	8
Compatible procedures	**0.703**	-0.073	-0.063	0.032	0.064	-0.212	0.050	0.304
Compatible philosophy	**0.757**	0.087	-0.041	-0.134	0.222	-0.078	0.162	0.252
Information management	0.120	0.058	0.033	0.085	0.009	**0.879**	0.136	0.090
Information integration	0.156	0.123	-0.016	-0.081	0.145	**0.816**	0.036	0.067
In-house training	0.078	0.107	0.108	**0.843**	0.095	-0.013	0.140	0.082
Outside training	0.056	-0.131	0.067	**0.816**	0.219	-0.032	-0.066	0.130
Company's memo	0.119	0.218	-0.196	**0.766**	-0.035	0.064	0.006	0.041
Financial strength	0.070	-0.199	-0.037	0.132	**0.594**	0.065	0.409	0.042
Regulation knowledge	0.095	-0.025	0.071	0.021	**0.847**	0.144	0.007	-0.104
Human resource	-0.030	0.103	0.125	0.164	**0.803**	-0.027	0.163	0.030
Technology development	0.075	-0.139	0.095	0.008	0.049	0.175	**0.839**	0.010
Plant capacity	0.013	-0.140	0.108	0.053	0.353	-0.015	**0.718**	0.032
Responsible	**0.793**	0.070	0.260	0.116	-0.083	0.229	0.035	-0.113
Qualified	**0.573**	-0.054	0.391	0.062	0.109	0.289	-0.273	0.030
Frank	**0.773**	0.023	0.166	0.204	0.027	0.239	0.008	-0.060
Thoughtful	**0.706**	-0.171	0.342	0.134	-0.101	0.206	0.038	0.041
Transferability (R)	-0.019	**0.858**	0.013	0.151	-0.005	0.166	-0.127	-0.100
Clear linkage (R)	0.046	**0.890**	-0.074	0.070	0.005	-0.072	-0.052	-0.106
Unable to be written	-0.068	**0.838**	-0.018	-0.030	-0.050	0.103	-0.114	-0.041
Working procedure	0.087	-0.030	0.006	0.178	-0.037	0.029	0.053	**0.792**
Partner's supervision	0.113	-0.214	0.136	0.038	-0.017	0.142	-0.023	**0.783**
Profitable	0.314	-0.152	**0.612**	-0.158	0.258	0.073	-0.010	0.006
Efficiency creation	0.129	0.013	**0.895**	-0.022	-0.008	-0.042	-0.008	0.134
Accredit	0.142	0.012	**0.831**	0.109	0.055	0.005	0.259	-0.005
Total Variance Explained								
Initial Eigenvalues	4.964	2.951	2.476	1.992	1.641	1.378	1.125	1.068
% of Variance	20.682	12.297	10.316	8.299	6.837	5.744	4.689	4.449
Cumulative %	20.682	32.980	43.296	51.595	58.432	64.175	68.865	**73.314**

Data Analysis

The procedures of data analysis were four-fold. First, variables in partner-related, relationship-related, and knowledge-related attributes were identified by using principal components analyses and correlation examinations. In factor analyzing, factor loadings were examined. Following Werner, Brouthers , and Brouthers (1996),

variables were considered to load on a factor if their factor weights were greater than 0.5..Complex loadings, where variables loaded on more than one factor, were not considered to be clean loadings and were disregarded. Next, dimensions of indicators of the dependent variable were classified by performing a principal components analysis for the extraction methods with the varimax rotation. A univariate examination of each indicator was also performed to understand the nature of variables and descriptive statistical results were reported.

Secondly, Kendall's tau-b was employed to assess the strength of relationships between variables. Kendall's tau-b is a non-parametric test which requires data measured on at least an ordinal scale and can be used with variables whose joint distribution is any specified distribution (Gibbons, 1993: 2). Kendall's tau-b is preferred over Spearman's rho because the *P*-values from the commonly used computer packages for tau are more accurate than those for rho (Gibbons, 1993: 24). Kendall's tau-b is also preferred over Pearson product moment correlation coefficient since the latter requires data measured on at least an interval scale and the assumption of a bivariate normal distribution (Gibbons, 1993: 24).

Third, the ANOVA was performed to reassure the effects of independent variables on each dimension of the dependent variable. Fourth, the hypotheses of the associations between nine independent variables and each dimension of local firm's learning were tested separately by employing multiple regression analyses and a multiple discriminant analysis. Results of the analysis are reported in chapter 5.