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EXPLORING THE ROLES OF TRANSACTION COSTS REDUCTION AND EXPLICIT COORDINATION IN MEDIATING THE IMPACTS OF IOS USE ON BUYER BENEFITS

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ABSTRACT

This paper develops a research model on the roles of transaction cost reduction and explicit coordination in mediating the impacts of inter-organizational information systems (IOS) use on buyer benefits. Empirical tests find that both the transaction costs reduction and explicit coordination are significantly impacted by IOS use. However, it is found that the impacts of IOS use on buyer benefits is only mediated through transaction costs reduction and not mediated through explicit coordination. These findings may imply that the idea of competition is still dominating the mindset of many managers in their value chain management. And these findings may also imply that it takes quite a lot of time and efforts for both IOS initiators and adopters to adapt to the IOS use enabled explicit coordination before business benefits can be generated fro relevant parties. This paper contributes to existing studies on IOS use impacts by 1) developing relevant scales, 2) testing the roles of transaction cost reduction and explicit coordination in mediating the impacts of IOS use on buyer benefits, and 3) indicating future research directions.

Keywords: Transaction Costs, Explicit Coordination, IOS Use, Buyer Benefits, and Empirical Tests.

INTRODUCTION

Many firms have already invested enormously (in billions of US dollars) in applying Internet technologies to develop IOSs (i.e., inter-organizational information systems) to establish their B2B e-commerce infrastructures and they are expecting to reduce transaction costs and improve their explicit coordination with their customers or suppliers [25,8,7,19,13]. Further, firms, and especially buyers, as the customers of various products and services, are expecting to improve their business performances at the bottom line through the reduced transaction costs and increased coordination [12,36]. Consequently, the issue of what are the perceived realized impacts of IOS use is worthy of being seriously investigated empirically because these perceptions may very well influence the next round of decisions on B2B e-commerce strategies and investments by both the customer and the supplier firms.

Existing studies have already investigated the impacts of IOS use on both the transaction costs reduction and the level of coordination [5,25,8,9,19,29]. However, either studies focusing on the coordination impacts do not consider the transaction costs reduction impacts [5], or studies focusing on transaction costs reduction do not explicitly incorporate the coordination impacts [29], or both the coordination and transaction costs reduction impacts are considered only in anecdotes [8,9,19]. Further, while transaction costs reduction and explicit coordination are two complementary mechanisms for firms to benefit from business exchanges [12,29], buyer benefits from the IOS based e-

commerce systems have not been empirically verified explicitly with both mechanisms incorporated simultaneously.

This current research is to partially fill these gaps by using survey data to empirically investigate the roles of transaction costs reduction and explicit coordination in mediating the impacts of IOS use on buyer benefits. The findings will help identify the dominant impact of the current e-commerce systems if it does exist. The question is whether it is the increased coordination or the transaction costs reduction? Further, findings will also help us understand different roles played by the transaction costs reduction and the explicit coordination in mediating IOS use impacts on buyer benefits. All findings together will extend current IOS use impacts studies and have practical implications.

CONCEPTS AND RESEARCH MODEL

IOS Use

As to the definition of IOS use, Massetti and Zmud's [27] research on EDI (i.e., electronic data interchange) use is followed. They proposed four EDI use dimensions, namely, volume, depth, breadth, and diversity. Truman [35] proposed the concept of interface integration which represents the integration of IOS systems with a firm's internal systems and is similar to the depth dimension in Massetti and Zmud [27]. Angeles and Nath [1] developed three levels of EDI implementation, also representing the depth dimension. Hart and Saunders [17] developed EDI use measurement items for volume and diversity. Premkumar, Ramamurthy, and Nilakanta [31] used the concept of EDI internal infusion to capture the degree of integration of EDI with a firm's internal systems and the concept of external infusion to represent the number of different partners connected through EDI and the amount of different types of business documents exchanged through EDI. Their concept of internal infusion is indeed similar to EDI use depth and their external infusion is the combination of EDI use breadth and diversity in Massetti and Zmud [27]. Most recently, Zhu, Kraemer, Gurbaxani, and Xu [39] also applied IOS use breadth, volume, and depth dimensions in their open standard IOS (i.e., Internet) adoption research model, which demonstrates the applicability of these IOS use dimensions to new advancements in technologies. Together, these studies have generated many insights into the concept of IOS use.

Transaction Costs and the Impacts of IOS Use

Transaction Costs: Clemons et al. [[9] classified transaction costs into coordination costs, operations risk and opportunism risk. Coordination costs include the cost of exchanging information on products (e.g., price and product characteristics) and incorporating that information into decision processes, the cost related to delays in the communication process, the cost of sharing design changes, and the cost of informing and being informed of changes in products and services delivery schedules [9]. Conceptually, Gulati and Singh [15] proposed that these coordination costs originate from the complexity of ongoing coordination of activities to be completed jointly or individually across firm boundaries. More specifically, Clemons et al. [9] indicated that causes of these coordination costs are uncertainties related to the availability and the delivery time of outsourced components, a supplier's ability to customize components, and the actions taken to reduce uncertainty. Operations risk is related to whether the other parties in a transaction willfully misrepresent or withhold information, or under-perform (i.e., shirk) their agreed-upon responsibilities [9]. It originates from differences in objectives among involved parties and is supported by information asymmetries or by difficulties in enforcing agreements. Opportunism is defined as the self-interest seeking with guile [38]. Opportunism originates from the difference in bargaining power between before and after relationship specific investments are made. The firm that makes relationship specific investments can be locked in the relationship since it may have to take a prohibitively high cost to switch to another potential partner.

Impacts of IOS Use on Transaction Costs Reduction: First, Malone et al. [26] proposed that the use of IT will significantly reduce the coordination costs between firms. Clemons et al. [9] also pointed out that information technology can reduce coordination costs since IT reduces the unit cost of both transmitting and reacting to information. Further, based on Galbraith's [11] observations, with IS support, the improved forecasting and shortened order cycles can reduce the level of the safety stock and the improved planning and scheduling can also reduce the slack-manufacturing capacity. We could treat all these inven-

tory carrying and capacity building costs as parts of the coordination costs. Thus, with the reduced costs of computer technologies and the increased power of computer systems, IOS use can help reduce coordination costs at the inter-organizational level.

Second, Clemons et al. [9] proposed that the increased information availability and processing capacity through IT can reduce operations risk because of the monitoring (i.e., informating) effect of IT [40]. To be more specific, since IT can be applied to improve the capability of firms to monitor their partners' behaviors and accordingly adjust the rewarding system, information technology can help reduce information misrepresentation, information withholding, or under-performance against agreement. For example, IOS may be linked to a supplier's schedules and production processes to detect potential delivery time delays and product defects. Hence, any under-performance, shirking, or information misrepresenting may be easily detected, which will help prevent business partners from under-performing against the agreement. Further, increased information processing capacity may also reduce operations risk by enabling more effective incentive structures. For example, if a retailer is using a checkout scanner system, related manufacturers can get to know precisely where and when their products are going and in what prices [9]. And this information can not only help manufacturers better supply their retailers, but also facilitate them to make decisions in sharing promotion benefits with the retailers. Thus, IOS uses may encourage retailers not to under-perform and consequently reduce operations risks in the exchanges for manufacturers.

Third, information technology can help reduce the opportunism risk originated from asset specificity, a small number of partners, and the loss of resources control [9]. Because information technology has features such as open technological standards, reusable software, intuitive human-computer interface, and embedded compatibilities for different versions of packages, information technology used for IOS is less transaction specific than traditional assets such as equipment, machinery, and tools [9]. Further, since electronic markets make it easy to switch to new suppliers at a low cost [3], opportunism risk due to a small number of selected suppliers may also be reduced. Finally, with the increased monitoring and infomating power of IOSs, a customer/supplier firm can better track the use of its proprietary information and technologies by its suppliers/customers and thus, the potential loss of resources can be controlled to a certain degree. Consequently, with all the above three points taken together, it is hypothesized that *IOS use helps reduce transaction costs (Hypothesis 1).*

Explicit Coordination and the Impacts of IOS Use

Explicit Coordination: Clemons et al. [9] clearly defined explicit coordination as "the degree to which operational decisions are integrated between economic activities across organizational boundaries". They argued that explicit coordination is quite different from ownership since the purpose of explicit coordination is to increase resource utilization and value. Similarly, Bensaou [5] defined inter-organizational cooperation as "the joint efforts by the buyer and supplier firms to design product and process, coordinate quality and delivery, and train and educate personnel." In this paper, explicit coordination and inter-organizational cooperation are interchangeable. In essence, explicit coordination represents the inter-penetration of firm boundaries to improve business efficiency and effectiveness.

Impacts of IOS Use on Explicit Coordination: With IOS uses, firms can coordinate with each other more easily and frequently across different space and time zones. Quite a few of studies have provided theoretical reasons and empirical evidence to support this argument. Bakos [4] proposed that an information link could improve coordination at the interface between a customer and its suppliers. And he also proposed that an electronic market promotes the match of buyers and suppliers, which implies an improved coordination. Short and Venkatraman [33] highlighted the fact that although initial benefits from IT come from the redesign of business process internal to AHSC and Baxter, the new focus is on how the supplier can manage the materials of hospitals through IOS. Kambil and Short [21] found that the electronic integration significantly increases the roles and linkages of tax preparation industry players. Holland [20] found that IOS use enhances the cooperative relationships in textile industry. Teo et al. [34] found that Trade Development Board of Singapore has taken advantage of the TradeNet opportunity to better coordinate business activities across organizational boundaries. In addition, Vijayasarathy and Robey's [37] empirical finding demonstrated that EDI use improves cooperation between trading partners in the retail industry. Further, Bensaou [5] found that IOS use in supply chains explains a significant portion of the cooperation variance in his Japanese data. Clearly, all these empirical studies point out

that IOS use has positive impacts on explicit coordination. Thus, it is hypothesized that *the more the IOS is used, the more the explicit coordination is among IOS participants (Hypothesis 2)*.

Buyer Benefits and Impacts of Transaction Costs Reduction and Explicit Coordination

Buyer Benefits: Whether an economy is efficient is largely decided by the benefits buyers can obtain in economic transactions and an inefficient system is where the suppliers obtain most of the consumer surplus [12,36]. For example, to measure the success of IS outsourcing, Grover et al. [14] proposed strategic, economic, and technological benefits from the buyer's point of view. By the same logic, if the IOS use enabled e-commerce system is treated as a channel for firms to outsource services and components, then these buyer oriented strategic, economic, and technological benefits from IS outsourcing can be adapted and used to understand benefits from the IOS use enabled e-commerce system. The following paragraph will discuss these buyer benefits.

Strategic benefits are those that have long-term implications for the competitiveness of a firm. These benefits include that: (1) by outsourcing components and services through, a customer firm can focus its limited number of engineers on product/process development activities that can maximally promote its competitiveness; (2) outsourcing allows the customer firm to leverage the competence of one or more specialized component suppliers to enhance its product and process design; and (3) through outsourcing, engineers and staffs can communicate with their counterparts in the provider firm and learn new technologies and administrative systems. Economic benefits include that (1) through outsourcing, a component supplier may be in a position to exploit economies of scale/scope in areas of equipment, facilities, and human resources since it may have many customers; and (2) a customer firm will have more predictable cost structures due to clear descriptions of cost structures in outsourcing contracts. Technological benefits mainly mean that outsourcing may allow a firm to gain immediate access to otherwise unavailable state-of-the-art process and product technologies, which can increase the firm's competitiveness in delivering an improved final product.

Impacts of Transaction Costs Reduction on Buyer Benefits: With the reduced inter-firm transaction costs, it is reasonable to project that both the buyer and the supplier may benefit from the costs reduction and further, the increased buyer/supplier benefits may stimulate both sides in transactions to design even better transactional mechanisms to more deeply cut the inter-firm coordination costs, reduce operations risk, and prevent opportunistic behaviors, which help form a positive feedback loop that will generate higher levels of buyer/supplier benefits. Thus, with the focus on buyer benefits, it is hypothesized that *the higher the impact of IOS use on transaction costs reduction, the higher the buyer benefits (Hypothesis 3)*.

Impacts of Explicit Coordination on Buyer Benefits: The increased explicit coordination among IOS participants will facilitate the continual reallocation of resources to more productive uses and change and reprioritize services that are possible and motivated for each party. Thus, it may stimulate the perception of new combinations of resources to improve the customer-oriented economy [28]. Further, the relational view of the competitive advantage also indicates positive impacts of explicit coordination on buyer benefits [10] and one source of competitive advantage in this view is the substantial knowledge exchanging, which can be clearly facilitated by the IOS enabled explicit coordination.

Empirically, Chatfield and Bjorn-Anderson [6] found that Japan Airline (JAL) used IOSs to collaborate with its supply chain firms to significantly improve its business growth and competitiveness. Thus, it is hypothesized that t*he explicit coordination among related IOS participants is positively and significantly related to buyer benefits (Hypothesis 4)*. The four proposed hypotheses together are summarized in the following research model (Figure 1).

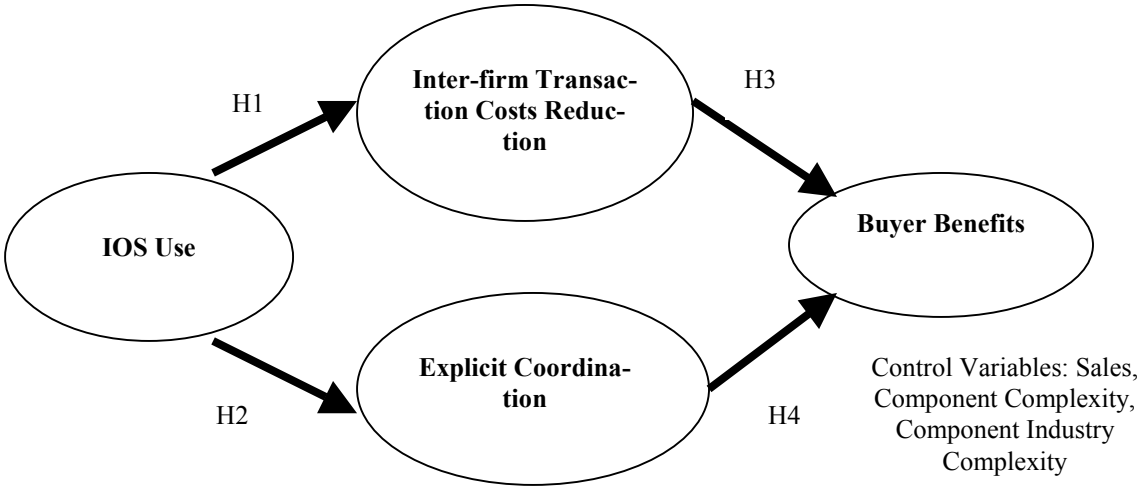

Figure 1: Research Model

Control Variables

In order to better test hypotheses, three variables such as sales, component complexity, and the component industry complexity are used to control the common method variance [22]. First, the sales volume represents the size of a company and it is consistently used as a control variable in many studies. Firms with different sales may have different levels of resources and operate at different power positions. And these different levels of resources and power locations may have implications for IOS use and its impacts. Second, the component complexity is to describe the outsourced component itself and its interfaces with other components in the final product. In the inter-firm component exchanges, the higher the component complexity is, the more the information exchanges are necessary in order for both the supplier and the buyer to deal with the increased level of interdependence. And it is reasonable to believe that the increased amount of information exchanges will motivate more use of IOSs. Third, the component industry complexity represents the number of similar firms competing in the same industry and the number of different models of the same component. The more complexity the component industry is, the more intense the competition is in that industry. The increased competition will surely impact both the explicit coordination and inter-firm transaction costs one way or the other. To better control the impacts of these contextual factors in hypotheses testing, these three factors are incorporated in the model as they are impacting all dependent and independent variables.

RESEARCH METHODOLOGY

Measurement Development

The measurement items of IOS use depth are generated based on Massetti and Zmud [27]; those of volume are adapted from Hart and Saunders [17] and Massetti and Zmud [27]; and those of IOS use diversity are adapted from Bensaou [5].

The breadth dimension is not included. This is because the purpose of the following survey is to focus on the relationship with a major chosen customer/supplier. Respondents are asked to evaluate all the constructs in that particular Inter-organizational relationship (IOR). Clearly, the unit of analysis is a chosen IOR rather than a portfolio of IORs for the responding firm and thus the IOS use breadth dimension is not applicable in the current research.

Items for transaction costs reduction are generated based on Clemons et al. [9] and Gulati and Singh [15]. Items for explicit coordination are adapted from Bensaou [5]. And items for buyer benefits are generated based on Grover et al. [14]. Field interviews were conducted to explore and verify the content domain and test the validity of these items. Two IS directors and one quality director from two auto parts suppliers agreed to have four interviews with the researcher. Each interview lasted around 1 hour to over 2 hours and feedbacks on the measurement items were used to refine and redesign measurement items. Further, a pretest was also implemented to refine measurement items by presenting the questionnaire

to two dissertation-stage Ph. D candidates, two IS professors, and one operation management professor. Literature review, field interviews, and the pretest helped improve the quality of the survey design. Next, a pilot study was implemented.

Pilot Study

Prior to the administration of a large-scale study, a pilot study was carried out to enhance the reliability and validity of measurement items and further refine the research design. 500 names were randomly selected from a name list containing 3925 different IS executives. The criteria for the name list are 1) top computer executives and 2) manufacturing and service companies. Further, those companies must meet at least one (and may not meet all) of the following requirements: 1) there are more than 25 IS employees, or 2) there are more than 300 desktop systems, or 3) those companies belong to Fortune 1000, or Forbes 500, or the InformationWeek 500. Applied Computer Research, Inc provided this name list. Surveys were mailed and phone calls were also made to all the 500 potential respondents. There were 31 responses and 29 of these responses were useful. Corrected item total correlation (CITC) was used to purify the measurement items, and the Cronbach alpha was used to test the reliability of the measurement items. Items were deleted iteratively if their CITC scores are below 0.5. A higher than 0.70 for alpha is also pursued in maintaining or deleting items [30]. After the pilot study, adjustments were made to improve the quality of measurement items. Appendix 2 lists all the items for the following large scale study.

Large Scale Study: Data Collection and Data

The list with 3425 IS executives' names left after the pilot study was used for the large-scale survey study. Two sets of surveys were mailed in US, each having several waves with two or three weeks in between. Three hundred phones calls were also made to remind managers of responding the questionnaire at their earliest convenience. General questions regarding why IS directors and managers did not respond were asked. The typical reasons for no responses were company policy not to answer surveys, retirements, time constraints, quitting jobs, changes of departments, and undeliverable addresses, which were consistent with those found in the pilot study. No statistics were taken in the process. Only different reasons were collected.

There were 82 useful responses from the 1st set of mailings and 123 useful responses from the 2nd set of mailings. Together, there are 205 useful responses and it is also found that there is no response bias by comparing the size and sales between the first set and second set respondents [2,23]. In the meantime, there are 198 returned without responses due to various reasons as mentioned earlier. Thus, the response rate is 205/(3425-198)=6.35%. Further, 23 of the 205 data points have missing values for constructs used in this current paper, thus only 182 data points from the data set will be used for analysis in this paper and the effective response rate is 182/(3425-198-23)=5.7%. While this is a relative low response rate and thus a limitation of this study, there are enough responses for statistical analysis. For example, Sethi and King [32] used 185 sample points to develop the extent to which IT applications provide competitive advantage using the structural equation modeling technique.

Table 1 shows the characteristics of the study sample. 65.9 percent of responding firms are from the manufacturing sector and 18.1 percent from service industries. As to firm size, 23.1 percent of responding firms have 1000 to 2499 employees and 35.2 percent have over 2500 employees. Sales for 82.4 percent of responding firms are larger than $100 million.

Clearly, large size and manufacturing firms are more likely to respond to this survey. As to respondents, 20.9 percent of them are CIOs, 34.1 percent are IS Directors, 22.5 percent are IS Managers, 11 percent are Vice Presidents, and the rest 11.5 percent of respondents did not specify their positions. Thus, respondents are most likely to be aware of or be directly involved in the management of IOS use.

Further, 39 percent of the respondents answered the survey questions based on IOS use in their customer relationships; 13.7 percent of the respondents answered questions based on IOS use in supplier relationships; and the rest did not specify relationships on which their responses were based. 22 percent of the responding firms are using an electronic market with many suppliers and many buyers in the market; 45.6 percent of the responding firms are using one-to-one IOS connections; 11 percent are using a system with one buyer and many suppliers; 8.2 percent are using a system with one supplier and many buyers; and the rest 13.2 percent did not specify the type of systems they are using. This variety of inter-organizational electronic systems and the inclusion of both customer and supplier relationships in the data set provide a good foundation to generalize findings from the following empirical tests.

Table 1: Characteristics of the Study Sample

Industry	Frequency	Percentage
Manufacturing	120	65.9%
Services	33	18.1%
Others (e.g., transportation) and unspecified	29	15.9%
Total	**182**	**100%**
Number of Employees	**Frequency**	**Percentage**
Less Than 100	10	5.5%
100-249	12	6.6%
250 to 499	19	10.4%
500 to 999	32	17.6%
1000 to 2499	42	23.1%
Over 2500	64	35.2%
Unspecified	3	1.6%
Total	**182**	**100%**
Annual Sales ($)	**Frequency**	**Percentage**
Less than 10 million and unspecified	10	5.4%
10 to 49.9 million	9	4.9%
50 to 99.9 million	13	7.1%
100 to 499.9 million	44	24.2%
500 to 1 billion	41	22.5%
Over 1 Billion	65	35.7%
Total	**182**	**100%**
Respondent Position	**Frequency**	**Percentage**
CIO	38	20.9%
IS Director	62	34.1%
Vice President	20	11.0%
IS Manager	41	22.5%
Unspecified	21	11.5%
Total	**182**	**100%**
Relationship Focus	**Frequency**	**Percentage**
Customer Relationship Management	71	39.0%
Supplier Relationship Management	25	13.7%
Unspecified	86	47.3%
Total	**182**	**100%**
Type of IOS	**Frequency**	**Percentage**
An electronic market with many suppliers and many buyers in the system	40	22.0%
One to one connection between the buyer and the supplier	83	45.6%
One buyer and many suppliers	20	11.0%
One supplier and many buyers	15	8.2%
Unspecified	24	13.2%
Total	**182**	**100%**

Data Analysis

Data Analysis Methods: Instruments are to be developed first and then hypotheses will be tested. First, Exploratory Factor Analysis (EFA) is applied to verify the convergent and discriminant validities of the construct measurement. Cronbach's Alpha is calculated for control variables to verify reliability. Second, hypotheses are tested using the structural equation modeling technique.

Scale Development: Factor analyses are performed for IOS use dimensions, inter-firm transaction costs reduction, explicit coordination, and buyer benefits using the SPSS package. Varimax rotation is also applied and detailed results are shown in Appendix 1. All the factor loadings are greater than 0.4 with big enough KMOs, which verify the necessary discriminant and convergent validities for all derived dimensions. Further, control variables such as component complexity and component industry complexity are found to have good alpha values (i.e., >=0.7) [29] as indicated in the Appendix 1.

Note: Factor loadings above 0.40 are significant with a sample size around 200 [16, p385]. The Kaiser-Meyer-Olkin (KMO) measures whether the effective sample size is adequate for the current factor analysis. Generally, a KMO score in the 0.90's is considered outstanding, the 0.80's as very good, the 0.70's as average, 0.60's as tolerable, 0.50's as miserable, and below 0.50 as unacceptable [16].

Structural Model Testing: To test hypotheses in Figure 1, the LISREL package is used to perform structural equation modeling tests. The results are displayed in Figure 2, which shows that the model has reasonable fit indices (RMR=0.076, RMSEA=0.060, NNFI=0.94, CFI=0.95, Chi-Square/Df =1058.47/640=1.65), all λ values are significant at 0.05 level and all the β values from the second order factors to their respective first order factors are significant at the 0.05 level. It is also found that H1, H2, and H3 are supported at the 0.01 level and H4 is not supported.

DISCUSSIONS, LIMITATIONS, AND FUTURE STUDIES

Empirical findings demonstrate that on average, firms have realized the two proposed impacts of the IOS enabled B2B e-commerce systems (i.e., the reduced transaction costs and the improved explicit coordination) and it seems that no single impact is more dominant than the other (i.e., both H1 and H2 are supported at the 0.01 level as indicated in Figure 2). Further, it is found that buyers do benefit from the IOS use enabled transaction costs reduction (i.e., H3 is supported at the 0.01 level as indicated in Figure 2). However, on average, buyers have not benefited significantly from the IOS use enabled explicit coordination improvement (i.e., H4 is not supported as indicated in Figure 2).

One explanation for buyers not being able to benefit from the IOS use enabled explicit coordination may be that the idea of competition is still dominating the mindset of many managers. Thus, the potential increased explicit coordination enabled by IOS use can not be easily realized to improve buyer benefits due to conflicts and confrontations in the supply chain, which are originated from the intense use of competition in managing value chain relationships. Consequently, in practice, managers should be repeatedly reminded that they should embrace an economy of a mixed mode of both market competition and hierarchy-like collaboration and that the economy is becoming even more so with the dramatic advancement of Internet technologies since 1990s [18,19]

Another explanation can be that even though managers may have already recognized the necessity of coordinating with customers, suppliers, and other stakeholders through IOS uses, it may still take quite a lot of time and efforts for both IOS initiators and adopters to adapt to the IOS use enabled explicit coordination. And only after both the buyers and suppliers have adapted their

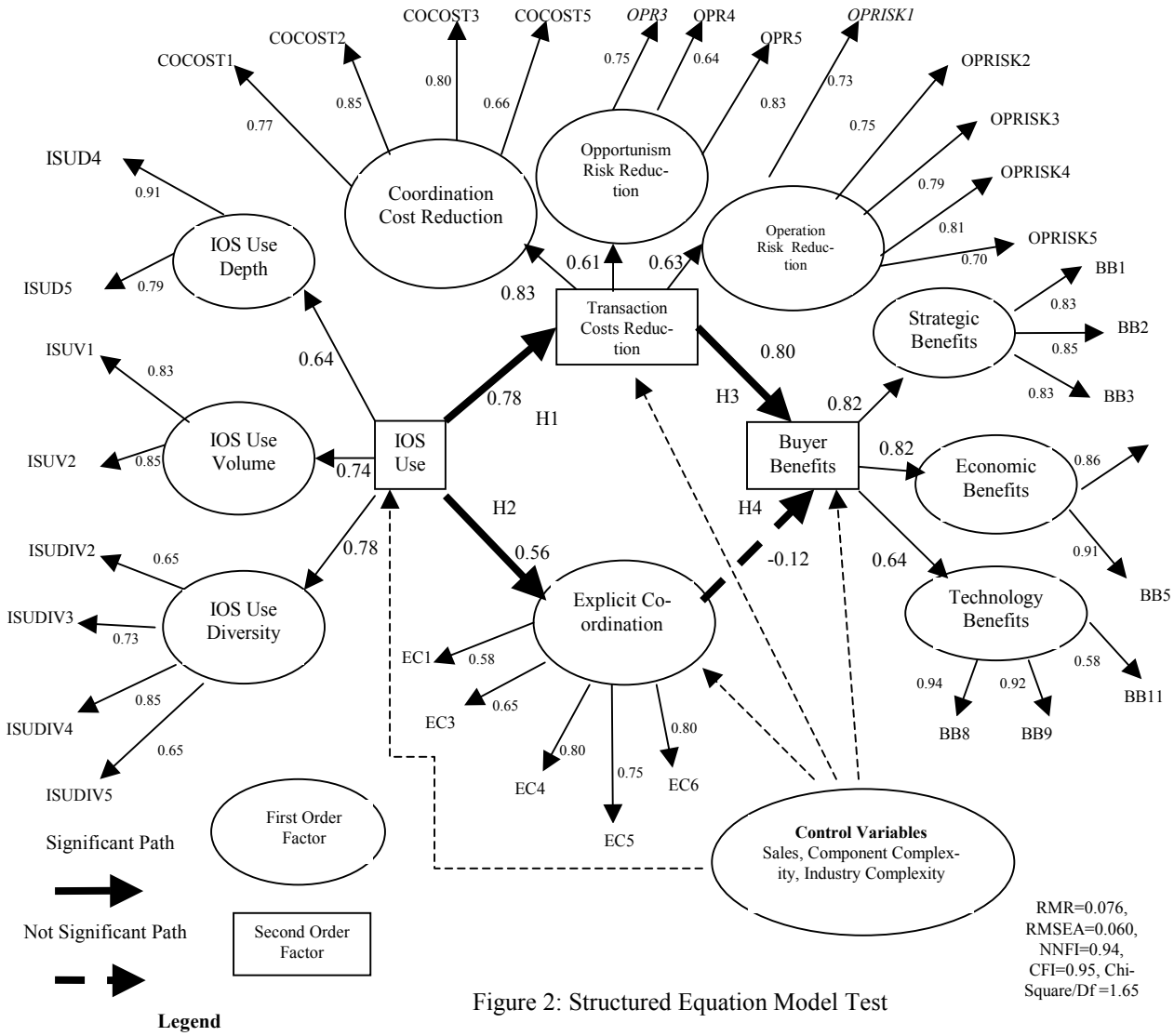

Figure 2: Structured Equation Model Test

systems, procedures, and people to the IOSs, can the real business benefits be generated. This explanation is indeed consistent with the interdependent nature of the IOS use payoff structure proposed in Chatfield and Yetton [7], which indicates that the payoff from IOS use depends on the simultaneous use of IOSs by both the initiators and adopters.

As to limitations, first, the sample characteristics in this study may limit the generalization of the findings to other situations and future studies can be more industry specific, focus on small and mid size companies, and use longitudinal data to produce more fine-grained findings regarding the role of transaction costs reduction and in particular, the role of explicit coordination in mediating the impacts of IOS use on buyer benefits. The second limitation is the low response rate. Future studies may obtain the sponsorship from an industry association and it is hoped that there may be more responses and consequently, an increased response rate may be achieved, which will help generalize findings. Third, this paper does not include supplier benefits. Future studies can simultaneously incorporate both the buyer and supplier benefits into model tests and it may be found that there is an unbalanced appropriation of IOS use benefits between buyers and suppliers and factors for the unbalanced appropriation should be explored further.

In conclusion, this paper developed instruments for the constructs in the research model. In particular, the transaction costs reduction scale is developed to incorporate coordination costs, operations risk, and opportunism risk, which is, to my knowledge, among the earliest attempts to develop a comprehensive transaction costs reduction scale in literature. Further, the findings that the transaction costs reduction is significantly mediating the impacts of IOS use on buyer benefits and the explicit coordination is not significantly mediating the impacts provide additional evidence to the existing studies of IOS use impacts and these findings can be used to remind managers of the missing link in their management of value chain relationships. It is believed that this paper, as a part of accumulative research efforts, contributes to the empirical testing of theoretical models that can guide future studies and practices.

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REFERENCES

[1] Angeles, R. and R. Nath, "An Empirical Study of EDI Trading Partner Selection Criteria in Customer-Supplier Relationships," *Information & Management,* 37, (2000), 241-255.

[2] Armstrong, J. S. & Overton, T. S. (1977). Estimating non-response bias in mail surveys. *Journal of Marketing Research.* 4(August) 396-402.

[3] Bakos, J. Y, "A Strategic Analysis of Electronic Marketplaces," *MIS Quarterly*, September (1991b), 295-310.

[4] Bakos, J. Y, "Information Links and Electronic Marketplaces: The Role of Interorganizational Information Systems in Vertical Markets," *Journal of Management Information Systems*, 8, 2 (Fall 1991a), 31-52.

[5] Bensaou, M., "Inter-organizational Cooperation: The Role of The Information Technology An Empirical Comparison of US and Japanese Supplier Relations," *Information Systems Research*, 8, 2, June (1997).

[6] Chatfield, A. T. and N. Bjorn-Andersen, "The Impact of IOS Enabled Business Process Change on Business Outcomes: Transformation of the Value Chain of Japan Airlines," *Journal of Management Information Systems,* 14, 1, (Summer 1997), 13-40.

[7] Chatfield, A. T. and P. Yetton, "Strategic Payoff from EDI as a Function of EDI Embeddedness," *Journal of Management Information Systems*, 16, 4, (Spring 2000), 195-224.

[8] Clemons, E. and M. Row, "Information technology and Industrial Cooperation: The Changing Economics of Coordination and Ownership," *Journal of Management Information Systems*, 9, 2, (Fall 1992), 9-28.

[9] Clemons, E. K., S. P. Reddi, and M. C. Row, "The Impact of Information Technology on the Organizational of Economic Activity: The 'Move to the Middle' Hypothesis," *Journal of Management Information Systems,* 10, 2, (Fall 1993), 9-35.

[10] Dyer, J. H. and H. Singh, "The Relational View: Cooperative Strategy and Sources of Interorganizational Competitive Advantage," *Academy of Management Review*, 23, 4, (1998), 660-679.

[11] Galbraith, J. R., *Organization Design*, Reading, MA, Addision-Wesley, (1985).

[12] Grover, V. and P. Ramanlal, "Six Myths of Information and Markets: Information Technology Networks, Electronic Commerce, and the Battle

for Consumer Surplus," *MIS Quarterly*, 23, 4, December (1999), 465-494.

[13] Grover, V., J. T. C. Teng, and K. D. Fiedler, "Investing the Role of Information Technology in Building Buyer-Supplier Relationships." *Journal of the Association for Information Systems.* 3, 2002, pp. 217-245.

[14] Grover, V., M. J. Cheon, and J. T. C. Teng, "The Effect of Service Quality and Partnership on the Outsourcing of Information Systems Functions," *Journal of Management Information Systems,* 12, 4, (Spring 1996), 89-116.

[15] Gulati, R. and H. Singh, "The Architecture of Cooperation: Managing Coordination Costs and Appropriation Concerns in Strategic Alliances," *Administrative Science Quarterly*, 43, (1998), 781-814.

[16] Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C., (1992). *Multivariate Data Analysis with Readings,* Third Edition, Macmillan Publishing Company, New York, NY.

[17] Hart, P. J. and C. S. Saunders, "Emerging Electronic Partnerships: Antecedents and Dimensions of EDI Use from the Supplier's Perspective," *Journal of Management Information Systems*, 14, 4, (Spring 1998), 87-111.

[18] Hennart, J. F. (1993), "Exploring the Swollen Middle: Why Most Transactions are a Mix of Market and Hierarchy," *Organization Science,* 4, 4, 529-547.

[19] Holland, C. P. and A. G. Lockett (1997), "Mixed Mode Network Structures: The Strategic Use of Electronic Communication by Organizations." *Organization Science,* 8, 5, September-October.

[20] Holland, C. P., "Cooperative Supply Chain Management: the Impact of Inter-organizational Information Systems," *Journal of Strategic Information Systems*, 4, 2, (1995), 117-133.

[21] Kambil, A. and J. E. Short, "Electronic Integration and Business Network Redesign: A Roles-Linkage Perspective," *Journal of Management Information Systems*, 10, 4, (Spring 1994), 59-83.

[22] Kline, T. J. B., L. M. Sulsky, and S. D. Rever-Moriyama, "Common Method Variance and Specification Errors: A Practical Approach to Detection." *The Journal of Psychology*, 2000, 134(4), 401-421.

[23] Lambert, D., & Harrington T. (1990). Measuring non-response bias in mail surveys. *Journal of Business Logistics.* 11(2) 5-25

[24] Lorin M. Hitt, Erik Brynjolfsson, "Productivity, Business Profitability, and Consumer Surplus: Three Different Measures of Information Technology Value" *MIS Quarterly*, Volume 20 Number 2 - June 1996.

[25] Malone, T. W. and J. F. Rockart (1992), "Information Technology and the New Organization," in J. F. Nunamaker and R. H. Sprague (Eds.), *Proceedings of the Hawaii International Conference on System Sciences,* IV, 636-643.

[26] Malone, T. W., J. Yates, and R. I. Benjamin, "Electronic Markets and Electronic Hierarchies," *Communications of the ACM*, 30, 6, June (1987), 484-497.

[27] Massetti, B. and R. W. Zmud, "Measuring the Extent of EDI Usage in Complex Organizations: Strategies and Illustrative Examples," *MIS Quarterly,* September (1996).

[28] Moran, P. and S. Ghoshal, "Markets, Firms, and the Process of Economic Development," *Academy of Management Review*, 24, 3, (1999), 390-412.

[29] Mukhopadhyay, T. and S. Kekre, "Strategic and Operational Benefits of Electronic Integration in B2B Procurement Processes." *Management Science*, 2002, 48, N. 10, 1301-1313.

[30] Nunnally, J. C. *Psychometric Theory*, McGraw Hill, New York, (1978).

[31] Premkumar, G., Ramamurthy, K., & Nilakanta, S., (Fall 1994) Implementation of Electronic Data Interchange: An innovation Diffusion Perspective, *Journal of Management Information Systems*, 11, 2, pp. 157-186.

[32] Sethi, V., & King, W. R. (1994). Development of measures to assess the extent to which an information technology application provides competitive advantage. *Management Science.* 40(12) 1601-1627.

[33] Short, J. E. and N. Venkatraman, "Beyond Business Process redesign: Redefining Baxer's Business Network," *Sloan Management Review*, Fall, (1992), 7-21.

[34] Teo, H., B. C. Y. Tan, and K. Wei, "Organizational Transformation Using Electronic Data Interchange: The Case of TradeNet in Singapore," *Journal of Management Information Systems*, 13, 4, (Spring 1997), 139-165.

[35] Truman, G. E., "Integration in Electronic Exchange Environments," *Journal of Management Information Systems*, 17,1 (Summer 2000), 209-244.

[36] Varian, H. *Microeconomic Analysis,* Norton, New York, 1984.
[37] Vijayasarthy, L. R. and D. Robey, "The Effect of EDI on Market Channel Relationships in Retailing," *Information & Management,* 33, (1997), 73-86.
[38] Williamson, O. E., *The Economic Institutions of Capitalism*, Free Press, New York, (1985).
[39] Zhu, K., K. L. Kraemer, V. Gurbaxani, and S. X. Xu, "Migration to Open-Standard Interorganizational Systems: Network Effects, Switching Costs, and Path Dependency." *MIS Quarterly*, 30, Special Issue, pp. 515-539, August 2006.
[40] Zuboff, S. *In the Age of the Smart Machine: The Future of Work and Power*, Basic Books, New York, (1984).

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APPENDIX 1: SCALE DEVELOPMENT

Factor Analysis: IOS Use KMO=0.768

Items	IOS Use Diversity	IOS Use Volume	IOS Use Depth
ISUD4	0.27	0.20	**0.85**
ISUD5	0.12	0.22	**0.90**
ISUV1	0.21	**0.86**	0.21
ISUV2	0.18	**0.88**	0.21
ISUDIV2	**0.73**	0.06	0.25
ISUDIV3	**0.82**	0.09	0.14
ISUDIV4	**0.82**	0.21	0.18
ISUDIV5	**0.68**	0.30	0.01
Eigen Values	2.50	1.75	1.74
Variance%	31.30	21.89	21.77
Cumulative%	31.30	53.18	74.96

Note: ISUDIV1, 6 are deleted due to cross loadings. ISUD1, 2, 3 are deleted due to their content being not measuring IOS use volume while they are highly loaded with the IOS use volume construct. The factor analysis specified 3 factors based on the conceptual model. All the factor loadings are greater than 0.4 and KMO is 0.768, which demonstrate the necessary discriminant and convergent validities for all derived dimensions. (Similar logic can be applied for other constructs in the following factor analysis.)

Factor Analysis: Transaction Costs Reduction KMO=0.829

Items	Operation Risk	Coordination Costs	Opportunism Risk
COCOST1	0.18	**0.83**	0.00
COCOST2	0.18	**0.86**	0.11
COCOST3	0.21	**0.82**	0.12
COCOST5	0.15	**0.68**	0.28
OPRISK1	**0.82**	0.21	-0.04
OPRISK2	**0.80**	0.19	0.14
OPRISK3	**0.74**	0.26	0.18
OPRISK4	**0.78**	0.18	0.22
OPRISK5	**0.73**	0.03	0.36
OPR3	0.16	0.18	**0.79**
OPR4	0.16	0.00	**0.80**
OPR5	0.17	0.22	**0.82**
Eigen Values	3.21	2.83	2.25
Variance%	26.78	23.55	18.77
Cumulative%	26.78	50.33	69.11

Note: COCOST4, OPR1, and OPR2 are deleted due to cross loadings.

Factor Analysis: Buyer Benefits and Explicit Coordination KMO 0.825

Items	Explicit Coordina-tion	Strategic Buyer Benefits	Techno-logical Buyer Benefits	Economic Buyer Benefits
BB1	0.14	**0.84**	0.15	0.20
BB2	0.14	**0.83**	0.20	0.20
BB3	0.11	**0.82**	0.23	0.24
BB4	-0.01	0.34	0.24	**0.82**
BB5	0.05	0.38	0.30	**0.77**
BB8	0.15	0.20	**0.91**	0.11
BB9	0.14	0.14	**0.88**	0.23
BB11	0.21	0.35	**0.58**	0.15
EC1	**0.67**	0.07	-0.12	0.43
EC3	**0.66**	0.19	0.26	-0.02
EC4	**0.83**	0.19	0.05	-0.01
EC5	**0.80**	0.16	0.15	-0.17
EC6	**0.83**	-0.10	0.22	0.17
Eigen Values	3.05	2.62	2.37	1.73
Variance%	23.48	20.16	18.21	13.32
Cumulative%	23.48	43.64	61.84	75.16

Note: BB6, BB7, BB10, and EC2 are deleted due to cross loadings.

Reliability Analysis for Control Variables

Variables	Items	Reliability (Cronbach's Alpha)
Component Complexity	CC1	**0.8**
	CC2	
Industry Complexity	CIC1	**0.7**
	CIC2	
Sales	SALES	**N/A**

Note: Both component complexity and industry complexity have reasonable reliability indices.

APPENDIX 2: MEASUREMENT ITEMS

All items have a scale from 1 to 7 with 1 meaning strongly disagree, 4 meaning neutral, and 7 meaning strongly agree.

IOS Use Depth	
ISUD1	Your IS applications transfer files to your partner's application automatically (Deleted)
ISUD2	Your partner's IS applications transfer files to your IS applications automatically (Deleted)
ISUD3	Your IS applications and your partner's applications can communicate with each other automatically. (Deleted)
ISUD4	Your IS applications can directly access the data base in your partner's computer systems
ISUD5	Your partner's IS applications can directly access the data base in your computer systems
IOS Use Diversity	
ISUDIV1	Purchasing personnel exchange data in electronic form with the partner (Deleted)
ISUDIV2	Engineering personnel exchange data in electronic form with the partner
ISUDIV3	Quality personnel exchange data in electronic form with the partner
ISUDIV4	Production control personnel exchange data in electronic form with the partner
ISUDIV5	Transportation personnel exchange data in electronic form with the partner
ISUDIV6	Payment personnel exchange data in electronic form with the partner (Deleted)
IOS Use Volume	
ISUV1	A high percentage of the total transactions with the partner is conducted through the IS
ISUV2	A large number of documents associated with the partner are exchanged through the IS

Coordination Costs	
COCOST1	The cost of exchanging product information (price, product characteristics, availability, and demand) with your partner has become low through IS use
COCOST2	The cost of incorporating exchanged information into the decision process has become low through IS use
COCOST3	The cost incurred due to delays in the communication channel with the partner has become low through IS use
COCOST4	The cost to share design changes quickly with the partner has become low through IS use (Deleted)
COCOST5	The cost to inform and to be informed of changes in delivery schedules of the component has become low through IS use

Operation Risks	
OPRISK1	It is less likely for any side in the relationship to deliberately misrepresent information through IS use
OPRISK2	It is less likely for any side in the relationship to withhold important information through IS use
OPRISK3	It is less likely to have inconsistent information in the relationship through IS use
OPRISK4	It is less likely to have incompatible information in the relationship through IS use
OPRISK5	It is less likely for any side in the relationship to under-perform its agreed-upon responsibilities (e.g., inferior component quality) through IS use
Opportunism Risks	
OPR1	Tacit engineering knowledge can be easily transferred to the other side opportunistically through IS use in the relationship (Deleted)
OPR2	Production skills can be easily transferred to the other side opportunistically through IS use in the relationship (Deleted)
OPR3	Opportunistic behavior is reduced because of less relationship specific investments by both sides through IS use
OPR4	Having small number of partners does not increase opportunistic behavior through IS use
OPR5	Opportunistic behavior is reduced because of the monitoring effect of the IS use in the relationship
Explicit Coordination	
EC1	Your business unit's operational decisions are highly integrated with those of your partner
EC2	There are coordinating processes that are specific to the relationship (Deleted)
EC3	There is joint effort and cooperation between your business unit and your partner in technical assistance.
EC4	There is joint effort and cooperation between your business unit and your partner in product planning
EC5	There is joint effort and cooperation between your business unit and your partner in product engineering
EC6	There is joint effort and cooperation between the business unit and your partner in process engineering
Buyer Benefits	
	Strategic Buyer Benefits
BB1	The buyer has been able to refocus on core business.
BB2	The buyer has enhanced the final product competitiveness.
BB3	The buyer has increased access to skilled personnel from the partner
	Economic Buyer Benefits
BB4	The buyer benefits from the economies of scale of the human resources of the partner
BB5	The buyer benefits from the economies of scale of the technology resources of the partner
BB6	The buyer has increased control of the component design costs (Deleted)
BB7	The buyer has increased control of the production costs (Deleted)
	Technological Benefits
BB8	The buyer has reduced the risk of product technology obsolescence
BB9	The buyer has reduced the risk of process technology obsolescence
BB10	The buyer has increased access to key process technologies (Deleted)
BB11	The buyer has increased access to key product technologies

Control Variables	
	Component Complexity
CC1	The component itself is complex
CC2	The component has to meet many criteria to fit into the final product
	Component Industry Complexity
CIC1	In the component industry, there are many similar firms
CIC2	There are a diversity of models in the industry for the component
Sales: The average annual sales $ (in millions) for your business unit. ( ) Less than 10 ( ) 10 - 49.9 ( ) 50 - 99.9 ( ) 100 - 499.9 ( ) 500 - 1 billion ( )Over 1 billion	