Suppliers' Innovative Capabilities and Their Relationship with Customers: An Evidence from Packaging Machinery Industry in China

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Abstract

In order to compete successfully in the marketplace, suppliers have to develop certain innovative capabilities that, in turn, depend on the type of relationship that is established with customers. Based on a study of 197 suppliers operating in the packaging machinery industry in China, structural equation modeling and multiple hierarchical regression are used to reveal the relationship between suppliers' innovation capability and their different roles in the supply chain. The research findings lend support to the hypothesis that the level of investment in technology and the acquisition of specific managerial capabilities are to a large extent, a determinant of supplier–customer interdependence.

1. Introduction

Choi et al. (2002) argue that the relationship of customers and the supplier has been characterized in terms of cooperative versus competitive relationships. Relationships are considered to be evolving towards more collaborative forms, such as the so-called Japanese-style keiretsu partnership (JSP) (Dyer and Ouchi, 1993; Martin et al., 1995). Imai (1990) defines a keiretsu as a "web of relationships ranging from tight to loose among companies working together". Internal control, cohesiveness, policy co-ordination and symbiotic relationships combine to form a keiretsu which links firms into groups.

The achievement of high-level performances in terms of cost, quality, and time-to-market appears ever more dependent on the quality and effectiveness of the supply network (De Toni and Nassimbeni, 1995; Dyer, 1996). The relationship between manufacturers and their parts suppliers has been recognized as a key element in the improvement process (Butcher, 1991).

2. Theory and literature

There is a group of studies that argue that supplier involvement in product development is more effective when close and cooperative buyer-supplier relationships are adopted as opposed to adversarial approaches （ Sobrero and Roberts, 2002; Takeishi, 2001）. The following elements are identified as being critical for achieving effectiveness and efficiency in product development:

* manufacturing capabilities enabling the firm to achieve effective links between R&D and manufacturing;
* engineers capabilities to carry out a wide spectrum of activities and tasks;
* superior capabilities of concurrent engineering;
* capacity of product managers to act as coordinators of multi-functional teams and project supervisors (so-called "heavyweight program manager");
* mutual involvement of suppliers and customers in the product concept stage.

There is general agreement among scholars and practitioners that the innovative capacity of suppliers is a critical factor of their ability to respond to the increasing demands and challenges set by customers. The shift in the intrinsic nature of supplier-customer relationships and the establishment of more complex forms of collaboration has been accompanied by aparallel evolution of the suppliers' technological base. It is, in fact, the integration of supplier technology that is the basis of successful long-term relationships (Kamath and Liker, 1994).

Supplier involvement in product development may range from giving minor design specific actions (e.g. to improve the manufacturability of a component) to being responsible for the complete development, design and engineering of a specific part or sub-assembly. Suppliers of different parts and components contribute to a different extent to the development of

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the final product. Supplier involvement may, thus, increase the complexity of managing development projects.

One of the key responses to reduce this complexity is to determine which type of involvement a manufacturer should have with the various suppliers who might been gagged simultaneously in a project (Kamath and Liker,1994). The segmentation of suppliers into different tiers of sourcing and role profiles (Dyer, 1996) fosters the reconfiguration and integrated management of the supply chain (Hartley et al., 1997) which, in turn, may help to prioritize activities thus making the involvement of suppliers more manageable.

As a consequence, there might be a whole range of postures that customers and suppliers can adopt within a relationship which can broadly be assumed to vary from one extreme, a durable-arm's-length relationship, to the other extreme, a strategic partnership. All these relative postures are characterized by different degrees of supplier collaboration in product development stages, R&D integration, inter-firm knowledge, risk sharing and mutual trust.

The central premise of this paper is that the technological capability profile of suppliers (both in terms of investment in R&D/acquisition of technology and complementary assets) is, to a large extent, a determinant of the supplier–customer interdependence in NPD.

3. Methodology

3.1. Customer–supplier relationship in new product development

The six constructs----customer's influence in product performance specifications (CIP); mutual involvement in product development (MIP); customer's influence in manufacturing specifications (CIM); R&D integration (R&D); stability of relationship (SR); supplier development (SD) define customer–supplier relationship in term of NPD. Therefore, it is possible to draw a profile of the suppliers included in the three distinct types.

A-type suppliers typically manufacture products of high complexity (complete bottling and packaging lines). Their relationship with customers most resembles some form of fully blown partnership.

B-type suppliers have responsibilities which include the provision of proprietary products or complete subsystems such as machines for different uses. These companies typically develop moderately complex products or standardized components to be assembled at a later date into final lines.

C-type firms are manufacturers of basic electronic and mechanical components. Because of the less specialized nature of the work required, the pool of firms capable of providing product and services is usually larger at this level and many firms of this cluster are largely despecialised (operating in a number of different industries).

3.2. Supplier innovation capabilities

Innovation crucial determinants reside in the interaction between technological and organizational processes. So this paper use Leonard-Barton's (1992) and Lefebvre et al.'s (1993) categories to measure innovation capabilities (IC). The supplier IC profile, therefore, consists of six aspects (constructs): absorptive capacity (AC), technological penetration (TP), technological scanning (TS), individuals' skills (IS), innovation-supporting managerial competence (MC) and innovation culture (INC).

3.3. Performance

Four different measures of performance were considered in this paper. In the context of selecting suppliers, customers usually retain firms that produce the highest aggregates core on: price (PR); quality (QUAL); flexibility of production (FLEX) and delivery times (T).

Table 1 Constructs and measures of variables

Customer–supplier relationship in NPD
A-type suppliers
B-type suppliers
C-type suppliers
Innovative capabilities
Absorptive capacity
Technological penetration
Technological scanning
Individual skills
Innovation-supporting managerial competence
Innovation culture
Performance measures
Price
Quality
Flexibility
Time

3.4. Sample and data collection

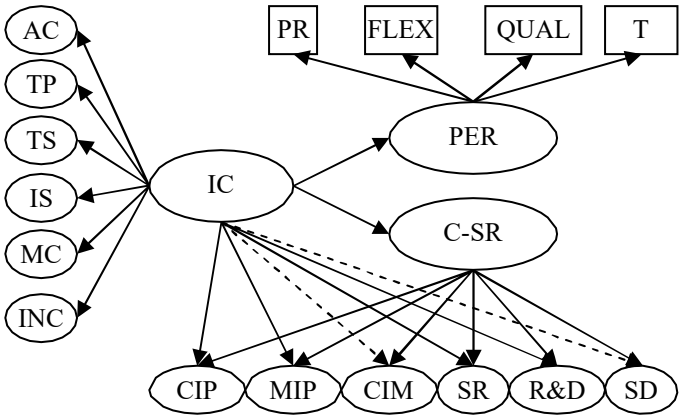
The results presented in this paper come from an in-depth questionnaire survey carried out among suppliers operating in the packaging machinery industry in Eastern China. 342 firms was survey in 2006. A final number of 197 usable questionnaires were obtained,

with a satisfying response rate of 58% (197 out of 342).

4. Results

4.1. LISREL and structural equation modeling

The relationships to be tested with structural equation modeling are shown in Figure 1.



GFI=0.931, AGFI=0.912, NFI=0.927, CFI=0.994, RMSEA=0.023, n=197

Figure 1 Research model of SEM

All of the 197 responses were submitted to LISREL to evaluate the model in Figure 1. The GFI of 0.931 indicates a good model to data fit. The goodness-of-fit index adjusted for degrees of freedom (AGFI) was 0.912, which is also good. Table 2 displays a summary of the data related to testing the hypothesized relationships shown in Figure 1.

The computed t-values judge the statistical significance of each theorized relationship, and they are well above the minimum acceptable value of 2.00. Path coefficients give an indication of the relative strength of each relationship.

Table 2 Summary of LISREL generated results

Relationship	t-value	Significant	Path coefficient
IC-C-SR	4.304	Yes	0.332
IC-PER	5.256	Yes	0.522
IC-CIP	4.178	Yes	0.432
IC-MIP	3.965	Yes	0.365
IC-CIM	0.619	No	0.082
IC-R&D	6.198	Yes	0.419
IC-SR	5.802	Yes	0.382
IC-SD	1.476	No	0.101

A significant positive relationship is shown between IC and S–CR. We may then posit that there is a causal relationship between the innovative profile of a firm and the role that is assigned to it by customers. A positive and significant relationship is also demonstrated between IC and PER. Firms with high levels of IC are high performing as measured by customer satisfaction and market performance. By combining these results, it maybe appropriate to claim that IC positively affect organizational performance through their impact on supplier–customer relationships.

The bottom portion of Table 2 displays a summary of the data generated by LISREL related to the testing of the hypothesized relationships between the constructs. It is worth noting that no causal relationship was found between IC/Customer's influence in manufacturing specifications and IC/Supplier Development.

4.2. Subgroup regression analysis

This paper uses multiple hierarchical regression analyses to draw a comparison among the innovative profiles of the three types of firms in the sample (Table 3).

As expected, suppliers that have established less stable relationships with the customers are less inclined to invest in technology and R&D. Moreover, the performance attributes that are more influenced by IC (except for C-type suppliers) are, in descending order of importance: (i) quality, (ii) flexibility, (iii) price, and (iv) lead-time. This conclusion can be drawn by looking at the number of variables in the regression equations and the variance explained for each performance indicator. The impact of IC on performance is not uniform. In general terms, IS are the strongest predictor of performance, followed by TP, a strong innovation-oriented culture, MC, AC and, lastly, TS. The relative importance of IC varies according to the type of suppliers considered. Absorptive capacity, in other words making appropriate investment in technological resources in order to increase the ability to evaluate, assimilate, and exploit extramural technological developments has some relevance for A-type suppliers only and is almost negligible for the other two types of suppliers. The number of AMT and methodologies that have been successfully adopted and their impact in terms of process innovativeness seem to play a more essential role in explaining the performances of B-type suppliers rather than those of A-type and C-type suppliers. As expected, the ability of a firm to identify opportunities, to understand and foresee the technological strategies of competitors and to evaluate emerging technologies is of some importance for A-type suppliers only. The tacit or explicit knowledge and know-how of employees seem to represent a major driver of performance for B and C-type suppliers. For MC, no substantial differences are noted among the three clusters of firms. The diffusion of innovation-oriented

values and results-oriented culture has been found to impact more heavily on the performance of B-type suppliers rather than of A-type suppliers.

Table 3 Results of regression analysis: standardized betas reported

Independent variables	A-type Suppliers				B-type Suppliers				C-type Suppliers			
	PR	QUAL	FLEX	T	PR	QUAL	FLEX	T	PR	QUAL	FLEX	T
AC	—	0.21*	0.15*	—	0.09*	—	—	—	—	—	—	—
TP	0.08*	0.23*	—	—	0.19*	0.07*	0.16*	—	0.14**	—	—	0.13*
TS	—	0.18*	—	—	—	0.10**	—	—	—	—	—	—
IS	—	0.18*	0.05*	—	—	0.12*	0.24*	0.03*	0.09*	—	0.13***	0.09*
MC	—	0.14*	0.03**	—	—	0.03*	0.25***	—	0.13***	—	—	0.09*
INC	—	0.18***	0.09*	—	—	0.02*	0.34****	—	0.11*	—	—	0.10
R^2	5.25%	41.3%	35.6%	—	11.6%	39.8%	37.7%	4.2%	30.7%	—	6.45%	31.5%

*p<0.10; ** p<0.05; ***p<0.01; **** p<0.001

5. Conclusions

The implications of this research are two fold.

First, from a theoretical standpoint, the empirical evidence tends to support the assumption that traditional innovative efforts and supportive organizational capabilities (managerial practices and IS) have a synergistic effect that largely depends upon the strategic role assumed by the supplier.

Second, from a practical perspective, the findings of this study have implications for both customers and suppliers. From the customer's point of view, the study reveals that the favored Japanese practices suggesting fewer suppliers and long-term relationships cannot be generalized beyond a certain limit. Partnerships with "contractual" suppliers manufacturing low priority and standard components are dysfunctional. By choosing inappropriate levels of responsibility for suppliers, a customer may waste resources, urge suppliers to design highly customized parts when "off-the-shelf" parts are available and, most important, require suppliers to play a role that is beyond the scope that their technological base and competencies would allow. The paper, on the other hand, maintains that for a buyer, adopting a set of differentiated supplier relations is becoming a generalized necessity. From the standpoint of the supplier, the research findings clearly indicate that for those firms that make it a goal to move up from a "contractual" to a "mature" or even a "partner" supplier, the development is expensive and time- consuming. It does not only require massive investments in new technology, but also to undergo a deep process of building, nurturing and developing specific capabilities in terms of TS abilities, IS and, most important, organizational values. This evolution is neither fast nor easy since it is highly path- dependent, requiring a learning process that is largely based on the firm's previous experience and history.

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