

The Relationships among Information Sharing, Process Integration and Supply Chain Responsiveness

Zhang, Min¹⁾, Zhao, Xiande ¹⁾

¹⁾The Chinese University of Hong Kong, Faculty of Business Administration, Department of Decision Sciences and Managerial Economics

Abstract

How to survive and develop in this hyper competitive environment has become a major concern for many companies. To deal with the increasing uncertainty, manufacturers need to respond the customer demands quickly. But manufacturers can not improve supply chain responsiveness by themselves, they need external resources, supply chain partners' information is one of them. Thus, sharing information with supply chain partners becomes important. However, information sharing along is not enough and manufacturers also need to integrate their internal processes to fully utilize the external resources. On the other hand, information sharing will increase interdependence between focal company and its environment. Resource dependence theory argues that this interdependence will bring power to the external roles and organizations' decisions will be constrained by those external roles. So, we propose that the impacts of external information sharing on process integration will be affected by supplier/customer use of power. Based on a sample of 571 Chinese manufacturers, we find that information sharing within supply chain is positively related to internal process integration and this relationship is moderated by supplier/customer use of non-mediated power but not mediated power. Information sharing also positively related to supply chain responsiveness but this relationship is mediated through the internal process integration.

1. Introduction

Supply chain has become the central organizing unit in today's market and several organization theory perspectives, such as strategic choice, resource-based, knowledge management and network collaboration, have been used in this research area (Miles and Snow, 2007). However, Kechen and Hult (2007a) point out that the potential of organization theory in supply chain management arena remains underdeveloped. Resource dependence theory (RDT) focus on the interdependence among firms and how the external partners affect organizations' decision (Pfeffer and Salancik, 1978). As supply chain members working closely and becoming highly interdependent with each other, this perspective demonstrates a great value in the supply chain context (Kechen and Hult, 2007b). In this post-industry epoch, manufacturers are operating in a highly uncertain environment. In order to master change and uncertainty, agile manufacturing, which emphasis on speed and fast response, has become objectives of many supply chains (Gunasekaran, 1998). Timely information sharing with suppliers and customers is the foundation of integration and will shorten lead time (Cachon and Fisher, 2000; Lee, 2000; Srinivasan et al., 1994). However, a growing body of researches in OM that attempts to identify the benefits that arise from information sharing providing a mixed result with respect to the usefulness of such information sharing (Kulp et al., 2004) and most published academic research has generally ignored the argument altogether by considering information sharing and internal process to lead-time reduction (Ward and Zhou, 2006). In this paper, we will explore the relationship between information sharing, process integration and responsiveness from the resource dependence perspective. In the next section, we will discuss the theory background and the conceptual model. After that is the methods and analysis. At last is the conclusion of this paper..

2. Conceptual Model and Hypotheses

RDT roots in sociology and political science (Pfeffer and Salancik, 1978). This theory argues that in order to survive and develop, organizations require resource from external environment and become interdependent with their transaction partners (Pfeffer, 1982). In this perspective, linkages among organizations are viewed as power relations and organizations are treated as coalitions that will alter their behaviors to acquire and maintain needed external resource (Ulrich and Barney, 1984). In this sense, organizations are externally constrained and the internal organizational process will be affected by these interdependences (Aldrich and Pfeffer, 1976). This approach has been widely used in management researches that focus on organization decisions under various environmental constraints, especially on linkages of interorganizational networks (Provan et al., 1980). For example, it has been used to explain the joint venture activities (Pfeffer and Nowak, 1976); interindustry merge patterns (Finkelstein, 1997); ownership redirection in franchising network (Windsperger and Dant, 2006).

Supply chain relationship has become a very important interorganization linkage and RDT has been used to explain why companies form relationship with supply chain partners when faced with uncertainty (e.g. Golicic et al., 2002; Murray et al., 2005). Based on RDT, Kechem and Hult (2007b) argue that the members in traditional supply chain will try to avoid being dependent on others and make others depend on it, however, members in the best value supply chain recognize that dependence can create mutual forbearance and trust. Thompson (1967) describes three types of task interdependence: pooled, sequential, and reciprocal. Pooled interdependence is defined as “each part renders a discrete contribution to the whole and is supported by the whole” and this demand standardization of the process. Information is a kind of important resource. In order to deal with the environmental uncertainty, manufacturers would like to cooperate with their supply chain partners to get this resource. Information sharing within supply chain needs contributions from every partners and high degree of information sharing among partners will increase interdependence (Clark et al., 2001). RDT argues that interdependence will bring power to the supply chain partners over the focal company and company’s decision will be affected by this external constraints. Since effective information sharing requires standardized process, we propose that the manufacturers’ decision on process integration will be affected by its information sharing behaviors with supply chain partners and this relationship will be moderated by the supplier/customer’s use of power. RDT also argues that interorganizational partnerships can help manage the uncertainty (Patnayakuni et al., 2006). Entering a supply chain relationship can create long-term cooperation agreements, which will reduce the uncertainty and improve the possibility of survival, the central goal of organization based on RDT (Crook and Combs, 2007). The manufacturer’s ability to deal with uncertainty can be expressed by the responsiveness of the supply chain, which indicates how fast the supply chain can satisfy customers’ demands. So, we propose that manufacturers’ information sharing with supply chain partners and process integration decision are all positively related to the responsiveness to customers. Figure 1 shows the research framework of this paper.

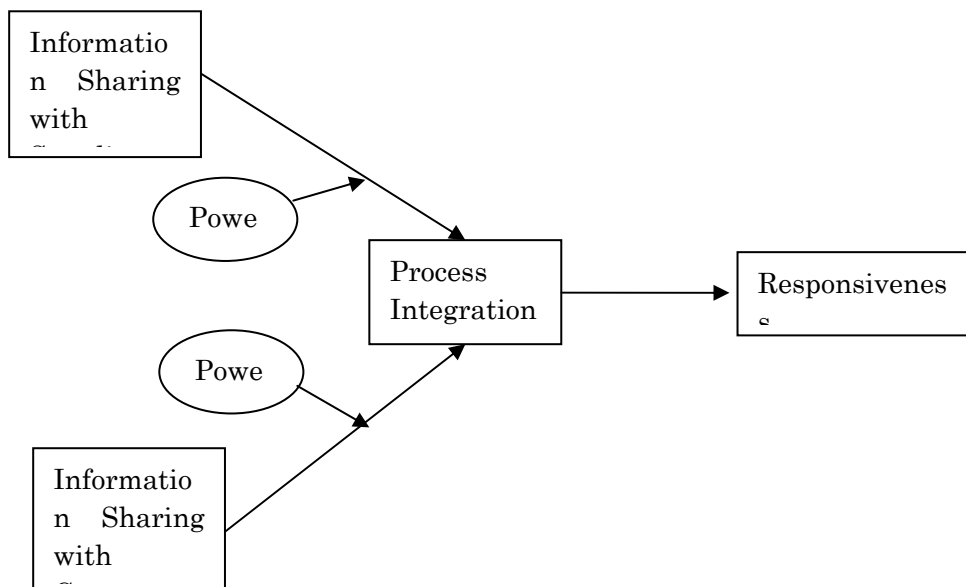


Figure 1 Research Framework

Business process integration has two characteristics: design processes for real-time information sharing and integrate several systems to manage their exercise (Kobayashi et al., 2003). Information sharing is the foundation of supply chain integration (Lee, 2000), and it forms the backbone of any business process integration (Becker et al., 2003; Kim and Umanath, 2005). Clark et al. (2001) propose a hierarchical model of supply-chain integration which suggests the information sharing

builds the foundation of integrated operations and process. This is because information sharing within supply chain requires standards for the integration of processes for real-time connectivity (Rai et al., 2006). So, external roles might require focal company integrating its internal process to facilitate such information sharing. Frohlich (2002) demonstrates that the most important barrier to the e-integration, which includes sharing information on demand/forecasting, inventory, scheduling etc, with supplier and customer comes from focal manufacturer. Thus, suppliers and customers might use their power, which comes from the interference based on RDT, to affect manufacturers' process integration decision. Generally speaking, there are two kinds of supply chain powers: mediated and non-mediated power (Brown et al., 1995; Benton & Maloni, 2005). Non-mediated power is more relational and positive while mediated power represents the competitive and negative use of power (Brown et al., 1995; Maloni & Benton, 2000). Supplier/customer use of power will enhance the impacts of information sharing on process integration. But mediated and non-mediated power might have different effects. The use of non-mediated power will improve the positive attitude toward the channel partners (Frazier & Summers, 1986) and this will increase the trust among supply chain partners, which will result in long-term orientation (Patnayakuni et al., 2006). As a result, manufacturers would like to integrate their process more ordering to the requirements of supply chain partners to enter long-term cooperation agreements. However, the frequent use of mediated power can damage relational norms and cooperation, reducing the strength of the relationship (Benton & Maloni, 2005; Boyer et al., 1997; Maloni & Benton, 2000). So, the mediated power will not affect the relationship between information sharing and process integration. Therefore, we propose the following hypothesis:

H1: Information sharing with suppliers is positively related to process integration

H2: Information sharing with customers is positively related process integration

H3: The relationship between information sharing and process integration is moderated by supplier/customer use of non-mediated power

H4: The relationship between information sharing and process integration is not moderated by supplier/customer use of mediated power

Newly developed technologies are enabling firms to rethink their information sharing decisions and explore new avenues for inter-organizational cooperation. Information sharing allows supply chain partners to improve forecasts, synchronize production and delivery, and coordinate inventory-related decisions (Rai et al., 2006). Information sharing within supply chain will improve operational performance (e.g. Frohlich, 2002; Power and Singh, 2007; Sahin and Robinson, 2005; Srinivasan et al., 1994). However, this is not always the case. Kulp et al. (2004) point out information sharing is a necessary but not sufficient for manufacturers to gain superior performance, without appropriate business processes for the utilization of information, information sharing can only lead to an overload of information and sharply limited value (Clark et al., 2001). Business processes need to be integrated to reduce delivery times. So, cross-functional process integration is a mediator between information sharing and supply chain responsiveness. Therefore, we propose the following hypothesis:

H5: Process integration will mediate the effects of information sharing on supply chain responsiveness

3. Methods

We collected data from five areas in China: Chongqing, Guangzhou, Hong Kong, Shanghai and Tianjin. To obtain a representative sample of manufacturing companies, we used the Yellow Pages of China Telecom in each of the four selected cities in mainland China and the Directory of the Chinese Manufacturers Association in Hong Kong as the sampling pool to get a representative sample of manufacturing companies. We randomly selected companies on the lists and contacted them through telephone calls. These companies represent a wide variety of industries, including food, beverage, alcohol, and cigarettes; chemicals and petrochemicals; wood and furniture; pharmaceutical and medical supplies; building materials; rubber and plastics; metal, mechanical, and engineering; electronics and electrical; textiles and apparel; toys; jewelry; arts and crafts; and publishing and printing. Key informants included the supply chain manager, CEO/president and vice president in charge of sales/marketing. A total of 1356 questionnaires were sent out, and 571 returned questionnaires were usable, making the usable response rate 42.11%.

The measures for mediated and non-mediated power were adopted from Brown, et al. (1995). The scale for system integration and process integration are adapted from the instrument developed by Narasimhan and Kim (2002). The information sharing with customer/supplier scale were largely derived from Narasimhan and Kim (2002) and Morash and Clinton (1998). The items for responsiveness were developed on the basis of work by Frohlich and Westbrook (2001) and Beamon (1999). The indicators are all measured on the seven-point Likert scale.

4. Analysis and results

We will follow the procedure suggested by Baron and Kenny (1986) in testing the moderator and mediator proposed by the research framework. The mean value of each constructs is used in the regression analysis. System integration is used as the control variable when we test the moderating effect of power on the relationship between information sharing and process

integration. The results of hierarchical regression are showed from Table 1 to Table 4. Three separated multiple regression analysis are used to test the mediating effects of process integration. Table 5 shows the results.

Table 1 Supplier information sharing with non-mediated power

<i>Variables</i>	<i>Model 1</i>		<i>Model 2</i>		<i>Model 3</i>	
	<i>Beta</i>	<i>p-value</i>	<i>Beta</i>	<i>p-value</i>	<i>Beta</i>	<i>p-value</i>
Step 1						
System Integration	0.682	.000	.584	.000	.572	.000
Step 2						
Supplier Information			.222	.000	.021	.757
Sharing						
Non-mediated Power			.033	.303	-.099	.052
Step 3						
Interaction					.304	.001
R square (Adj.)	.465 (.464)		.512 (.509)		.521 (.518)	
Change for R square				.047	.009	
P-value for change of R square				.000	.001	

Table 2 Supplier information sharing with mediated power

<i>Variables</i>	<i>Model 1</i>		<i>Model 2</i>		<i>Model 3</i>	
	<i>Beta</i>	<i>p-value</i>	<i>Beta</i>	<i>p-value</i>	<i>Beta</i>	<i>p-value</i>
Step 1						
System Integration	0.682	.000	.582	.000	.581	.000
Step 2						
Supplier Information			.244	.000	.231	.002
Sharing						
Mediated Power			-.026	.398	-.040	.593
Step 3						
Interaction					.023	.838
R square (Adj.)	.465 (.464)		.511 (.509)		.511 (.508)	
Change for R square				.047	.000	
P-value for change of R square				.000	.838	

Table 3 Customer information sharing with non-mediated power

<i>Variables</i>	<i>Model 1</i>		<i>Model 2</i>		<i>Model 3</i>	
	<i>Beta</i>	<i>p-value</i>	<i>Beta</i>	<i>p-value</i>	<i>Beta</i>	<i>p-value</i>
Step 1						
System Integration	0.682	.000	.538	.000	.542	.000
Step 2						
Customer Information			.248	.000	.052	.322
Sharing						
Non-mediated Power			.109	.000	-.024	.557
Step 3						
Interaction					.308	.000
R square (Adj.)	.465 (.464)		.539 (.536)		.558 (.555)	
Change for R square				.074	.019	
P-value for change of R square				.000	.000	

Table 4 Customer information sharing with mediated power

<i>Variables</i>	<i>Model 1</i>		<i>Model 2</i>		<i>Model 3</i>	
	<i>Beta</i>	<i>p-value</i>	<i>Beta</i>	<i>p-value</i>	<i>Beta</i>	<i>p-value</i>
Step 1						
System Integration	0.682	.000	.532	.000	.532	.000
Step 2						
Customer Information Sharing			.296	.000	.260	.000
Mediated Power			-.011	.700	-.067	.502
Step 3						
Interaction					.071	.559
R square (Adj.)	.465 (.464)		.529 (.526)		.529 (.526)	
Change for R square				.064		.000
P-value for change of R square				.000		.559

Table 5 Mediating effect of process integration

Dependent Variable	R Square	Independent Variable					
		Supplier Information Sharing		Customer Information Sharing		Process Integration	
		Beta	P-value	Beta	P-value	Beta	P-value
Process Integration	.346	.208	.000	.437	.000		
Responsiveness	.145	.095	.055	.314	.000		
Responsiveness	.183	.045	.366	.208	.000	.242	.000

The significant of changes in R square indicate the moderating effects. The model 2 in the first four tables suggests that both customer information sharing and supplier information sharing significantly increase the process integration. The last cell in table 1 and table 3 shows that the relationship between information sharing and process integration is moderated by the use of non-mediated power; while the last cell in table 2 and 4 shows that the use of mediated power is not a moderator. The first row in table 5 suggests that the predictors significantly affect the mediator; the second row shows that the predictors significantly affect the dependent variable and the third row, the mediator significantly affect the dependent variable. So, the results satisfy the requirement of mediation effects. Since in the last regression the supplier information sharing becomes insignificant, we propose it is a full mediator. However, the coefficient of customer information sharing is still significant and only becomes smaller comparing with the second regression, so we propose it is a partial mediator. Based on Baron and Kenny (1986) we test the significance of the indirect effect of customer information sharing, the result t value equals 2.73, which is significant at 0.05 level. This indicates process integration is also a mediator for customer information sharing. In a word, all five hypotheses are supported by the empirical evidence.

5. Conclusions

A Supply chain integration has drawn attentions from both researchers and practitioners. However, to achieve this aim is not an easy job. Manufacturers need to share information with its supply chain partners. Based on RDT, we propose that information sharing will increase interdependence and this will affect manufacturers' decision about integration, that is, process integration and its ability to deal with uncertainties, that is, responsiveness of supply chain. From this perspective, we hypothesize that supply chain information sharing positively relates to the process integration and this relation is moderated by the supplier/customer use of power and the impact of information sharing on supply chain responsiveness is mediated by the degree of process integration. All hypotheses are supported by a sample of 571 Chinese manufacturers.

References

- [1]Aldrich, H.E., and Pfeffer, J., 1976, Environments of organizations, Annual Review of Sociology, Vol.2, pp. 79---105
[2]Baron, R. M. and Kenny, D. A., 1986, The Moderator-Mediator Variable Distinction in Social Psychological Research:

Conceptual, Strategic, and Statistical Considerations, *Journal of Personality and Social Psychology*, Vol. 51, No. 6, pp. 1173-1182

- [3] Beamon, B.M., 1999, Measuring supply chain performance, *International Journal of Operations & Production Management*, 19(3), 275-292.
- [4] Becker, J., Dreiling, A., Holten, R., and Ribbert, M., 2003, Specifying information systems for business process integration--- A management perspective, *Information Systems and e-Business Management*, Vol.1, pp. 231---263
- [5] Benton, W.C., Maloni, M., 2005. The influence of power driven buyer/seller relationships on supply chain satisfaction. *Journal of Operations Management* 23, 1-22.
- [6] Boyer, K.K., Leong, G., Ward, P., Krajewski, L., 1997. Unlocking the potential of advanced manufacturing technologies. *Journal of Operations Management* 15(4), 331-347.
- [7] Brown, J.R., Lusch, R.F., Nicholson, C.Y., 1995. Power and relationship commitment: Their impact on marketing channel member performance. *Journal of Retailing* 71(4), 363-392.
- [8] Cachon, G.P., and Fisher, M., 2000, Supply chain management and the value of shared information, *Management Science*, Vol.46, No.8, pp.1032---1048
- [9] Clark, T., Croson, D.C., Schiano, W.T., 2001, A hierarchical model of supply-chain integration: Information sharing and operational interdependence in the US grocery channel, *Information Technology and Management*, Vol.2, pp.261---288
- [10] Crook, T.R., and Combs, J.G., 2006, Sources and consequences of bargaining power in supply chain, *Journal of Operations Management*(2006)
- [11] Frazier, G.L., Summers, J.O., 1986. Perceptions of inter-firm powers and its use within a franchise channel. *Journal of Marketing Research* 23 (5), 169-176.
- [12] Frohlich, M. T. and Westbrook, R., 2001. Arcs of integration: an international study of supply chain strategies, *Journal of Operations Management*, 19, 185-200.
- [13] Frohlich, M.T., 2002, E-integration in the supply chain: Barriers and performance, *Decision Science*, Vol.33, No.4, pp.537---556
- [14] Golicic, S.L., Davis, D.F., McCarthy, T.M., and Mentzer, J.T., 2002, The impact of e-commerce on supply chain relationship, *International Journal of Physical Distribution and Logistics Management*, Vol.32, No.10, pp.851---871
- [15] Gunasekaran, A., 1998, Agile manufacturing: Enablers and an implementation framework, *International Journal of Production Research*, Vol.36, pp. 1223---1247
- [16] Ketchen, D.J., and Hult, G.T.M., 2007a, Toward great integration from organization theory and supply chain management, *Journal of Operations Management*, Vol.25, pp. 455---458
- [17] Ketchen, D.J., and Hult, G.T.M., 2007b, Bridging organization theory and supply chain management: The case of best value supply chains, *Journal of Operations Management*, Vol.25, pp. 573---580
- [18] Kim, K.K., and Umanath, N.S., 2005, Information transfer in B2B procurement: An empirical analysis and measurement, *Information and Management*, Vol.42, pp.813---828
- [19] Kobayashi, T., Tamaki, M., Komoda, N., 2003, Business process integration as a solution to the implementation of supply chain management system, *Information & Management*, Vol.40, pp. 769---780
- [20] Kulp, S.C., Lee, H.L., and Ofek, E., 2004, Manufacturing benefits from information integration with retail customers, *Management Science*, Vol.50, No.4, pp.431---444
- [21] Lee, H.L., 2000, Creating value through supply chain integration, *Supply Chain Review*, September/October 2000
- [22] Maloni, M. Benton, W.C., 2000. Power influences in the supply chain. *Journal of Business Logistics* 21(1), 49-73.
- [23] Miles, R.E., and Snow, C.C., 2007, Organization theory and supply chain management: An evolving research perspective, *Journal of Operations Management*, Vol. 25, pp.459---463
- [24] Morash, E.A. and Clinton, S. R., 1998. "Supply chain integration: customer value through collaborative closeness versus operational excellence." *Journal of Marketing Theory and Practice*, 6(4), 104-20.
- [25] Murray, J.Y., Kotabe, M., and Zhou, J.N., 2005, Strategic alliance-based sourcing and market performance: Evidence from foreign firms operating in China, *Journal of International Business Studies*, Vol.36, pp. 187---208
- [26] Narasimhan, R. Kim, S.W., 2002. Effect of supply chain integration on the relationship between diversification and performance: evidence from Japanese and Korean firms. *Journal of Operations Management* 20(3), 303-323.
- [27] Patnayakuni, R., Rai, A., and Seth, N., 2006, Relational antecedents of information flow integration for supply chain coordination, *Journal of Management Information Systems*, Vol.23, No.1, pp. 13---49
- [28] Pfeffer, J., and Nowak, P., 1976, Joint ventures and interorganizational interdependence, *Administrative Science Quarterly*, Vol. 21, pp.398---418
- [29] Pfeffer, J. and Salancik, G.R., 1978, *The External Control of Organizations: A Resource Dependence Perspective*, Harper & Row, N.Y.
- [30] Pfeffer, J., 1982, *Organizations and Organization Theory*, Pitman, M.A.
- [31] Pfeffer, J., and Davis-Blake, A., 1987, Understanding organizational wage structure: A resource dependence approach,

Academy of Management Journal, Vol.30, No.3, pp. 437---455

- [32] Power, D., and Singh, P., 2007, The e-integration dilemma: The linkages between Internet technology application, trading partner relationships and structural change, *Journal of Operations Management* (2007)
- [33] Provan, K.G., Beyer, J.M., and Kruytbosch, C., 1980, Environmental linkages and power in resource-dependence relations between organizations, *Administrative Science Quarterly*, Vol.25, No.2, pp. 200---225
- [34] Rai, A., Patnayakuni, R., and Seth, N., 2006, Firm performance impacts of digitally enabled supply chain information capabilities, *MIS Quarterly*, Vol.30, No.2, pp. 225---246
- [35] Sahin, F., and Robinson, E.P., 2005, Information sharing and coordination in make-to-order supply chains, *Journal of Operations Management*, Vol.23, pp. 579---598
- [36] Srinivasan, K., Kekre, S., and Mukhopadhyay, T., 1994, Impact of electronic data interchange technology on JIT shipment, *Management Science*, Vol.40, No.10, pp.1291---1304
- [37] Thompson, J.D., 1967, *Organizations in Action*, McGraw-Hill, New York
- [38] Ulrich, D. and Barney, J.B., 1984, Perspectives in organizations: Resource dependence, efficiency and population, *Academy of Management Review*, Vol.9, No.3, pp.471---481
- [39] Ward, P., and Zhou, H., 2006, Impact of information technology integration and lean/just-in-time practices on lead-time performance, *Decision Science*, Vol.37, No.2, pp. 177---203
- [40] Windsperger, J., and Dant, R.P., 2006, Contractibility and ownership redirection in franchising: A property rights view, *Journal of Retailing*, Vol.82, No.3, pp.259---272