Suggested Steps for Developing Better Measures of Customer-Supplier Relationships

Seungho Jung[+]

Department of Information Systems
Pusan University of Foreign Studies Busan, 608-738, KOREA
Tel: +82-51-640-3538, E-mail: sjung428@pufs.ac.kr

Abstract. The purpose of this paper is to show general steps of developing better measures for the survey questionnaire. The steps introduced can be adopted by researchers in disciplines such as management, psychology, behavioral science, etc. As an exemplary case, the customer-supplier relationship is used to show suggested steps in great detail. Several suggested steps and techniques are selected after carefully reviewing the works of previous researchers such as Churchill (1979), DeVellis (1993), Dunn et al. (1994), Hayes (1994), Larson and Sinha (1995), Tabladillo and Canfield (1994), and Tamimi, Gershon and Currall (1995). The steps, which are explained in depth in the following sections, are: (1) specify domain of construct, (2) generate sample of items, (3) pilot study, (4) data collection, (5) assess reliability and validity.

Keywords: customer-supplier partnership, questionnaire, effective measures

1. INTRODUCTION

The measures developed in this paper are commonly used in the inductive, descriptive, and applied research whose major data collection method is a survey questionnaire. The inductive research primarily deals with data to derive conclusions about research subjects or hypotheses. Data are statistically analyzed and organized to produce quantitative findings, which become the basis of theoretical assertions on the research subject. Then, conclusions from results are drawn and generalized to the extent possible. The descriptive research method is appropriate for data derived from simple observational situations similar to the survey questionnaire. Although the descriptive research method relies on observation for collecting data, those data must be organized and presented systematically, so that valid and accurate information and knowledge can be drawn from them. The applied research, unlike basic research in which knowledge is the primary end in itself and the researchers' major interest is in discovering the central factors (or truth) in a problem (Goode and Hatt, 1952; Patton, 1990), uses past and present theories and assertions to study the research subject.

This research utilizes non-experimental research design, with the main purpose of seeking explanations of the relationships between independent and dependent variables. A non-experimental research design is a systematic empirical inquiry in which the researcher does not have direct control of independent variables because their manifestations have already occurred or because they are inherently not manipulable (Kerlinger, 1986). Using real world customer-supplier relationships in a non-experimental design, this research takes advantage of involving as many participants as possible, given resource constraints, using the survey questionnaire.

For the above-mentioned processes, this research defined two different sets of variables: independent variables — customer-supplier joint action (joint use of specific tools and joint practices); and dependent variables — shared results of customer-supplier joint action (role integrity, conflict resolution, flexibility, and mutuality).

This paper is organized as follows. Section 1 gives the introduction. And then, Section 2 explains several steps of developing data collection instrument in depth, followed by the questionnaire's reliability and validity in Section 3. Finally, Section 4 gives limitations and further research areas of this paper as conclusions.

2. DEVELOPMENT OF DATA COLLECTION INSTRUMENT-SURVEY QUESTIONNAIRE

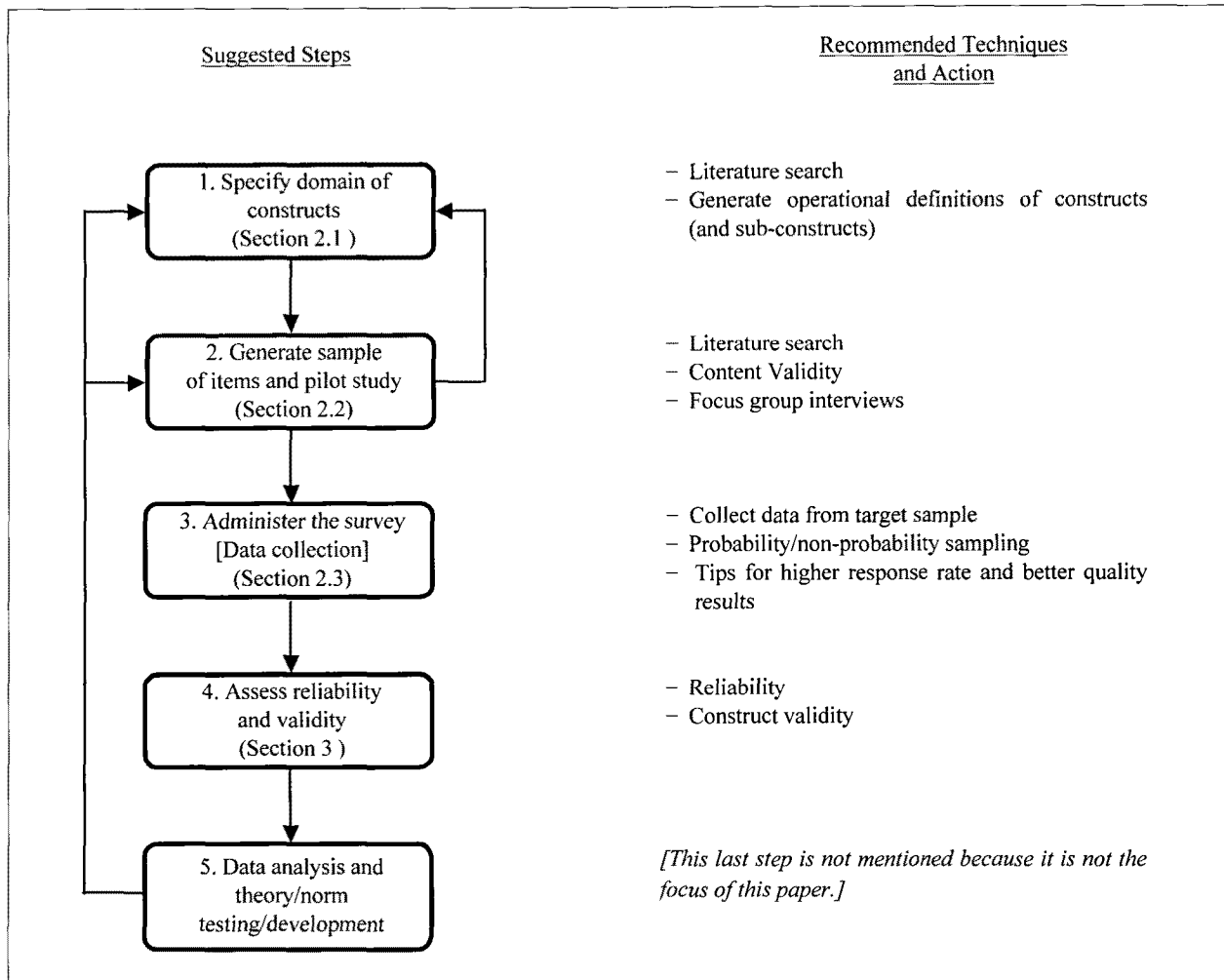The purpose of the survey questionnaire used in this

Suggested Steps	Recommended Techniques and Action
1. Specify domain of constructs (Section 2.1)	– Literature search – Generate operational definitions of constructs (and sub-constructs)
2. Generate sample of items and pilot study (Section 2.2)	– Literature search – Content Validity – Focus group interviews
3. Administer the survey [Data collection] (Section 2.3)	– Collect data from target sample – Probability/non-probability sampling – Tips for higher response rate and better quality results
4. Assess reliability and validity (Section 3)	– Reliability – Construct validity
5. Data analysis and theory/norm testing/development	*[This last step is not mentioned because it is not the focus of this paper.]*

Figure 1. Suggested steps for developing effective measures

research is to collect quantitative data for statistical analysis. It is necessary to collect the appropriate amount of quantitative data from which conclusions could be reached concerning the relationships between independent and dependent variables. To develop the survey questionnaire, the general guidelines in Figure 1 were followed, and more detailed information about how each step was conducted is explained in each of the following sections.

2.1 Specify Domain of Constructs

The first suggested step for developing effective measures for a survey questionnaire involves specifying the domain of constructs. For this research, major constructs—joint action and the four shared result measures—were defined based on previous literature in relational-ism, which are summarized in Table 1.

2.2 Generate Sample of Items

. The second step shown in Figure 1 is to generate items, which measure or capture the domain as specified. For the survey questionnaire items developed in this research, two sub-steps below were followed.

2.2.1 Initial Survey Questionnaire Development

Using the constructs shown in Table 1, the survey questionnaire was developed by the researcher based on previous research activities: readings and observation of literature on customer-supplier partnerships in disciplines such as marketing, purchasing, and industrial engineering. However, most items developed in this step were not directly adopted from the previous literature on customer-supplier partnerships. This is because the constructs previously used by other researchers were treated differently. Therefore significant changes were made to those items adopted

Table 1. Constructs used in this research

Constructs	Conceptual definition	Source
Independent variable: Joint Action	Inter-penetration of organizational boundaries.	Guetzkow, 1966; Laumann, Galaskiewicz and Marsden, 1978
Dependent variables: Shared results from the joint action	– *Role integrity* : The extent to which parties maintain highly complex and multi-dimensional roles in terms of duration, extent of specific transaction, and range of obligations.	Kaufmann and Dant, 1992
	– *Conflict resolution* : Internal and informal mechanisms (procedures/ processes/activities) to resolve any problems that arise in the transactional and relational exchanges between the two organizations, smoothly and more favorably to each other.	Dant and Schul, 1992; Kaufmann and Dant, 1992
	– *Flexibility*: A bilateral expectation of willingness to make adaptations as operating environments change.	Heide and John, 1992
	– *Mutuality*: In relational terms, mutuality refers to a requirement of a positive incentive to cooperate with the partner. It also refers to equity in the distribution of surpluses and burdens (or benefits and expenses) over the long-term business transactional horizon.	Boyle *et al.*, 1992

from the previous literature although the basic idea came from the original items. Table 2 shows measurement and data collection methods for the survey questionnaire items.

2.2.2 Pilot Study

The pilot study was conducted using 46 managers of previous SPQA (Senate Productivity and Quality Award, USA) applicant companies for their feedback on the appropriateness of each item of the survey questionnaire. A 21.7% response rate (10/46) was obtained and summary results are shown in Figure 2.

Although the reliability coefficients of most constructs are relatively high, one construct – CR (conflict resolution) – does not meet the generally accepted internal- consistency range: 0.70 in general and 0.6 or 0.5 for exploratory work involving the use of newly developed scales (Nunnally, 1978). This may be caused by some deficiencies associated with newly developed items, as in this research. To examine why the reliability coefficient of CR was too low, correlation coefficients of items in CR were calculated. As a result, some correlation coefficients were very low, such as 0.15 between the first and second items and 0.12 between the fourth and sixth items, and 0.14 between the fifth and seventh items. To overcome this low reliability coefficient problem and to develop

Table 2. Measurement and data collection methods for initial survey questionnaire[1] (Prior to pilot test)

Variables and indicators	Operationalization of indicators and item(s)	Level of measurement	Number of items
Organizations			
– Partner	Single vs. multiple sources for certain items	Nominal	1
– Organizational tenure	Number of years with the partner	Ratio	1
– Amount of business with the partner	% amount of sales to/purchasing from the partner	Ratio	1
– Total annual sales volume	Average total sales volume of the company	Nominal	1
Individual demographics			
– Status	Customer (buyer) vs. supplier (seller)	Nominal	1
– Sex	Male vs. Female	Nominal	1
– Job tenure	Number of years or months of experience with this job	Ratio	1
– Organization tenure	Number of years or months of experience with this organization	Ratio	1

1 : The final version full survey questionnaire is shown in Table 6

Table 2. Measurement and data collection methods for initial survey questionnaire (cont.)

Variables and indicators	Operationalization of indicators and item(s)	Level of measurement	Number of items
Customer-supplier *joint action* – Joint use of tools	Inter-penetration of organizational boundaries by: Joint implementation and deployment of specific and already-existing TQM tools (**TQMT**) [TQMT1] We are using specific tools with our partner to jointly design new products. [TQMT2] People in the two companies use mechanisms or tools to design better quality systems. [TQMT3] The relationship with our partner involves the use of quality tools for longer term planning.	Ordinal	3
– Joint practices	Personal contacts for joint planning, problem-solving, and exchange of strategic information without using specific TQM tools (**PRAC**) [PRAC1] Our partner is involved in joint planning activities with us that traditionally were considered only one party's responsibility. [PRAC2] In the relationship with our partner, there is an exchange of strategic information, such as cost and price structure. [PRAC3] The relationship with our partner includes formal evaluation and assessment. [PRAC4] In our relationship, the responsibility for certain tasks has always been assigned to one *or* the other party. [PRAC5] The relationship with our partner involves frequent personal contacts for exchange of ideas and information. [PRAC6] We are willing to put aside contract terms in order to jointly work through difficult technical or quality problems that arise. [PRAC7] The relationship could be described as a 'long-term joint venture' or partnership.	Ordinal	7
Shared results – Role integrity	Level of complexity and multi-dimensionality of roles: – With financial impact (**RIW**) [RIW1] We have made financial investments in our company, such as tooling, equipment, and training employees, dedicated to the relationship with our partner. [RIW2] If our relationship with our partner were discontinued, our sales would suffer. [RIW3] My company, when appropriate, invests money in our partners facilities and equipment. [RIW4] Our partner shares information to help our company increase quality and productivity. [RIW5] We provide each other with technical support in substantial detail. [RIW6] Our partner makes an effort to help us during financial emergencies, for example, deferring payments or paying in advance. [RIW7] Our partner helps us identify cost reduction opportunities.	Ordinal	7
– Role integrity	– Without financial impact (**RIWO**) [RIWO1] Both parties share information on performance in meeting the expectations and needs of the other. [RIWO2] Our partner offers specific suggestions to help us improve our processes and procedures. [RIWO3] Our partner is responsive in maintaining a cooperative relationship with us. [RIWO4] From time to time, we are willing to make sacrifices to help our partner. [RIWO5] Both parties have multi-dimensional roles that go beyond the mere buying and selling of products. [RIWO6] The relationship with our partner includes diverse expectations over many issues. [RIWO7] We keep each other informed about events or changes that may affect the other party. [RIWO8] We regularly provide our partner with long-range forecasts of supply capabilities or demand requirements. [RIWO9] We are responsive in maintaining a cooperative relationship with our partner.	Ordinal	9

II : All ordinal scales are 6 point scales: 1 - Strongly disagree, 2 - Disagree, 3 - Somewhat Disagree, 4 - Mildly agree, 5 - Agree, and 6 - Strongly agree.

Table 2. Measurement and data collection methods for initial survey questionnaire (cont.)

Variables and indicators	Operationalization of indicators and item(s)	Level of measurement	Number of items
– Conflict resolution	Level of internality and informality of mechanisms to solve problems **(CR)** [CR1] Our procedures for dealing with disputes in the relationship with the partner are informal. [CR2] Problems that arise in the course of this relationship are treated as *joint* rather than *individual* responsibilities. [CR3] Each conflict is treated as a further improvement opportunity. [CR4] Neither party abuses its power over the other party. [CR5] Rather than relying on legal procedures to resolve conflicts (i.e., filing a suit), both parties rely on more informal means. [CR6] Temporary setbacks in our partners performance commitment are accepted and resolved in an aligned and negotiated way.	Ordinal	6
- Flexibility	Level of bilateral expectation of willingness to make adaptation **(FLEX)** [FLEX1] The procedures and routines developed by our partner are adapted to our particular situation. [FLEX2] Changes in the terms of ongoing transactions with our partner are made if unanticipated economic events occur. [FLEX3] The relationship with our partner can be characterized as flexible. [FLEX4] Our partner is flexible in response to requests we make.	Ordinal	4
– Mutuality	Level of positive incentives to cooperate with the partner and equity in the distribution of surpluses and burdens in the long-term – With short-term and direct financial impact **(MUW)** [MUW1] Any concessions we make to help our partner will even out in the long run. [MUW2] The benefits my company realizes from this relationship are proportional to the efforts put forth. [MUW3] Our company gets a fair share of the financial rewards and cost savings from the relationship with our partner. [MUW4] Benefits from problem solving with our partner are shared jointly. [MUW5] If our partner helps us reduce our costs, the partner also benefits. [MUW6] Our partner emphasizes what they will offer in return for our cooperation or participation.	Ordinal	6
– Mutuality	– Without short-term and direct financial impact **(MUWO)** [MUWO1] Both parties are committed to improvement that benefits the relationship as a whole, not just the individual parties. [MUWO2] There is a strong spirit of fairness in the relationship with our partner.	Ordinal	2
– Specific tools/ practices and their effectiveness	The next set of questions consists of two steps each. First, check (√) the tool or joint practice you are currently using in your relationship with your partner. And *second*, indicate the overall effectiveness of each tool or joint practice you checked by circling appropriate number. If there are other tools or joint practices you and your partner are using that were not listed in the previous question, please list them below.	Nominal and ordinal	2
– Perceived performance changes	First, identify the impact of using tools or joint practices by specifying a *percentage increase* or *decrease*. *Second*, identify only tools/practices that are predominantly responsible for the percentage increase/decrease in quality, cost, cycle time, and other performance dimensions. Based on all the tools/joint practices you identified, what is the *overall* effect on organizational performance?	Ratio and nominal	2
– Satisfaction level with the partner	Overall, my level of satisfaction with this partner is very high.	Ordinal	1
– Quality of partnership	Overall, the quality of the partnership with this partner is very high.	Ordinal	1

II : All ordinal scales are 6 point scales: 1 - Strongly disagree, 2 - Disagree, 3 - Somewhat Disagree, 4 - Mildly agree, 5 - Agree, and 6 - Strongly agree.

Pearson Correlation Coefficients

	TQMT	PRAC	RIW	RIWO	CR	FLEX	MUW	MUWO
TQMT	1.000							
PRAC	.8817	1.000						
RIW	.8318	.7396	1.000					
RIWO	.8934	.9539	.6458	1.000				
CR	.7891	.6798	.5896	.7665	1.000			
FLEX	.6171	.7099	.3780	.7683	.3524	1.000		
MUW	.6691	.7637	.3702	.8530	.5530	.7444	1.000	
MUWO	.6580	.8055	.3835	.8663	.7032	.5874	.9302	1.000

Simple Statistics

Variable	Mean	Std Dev	Minimum	Maximum
TQMT	4.850000	0.826640	3.500000	5.750000
PRAC	4.300000	0.627556	3.500000	5.333333
RIW	4.233333	0.577231	3.000000	4.888889
RIWO	4.780000	0.676264	3.700000	5.800000
CR	4.514286	0.447720	4.000000	5.285714
FLEX	4.660000	0.607728	3.800000	5.900000
MUW	4.550000	0.950512	2.250000	5.625000
MUWO	4.850000	1.179689	2.000000	6.000000

Internal-consistency Reliability (α)

ALPHA-TQMT:	0.6300813	ALPHA-PRAC:	0.6008359
ALPHA-RIW:	0.6587073	ALPHA-RIWO:	0.8870532
ALPHA-CR:	0.0955254	ALPHA-FLEX:	0.8637518
ALPHA-MUW:	0.9300538	ALPHA-MUWO:	0.5322688

Figure 2. Summary results of the pilot study with SPQA companies
(Summary results were generated from SAS/PC.)

better items with higher reliability and validity, continuous revisions were made to increase face and content validity.

2.3 Data Collection

This section corresponds to the third step of Figure 1, and includes sampling strategies and data collection procedures for the survey questionnaire.

2.3.1 Sampling Strategy for Survey Questionnaire

Because one of the major objectives of survey research is to draw generalizable conclusions to the extent possible, ideal data would be drawn from the total population. To obtain this objective with limited resources in terms of access and time, the following five sample selection criteria were used: ① Industry type and ownership— private manufacturing; ② Geographic location— U.S.-based; ③ Number of participants—1,811 potential respondents; ④ Industry scope—SIC 35, 36, and 37; and ⑤ Nature of participant—partnerships.

The first and second criteria indicate that this study sampled only privately owned manufacturing companies in the USA. The third criterion indicates that this study used 1,811 individuals as potential survey questionnaire participants. The last two criteria imply that this research used companies specializing in certain types of industries: SIC (Standard Industrial Classification) 35 (industrial equipment and machinery), 36 (electronic and electric equipment, and 37 (transportation equipment), and in partnership.

Two sources were used to sample potential respondents of the survey questionnaire: (1) 999 managers from the *Directory of Corporate Affiliations* (1999) and (2) 812 American Society for Quality Customer-Supplier Division (ASQ-CSD) members who work in companies that are listed in SIC 35, 36, and 37 category. For the 999 managers (each of 333 managers of buying, selling, and operations/production functions) from the *Directory of Corporate Affiliations*, a stratified sampling method was used. The intent in stratified sampling was to reduce sampling variability by creating relatively homogeneous strata (Pedhazur and Schmelkin, 1991). For the 812 ASQ-

CSD members, the researcher contacted the chair of the division. Eight hundred and twelve members' names and addresses falling into the first, second, and fourth sampling categories were provided by the ASQ headquarters.

2.3.2 Data Collection Procedures for the Survey Questionnaire

There were two mailings to each of the two sources of potential survey questionnaire respondents. The survey questionnaire was mailed to 999 managers whose names were taken from the directory in the first mailing. Although each company used different names for the above official positions, the survey questionnaire was delivered directly to individuals who were the most responsible for buying, selling, and operation-/production-related activities. One week after the first mailing, a follow-up call (or fax or letter) / thank you letter was mailed to increase the overall response rate. First, a follow-up call/fax/letter, depending on availability, asking non-respondents to answer the survey questionnaire was made/sent to all non-respondents. Second, a thank you-message was sent to all participants in the survey questionnaire who had replied by the follow-up stage.

In the first mailing to the 812 ASQ-CSD members, the same procedures were followed. In the follow-up, however, only a follow-up letter was sent to all non-respondents because their phone and fax numbers were not available. This is because a follow-up letter, not a follow-up call or fax, was agreed upon by the researcher and the chair of ASQ-CSD in order to protect members' privacy.

3. ASSESS RELIABILITY AND VALIDITY

To determine the quality of the survey items, two methods were used: (1) reliability analysis using Cronbach's alpha and (2) factor analysis.

3.1 Reliability Analysis

Reliability is the degree to which measurements are free from random errors (X_R). Mathematically, perfect reliability means $X_R = 0$. A highly reliable survey questionnaire accurately measures the specified construct (Churchill, 1979). Generally, a reliability of 0.7 is a minimally acceptable level of reliability (Kerlinger, 1973), and 0.8 or greater is preferable, although Nunnally (1978) states that a lower reliability, such as 0.6 or even 0.5, is acceptable for newly developed items. For this study, Cronbach's internal-consistency reliability was used. Table 3 shows the results of reliability analysis. (a^* : Cronbach's coefficient alpha if item were deleted; a^{**} : Overall Cronbach's coefficient alpha.) Although some items, if deleted from the scale, would improve internal-consistency, they were not deleted

at this stage in order to examine how items across scales related to each other.

3.2 Factor Analysis

Validity means having a conclusion correctly defined from the premises (Davis and Cosenza, 1985). In other words, it means the survey questionnaire items measure what they are supposed to measure. A valid measure should yield correct estimates of what is being assessed: (1) the survey questionnaire instrument is actually measuring the concept in question and (2) the concept is measured accurately. In other words, the first (1) without the second (2) is possible, but *not* vice versa. That is, the concept cannot be measured accurately if some other concept is being measured.

For this research, construct validity was assessed using factor analysis (DeVellis, 1991). Factor analysis was used because it determined whether the survey questionnaire actually measures the concept in question. Factor analysis also indicates the number of underlying factors a set of items is measuring and which items are measuring which factors (Churchill, 1979). This section includes the four factor analyses resulting from combining conceptually similar constructs: joint use of specific tools (TQMT) and joint practices (PRAC), role integrity with (RIW) and without (RIWO) financial impacts, conflict resolution (CR) and flexibility (FLEX), and mutuality with (MUW) and without (MUWO) financial impacts. For the factor analyses shown below, (1) principal component factor extraction option, (2) prior communality of 1.0, and (3) promax rotation option were used.

3.2.1 First Factor Analysis (TQMT & PRAC)

Ten items ([TQMT1]~[TQMT3] and [PRAC1]~[PRAC7]) were entered into a factor analysis. The factor pattern matrix is shown in Table 4(Factor loadings were multiplied by 100 and rounded to the nearest integer; Factor loadings less than 0.40 were suppressed).

As shown in Table 4, four items (TQMT1, TQMT2, TQMT3, and PRAC3) loaded most strongly onto Factor 1 and three (PRAC6, PRAC7 and PRAC5) onto Factor 2. Internal consistency for these groupings was: a for Factor 1 = 0.67 and a for Factor 2 = 0.64.

The alpha value for three items loaded onto Factor 3 (PRAC1, PRAC2, and PRAC4) was 0.32. Therefore the following actions were taken:

- No scale was constructed that related to Factor 3 because of low reliability.
- PRAC1 was switched to Factor1 because this item also loaded onto Factor 1 and the switching resulted in an increase in a for Factor 1 to 0.71 from 0.67.
- PRAC2 was switched to Factor 2 although this item loaded more strongly onto Factor 3 (which was not used). This caused an increase in (for Factor 2 to 0.65

Table 3. Operational measures of variables and reliability analysis (See Table 2 for the exact content of each item.)

Variables and indicators	Item(s) and α^* [α^* value is inside ( )]	α^{**}
Individual demographics Status (or Perspective)	Customer (buyer) or supplier (seller) (—)	
Title	[Official title] of [Dept. or section or division] (—)	
Job tenure	Number of years or months of experience with this job (—)	—
Organization tenure	Number of years or months of experience with this organization (—)	
Business partnership tenure	Number of years or months of experience with this partner (—)	
Organizations Total annual sales volume	Average total sales volume of the company (—)	
Number of employees	Total number of employees (—)	
Status of the company	Parent organization? (—)	
Partner	Single vs. Multiple sources for certain items (—)	
Amount of business with the partner	% amount of sales to/purchasing from the partner (—)	—
Number of partner company's employees	Total number of partner companys employees (—)	
Proportion of partnerships	% of partnership with customers and supplier (—)	
Joint use of tools [TQMT]	[TQMT1] (0.70); [TQMT2] (0.52); [TQMT3] (0.57)	0.69
Joint practices [PRAC]	[PRAC1] (0.53); [PRAC2] (0.53); [PRAC3] (0.60); [PRAC4] (0.69);[PRAC5] (0.51) [PRAC6] (0.56); [PRAC7] (0.51)	0.60
Role integrity with financial impacts [RIW]	[RIW1] (0.53); [RIW2] (0.59); [RIW3] (0.52); [RIW4] (0.42); [RIW5] (0.43); [RIW6] (0.48); [RIW7] (0.47)	0.53
Role integrity without financial impacts [RIWO]	[RIWO1] (0.74); [RIWO2] (0.75); [RIWO3] (0.74); [RIWO4] (0.77); [RIWO5] (0.72) [RIWO6] (0.73); [RIWO7] (0.73); [RIWO8] (0.73); [RIWO9] (0.72)	0.76
Conflict resolution [CR]	[CR1] (0.80); [CR2] (0.63); [CR3] (0.68); [CR4] (0.61); [CR5] (0.67); [CR6] (0.66)	0.72
Flexibility [FLEX]	[FLEX1] (0.64); [FLEX2] (0.70); [FLEX3] (0.44); [FLEX4] (0.41)	0.63
Mutuality with financial impacts [MUW]	[MUW1] (0.75); [MUW2] (0.75); [MUW3] (0.69); [MUW4] (0.71); [MUW5] (0.79) [MUW6] (0.74);	0.77
Mutuality without financial impacts [MUWO]	[MUWO1] (—); [MUWO2] (—)	0.79
Identification of tools/joint practices used and their effectiveness and internalization	*First*, check (√) only tools/practices your company is using jointly with your partner. *Second*, indicate the overall effectiveness of each tool or joint practice you checked by circling the appropriate number. And third, indicate whether or not each tool or joint practice you checked is internalized into the way you and your partner companies do business by circling the appropriate number. (—) Please list below any additional tools/practices not listed in the previous question that you and your partner company are using jointly. (—)	—
Measuring perceived changes in organizational performance dimensions ~	*First*, identify the impact of using tools or joint practices by specifying a *percentage increase or decrease*. *Second*, identify only tools/practices that are predominantly responsible for the percentage increase/decrease in quality, cost, cycle time, and other performance dimensions. (—) Based on all the tools/joint practices you identified, what is the *overall* effect on organizational performance? (—)	—
Level of satisfaction and quality of partnership	Overall, my level of satisfaction with this partner is very high. (—) Overall, the quality of the partnership with this partner is very high. (—)	—

α^*: Cronbach's coefficient alpha if item were deleted α^{**} : Overall Cronbach's coefficient alpha

Table 4. Factor pattern matrix for Joint Use of Specific Tools (TQMT) and Joint Practices (PRAC)
(Bolded items, also highlighted by *, indicate which items were loaded onto which factors.)

	FACTOR1	FACTOR2	FACTOR3
TQMT1	**73** *		
TQMT2	**76** *		
TQMT3	**73** *		
PRAC3	**52** *		
PRAC6		**78** *	
PRAC7		**74** *	
PRAC5	45	**70** *	
PRAC1	**55** *		68
PRAC2		**43** *	65
PRAC4			− 59

Table 5. Second, third, and fourth factor analyses

	Factor pattern matrix	Actions taken
2ⁿᵈ : RIW & RIWO	FACTOR1 FACTOR2 FACTOR3 RIWO3 **72** * RIW4 **73** * RIWO7 **65** * RIW7 **65** * 51 RIW5 **60** * RIWO1 **59** * RIWO2 **57** * RIWO5 53 **42** * RIWO6 **53** * RIWO8 **50** * 44 RIW1 **70** * RIW2 **66** * RIWO4 **70** * RIWO9 50 **58** * RIW3 82 RIW6 61	Alpha values for items before taking any necessary actions were 0.82 for Factor 1 (RIWO3, RIW4, RIWO7, RIW7, RIW5, RIWO1, RIWO2, RIWO5, RIWO6, and RIWO8), 0.63 for Factor 2 (RIW1, RIW2, RIWO4, and RIWO9), and 0.43 for Factor 3 (RIW3 and RIW6). *Actions taken* : (1) RIW3 and RIW6, loaded only onto Factor 3, were excluded from further analysis because of low reliability; (2) RIWO5, which loaded onto both Factor 1 (0.53) and Factor 2 (0.42), was switched to Factor 2 for two reasons. First, RIWO 5 was conceptually more aligned with other items in Factor 2 than with items in Factor 1 because it specifically relates to multi-dimensional roles. Second, as a result, α for Factor 2 increased to 0.69 from 0.63, although switching decreased α for Factor 1 to 0.81 from 0.82. Because of 0.81 was sufficiently high, RIWO5 was grouped in Factor 2. *Summary* : 9 items (RIWO3, RIW4, RIWO7, RIW7, RIW5, RIWO1, RIWO2, RIWO6, and RIWO8) and 5 items (RIWO5, RIW1, RIW2, RIWO4, and RIWO9) were retained in Factor 1 and Factor 2. These two factors were called 'informed partners' (INFPRT; final α = 0.81) and 'role integrity' (RI; final α = 0.69).
3ʳᵈ : CR & FLEX	FACTOR1 FACTOR2 CR4 **82** * FLEX4 **80** * FLEX3 **82** * CR2 **78** * CR6 **73** * CR5 **60** * CR3 **59** * − 43 FLEX1 CR1 87 FLEX2	All items loaded strongly onto two factors except two: FLEX1 and FLEX2. These two items were deleted because they did not load onto any factor, and because, as indicated in Table 3, they decreased the internal-consistency of the scale FLEX. The alpha value for the seven items loaded onto Factor 1 was 0.84. The single item CR1, loaded onto Factor 2, was deleted for the following two reasons: (1) Including it with other items in Factor 1 decreased internal-consistency (from 0.84 to 0.82); (2) As indicated in Table 3, this item decreased internal-consistency of CR and would have been a candidate for deletion based on the reliability analysis. *Summary* : The items loaded onto Factor 1 (CR4, FLEX4, FLEX3, CR2, CR6, CR5, and CR3) were called 'conflict resolution' (CR; final α = 0.84).
4ᵗʰ : MUW & MUWO	FACTOR1 MUWO2 **83** * MUWO1 **81** * MUW3 **80** * MUW4 **77** * MUW6 66 MUW1 65 MUW2 63 MUW5 47	Four items loaded onto Factor 1. The alpha value for the items was 0.85. This factor was called 'mutuality' (MU; final α =0.85) (without differentiating *with* and *without* financial impacts). The remaining four items were excluded from future analysis because they did not load strongly onto Factor 1 and because α for Factor 1 decreased if they were included in Factor 1.

Table 6. Operational measures of variables and changes made in scales after reliability analysis and factor analysis (See Table 2 for the exact content of each item.)

Variables and indicators	Operationalization of indicators and item(s)	α
Individual demographics Status (or Perspective)	Customer (buyer) or supplier (seller)	
Title	[Official title] of [Dept. or section or division]	
Job tenure	Number of years or months of experience with this job	—
Organization tenure	Number of years or months of experience with this organization	
Business partnership tenure	Number of years or months of experience with this partner	
Organizations Total annual sales volume	Average total sales volume of the company	
Number of employees	Total number of employees	
Status of the company	Parent organization?	
Partner	Single vs. Multiple sources for certain items	—
Amount of business with the partner	% amount of sales to/purchasing from the partner	
Number of partner company's employees	Total number of partner companys employees	
Proportion of partnerships	% of partnership with customers and supplier	
Joint use of tools [TQMT] 5 items	[TQMT1], [TQMT2], [TQMT3], [PRAC1], [PRAC3]	0.71
Joint practices [PRAC] 4 items	[PRAC2], [PRAC5], [PRAC6], [PRAC7]	0.65
Informed partners [INFPRT] 9 items; Informed partners resulting from frequent information sharing/suggestion providing (_added_)	[RIW4], [RIW5], [RIW7], [RIWO1], [RIWO2], [RIWO3], [RIWO6], [RIWO7], [RIWO8]	0.81
Role integrity [RI] 5 items	[RIW1], [RIW2], [RIWO4], [RIWO5], [RIWO9]	0.69
Conflict resolution [CR] 7 items	[CR2], [CR3], [CR4], [CR5], [CR6], [FLEX3], [FLEX4]	0.84
Mutuality [MU] 4 items	[MUW3], [MUW4], [MUWO1], [MUWO2]	0.85
Identification of tools/joint practices used and their effectiveness and internalization	Exactly same as in Table 3.	—
Measuring perceived changes in organizational performance dimensions	Exactly same as in Table 3.	—
Level of satisfaction and quality of partnership	Exactly same as in Table 3.	—

from 0.64.

• PRAC4 was deleted and excluded from further analysis because this item loaded only onto Factor 3, whose α value was 0.32.

In summary, 5 items (TQMT1, TQMT2, TQMT3, PRAC1 and PRAC3) were retained in the construct TQMT and 4 items (PRAC2, PRAC5, PRAC6 and PRAC7) were retained in the PRAC construct. These were called 'joint use of tools' (TQMT ; final $\alpha = 0.71$) and 'joint practices' (PRAC; final $\alpha = 0.65$), respectively.

3.2.2 Second(RIW & RIWO), Third(CR & FLEX), and Fourth(MUW & MUWO) Factor Analyses

Using the same method and analytic procedures, the

second, third, and fourth factor analyses were conducted, and Table 5 shows summary results and actions taken.

3.3 Changes Made in Scales after Factor Analysis

Based on the results of the reliability analysis and the factor analysis described in the preceding sections, changes were made to the scales identified in Table 3. These changes also imply changes to the four dependent variables, which are now: informed partners, role integrity, conflict resolution, and mutuality. Table 6 shows new scales based on all changes.

Table 7. Correlations between survey items and scale averages

Constructs/ Factors	Items	Construct / Factors					
		TQMT	PRAC	RI	INFPRT	CR	MU
TQMT	TQMT1	**.75**	.14	.18	.32	.09	.13
	TQMT2	**.74**	.38	.22	.56	.45	.25
	TQMT3	**.71**	.36	.37	.49	.36	.18
	PRAC1	**.62**	.54	.30	.49	.39	.34
	PRAC3	**.53**	.21	.27	.35	.17	.07
PRAC	PRAC2	.38	**.70**	.23	.48	.41	.47
	PRAC5	.40	**.68**	.24	.61	.57	.41
	PRAC6	.15	**.67**	.19	.47	.60	.36
	PRAC7	.36	**.73**	.32	.54	.59	.44
RI	RIW1	.42	.15	**.68**	.18	.04	.05
	RIW2	.08	− .01	**.71**	− .01	− .09	.15
	RIWO4	.21	.33	**.67**	.14	.28	.17
	RIWO5	.35	.40	**.51**	.46	.34	.25
	RIWO9	.28	.49	**.61**	.45	.46	.17
INFPRT	RIW4	.48	.50	.16	**.73**	.47	.42
	RIW5	.47	.53	.32	**.63**	.54	.39
	RIW7	.40	.56	.06	**.69**	.46	.45
	RIWO1	.49	.46	.14	**.65**	.52	.41
	RIWO2	.42	.38	.22	**.62**	.35	.26
	RIWO3	.30	.51	.15	**.64**	.50	.48
	RIWO6	.41	.40	.32	**.57**	.29	.25
	RIWO7	.29	.54	.13	**.60**	.51	.40
	RIWO8	.38	.41	.30	**.60**	.26	.15
CR	CR2	.35	.63	.28	.58	**.78**	.48
	CR3	.35	.45	.24	.49	**.64**	.31
	CR4	.26	.58	.17	.50	**.83**	.55
	CR5	.19	.51	.32	.38	**.60**	.32
	CR6	.37	.59	.18	.53	**.73**	.48
	FLEX3	.33	.65	.14	.62	**.83**	.66
	FLEX4	.31	.60	− .03	.63	**.78**	.64
MU	MUW3	− .39	− .60	− .32	− .60	.38	**.74**
	MUW4	.28	.69	.19	.51	.65	**.82**
	MUWO1	.30	.56	.12	.51	.63	**.83**
	MUWO2	.39	.57	.20	.62	.61	**.82**

3.4 Correlations between Survey Items and Scale Averages

Next, to see if the revised set of items correlates highly with scales (variables) they are intended to measure, correlations between all remaining items and the scale average were calculated as used in Saraph, Benson, and Schroeder (1989). Table 7 shows the results. Table 7 implies that items have been appropriately assigned to scales. For example, because TQMT is the average of 5 items (TQMT1, TQMT2, TQMT3, PRAC1, and PRAC3), a high correlation between TQMT and the five individual items was expected. In addition, since the five items in TQMT showed relatively smaller correlations with the other scales, it was concluded that they have been assigned

appropriately to the scale TQMT.

4. CONCLUSIONS

Some limitations and areas for further research are discussed in this section. If the design of this research − non-experimental − using the survey questionnaire is used, the ability to draw causal inferences is usually limited. Due to the characteristics of the survey questionnaire using the measures developed through the steps introduced here, this research may be able to provide only the evidence of relationships between independent and dependent variables, but not evidence of cause-and-effect relationships. Another limitation is that the measures developed

here can be applied only to the research sample selected for this paper: customer-supplier relationships in SIC 35, 36, and 37 private manufacturing companies. Because of this, a caution must be exercised in generalizing findings to other relationships with different characteristics.

Future research could improve the reliability and validity of the scales. Although Cronbach's alpha values were considered acceptable for newly developed scales, Nunnally(1978) suggests that frequently used scales should have a minimum alpha value of 0.80. This can be accomplished by continuing to add and modify items, based on feedback obtained by testing the scales in various samples. It is important to test these scales using samples from other populations in order to enhance their generalizability.

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