The Relationship Between Intra-Organizational And Inter-Organizational Coordination And Its Influence On Product Quality Improvement

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ABSTRACT

A sample of 225 firms is analyzed, using structural equation modeling, to test five hypotheses. This study seeks to gain a better understanding of the practice of coordination among functional areas within the buying firm as well as between buyer firms and their key suppliers. The implications of this research suggest that it is important for firms to focus on their long-term success as they work with key suppliers. The research shows when the stakeholders of the firm support its efforts to coordination and cooperation with its key suppliers, the firm benefits. Evidence shows cross-functional coordination enhances the firm's capability to cooperate with its key suppliers. The findings are significant to supply chain manager and to the various functional managers in charge of quality, production, R&D, and customer service and their respective counter parts in supplier firms. Finally, this study expands prior research and fills a gap in the literature by showing the importance of inter-organizational coordination between the buyer's supply management/purchasing function and the supplier's operations function. This study reveals that conformance to specifications, product reliability and overall product quality performance can be significantly improved when these inter-organizational functional areas coordinate their requirements. The study also shows that product quality can be significantly improved when intra-organizational and inter-organizational coordination occurs simultaneously.

Key Words: Intra-organizational Coordination, Inter-organizational Coordination, Product Quality Improvement

INTRODUCTION

The purpose of this research is to gain further knowledge on the relative importance of coordination and cooperation activities between functional areas and between the buyer firm and its key suppliers. This practice is worthy of further investigation to determine the benefits realized by firms across industries, especially with respect to product quality improvements. This study seeks to answer the following research questions: (1) What is the relationship between intra-organizational coordination and inter-organizational coordination; and (2) What is the relationship between inter-organizational coordination and product quality improvement?

Table 1: Importance of Coordination Within and Between Organizations

Theoretical Views (1)	**Literature(2)**	**Intra-firm/functional Coordination(3)**	**Inter-firm/supply chain Coordination(4)**
Resource Based View of the Firm	Prahalad and Hamel (1990); Kogut and Zander (1992)	Coordination across functional areas is a resource or process capability leading to competitive advantage	Inter-firm Cooperation and coordination provided relational advantage
	Penrose (1959); Aaker (1995); Barney (1991)	Knowledge and Experience of the Management Team are valuable resources for a firm because that cannot be easily copied by others	
	Hart (1995) Grant (1996)	Critical functions within a firm are its valuable capabilities	
Relational Exchange Perspective	Alter and Hage (1993); Aldrich (1976); Levine and White (1961); Schmidt and Kochan (1977)		Effective functional and supply chain integration reduces decision uncertainty
	Heide and John (1990); Zaheer and Venkatraman (1995)		High degree of inter-organizational collaboration and joint problem solving helps organizations to acquire scarce resources and manage environmental uncertainty effectively
Information Processing and Organizational design perspective	Lawrence and Lorsch (1967); Galbraith (1977);	Functional coordination enhances innovation and reduces uncertainty in decision making	Successful coordination between functional areas and between firms enhances the alliance success.
	Cohen and Levinthal (1990);	Cross-functional coordination increases the absorptive and information processing capacity	
Supply Chain Integration View	Hill (1989); Handfield et al. (2000); Prahinski and Benton (2004); Jack and Raturi (2003)	Functional coordination helps firms interact better with other organizations	Better coordination with suppliers enhances the operational efficiency and performance of functions within.
	Martin et al. (1995); Mudambi and Helper (1998); Bensaou (1999); Masella and Rangone (2000); Lusch (1996); Berry et al. (1997);	Better coordination of functional activities for production volume, and quantity and quality order requirements;	Complex products and services demand higher degree of coordination with suppliers
	Bookbinder and Cakanyildirim (1999);	Variability in lead time can affect buyer-supplier coordination	Uncertainty in buyer-supplier relationships can introduce product quality and quantity shortage problems
	Farmer (1981); Ammer (1989) Achrol (1997); Gilliand and Bello (2002); Krajewski and Ritzman (2002)	Uncertainty in the supply chain necessitates strong inter-functional coordination of buyer	
	Benton and Krajewski (1990); Carter (1993)		Parallel patterns of communication between functional units of buyer and supplier facilitates quality improvement
	Ansari and Modarress (1994); Forker (1997); Das and Narasimhan (2000); Johnson et al. (2002)		Supplier assistance in quality improvement can provide a competitive advantage

THEORETICAL GROUNDING

Table 1 summarizes the extant literature above theoretical views related to the importance of intra-organizational and inter-organizational coordination for achieving better organizational outcomes.

An organization's ability to effectively achieve functional and supply chain integration is essential to respond to the demands of uncertain business environments (Grant, 1996). The resource-based view of the firm emphasizes coordination across functional areas as a resource to sustaining a competitive advantage (Prahalad and Hamel, 1990). The knowledge and experience of the management team is considered an important resource of the firm that cannot be easily copied by competitors (Penrose, 1959; Barney, 1991; Aaker, 1995). Critical functional areas within the firm represent the firm's capabilities (Hart, 1995) that help to sustain competitive advantage.

We can also examine the role of cross-functional and supply chain integration from an inter-organizational relationship view. An inter-organizational relationship refers to two or more organizations coming together to achieve a goal, perform a task, and/or provide a service. Relationships form when members of two or more organizations can receive mutual benefits or gains from interacting (Levine & White, 1961; Aldrich, 1976). The managers of each organization believe that each is better off interacting than by remaining autonomous. The nature of the interactions are characterized by a high degree of cooperation and problem solving since they are all motivated to coordinate their efforts for mutual benefit. Levine and White (1961) stressed that exchange resulted from the scarcity of three elements over which the agency must have control: (1) clients to serve, (2) resources (equipment, knowledge, or funds), and (3) services of people who can direct the resources to the clients. When an agency does not have control over either of these elements, an exchange occurs in order that the agency can attain its goal of serving its clients. Coordination and cooperation between organizations to obtain the scarce elements occurs in order to maximize goal attainment.

Information processing and supply chain literature also stresses the importance of coordination within and between organizations. The successful coordination of activities between functional areas and between organizations enables the functional areas to plan and carry out their activities jointly (Heide and John, 1990; Zaheer and Venkatraman, 1995). The coordination mechanisms range from simple rules and procedures, to departmental goals, to complex cross-functional teams that enhance inter-organizational and cross-functional relationships (Galbraith, 1977). Highly turbulent business environments and tasks involving high degree of interdependence between functional areas and organizations require more coordination. Functional coordination is considered a necessity for world class operations strategy (Lawrence and Lorsch, 1967; Galbraith, 1977). The firms with effective coordination will demonstrate strong internal cooperation (between marketing and operations, operations and engineering, operations and purchasing) to meet the demands of the firm's competitive environment (Anderson and Narus, 1990).

Inter-organizational coordination decreases these uncertainties in the environment. In inter-organizational relationships, the exchange of knowledge and information that is very critical for the success of the firms can be achieved only through complex personal and social interactions. Personal and informal methods of coordination serve as a social control mechanism for managing inter-organizational relationships.

Intra-Organizational Coordination And Inter-Organizational Coordination

The upstream relationship in the supply chain involves interactions between the buyer and supplier firms. Employing coordination activities for product volume, order quantities and quality requirements helps to remove barriers between buyer and supplier firms (Hill, 1989). Cross-functional areas in the buyer's firm should work closely with their key suppliers (Handfield et al., 2000; Prahinski and Benton, 2004) to achieve greater efficiencies and improve performance (Jack and Raturi, 2003). The buyer-supplier literature indicates that many buying firms have considered the need to better manage their business relationships with their key suppliers. Firms establish strategic cooperative relationships with key suppliers to guard against the negative consequences associated with the scarcity of resources and inefficient operations. Companies that focus their time and effort on coordinating their product requirements with key suppliers and establish cooperative relationships with these suppliers should have better outcomes (Martin et al., 1995; Mudambi and Helper, 1998; Bensaou, 1999; Masella and Rangone, 2000). As buyer firms attempt to work closer with key suppliers, efficiencies can increase (Lusch, 1996; Berry et al., 1997).

Since marketing's focus is on downstream relationships with the firm's customers, coordination between operations and marketing would add value to the interaction between firms (Achrol, 1997). The role of purchasing in dealing with the firm's suppliers should mirror the role of marketing in dealing with the firm's customers (Farmer, 1981; Ammer, 1989). Marketing translates the customer needs into product requirements; purchasing orders materials from the supplier to be converted into products and services to meet customer needs. Therefore, the coordination between operations and marketing is related to the upstream activities between the buyer and supplier firm.

Efforts to coordinate between buyer and supplier firms can be impaired by variability in lead-time (Bookbinder and Cakanyildirim, 1999). Uncertainty in the supply chain makes it imperative for all of the functional areas in the buyer firm to work closely together and coordinate their requirements with the firm's key suppliers. This cross-functional coordination is a complex organizational and process capability that emerges as a result of stronger interaction and learning between functions within the firm. This emergent process capability is considered a valuable, socially complex resource in many organizations (Kogut and Zander, 1992). Cross-functional coordination enhances the firm's ability to deal with other firms upstream and downstream in the supply chain. An example was the use of "an advanced planning and scheduling system to link the scheduling process demand data and forecasts, supply chain facility and inventory decisions, and the capability of suppliers so that the entire supply chain could operate more efficiently" (Krajewski and Ritzman, 2002, p. 843).

When a supplier is not a key supplier of the buying firm, the product or service may be a commodity or low dollar item which can be obtained without difficulty on the open market. Large scale or complex purchases may require more coordination with a few key suppliers (Gilliand and Bello, 2002). The following hypotheses are offered to examine the relationship between intra-organizational coordination and inter-organizational coordination and depicted in Figure 1:

H1a: Coordination between operations and engineering within the firm has a positive influence on inter-organizational coordination.

H1b: Coordination between operations and purchasing within the firm has a positive influence on inter-organizational coordination.

H1c: Coordination between operations and marketing within the firm has a positive influence on inter-organizational coordination.

H1d: Intra-organizational coordination has a positive influence on inter-organizational coordination.

Inter-Organizational Coordination And Product Quality Improvement

Firms that emphasize inter-organizational coordination gain insight into methods to eliminate waste and improve their firms' performance (Grant, 1996). The coordination activities determine the information processing capacity required for accomplishing the organizational and inter-organizational tasks efficiently, and that enables the firm to achieve higher levels of performance (Cohen and Levinthal, 1990; Grant, 1996). Several researchers specifically discuss the issue of product quality performance with respect to the buyer-supplier relationship. Benton and Krajewski (1990) introduce the concept of supply side uncertainty to show that part commonality can be used to reduce order backlog. The result is an increase in total inventories which creates a situation that is more susceptible to supplier quality problems. Supplier quality is one aspect of supplier performance; it is evaluated based on the ability of the supplier to provide the requisitioned quantity of defect-free parts. Supplier quality problems can affect the quantity of the shipment and create immediate shortages.

Carter (1993) found that parallel patterns of communication - direct communication between functional counterparts in the buying and selling organizations -allows for quality to be designed into the product. Ansari and Modarress (1994) developed a conceptual framework depicting that suppliers have an important role in product quality with respect to quality function deployment (QFD). QFD integrates functional areas across firms to help meet the customers' demand for higher quality products.

According to Forker (1997), global competition and domestic economic pressures have pushed American firms to increase product quality. General Motors' (GM) decision to obtain critical stampings and other parts from its suppliers might not have been a good strategy due to the lack of prior development of supplier competence by GM (Das and Narasimhan, 2000). Other companies built plants where suppliers were housed under the same roof. Companies in other industries were noted for their efforts to develop a group of technologically capable suppliers through close coordination. Firms in a supply chain relationship can increase their competitive advantage if they work together. Both internal teams and customer teams could play a role in the overall competitiveness of many firms (Johnson et al., 2002). The following hypothesis is related to the relationship between coordination between firms and product quality improvement and shown in Figure 1:

H2: Inter-organizational Coordination has a positive influence on product quality improvement.

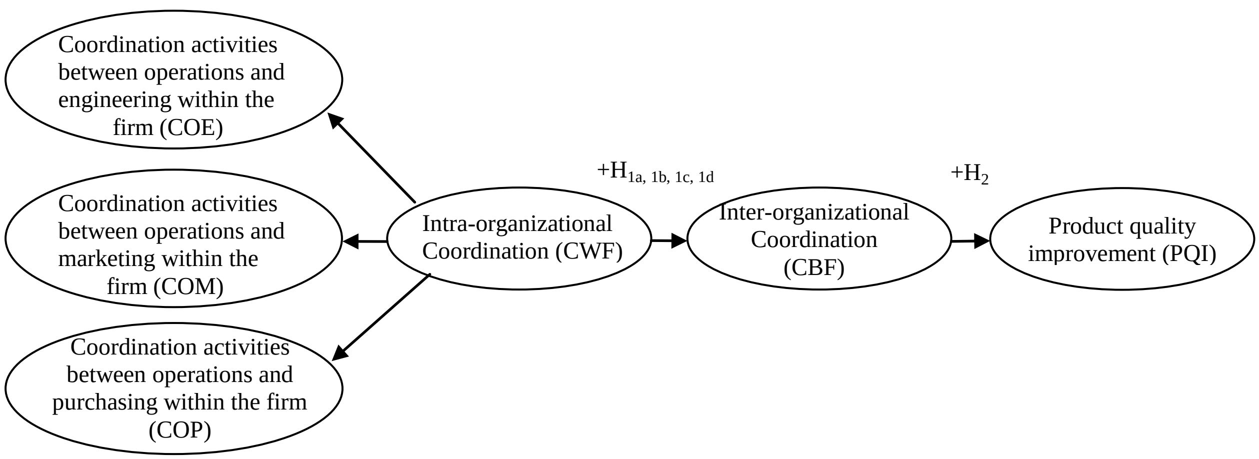

Figure 1
Theoretical model of the hypothesized relationships between intra-organizational coordination, inter-organizational coordination and performance quality improvement

RESEARCH METHOD

The Institute for Supply Management's membership list of over 6,000 members across industries was used to administer a mail survey to senior managers from 1000 randomly selected firms. Of the 1,000 firms targeted, we received competed responses from a total of 231 firms with a response rate of 23 percent. Early and late respondents were examined for non-respondent bias by conducting t-tests. The tests revealed that there were no significant differences between the groups of early and late respondents for responses on the 20 scale items (Wilk's Lambda = .9861, F=.43, p=.9400). The responses represented a variety of industries and majority of respondents held high-level positions such as general manager, vice president, director, or manager. The demographics for the sample of 231 firms are shown in Table 2.

Table 2: Demographics of the sample of 231 firms

Industries Represented in the Sample	
Aluminum (3 firm)	Medical (8 firms)
Aerospace (6 firms)	Mining (5 firms)
Aviation (3 firms)	Misc. manufacturing (45 firms)
Automotive (8 firms)	Packaging (2 firms)
Banking (5 firms)	Plastics (4 firms)
Chemical (7 firms)	Pharmaceutical (6 firms)
Computer (3 firms)	Pumps (2 firms)
Construction (2 firm)	Semiconductor (4 firms)
Distribution (13 firms)	Steel (6 firms)
Electronics (14 firms)	Telecommunications (8 firms)
Food (13)	Transportation (5 firms)
Furniture (3 firms)	Testing (5 firms)
Healthcare (4 firms)	Tools (2 firms)
Heating (2 firms)	Utility (9 firms)
Insurance (2 firms)	Misc. services (8 firms)
Metal (6 firms)	Others (19 firms)*

- The sample consisted of 169 manufacturing firms and 62 service firms.
- On average, the firms in the sample had $100 million in sales and 9597 employees.
- The average firm in the sample has been a customer to their most important supplier for 16 years.
- On average, 23 percent of the customer firms' business was with their most important supplier.

*****Note: Only one firm was represented in each of the 19 other categories.

Survey Instrument And Scale Refinement

We employed a multi-item survey instrument that was developed on the basis of an extensive review of the literature. Survey questions consisted of scales adapted from previous studies (Anderson and Narus, 1990; Butaney and Wortzel, 1988; Bracker and Pearson, 1986). The survey instrument contained questions pertaining to the factors in the model shown in Figure 1. The survey instrument was pre-tested for clarity by five academics and sixty-seven business professionals. The firm was the unit of analysis and the survey asked questions with respect to the functional areas within the buying firm and a key supplier of the buying firm.

An analysis of variance tests were conducted for the effect of size and technological intensity. We measured the firm's size based on gross sales. There was no significant difference between firms based on size for the 20 scale items tested (Wilk's Lambda =.8016, F = 1.13, p=.2725). The variable for technological intensity was measured in terms of the firm's primary products categorized as low, medium, or high technological intensity. There was no significant difference between firms based on technological intensity of their primary products for the 20 scales items tested (Wilk's Lambda = .8925, F=.59, p=.9775).

The constructs were captured with a seven point likert scales. Scale refinement consisted of examining the item-to-total correlations for the scale items and confirmatory factor analysis. Due to missing data for some survey items, the data analysis proceeded with 225 surveys. Table 3 shows the scale items and Cronbach coefficient alpha level for each factor depicted in the model. The Cronbach coefficient alpha levels for scales were .70 and above (Churchill, 1979). The final factor loadings and descriptive statistics are shown in Table 4. All of the items met the minimum requirements for an item to be a significant factor load (Hair et al., 1998).

Table 3: Factors, indicator variables, scales items and Cronbach's coefficient alpha

Factors	Indicator Variables and Scales	Standardized Coefficient Alpha
Coordination between operations and purchasing within the firm (COP)	To what extent does operations coordinate with purchasing/ supply management regarding the following areas in unit production? (1 = To no extent, 7 = To a great extent) Var 1 – Production volume Var 2 – Quality requirements Var 3 – Order quantities	.8190
Coordination between operations and marketing within the firm (COM)	Var 4 – To what extent does sales/marketing coordinate customer requirements with operations? (1 = To no extent, 7 = To a great extent) Var 5 – Sales/Marketing works with operations to ensure the customer's needs are met. (1= Strongly Disagree, 7 = Strongly Agree) Var 6 – Sales/Marketing supports operations to meet operations' production needs? (1= Strongly Disagree, 7 = Strongly Agree)	.8315
Coordination between operations and engineering within the Firm (COE)	Var 7 – To what extent does engineering coordinate product and/or process design requirements with operations? (1 = To no extent, 7 = To a great extent) Var 8 – Engineering works with operations to ensure the process and product design is compatible. (1= Strongly Disagree, 7 = Strongly Agree) Var 9 – Engineering support operations to meet operations' production needs? (1= Strongly Disagree, 7 = Strongly Agree)	.8789
Coordination between firms (CBF)	Var 10 – To what extent does your supplier's operations department discuss their requirements with your purchasing/supply management department? (1 = To no extent, 7 = To a great extent) Var 11 – To what extent does your company's purchasing/supply management department coordinate with your supplier's operations department regarding product quality requirements? (1 = To no extent, 7 = To a great extent) Var 12 – Together, our firm and our supplier create a synergy that benefits both companies. (1= Strongly Disagree, 7 = Strongly Agree) Var 13 – Our supplier is very cooperative in meeting the quality standards set by our company. (1= Strongly Disagree, 7 = Strongly Agree)	.7032
Product quality improvement (PQI)	Indicate your company's position in the following dimensions of product quality over the past five years. (1 = Significantly lower, 4= Remain Constant, 7 = Significantly higher) Var 14 – Overall product quality performance is Var 15 – Product reliability is Var 16 – Product conformance to specifications is	.9087

A second order factor was employed for the latent factor intra-organizational coordination using the covariance among the first order factors (Byrne, 1995). Based on the correlation analysis, the first order factors (coordination between operations and purchasing, coordination between operations and marketing, and coordination between operations and engineering) are all significantly correlated ($p<.001$, respectively). The purpose for using the second order factor is to increase the generalizability of the latent construct intra-organizational coordination (Gorsuch, 1983). The second order factor also helps to maximize the number of degrees of freedom for estimating the path coefficients in the structural equation model and in turn helps to improve the model fit (Cf. Prahinski and Benton, 2004).

Table 4: Factor loads promax rotation method (n=225), means and standard deviations for variables

Factors	Variables	Mean	Stdev	COP*	COM*	COE*	CBF*	PQI*
COP	Var 1	5.004	1.629	0.7708	0.0210	0.0762	-0.0603	0.0008
	Var 2	4.942	1.479	0.7461	-0.0165	-0.0333	-0.0015	0.0332
	Var 3	5.008	1.592	0.6820	0.0394	-0.0295	0.1470	-0.0398
COM	Var 4	4.364	1.682	0.0680	0.6845	0.0739	-0.0595	0.0375
	Var 5	4.853	1.482	-0.0158	0.8308	-0.0266	0.0279	-0.0319
	Var 6	4.262	1.466	-0.0074	0.7172	0.0921	-0.0020	-0.0297
COE	Var 7	4.755	1.622	0.0937	0.0781	0.6235	-0.0258	0.0561
	Var 8	4.764	1.524	-0.0660	0.0883	0.8567	0.0316	-0.0036
	Var 9	4.840	1.518	0.0009	-0.0362	0.9087	0.0188	-0.0207
CBF	Var 10	4.795	1.685	0.0931	-0.0380	0.0383	0.6268	-0.0614
	Var 11	5.257	1.746	-0.0388	0.2447	-0.0832	0.6503	0.0652
	Var 12	5.524	1.210	-0.0229	0.0608	0.0096	0.5299	0.2643
	Var 13	5.822	0.988	0.0166	-0.1344	0.0519	0.4272	-0.0358
PQI	Var 14	5.426	0.863	-0.0143	-0.0120	- 0.0273	-0.0005	0.8890
	Var 15	5.515	0.881	0.0782	-0.0729	-0.0169	0.0080	0.9035
	Var 16	5.493	0.968	-0.0592	0.0593	0.0677	-0.0164	0.8018

Note: *Rotated factor pattern (standardized regression coefficients)

DATA ANALYSIS

SAS ® statistical procedure, Proc Calis was used to conduct the confirmatory factor analysis and structural equation modeling (Anderson and Gerbing, 1988). Confirmatory factor analysis was used to demonstrate adequate model fit and establish convergent and discriminate validity for the underlying variables (scale items) and their respective factors in the model. Four structural equation models were used to test the hypothesized relationships in the model.

Confirmatory Factor Analysis

We conducted confirmatory factor analysis for the measurement model since it allowed all of the factors in the model to covary. Model fit was evaluated with several indices such as the chi-square/degrees of freedom ratio, GFI, CFI, NNFI, and RMSEA (as shown in Table 5). The measurement model requires a t-statistic of 2.0 or greater and that no standard error associated with the t-statistics is near zero (such as .0003). The expected composite reliability should be .60 and the variance extracted should be .50 or higher as a rule of thumb (Fornell and Larcher, 1981; Hatcher, 1994).

A reasonable fit of the data was achieved for the measurement portion of the model since all of the indices (GFI, CFI, NNFI, RMSEA) were at the desired level for the chi-square/ degrees of freedom ratio as shown in Table 5. The composite reliabilities for each factor were above .60. The variance extracted for four of the factors was above .50 and one of the factors was below .50 (see Table 6). Taken as a group, the constructs in the model performed fairly well (Hatcher, 1994). The t-statistics for the indicator variables were also significant at $p < .001$, and no standard errors were near zero. The paths in the model were all significant at $p< .05$, and the R-square values were acceptable based on the R-square values of previous research studies in this area (Carr and Pearson, 1999). Table 6 shows the factor loads, standard error, t-values, and R-square values.

Table 5: Measures of model fit for measurement and hypothesized models

Fit Index	Desirable Range	Measurement Model	Hypothesized Structural Model	Structural Model (COP)	Structural Model (COE)	Structural Model (COM)
Chi-square test statistic		204	204	81	66	81
Degrees of Freedom		95	100	34	34	34
Chi-square/degrees of freedom (Hair et al., 1998)	≤3.0	2.15	2.04	2.38	1.94	2.38
GFI	≤0.90	.8968	.8967	.9313	.9407	.9240
Bentler's (1989) CFI	≤0.90	.9358	.9387	.9481	.9708	.9427
Bentler and Bonett's (1980) NNFI	≤0.90	.9189	.9264	.9313	.9613	.9241
RMSEA	≤0.08 (reasonable fit)	.0716	.0682	.0790	.0646	.0836
RMSEA confidence interval, (Browne and Cudeck, 1993)	0.00≤RMSEA≤0.05; indicates close fit 0.05<RMSEA≤0.08; indicates reasonable fit 0.08<RMSEA≤0.10; indicates mediocre fit 0.10< RMSEA; indicates poor model fit	.0581, .0851	.0548, .0816	.0572, .1011	.0408, .0877	.0622, .1054

*Note: There is no significant difference in the fit of the data to the model for the hypothesized structural model and the measurement model. Based on the RMSEA and the Chi-square/degrees of freedom ratio, the hypothesized structural model provides the best model fit.

Table 6: Factor loading, standard errors, t-values, R-squared

Indicator variables and their underlying factors	Standardized Factor loads	Standard Error	t-value	R-squared	Composite reliability	Variance extracted*
Coordination between operations and purchasing within the firm (COP)					.8134	.5926
Var 1	.8075	.0698	14.0586	.6539		
Var 2	.7577	.0648	12.8853	.5722		
Var 3	.7429	.0695	12.6893	.5519		
Coordination between operations and marketing within the firm (COM)					.8290	.6188
Var 4	.7176	.0684	13.6394	.5148		
Var 5	.8439	.0589	16.4160	.7116		
Var 6	.7934	.0591	15.2173	.6301		
Coordination between operations and engineering within the firm (COE)					.8810	.7152
Var 7	.6797	.0639	12.5953	.4629		
Var 8	.9242	.0519	19.8140	.8509		
Var 9	.9109	.0517	19.5143	.8328		
Inter-Organizational Coordination (CBF)					.6940	.3623
Var 10	.6110	.1220	8.4452	.4714		
Var 11	.5786	.1271	7.9517	.4149		
Var 12	.5782	.0872	8.8531	.3246		
Var 13	.6378	.0719	7.9455	.2593		
Product quality improvement (PQI)					.9087	.7682
Var 14	.8869	.0468	16.3818	.7859		
Var 15	.9345	.0463	17.7887	.8738		
Var 16	.8049	.0549	14.2156	.6481		
Intra-Organizational Coordination (CWF)					.6800	.4217
COP	.4846	.1237	5.2567	.2349		
COM	.7271	.1256	7.4865	.5286		
COE	.7083	.1313	7.3887	.5016		

*Note: The estimate for the variance extracted is based on the Fornell and Larcker (1981) formula.

The model fitness was examined using convergent and discriminant validity statistics. Convergent validity was supported; and, all of the t-values for the factors were greater than 2.0 and significant at $p<.05$. Discriminant validity was evident by the fact that none of the correlations among the factors in the model were extremely high (Hatcher, 1994). Further, none of the confidence intervals plus or minus two standard errors of the factor correlation coefficients included 1.0 (Anderson and Gerbing, 1988).

We validated the second order factor by examining the correlations among the first order factors and the results are shown in Table 7. It was anticipated that one second order factor would exist within the hypothesized model. The factor loadings of COE, COP and COM on CWF, in the hypothesized model were significant and support the theoretical second order relationships (Shown in Figure 2).

Table 7: Inter-factor correlations promax rotation method

Factors	PQI	COE	COM	COP	CBF
PQI	1.0000				
COE	0.1781	1.0000			
COM	0.2010	0.5238	1.0000		
COP	0.1705	0.2865	0.2823	1.0000	
CBF	0.2802	0.3198	0.2992	0.4613	1.0000

Note: Since the correlation coefficients are based on the Promax Rotation procedure significance tests are not applicable (Gorsuch, 1983). The correlation analysis does indicate that all of the factors are significantly correlated at $p<.05$.

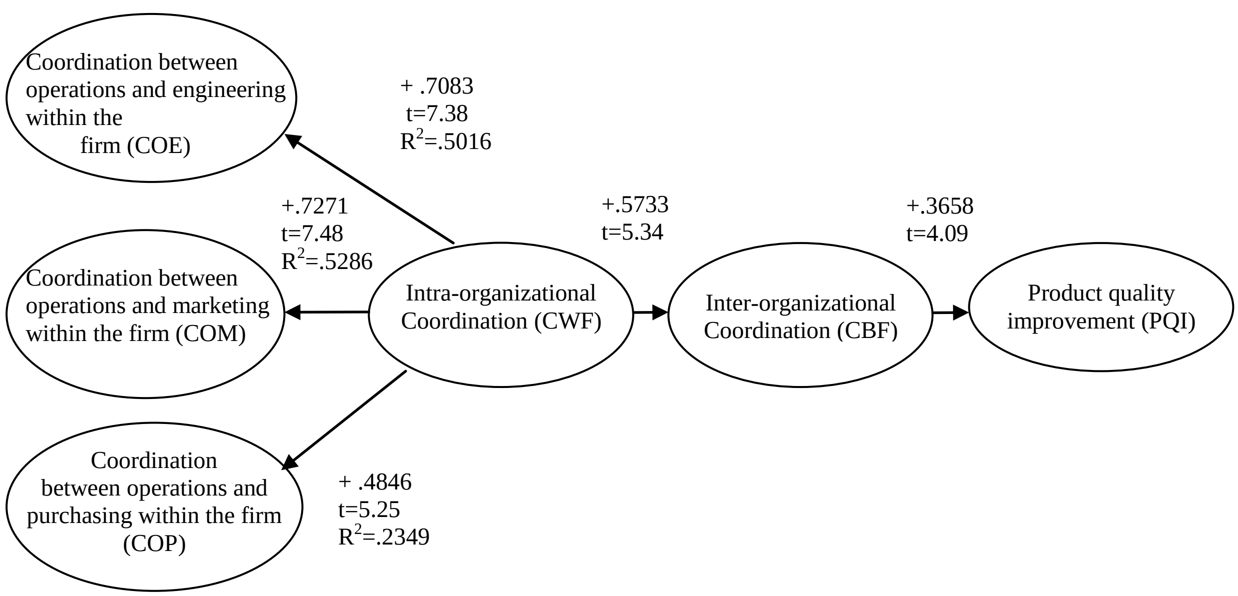

Figure 2
Structural model of the hypothesized relationships between intra-organizational coordination, inter-organizational coordination and performance quality improvement

Structural Equation Modeling

The structural model differs from that of measurement model since only exogenous factors in the model covary. The variance estimates were made for the exogenous factors but not for the endogenous factors. The same indices mentioned above were used to determine the fit of the data to the model. For the structural portion of the model, a reasonable fit of the data to the model was achieved (Shown in Table 5). The indicator variables of the structural model were the same as in the measurement model. The t-value for the path coefficient between the factor CWF (intra-organizational coordination) and CBF (inter-organizational coordination) was positive and significant (p<.05). The t-value for the path coefficient between CBF and PQI (product quality improvement) was positive and significant (p<.05) as shown in Table 8.

Table 8: Summary of test results for hypothesized model

Model	Hypothesis	Path	Standardized Path Coefficient	t-value	Hypothesis supported	Factor	R^2
Hypothesized Structural Model (with second order latent factor CWF)	H_{1d}	CWF → CBF	.5733	5.34	Yes, p<.001	CBF	.3287
	H_2	CBF → PQI	.3658	4.09	Yes, p<.001	PQI	.1338
Structural Models (with first order factors COP, COM, COE)	H_{1a}	COE → CBF	.3813	4.38	Yes, p<.001	CBF	.1454
	H_2	CBF → PQI	.3727	4.23	Yes, p<.001	CBF	.1389
	H_{1b}	COP → CBF	.5059	5.19	Yes, p<.001	CBF	.2559
	H_2	CBF → PQI	.3431	3.93	Yes, p<.001	CBF	.1177
	H_{1c}	COM → CBF	.3299	3.60	Yes, p<.001	CBF	.1088
	H_2	CBF → PQI	.3737	4.11	Yes, p<.001	CBF	.1397

Note: The path between the second order factor CWF and CBF provides an overall measure for testing hypotheses 1d. Further tests were conducted for hypotheses 1a,b,c using three separate models to demonstrate the significance of the path between each factor and the factor CBF. All of the paths in all of the models were positive and significant at p<.001.

Three separate structural equation models were used to test the hypothesized relationships for COM → CBF (RMSEA = .0836), COP → CBF (RMSEA = .0790), and COE → CBF (RMSEA = .0646). All of the fit indices for the three models were similar to the hypothesized model, except for the RMSEA statistic in the model of COM → CBF. The other two models had a reasonable fit with RMSEA statistics similar to the hypothesized model. The hypothesized relationships were all positive and significant in each model (p<.001, respectively). The results are shown in Table 7 and depicted in Figures 1a, 1b, and 1c.

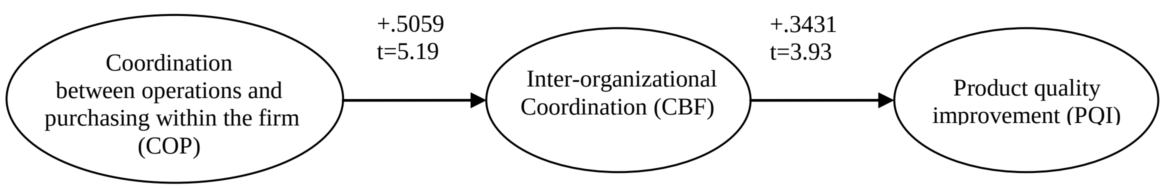

Figure 1a.
Structural model of the hypothesized relationships between coordination between operations and purchasing, inter-organizational coordination and performance quality improvement

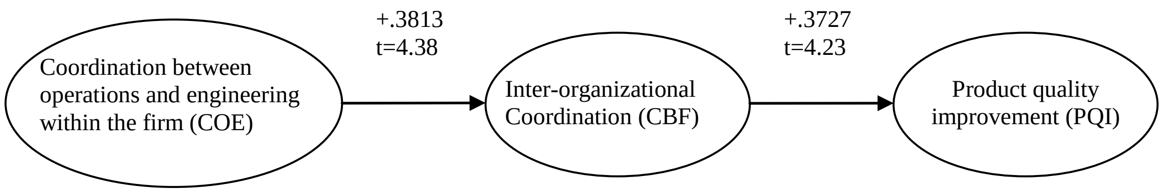

Figure 1b.
Structural model of the hypothesized relationships between coordination between operations and engineering, inter-organizational coordination and performance quality improvement

Figure 1c.
Structural model of the hypothesized relationships between coordination between operations and marketing, inter-organizational coordination and performance quality improvement

We compared the measurement model and structural model to evaluate the goodness of fit as shown in Table 4. The chi-square difference test was used to compare model fitness of the structural and measurement models. Based on the chi-square difference test, there is no significant difference in the fit of the measurement model and the structural model. Shown in Table 4 are other indices used to determine goodness of fit. The model was also compared to an alternative model by adding another path to the model between CWF and PQI. The path between CWF and PQI was not significant when CBF is also included in the model. Thus, the hypothesized model provided the best model fit.

Control For Firm Type

The literature supports that there might be a difference in the degree that high technology firms emphasized functional integration when compared to low technology firms (Olson, Walker, Ruekert, and Bonner, 2001; Jassawalla and Sashittal, 1996). Consequently, the sample was split into three groups based on the respondents' indication of the technological intensity of their firm's primary products (92 firms had high-tech products, 83 firms had medium-tech products, and 50 firms had low-tech products). The high-tech sample was used to test the relationships in the hypothesized model. Data from the sample of firms with high-tech products provided a reasonable fit to the hypothesized model. The sample size for the firms with low-tech products was rather small and deemed inadequate to test the model fit to the data. Further examination of the loadings for the latent factor CWF were all positive and significant for the sample of high-tech firms ($p<.001$ for COM, $p<.001$ for COP, and $p<.001$ for COE). The structural model fit for the high-tech sample was not significantly different from the measurement model. Only the causal path between CWF and CBF was positive and significant based on the sample of high-tech firms ($p<.001$ for CWF and CBF).

The sample consisted of both manufacturing and service firms. We examined the fit of the model for the manufacturing firms (n=165) separate from the service firms (n=60). The data from the manufacturing firms was used to test the hypothesized model and it provided a reasonable fit to the model. The sample size for the service firms was rather small and deemed inadequate to test the fit of the model to the data. The loadings for the latent factor CWF were all positive and significant for the manufacturing firms ($p<.001$ for COM, $p<.001$ for COP, and p<.001 for COE). Also, the causal paths between CWF and CBF and between CBF and PQI were positive and significant (p<.001 for CWF $\rightarrow$CBF, p<.01 for CBF $\rightarrow$ PQI).

DISCUSSION

There is support for the second order factor CWF. The relationships among the first order factors COE, COP, and COM, based on the measurement model, are positive and significant. These three first order factors all loaded on the second order factor CWF. This demonstrated that COE, COP and COM were all measuring the construct: CWF. The covariance among the factors was explained by the second order factor CWF (Byrne, 1995). The inter-factor correlations demonstrated that the factors were significantly correlated with each other.

The hypotheses 1_a, 1_b, 1_c, and 1_d referred to coordination between the buying firm and its key supplier. All four of the hypotheses were supported. An interesting result of this study was the fact that cross-functional activities among operations and purchasing, operations and marketing, and operations and engineering had significant roles in coordinating activities with key suppliers. The overall variance accounted for in the factor CBF was approximately 33 percent. While there are other factors that may contribute to CBF, coordination within the firm has a noteworthy contributing influence on CBF. The sample of firms included in this study included both service firms (n=60) and manufacturing firms (n=165). For the manufacturing firms in the sample, the intra-organizational coordination between functions had a significant influence on the inter-organizational coordination between buyer and key supplier firms. The fact that these relationships were positive and significant when the service firms were also included in the sample further strengthens the value of the hypothesized relationships to firms in general.

The second hypothesis stated that coordination of activities between the buyer and the key supplier firms (CBF) is positively related to the buyer's product quality improvement (PQI). Coordination of activities between firms is helpful in increasing performance with respect to product quality. The variance accounted for by the factor PQI was approximately 13 percent. While this is not a major portion of the variance, it represents a noteworthy amount of influence. A common goal of the buying firm is to source from suppliers that will help the buying firm to improve the quality of its products. When coordination of activities between the buyer and the key supplier occurs, the key supplier has a better understanding of the buyer's requirements. It is important for the appropriate functions of the buying firm and key supplier firm to coordinate and cooperate with respect to product quality requirements. Both the buying firm's and the key supplier's purchasing/ supply management function coordinated and cooperated with their respective operations functions. Creating synergies between the buyer and key supplier firm contributed to product quality improvement.

RESEARCH LIMITATIONS AND IMPLICATIONS

As with all research, this study has some limitations. Some survey items were dropped during the data analysis; however, the total number of survey items remaining was sufficient to conduct the analysis and test the hypotheses. While the total number of firms in the sample was sufficient to test the hypothesized model, dividing the sample between manufacturing and service firms did not provide an adequate number of service firms to assess the model fit. The service firms contributed to the cross-functional relationships found in this study; however, caution should be used when comparing the results of this research to service firms in general. Future research should collect data from service firms to gain more understanding of the roles of key suppliers in different industries. Future work could also determine which types of service firms benefit from cross-functional integration to improve relationships with key suppliers.

The business environment is dynamic and changes overtime. This research represents data collected from a sample of buyer firms in the year 2003. Longitudinal studies that gather data from the same sample over time would be a method of validating the findings of this study. A case study method can be used to develop new theories concerning inter-organizational relationships. Future research could use case studies to collect data from multiple respondents within the same firm or multiple respondents across firms to further validate the findings of this study and increase the our knowledge in this area.

There are several implications of this study. First, establishing a high degree of intra-organizational coordination will better enable the firm to conduct business with its key suppliers (Hill, 1989). Intra-organizational cooperation and coordination between operations and marketing, operations and purchasing, operations and engineering have a significant influence on the degree of coordination between firms. This finding gives increased importance to ensuring that the functional areas work together. Managers may believe that the firm's key suppliers will automatically work with the appropriate functional areas to meet the buying firm's requirements (Berry et al., 1997). Generally, the exchange transaction occurs between marketing and purchasing. Management should understand that the appropriate working relationships may not necessarily be between the key supplier firm's marketing area and the buying firm's purchasing area. To benefit the buying firm and maintain an ongoing working relationship between the buyer and key supplier firm, the appropriate function may be the operations function of the key supplier firm and either the operations and purchasing, operations and engineering, or operations and marketing functions of the buyer firm. These functional areas should be involved in cross-functional teams to more effectively transact business between the buyer and the key supplier firm. This applies particularly to manufacturing firms, while the results are unclear for the services firms included in the study (Krajewski and Ritzman, 2002).

Second, companies that are not coordinating and cooperating with their key suppliers should begin developing relationships with these suppliers. There are many examples of companies that currently benefit from improved relationships between their company and their key suppliers. Toyota and Honda are examples of companies that benefit from improved coordination and cooperation with key suppliers. While, General Motors and DaimlerChyrsler suffered from their lack of coordination and cooperation with key suppliers. Benefits of close coordination and cooperation with key suppliers at Toyota and Honda include improved supply chain efficiency such as lower cost, increased flexibility, and improved quality. Key suppliers can impact the buying firm's product quality either positively or negatively as demonstrated by the highly publicized Ford Motor Company and Firestone Tire Company buyer-supplier relationship (Noggle and Palmer, 2005). The impact can be positive if the firms work together to meet the buying firm's quality needs.

Third, since manufacturers are no longer vertically integrated, supplier coordination and cooperation are even more important to their success. Consequently, key stakeholders must realize that firm performance and product quality improvements are strongly influenced by the degree of coordination and cooperation with the firm's key suppliers (Carter, 1993). The working relationships among functions within the firm and between firms and their key suppliers have significant benefits. A long-term view should be taken to allow firms to build relationships with key suppliers and remain competitive in a global economy.

Fourth, without cooperation and cooperation between firms, adversarial relationships may develop when firms do not meet one another's expectations. While the dominant firm may prevail in the market, their success may be short-term as noted above by the automotive examples. More coordination and cooperation among firms is expected to lead to long-term success for both firms. Long-term success for companies implies less need for government bail-outs for firms and employees should benefit by more job stability. While several of implications are offered above, we welcome email, telephone, or a personal dialogue on issues and questions arising from this study.

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