The Influence of Interfirm Learning Capabilities on Supply Chain Management Performance

Eric T.G. Wang
Department of Information Management
National Central University, Taiwan
ewang@mgt.ncu.edu.tw

Hsiao-Lan Wei
Department of Information Management
National Central University, Taiwan
hlwei@mgt.ncu.edu.tw

Abstract

Recognizing that external knowledge is fundamental to build capabilities, organizational learning and knowledge management have become important issues in supply chain research. Interorganizational relationship can extend a firm's knowledge base and allow it to exploit and apply external sources of knowledge, which can result in superior performance. For investigating the effective interorganizational learning capabilities for knowledge acquisition and exploitation from supply chain partners, this paper identifies learning orientation, relationship quality, and interoganizational system (IOS) usage as three important learning capabilities in supply chain management. The results suggest that learning orientation has significant, positive effects on relationship quality and IOS usage. Relationship quality has positive direct effects on both IOS usage and supply chain management performance. But IOS usage does not influence supply chain management performance significantly. Finally, the implications of the study are provided.

1. Introduction

Facing with increasingly environmental uncertainty and global competition, firms need to develop dynamic capabilities to gain and sustain competitive advantage. The ability to manage interfirm relationships has been recognized as one of these vital capabilities for organizations to secure competitive advantage [17][21][31]. This relational capability may extend a firm's knowledge base and allow it to exploit and apply external sources of knowledge, which can result in superior performance [22][32][61]. Indeed, supply chain members learn and gain new skills and knowledge from partners through investing heavily in advanced interorganizational technologies, such as JIT purchasing, vendor managed inventory (VMI), collaborative planning, forecasting and replenishment (CPFR) programs [39][49][66]. Learning and knowledge are believed to play a significant role in interfirm relationships and supply chain management.

Recognizing that external knowledge is fundamental to build capabilities, organizational learning and knowledge management have become important issues in supply chain research [8][29][32][35][51][67]. Some researchers have investigated the role of knowledge-sharing in supply chain network [20][65]. Others have examined the mechanisms facilitating supply chain learning [8] and the importance of learning and knowledge management for supply chain change [35][67]. There is a growing interest in the supply chain application of learning principles, but most of these studies are case-based descriptions (e.g. [8][35][65][67]). Besides, studies show that many firms have a lack of absorptive capacity in assimilating new knowledge from partners [69]. The objective of this article is to extend this stream of research by empirically examining the influence of interfirm learning capabilities on supply chain management performance.

Given the widely acclaimed strategic importance of external knowledge and information, firms require to build capabilities for acquisition, assimilation,

transformation, and exploitation of knowledge from supply chain partners [20][65][69]. Although learning from partners is important for gaining advantage, little is known about what capabilities are essential in the interfirm learning process and why these capabilities can benefit supply chain members. Realization of the potential advantage of interorganizational learning and knowledge management is determined by a firm's intent to learn and the characteristics of buyer-supplier dyad [34].

In this article, three important characteristics constituting interfirm learning capabilities in a supply chain are identified: learning orientation, relationship quality and interorganizational systems (IOS) usage. Learning orientation is a cultural orientation that institutes learning processes for stimulating employees' intention for acquiring new knowledge when interacting with external environments. Relationship quality and IOS usage has been recognized as important collaboration-specific capabilities for generating benefits [10][11]. They are important for knowledge acquisition and exploitation in interorganizational learning processes. The three learning capabilities are complementary and have complex relationships. We examine the relatinoships among these learning capabilities as well as the effects of these capabilities on supply chain management performance.

This paper makes a twofold contribution in the supply chain management field. First, the study applies organizational learning perspective in the supply chain context and empirically investigates its role in supply chain practices. There is a growing interest in the supply chain application of learning principles, but most of these studies are case-based descriptions. For example, Bessant et al. [8], in a detailed study of six UK supply chains, explore the potential of shared learning between firms and the various stages of implementing supply chain learning. West and Burnes [67] in a field study with automotive industry found that organizational learning is an important factor in building competitiveness by dealing proactively with change. The present study undertakes an empirical study to investigate the impact of learning capabilities on supply chain management performance, thus providing generalizable results beyond the specific case studies. Second, the study identifies a set of capabilities for effective interfirm learning processes and examines their complicated relationships. In sum, this paper aims to contribute to the continued development and success of supply chain management in general.

2. Conceptual Background and Research Model

While supply chain relationships are becoming more complex in scope after developing strategic collaboration, it is an ideal area where organizational learning activities can yield synergy and competitive advantage [30]. The learning process can enhance the effectiveness of implementing new process flows substituted for the old ones. For examples, jointly product design and EDI practices are models of change that incorporate learning ability with new cooperation processes. Complementary knowledge from external linkages may evolve into important sources of new idea and improve performance [18][19][52]. The involvement of suppliers in manufacturer's product design reveals that knowledge flows between manufactures and suppliers play a key role in supply chain management. The ability to create and manage buyer-supplier knowledge-sharing processes can successfully improve supply chain performance [20]. This ability to assimilate and exploit knowledge and technology from supply chain partners is relied on a set of crucial learning capabilities. The remainder of this section defines these important capabilities: learning orientation, relationship quality, and IOS usage.

2.1 Learning Orientation as a Learning Capability in Supply Chains

As firms are seeking ways to respond to changing environment, learning orientation is an important organizational culture to break the barriers between the organization and the environment [67] and encourage the acquisition and use of external knowledge. Learning orientation can influence the ability to use information and transform it into knowledge as an essential part of the innovative process [35]. It is consisted of three organization values—commitment to learning, open-mindedness, shared vision — that influence the direction and intensity to create and use knowledge and challenge an organization's theory in use [54]. Learning orientation can highlight an organization's ability to explore the unknown and to identify novel solutions in uncertain contexts [55]. This is important for a firm to learn in supply chains.

A learning-oriented organization intends to keep best solutions in organization memory for immediate response to new changes and also encourages the generation of new knowledge to satisfy the product and service attributes that customers value [57]. Despite the important knowledge producing behaviors, questioning existing knowledge values is critical for firms to generate differentiated innovations [6]. A learning-oriented organization with an open mind will not hesitate to change through learning from its customers or suppliers and the effect of knowledge from external partners will last for a certain period by imposing the learned knowledge into the organizational memory [17]. Accompanied by learning orientation, firms can develop greater interfirm capabilities in supply chains and make better decisions based on the shared and undistorted information in managers' mental model.

2.2 Relationship Quality as a Learning Capability in Supply Chains

Dyer and Singh [21] indicated that effective supply chain management often involves close, trusting relationship with long-standing suppliers. The close relationship help firms to generate new capabilities by absorbing knowledge from external environments [11]. The good relationship quality creates expectations of trust and mutual exchange of information that motivate trading information and knowledge flows [62][63]. Frequent contact and emotional closeness among supply chain members enhance the amount of complex knowledge transferred [25] because parties involved in knowledge exchange require a reciprocating process to balance the expected ratio of costs and benefits associated with such exchange [50]. Therefore, relationship quality is one of the most important capabilities helping acquire and assimilate knowledge in a supply chain.

Some studies suggested that information access and knowledge flows are important benefits of network relations, such as supply chain relationships, for better performance [3][7][27][62]. Anderson et al. [3] suggested that a firm's close relationships with suppliers and customers would facilitate the assimilation of new knowledge and then advance its performance. Baum et al. [7] found that new firms had better performance when their network ties promote learning and maximize diverse information access. Helper [27] and Uzzi [62] found that close supplier-manufacturer relationships enable the information exchange of tacit and proprietary know-how. These evidences also reveal the vital role of relationship quality in knowledge exchanged and interorganizational learning processes.

Relationship quality is a multidimensional construct characterized by trust, commitment, communication, coordination and joint problem solving [42][46]. Trust and commitment represent the stability and

sustainability of a long-term relationship, which can promote favorable attitudes and behaviors of partners and facilitate resource investment and sharing [58]. These are critical for knowledge acquisition because they influence both the extent and efficiency of knowledge exchanged in interorganizational relationships [33]. Communication, coordination, and joint problem solving processes between partners allow a firm to analyze, process, interpret, and understand the information obtained from external sources as externally acquired knowledge may be context specific and incomprehensible [69]. Through frequent communication and coordination between buyers and suppliers, they can improve their mutual understanding and speed up learning the knowledge. Joint problem solving is especially important in the urgent needs for external knowledge while such process can immediately import partner's knowledge into the firm through open discussion to reach a solution.

2.3 IOS Usage as a Learning Capability in Supply Chains

In recent years, sharing information with supply chain partners through IOS, such as Electronic Data Interchange (EDI), is a critical component of supply chain management [28]. Firms find new ways to exploit and expand information capabilities strategically in supply chains through using IOS to reduce total cycle time and to improve responsiveness [14][24]. As an important part of organizational memory, IOS can make knowledge explicit, communicable, and integrated [60], thus reducing the barrier to learn. Firms can solve problems with available and qualified information and can gain more knowledge from external environment. The creative use of IOS in normal operations allows firms to exploit knowledge and the greater extent of IOS usage can penetrate the new knowledge embedded in IOS into a larger scope of work operations. As such, the interaction between IOS and users can facilitate the learning of the embedded knowledge.

The implementation of information systems actually is the process of knowledge externalization and combination. In order to codify requirements and formalize work processes, people are forced to reflect on how they understand their work and articulate their tacit knowledge into explicit knowledge. The explicit knowledge then can be combined into more complex and systematic sets of knowledge to form new knowledge [47]. This knowledge transformation continuously occurs in IOS implementation in particular as different technology frames of reference from suppliers, customers, and many functional departments may yield incompatible interpretation of the same information [16][48]. The ability of firms to combine theses knowledge into a new schema of information systems represents a learning capability, which provides opportunities to alter the way to do things and to improve work processes [15][69].

2.4 Research Hypotheses

The relationships between learning orientation, relationship quality, and IOS usage, are more fully developed in the followings. Testable hypotheses are proposed accordingly.

2.4.1 Learning Orientation and Relationship Quality

Learning orientation plays an important role in reducing the resistance to accept external knowledge. As the established organizational systems can best handle both explicit and tacit information within a firm, managers have difficulty accepting external information for change [38]. Though a company's accumulated knowledge base creates its core capabilities, the swift-moving environment forces the firm to challenge its current paradigms that may have rigidities from the

core capabilities [36]. Learning orientation can stimulate employees' continually striving for new approaches when interacting with external environments. The value of continual exploration of new approaches may stimulate "double-loop learning", thus leading to innovation [54]. With shared vision and open mindedness, learning orientation is the prerequisite learning capability in a supply chain.

Learning orientation is important to the long-term relationships in supply chains and it can facilitate partners to exercise better communication and to coordinate for joint-problem solving. Hult et al. [30] suggest that learning orientation has a positive influence on supply chain relationships, especially on relationship commitment. As learning orientation influences the propensity of a firm to create and use knowledge from supply chain partners, the firm with strong learning orientation encourages employees to constantly reframe their fundamental operations philosophies with new knowledge [54][57]. Those boundary-spanning employees, who are involved in relations between firms, are enthusiasm to acquire knowledge from partners and develop personal trust and social exchange through informal collaboration networks. The informal collaboration network can influence the relationship quality among firms and provide another powerful means to acquire information and knowledge [38]. Accordingly, we present the following hypothesis.

H1: The greater the learning orientation of a firm, the better is the relationship quality between the firm and its suppliers.

2.4.2 Learning Orientation and IOS Usage

Implementing an IOS actually involves both IT systems installations and business relationship restructuring. Both retarding and supporting forces for change coexist, therefore, managers have to create the mindset that challenges the old model sufficiently [37]. A learning-oriented organization has the open-minded vision to experiment, evaluate, enforce and extend the emerging new model [54]. It helps not only challenge the defensive routines but also redefine the deep structure [37]. In reality, the deep structure lies hidden in an organization and inhibits the learning processes, while more surface level structure may break down after IOS implementation. People committed to learn can explore the real benefits of external absorbed knowledge through building and reinforcing the deep structure [37]. Therefore, we present the following hypotheses.

H2: The greater the learning orientation of a firm, the greater is the IOS usage.

2.4.3 Relationship Quality and IOS Usage

Cooperating across systems is a very sensitive aspect of partnership because it may incur some changes and boundary-spanning persons may resist to such changes [13]. This problem requires trust and openness to overcome and cannot be resolved easily in the short term. Hart and Saunders [26] also found that trust was positively related to the extent of EDI usage. Thus, establishing good relationship quality between supply chain members is a prerequisite for successful implementation of IOS [41]. Another issue stemming from the technical area is the differences of IT knowledge base between partners [13]. Small suppliers typically have insufficient IT knowledge to build an integrated system that can provide accurate, timely information. If the parties have better relationship quality, they should be easier to improve internal IT capability with the infusing knowledge of their partners. Commitment to a lasting relationship will encourage both parties to invest specific assets like IOS [41]. Effective communication, coordination, and joint problem solving will reduce the resistance to change and reduce the uncertainty of partners, thus increasing the possibility of adopting IOS. Accordingly, we propose the following hypothesis:

H3: The better the relationship quality, the greater is the IOS usage.

2.4.4 Relationship Quality and Supply Chain Performance

Good relationship quality is in fact a well-developed capability of resource flexibility because it renews a firm's knowledge base necessary in using and reconfiguring current resources [69]. Relationship quality can help the firm track changes effectively and then facilitate the development of production and technological competencies in response to environmental changes. The flexibility created from new knowledge stock can enhance supply chain performance because it gives the supply chain ability to handle difficult, customized order, to rapidly adjust production capacity, and to respond to target markets [64]. Moreover, learning from working closely with suppliers provides alternate knowledge sources in areas such as cost reduction, new product development, and quality improvement [32]. These new knowledge sources prevent firms from overemphasizing on existing knowledge and being trapped in limited organizational actions [69], which may impede the creation of innovation. Thus, relationship quality is a critical learning capability to create and sustain competitive advantage. Accordingly, we propose the following hypothesis:

H4: The better the relationship quality, the greater is the supply chain management performance.

2.4.5 IOS Usage and Supply Chain Performance

Successful IOS usage ultimately increases the ability of the organization to provide accurate, timely information across supply chains. With greater information capacity enabled by IOS, supply chain members can exchange much more information and knowledge to improve resource coordination. As new supply chain management knowledge is operationalized into IOS, IOS can make the knowledge standardized and then institutionalized in a cost-effective manner. This provides opportunities to modify and revise each supply chain member's knowledge premise and assumptions for the coordination of the organizational tasks, thus resulting in business process redesign [9]. The delivery and production processes of both buyers and suppliers can then be improved jointly. Through seamless information channels, the buying firm can integrate its planning effort with suppliers and learn how to response to uncertain environment more efficiently. Similarly, the suppliers can benefit from the buyer's early release of product or order information to optimize the allocation of production capacity, thus reducing time to market as well as inventory levels. Accordingly, we present the following hypothesis.

H5: The greater the IOS usage, the greater is the supply chain management performance.

3. Research Methodology

3.1 Sample and Data Collection

Mail survey methodology was chosen and the sampling frame was obtained from randomly selected large manufacturing firms in Taiwan. A draft survey was compiled and developed based on measures identified in the literature. The draft survey was then translated into Chinese and verified and refined for its translation accuracy by a Ph.D. in management and two doctoral students. The final version of the survey was distributed to the purchasing managers of 993 manufacturing firms randomly selected from the directories of 2000 *Top 5000 largest firms in Taiwan* published by China Credit Information Services, Ltd.

Totally 126 surveys were returned, with 118 having completed data used for subsequent analysis, yielding an

effective response rate of 12%. To assess the potential of response bias, non-response analyses were then applied to ensure the absence of non-response bias [5]. The respondents were divided into two halves based on the dates of return. Comparisons on company assets, employee numbers, relationship length, and purchase volume of the two groups of sample showed no significant differences based on the results of χ^2 tests. Accordingly, there appeared to be no non-response bias in this study.

3.2 Measures and Validation

Relationship quality is assessed with the following five dimensions: trust, commitment, coordination, communication, and joint problem solving. *Trust* refers to the honesty and promises of suppliers by obeying transaction rules and keeping good attitudes and behaviors. *Commitment* refers to relationship commitment that represents the degree of satisfaction for the parties involved and the long-term commitment to the supply chain relationship. It will be assessed with items selected and modified from the scale developed by Anderson and Weitz [2] and also used by Hult et al. [30]. Building on Sivadas and Dwyer's [56] work, *Communication* measures on quality (timely and adequate information) and information sharing (exchange critical know-how). *Coordination* refers to the extent to which partners function according to the needs and requirements of the other parts and the whole system. *Joint problem solving* will reference the definition of Mohr and Spekman's [42] work.

Learning orientation is based on the original definition and scale developed by Sinkula et al. [54]. It is a second-order construct with three first-order dimensions: commitment to learning, shared vision, open-mindedness. Each was measured using six items.

IOS usage refers to the degree of inter-organizational system usage as coordinating mechanism of supply chain activities. The mechanisms identified by this study, thus, include order processing, market information sharing, production capacity coordination, inventory level coordination, support for logistics integration, support for material or component design, support for conflict resolution, and support for quality control [4][43][45][59].

Supply chain management performance will be assessed with four dimensions including cost reduction, flexibility, delivery, and quality improvement of buying firms' performance [40][44][53].

4. Results

Partial Least Squares (PLS), a latent structural equations modeling technique, was selected to analyze both measurement validity and linkages in the theoretical model. The advantage of using PLS is that it is not restricted by the distribution requirements and sample size limitations of other structural equation modeling tools [12]. The analysis strategy involved a two-stage approach because the measures for learning orientation and relationship quality consisted of second order factors. The psychometric properties of all scales were first assessed through confirmatory factor analysis. The structural relationships were examined next, using factor scores for the second-order factors of learning orientation and relationship quality.

4.1 Measurement Model

The psychometric properties of the scales are assessed in terms of item loadings, discriminant validity, and internal consistency. Item loadings and internal consistencies (also known as composite reliability) greater than .70 are considered acceptable [23]. All items used in the study exhibited high loadings (>.70) on their respective constructs. Furthermore, all constructs in the model exhibit good internal consistency as

evidenced by their composite reliability scores, all at least .90 exceeding minimal reliability criteria (Table 1).

Discriminant validity was assessed by applying two criteria [12]: (1) items should load more highly on constructs they are intended to measure than on other constructs (i.e. loadings should be higher than cross-loadings) and (2) the square root of the average variance extracted (AVE) should be larger than the inter-construct correlations. Cross-loadings were computed by calculating the correlations between latent variable component scores and the manifest indicators of other latent constructs [1][12]. Without exception, all items load more highly on their own construct than on other constructs. Also, as shown by comparing the inter-construct correlations and the square root of AVE (shaded leading diagonal) in Table 1, the square root of the AVE for each construct was greater than 0.707 (i.e. AVE > 0.50) and greater than the correlation between the construct and other constructs, indicating that all constructs share more variance with their indicators than with other constructs. Overall, the self-report measurement instrument exhibited sufficiently strong psychometric properties to support valid testing of the proposed structural model.

Table 1 Reliabilities and Correlations among Latent Constructs

	Mean	Std.	Reliability[a] (# of items))	LO: CTL	LO: OM	LO: SV	RQ: TRUT	RQ: CMIT	RQ: CMUN	RQ: COOR	RQ: JPRL	IOS	PER: QTY	PER: DEL	PER: CR	PER: MF
LO: CTL	4.09	0.62	0.92(6)	0.81												
LO: OM	3.74	0.72	0.94(6)	0.72	0.85											
LO: SV	3.70	0.71	0.92(6)	0.71	0.77	0.82										
RQ: TRUS	4.09	0.76	0.95(3)	0.67	0.73	0.79	0.79									
RQ: CMIT	4.03	0.65	0.94(4)	0.24	0.18	0.19	0.29	0.93								
RQ: CMUN	4.03	0.65	0.96(5)	0.30	0.28	0.31	0.42	0.84	0.89							
RQ: COOR	3.88	0.63	0.93(3)	0.40	0.29	0.36	0.43	0.75	0.80	0.91						
RQ: JPRL	3.96	0.61	0.93(3)	0.38	0.37	0.37	0.46	0.71	0.73	0.73	0.90					
IOS	3.39	0.81	0.96(9)	0.43	0.38	0.43	0.48	0.74	0.79	0.78	0.77	0.91				
PER: QTY	3.86	0.50	0.92(5)	0.35	0.31	0.30	0.40	0.41	0.50	0.41	0.42	0.48	0.87			
PER: DEL	3.77	0.70	0.95(3)	0.39	0.41	0.35	0.46	0.49	0.53	0.42	0.41	0.45	0.43	0.84		
PER: CR	3.37	0.65	0.92(4)	0.22	0.32	0.24	0.37	0.62	0.56	0.52	0.50	0.50	0.34	0.51	0.93	
PER: MF	3.56	0.64	0.96(3)	0.43	0.46	0.42	0.46	0.41	0.44	0.44	0.41	0.48	0.30	0.48	0.57	0.86

[a]Composite Reliability

The shaded numbers on the leadning diagonal are the square root of AVE. Off diagonal elements are the correlations among constructs.

LO=Learning Orientation; RQ=Relationship Quality; PER=Performance

4.2 The Structural Model

The PLS structural model and hypotheses were assessed by examining path coefficients (similar to standardized beta weights in a regression analysis) and their significance levels. The path coefficients and explained variances for the model are shown in Figure 1. All of the constructs were modeled as reflective and constructs with multi-dimensions were measured using summated scales, which are represented by factor scores derive from the confirmatory factor analysis. This was necessary since PLS does not directly support second order factors [1][68]. Following Chin [12], bootstrapping (with 500 resamples) was performed to obtain estimates of standard errors for testing the statistical significance of path coefficients using *t*-tests.

Figure 1 summarizes model-testing results. Findings provide support for Hypothesis 1, relating learning orientation to relationship quality ($t = 4.50$, $p < 0.001$). Hypothesis 2, which posited that learning orientation would influence IOS usage, was also supported ($t = 2.46$, $p < 0.05$). As for Hypothesis 3, we found that, as predicted, relationship quality was positively associated with IOS usage ($t = 6.04$, $p < 0.01$). Hypothesis 4, which posited that relationship quality would influence supply chain performance, was supported ($t = 8.50$, $p < 0.01$). Finally, as for Hypothesis 5, we found that, IOS usage was not positively associated with supply chain performance ($t = 1.68$, $p < 0.1$), though this could be slightly significance by setting lower significance level (α=0.1). Explained variance for supply chain performance was 41.4%. Learning orientation explains 16.4% and 27.6% of the variance in relationship quality and IOS usage respectively.

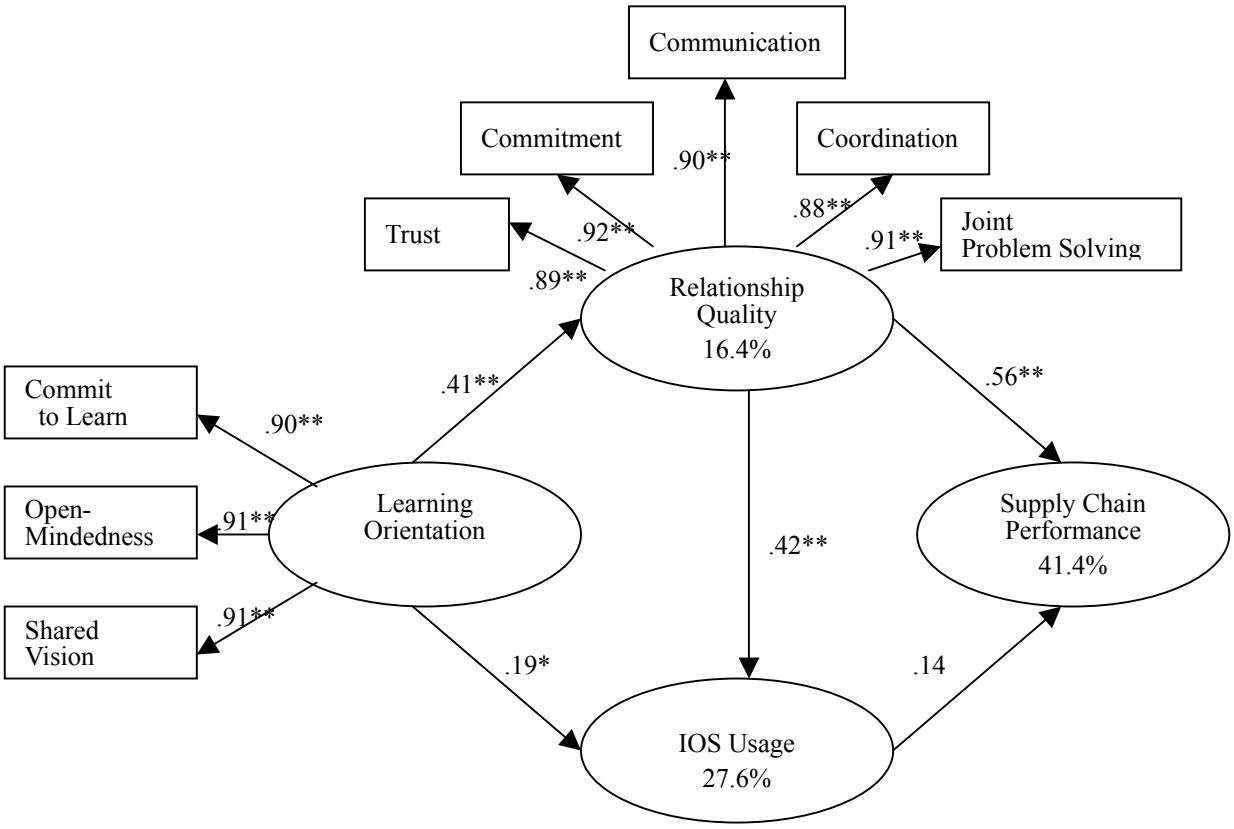

Figure 1 PLS Results

5. Conclusion

This research from the organizational learning perspective identifies learning orientation, relationship quality and IOS usage as the important learning capabilities in supply chain management and investigate their influence on supply chain performance. To compete at the supply chain level, the learning capabilities in the supply chain are essential for determining the competitive advantage of the firms. Our research results support that learning orientation influences both relationship quality and IOS usage in the supply chain. Therefore, a positive learning culture is beneficial for firms that aspire to stand out through supply chain learning process. Relationship quality has positive impact on supply chain performance, thus revealing that good relationship helps acquire and assimilate external knowledge from supply chain partners to sustain and create advantage. For effective learning, well-established norms, practices, and beliefs may have to be challenged, and managers should encourage employees to pursue knowledge related to supply chain change management.

The empirical result does not reveal a strong effect of IOS usage on supply chain management performance. One explanation may be that IOS usage in Taiwan is still in the initial stage, therefore, the scope of implementation may be limited and the overall benefits are too early to be observed. The survey data shows that only 23% of respondents implement and use advanced types of IOS systems (e.g., EDI, B2B systems, and WWW-based systems) to support some aspects of their supply chain activities. Also, the implementation of IOS involves two or more different organizations. This makes it much more difficult than that of traditional IS systems.

The results support that relationship quality has positively direct effects on both IOS usage and supply chain management performance. The positive effect of relationship quality on IOS usage indicates that good relationship is helpful in facilitating IOS usage because it can reduce the uncertainty faced by both parties and counter the resistance of boundary-spanning persons. Also, relationship quality has a significantly positive effect on supply chain management performance. Incorporating external partners into a firm's internal business process not only is a way to focus on its core competencies but also can integrate the competencies in the supply chain [11]. The importance of partnership possibly depends on the knowledge integration for generating exponential explosion of benefits in the supply chain, more than that of individual firm's.

Major change is required to generate a cooperative, strategic relationship and to utilize IOS usage. This change based on supply chain management concepts represents a strategic reorientation to realize long-run adaptation to current violent environment. Learning orientation can contribute to the change process by challenging old mental models and facilitating knowledge acquisition and exploitation. Learning may take time and produce some negative results in the experimental process, but the absence of organizational knowledge accumulated for the complexities of supply chain practices may impede the utilization of these new practices. Managers should recognize the importance learning orientation and have plans to encourage organizational learning in supply chain management [8].

Further research can overcome some of the limitations of this study. We measured the dyadic construct, relationship quality, as well as IOS usage from the perspective of the buyer. We did this by assuming that both buyers' and suppliers' perception of relational attributes are prominent and equal in their view of the entire relationship. However, perceptions from both sides of partner relationships might provide a different view than that provided by perceptions from one side

alone. Future research could gather information from both sides to yield bilateral perceptions and determine if these results reveal difference. Additional research also might be devoted to determine other important constructs that might impact supply chain change process.

References

[1] Agarwal, R. & Karahanna, E. "Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage," *MIS Quarterly*, 2000,24(4), 665-694.

[2] Anderson, E. &Weitz, B.A. "The use of pledges to build and sustain commitment in distribution channels," *Journal of Marketing Research*, 1992,24, 18-34.

[3] Anderson, U., Forsgren, M., & Holm, U. "Subsidiary embeddedness and competence development in MNCs - a multi-level analysis," *Organization Studies*, 2001,22(6), 1013-1034.

[4] Angeles, R. & Nath, R. "Partner congruence in electronic data exchange (edi)-enabled relationships," *Journal of Business Logistics*, 2001,22(2), 109-127.

[5] Armstrong, J.S. & Overton, T.S. "Estimating non-response bias in mail surveys," *Journal of Marketing Research*, 1977,14, 396-402.

[6] Baker, W.E. & Sinkula, J.M. "Learning orientation, market orientation, and innovation: Integrating and extending models of organizational performance," *Journal of Market Focused Management*, 1999,4, 295-308.

[7] Baum, J.A.C., Calabrese, T., & Silverman, B.S. "Don't go it alone: Alliance network composition and starup's performance in canadian biotechnology," *Strategic Management Journal*, 2000,21(3), 267-294.

[8] Bessant, J., Kaplinsky, R., & Lamming, R. "Putting supply chain learning into practice," *International Journal of Operations & Production Management*, 2003,23(2), 167-184.

[9] Broadbent, M., Weill, P., & St Clair, D. "The implications of information technology infrastructure for business process redesign," *MIS Quarterly*, 1999,23(2), 159-182.

[10] Cagliano, R., Caniato, F., & Spina, G. "E-business strategy: How companies are shaping their supply chain through the internet," *International Journal of Operations & Production Management*, 2003,23(10), 1142-1162.

[11] Celuch, K.G., Kasouf, C.J., & Peruvemba, V. "The effects of perceived market and learning orientation on assessed organizational capabilities," *Industrial Marketing Management*, 2002,31, 545-554.

[12] Chin, W.W. *The partial least squares approach to structural equation modeling*. Modern methods for business research, ed. G.A. Marcoulides, Mahwah, NJ: Lawrence Erlbaum Associates, 295-336.1998.

[13] Christopher, M. & Juttner, U. "Developing strategic partnerships in the supply chain: A practitioner perspective," *European Journal of Purchasing and Supply Management*, 2000,6(2), 117-127.

[14] Daugherty, P.J. & Pittman, P.H. "Utilization of time-based strategies: Creating distribution flexibility/responsiveness," *International Journal of Operations and Production Management*, 1995,15(2), 54-61.

[15] Davenport, T. & Short, J. "The new industial engineering: Information technology and business process redesign," *Sloan Management Review*, 1990,31(4), 11-27.

[16] Davidson, E.J. "Technology frames and framing: A socio-cognitive investigation of requirements determination," *MIS Quarterly*, 2002,26(4), 329-358.

[17] Day, G.S. "The capabilities of market-driven organizations," *Journal of Marketing Research*, 1994,58, 37-52.

[18] Decarolis, D.M. & Deeds, D.L. "The impact of stocks and flows of organizational knowledge on firm performance: An empirical investigation of the biotechnology industry," *Strategic Management Journal*, 1999,20(10), 953-968.

[19] Deeds, D.L. & Hill, C. "Strategic alliances and the rate of new product development: An empirical study of new

biotechnology firms," *Journal of Business Venturing*, 1996,11(1), 41-58.

[20] Dyer, J.H. & Nobeoka, K. "Creating and managing a high-performance knowledge-sharing network: The toyota case," *Strategic Management Journal*, 2000,21(3), 345-367.

[21] Dyer, J.H. & Singh, H. "The relational view: Cooperative strategy and sources of interorganizational competitive advantage," *Academy of Management Review*, 1998,23, 660-679.

[22] Eisenhardt, K.M. & Martin, J.A. "Dynamic capabilities: What are they?," *Strategic Management Journal*, 2000,21(10-11), 1105-1121.

[23] Fornell, C. & Larcker, D.F. "Evaluating structural equations models with unobservable variables and measurement error," *Journal of Marketing Research*, 1981,18(1), 39-50.

[24] Golden, W. & Powell, "Exploring inter-organisational systems and flexibility in ireland: A case of two value chains," *International Journal of Agile Management Systems*, 1999,1(3), 169-187.

[25] Hansen, M.T. "The search-transfer problem: The role of weak tie in sharing knowledge across organization subunits," *Administrative Science Quarterly*, 1999,44(1), 82-111.

[26] Hart, P.J. & Saunders, C.S. "Emerging electronic partnerships: Antecedents and dimensions of edi use from the supplier's perspective," *Journal of Management Information Systems*, 1998,14(4), 87-111.

[27] Helper, S. "Comparative supplier relations in the u.S. And japanese auto industries: An exit voice approach," *Business Economic History*, 1990,19, 153-162.

[28] Holland, C.P. "Cooperative supply chain management: The impact of interorganizational information systems," *Journal of Strategic Information Systems*, 1995,4(2), 117-133.

[29] Hult, G.T.M., Hurley, R.F., Giunipero, L.C., & Nichols, J.E.L. "Organizational learning in global purchasing: A model and test of internal users and corporate buyers," *Decision Sciences*, 2000,31(2), 293-325.

[30] Hult, G.T.M., Nichols Jr, E.L., Giunipero, L.C., & Hurley, R.F. "Global organizational learning in the supply chain: A low versus high learning study," *Journal of International Marketing*, 2000,8(3), 61-83.

[31] Jap, S. "Pie-expansion efforts: Collaboration processes in buyer-seller relationships," *Journal of Marketing Research*, 1999,36, 461-475.

[32] Johnson, J.L. & Sohi, R.S. "The role of relational knowledge stores in interfirm partnering," *Journal of Marketing Research*, 2004,68(3), 21-36.

[33] Lane, P. & Salk, J.E. "Absorptive capacity, learning, and performance in international joint ventures," *Strategic Management Journal*, 2001,22(12), 1139-1161.

[34] Lane, P.J. & Lubatkin, M. "Relative absorptive capacity and interorganizational learning," *Strategic Management Journal*, 1998,19(5), 461-477.

[35] Lee, G., Bennett, D., & Oakes, I. "Technological and organisational change in small- to medium-sized manufacturing companies: A learning organization," *International Journal of Operations & Production Management*, 2000,20(5), 549-572.

[36] Leonard-Barton, D. "Core capabilities and core rigidities: A paradox in managing new product development," *Strategic Management Journal*, 1992,13, 111-125.

[37] Macbeth, D.K. "Emergent strategy in managing cooperative supply chain change," *International Journal of Operations & Production Management*, 2002,22(7), 728-740.

[38] Macdonald, S. "Learning to change: An information perspective on learning in the organization," *Organization Science*, 1995,6(5), 557.

[39] Magretta, J. "The power of virtual integration: An interview with dell computer's michael dell," *Harvard Business Review*, 1998,76, 72-84.

[40] Mentzer, J.T., Flint, D.J., & Kent, J.L. "Developing a logistics service quality scale," *Journal of Business Logistics*,

1999,20(1), 9-32.

[41] Moberg, C.R., Culter, B.D., Gross, A., & Speh, T.W. "Identifying antecedents of information exchange within supply chains," *International Journal of Physical Distribution and Logistics Management*, 2002,32(9), 755-770.

[42] Mohr, J. & Spekman, K. "Characteristics of partnership success: Partnership attributes, communication behavior and conflict resolution techniques," *Strategic Management Journal*, 1994,15, 135-152.

[43] Morash, E.A. & Clinton, S.R. "Supply chain integration: Customer value through collaborative closeness versus operational excellence," *Journal of Marketing Theory and Practice*, 1998,6(4), 104-120.

[44] Narasimhan, R. & Jayaram, J. "Causal linkage in supply chain management: An exploratory study of north american manufacturing firms," *Decision Sciences*, 1998,29(3), 579-605.

[45] Narasimhan, R. & Kim, S.W. "Information system utilization strategy for supply chain integration," *Journal of Business Logistics*, 2001,22(2), 51-75.

[46] Naude, P. & Buttle, F. "Assessing relationship quality," *Industrial Marketing Management*, 2000,29, 351-361.

[47] Nonaka, I., Toyama, R., & Konno, N. "Seci, ba and leadership: A unified model of dynamic knowledge creation," *Long Range Planning*, 2000,33, 5-34.

[48] Orlikowski, W. & Gash, D. "Technology frames: Making sense of information technology in organizations," *ACM Transactions on Information Systems*, 1994,12(2), 174-207.

[49] Raghunathan, S. "Interorganizational collaborative forecasting and replenishment systems and supply chain implications," *Decision Sciences*, 1999,30(4), 1053-1071.

[50] Schulz, M. "The uncertain relevance of newness: Organizational learning and knowledge flows," *Academy of Management Journal*, 2001,44(4), 661-681.

[51] Scott, J.E. "Facilitating interorganizational learning with information technology," *Journal of Management Information Systems*, 2000,17(2), 81-113.

[52] Shan, W. & Walker, G. "Interfirm cooperation and starup innovation in the biotechnology industry," *Strategic Management Journal*, 1994,15(5), 387-394.

[53] Shin, H., Collier, D.A., & Wilson, D.D. "Supply management orientation and supplier/buyer performance," *Journal of Operations Management*, 2000,18, 317-333.

[54] Sinkula, J.M., Baker, W.E., & Noordewier, T. "A framework for market-based organizational learning: Linking values, knowledge, and behavior," *Journal of the Academy of Marketing Science*, 1997,25(4), 305-318.

[55] Sitkin, S.B., Sutcliffe, K.M., & Schroeder, R.G. "Distinguishing control from learning in total quality management: A contingency perspective," *Academy of Management Review*, 1994,19(3), 537-564.

[56] Sivadas, E. & Dwyer, F.R. "An examination of organizational factors influencing new product success in internal and alliance-based processes," *Journal of Marketing Research*, 2000,64(1), 31.

[57] Slater, S.F. & Narver, J.C. "Market orientation and the learning organization," *Journal of Marketing*, 1995,59(3), 63-74.

[58] Spekman, R.E., Kamauff, J.W., & Myhr, N. "An empirical investigation into supply chain management: A perspective on partnership," *International Journal of Physical Distribution and Logistics*, 1998,28(8), 630-650.

[59] Stank, T., Crum, M., & Arango, M. "Benefits of interfirm coordination in food industry supply chain," *Journal of Business Logistics*, 1999,20(2), 21-41.

[60] Stein, E.W. & Zwass, V. "Actualizing organizational memory with information systems," *Information Systems Research*, 1995,6(2), 85-117.

[61] Teece, D.J., Pisano, G., & Shuen, A. "Dynamic capabilities and strategic management," *Strategic Management Journal*, 1997,18(7), 509-533.

[62] Uzzi, B. "Social structure and competition in interfirm networks: The paradox of embeddedness," *Administrative*

Science Quarterly, 1997,42(1), 35-67.

[63] Uzzi, B. & Gillespie, J.J. "Knowledge spillover in coporate financing networks: Embeddedness and the firm's debt performance," *Strategic Management Journal*, 2002,23, 595-618.

[64] Vickery, S., Calantone, R., & Droge, C. "Supply chain flexibility: An empirical study," *The Journal of Supply Chain Management*, 1999,35(3), 16-24.

[65] Wagner, B.A. "Learning and knowledge transfer in partnering: An empirical case study," *journal of Knowledge Management*, 2003,7(2), 97-113.

[66] Waller, M., Johnson, M.E., & Davis, T. "Vendor-managed inventory in the retail supply chain," *Journal of Business Logistics*, 1999,20(1), 183-203.

[67] West, P. & Burnes, B. "Applying organizational learning: Lessons from the automotive industry," *International Journal of Operations & Production Management*, 2000,20(10), 1236-1251.

[68] Yi, M.Y. & Davis, F.D. "Developing and validating an observational learning model of computer software training and skill acquisition," *Information Systems Research*, 2003,14(2), 146-169.

[69] Zahra, S.A. & George, G. "Absorptive capacity: A review, reconceptualization, and extension," *Academy of Management Review*, 2002,27(2), 185-203.