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The Influence of Supply Chain Relationships on The Adoption of Open Standards Inter-Organizational Information Systems: A Conceptual Framework

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Abstract

This study provides a conceptual framework to analyze where the formal and informal inter-organizational interactions influence the adoption decisions of open standards inter-organizational information systems (IOIS). Based on the Internet, open standards IOIS can help companies access to broader markets and make interfirm collaboration much easier and cheaper.In spite of these benefits, open standards IOIS have not been widely adopted by companies for external connection, which leads to questions about the importance of higher openness for inter-organizational systems. We argue that the characteristics of supply chain networks are fundamental for companies' choices of IOIS. The levels of linkages and interdependence between companies will affect how companies respond to external influences as well as heat demand for broader connection or tighter integration. Personal guanxi, the informal connections between individuals, also play an important part in companies' adoption decisions, especially in Asian countries where guanxi is prevalent business culture. Combining the different theoretical perspectives, we propose a conceptual framework and several integrative propositions for the analysis of the adoption decisions of open standards IOIS in the inter-organizational context.

Keywords: Supply Chain Relationship; Inter-Organizational Information System; Open Standards; Guanxi; IOIS;

1. Introduction

Since the 1990s, the advancement in Internet and web technologies has brought alternative inter-organizational information system (IOIS) solutions for companies to manage supply chain relationships. With the emergence of Internet-based open information standards such as XML and web services, there have been a tendency for industrial practitioners to migrate from proprietary and EDI-based IOIS to open standards IOIS [44]. Many industries have put great efforts in establishing and spreading industry-specific XML-based information standards such as the RosettaNet in the semiconductor industry, ACORD in the insurance industry and HL7 in the healthcare industry. Apart from vertical standards, horizontal standards have been developed with the intention to support cross-industry collaboration, such as ebXML published by OASIS [43]. Compared with traditional EDI systems that based on proprietary valued add networks (VANs), open standards IOIS exchange data via the public Internet platform, which provides higher degrees of system openness and thus can facilitate broader interfirm coordination [17, 44]. In addition, while EDI only supports one-to-one information sharing and batch document exchange, open standards permits the sharing of intensive real-time data among different trading partners, which allows for more efficient supply chain collaboration practices such as just-in- time manufacturing and collaborative forecasting [6, 17]. Furthermore, the implementation of open standards IOIS needs lower installation and operation costs [25], lower technical complexity and less customization [44], which can promote more extensive industrial adoption that helps large companies integrate their small and medium sized (SME) supply chain members [7, 28].

In spite of the perceived business potential of open standards, the number of companies that have implemented open standards IOIS for inter-organizational communication has been less than expected. Many industrial open standards

initiatives have encountered great difficulties in the standards establishing and spreading processes [37]. Additionally, as open standards IOIS can sufficiently reduce the costs of partner searching and connection, it is expected that companies will electronically connect with more supply chain members [9]. However, it is surprising to find that even in the financial industry where XML has been widely accepted, XML is primarily used for internal application integration instead of external communication with other organizations [16]. for tightly coupling with only a few long-term business partners rather than with many partners [2, 19]. These facts raise questions about the importance of openness for inter-organizational communication technologies. While the technologies are open, the inter-organizational relationships are in various forms that some companies may prefer in a small network that is closely collaborated. Inter-organizational relationships will greatly affect adoption decisions by firms [5, 7, 39]. In addition, the adoption of open standards requires the collaboration and mutual information sharing among different parties. The hybrid and complex forms of inter-organizational interactions and interdependence will influence the complexity of open standards IOIS adoption. Therefore, it is important to develop an integrated framework incorporating inter-organizational relationships for the analysis of open IOIS adoption.

This study is organized as follows: First, the characteristics of different supply chain relationships and their effects on companies' choices of electronic connections will be discussed. In the following section different theoretical perspectives and propositions along with an integrated conceptual framework will be presented. Finally, conclusions and implications for future research will be made in the last section.

2. Supply Chain Relationships

The interactions in supply chain networks can be classified based on two fundamental aspects. The first aspect is the level of operational linkages in a dyadic relationship. Supply chain relationships can range from very short-term arm's length relationship to a closely coordinated relationship that requires dedicated investments [11]. In arm's length relationships, trading partners normally conduct transactions for only a few times, and the relationship will end once the transactions stop [22]. In collaborative relationships, the business partners will make relationship-specific investments, adapt operational processes and share product information jointly [11]. Different levels of electronic integration will be established based on the degree of collaboration. Collaborative business partners can choose different levels of electronic integration, from electronically coordinating only a few selected business activities and functions or integrating multiple divisions and functions, to closely coordinating business processes [33].

Another aspect that differentiates supply chain relationships is the buyer/supplier dominance level. A buyer/supplier is in a dominant position when there are a few buyers/suppliers in the market, when the buyer/supplier occupies a large share of their partners' total market and revenue, or when the switching costs are high for the trading partners of the buyer/supplier. If both sides of partners are not dominant, the dyadic relationship is referred to as independent. If both sides of the business partners are in dominant positions,their relationship is interdependent[12]. The level of dominance will affect the level of value appropriation in transactions. When one side of the relationship is dominant, the dominant side will be adversarial and appropriate most of the value from the transactions. When the relationships are independent or interdependent, the business partners will be reciprocal and business value will be equally shared [13]. Therefore, the dominance levels in a certain supply chain will influence the benefits allocation that different parties will gain from adopting open standards IOIS. For dominant companies, they would have more incentives to adopt open standards IOIS as they can appropriate more value from connecting with other partners.

Combining the two aspects, supply chain relationships can be classified into four categories that are buyer/supplier dominant arm's length relationship, buyer/supplier dominant collaborative relationship, independent reciprocal arm's length relationship, and interdependent reciprocal collaborative relationship[11]. Different Supply chain relationships are the fundamental factors in firm's decision to adopt open standards IOIS. Companies Preference for openness depends on the number of partners they have and the levels of collaboration with the partners. In addition, the relationship with the partners will also affect how companies respond to the external influence and other inter-organizational factors. The interactive effects will consequently lead to different adoption decisions.

3. Theoretical Perspectives and Conceptual Framework

3.1. Institutional Theory

Institutional theory offers a useful theoretical view to study innovation diffusion. According to institutional theory, organizational behaviours are influenced by the isomorphic pressures that are embedded in the institutional environment [14]. Organizations respond to these pressures in order to be legitimated in the market. Three types of institutional pressures have been identified, which are coercive, normative and mimetic pressures. Coercive pressures mostly come from other organizations such as the supplier, customers and government. Normative pressures stem from professionalization and shared norms. Mimetic pressures are when organizations imitate the practice and strategies of successful competitors [14].

Many studies have investigated how institutional pressures influence organizations' intention to adopt IOIS technologies. According to Teo et al. [35], normative pressures demonstrate the strongest positive influence on firms' intention to adopt Financial EDI (FEDI) while the positive effects of coercive pressures and mimetic pressures on adoption intention are less significant. Similarly, the study of Liu et al. [23] on Internet-enabled Supply Chain Management systems (eSCM) reveals the strong positive relationships that normative pressures and coercive pressures have with the adoption intention of eSCM. However, the effects of mimetic pressures are shown to be not significant, which is not consistent with the results of Teo et al. [35].

Bala and Venkateshc[3] study the power of institutional forces at different stages of the assimilation of RosettaNet in the high-tech industry. It is identified that normative pressures are important factors that lead to the adoption and general deployment in the dominant firms. For the non-dominant firms, all three types of pressures are equally important for the adoption and greater deployment of RosettaNet .Zhang and Dhaliwal [42] reveal that partner dependence (coercive pressures) and IT usage intensity (normative pressures) provides strong positive incentives for the diffusion of inter-organizational supply chain management technologies in Chinese companies. However, the effects of competition intensity (mimetic pressures) are found to be not significant on technology diffusion.

All the studies that have been discussed above suggest a positive relationship between normative pressures and IOIS adoption by firms. For firms in dominant positions, they may perceive more normative pressures from the expectation of other supply chain members because they occupy more market share and resources[3]. Therefore, this study posits that:

H1a: normative pressures have positive effects on firm's decision to adopt open standard IOIS.

H1b: normative pressures have greater effects on dominant firm's decision to adopt open standard IOIS.

Although most researches show positive effects of coercive pressures on IOIS adoption, Son and Benbasat [34] find that that the effects of coercive pressures on the intention to adopt B2B to be not significant, which is inconsistent with the results of the previous studies.The Inconsistency is explained to be induced by the different functions of the IOIS technologies. While EDI is mainly utilized to integrate existing business partners, B2B is primarily used as a tool to search for new partners. Therefore, coercive pressures have a powerful influence on the adoption intention of IOIS technologies that is used to manage existing business relationships. Therefore, coercive pressures will affect non-dominant firms in collaborative relationships to adopt open standards IOIS in the need to manage relationships with the dominant suppliers/ buyers. For firms with arm's length relationships, coercive pressures would not have significant effects as these firms mostly utilizeIOIS for searching and connecting with new partners. Based on these discussions, this study thus makes the following proposition:

H2: coercive pressures positively influence non-dominant firms with collaborative relationships adopt open standard IOIS.

The empirical results for the influence of mimetic pressures are mixed. The inconsistencies in different findings can be explained by the uncertainty theories that have been cited in Teo et al. [35]which posit that when higher complexities are involved in a technology and the potential users are not capable to understand the possible outcomes of adoption, they tend to refer to the practices of the existing users to reduce the costs and risks of implementation

[14, 18].Although open standards IOIS are less technically complex and cheaper comparing with traditional EDI based-IOIS, many SEMs still lack technical expertise for successful implementation [21]. Therefore, mimetic pressures are supposed to be positively related to open standards IOIS adoption decisions for non-dominant firms with limited technical resources and expertise. The following proposition is thus proposed:

H3: normative pressures have positive effects on non-dominant firm's decision to adopt open standard IOIS.

3.2. Units

Inter-organizational standards are crucial for the technical interoperability of IOIS. The economic consequences of symmetric interoperability were first identified by the study of Rohlfs [31], according to which the increasing the amount of users of a certain standard would lead to the increase of the utility of other users of these standards. This economic effect is now referred to as the direct network effect. The effect of asymmetric interoperability was later revealed by the study Katz and Shapiro [20], according to which the standards with the largest number of participants prone to attract more complementary products which in turn make this standard more attractive to other users. This positive feedback loop will result in "demand side economies of scale", which brings indirect network effect. Network effects are similar to institutional forces in a way that they both stem from external organizations such as suppliers, customers and peer companies. However, while institutional forces are when organizations are compelled by the external pressures to make organizational changes for market survival, network effects are when organizations actively seek economic rents from connecting with more business partners.

It is suggested that due to the ability to search and connect to new business partners, open standards IOIS is able to offer stronger network effects than EDI that only supports transactions with a limited number of existing trading partners [38, 44]. Based on the types inter-organizational relationships that open standards IOIS support, Zhu et al. [44]classify network externalities associated with open standards IOIS adoption into two categories. The extent to which the partners in the vertical supply chain support IOIS is defined as trading community influence, which mostly comes from customers and suppliers. In addition, open standards IOIS adoption level of the horizontal peer companies in the same industry is named as peer adoption. It is found that both trading community influence and peer adoption are significant drivers of the decisions of companies to migrate from traditional IOIS to open standardsIOIS[44]. With access to larger trading communities,companies can improve their knowledge of the market and havemore sourcing and selling choices [1, 8, 32]. Network Effects are especially important for companies with arm's length relationship with their partners as greater network effects will lead to greater business opportunities. Therefore, the following propositions are made:

H4a: networkbenefits have positive effects on firm's decision to adopt open standard IOIS.

H4b: network benefits have greater effects on the open standards IOIS adoption decisions for firms with arm's length relationships.

To test network effects, the constructs used to collect respondent data should be carefully designed to eliminate any ambiguity and bias. In Zhu et al. [44], the questionnaire questions that are used to collect information of how the respondents appraise trading community influence and peer adoption in their decision to adopt open standards IOIS are to some extent poorly structured that cannot manifest true valuation of network benefits by the respondents. For example, the respondents were asked to give weight on "the degree that Internet usage has been promoted by support from suppliers" to show how trading community influence affects their adoption decision. However, this question might be ambiguous as it is hard to distinguish whether the respondents give their certain score based on the institutional pressures they perceive from the suppliers or because of the perceived potential of network benefits from connecting with their suppliers. Therefore, the empirical results supporting the positive effect of network externality on adoption might be biased. It is important to address this problem and design measurement items with cautiousness to collect data that can accurately reflect how companies value the network benefits that open standards IOIS can potentially offer. Additionally, trading community influence and peer adoption only cover network effects from vertical industry connection. With the wide adoption of horizontal standards that can support cross-industry connection such as ebXML, it is also important to take account for the possible network benefits that could be gained from cross-industry connection.

3.3. Units

The realization of network externalities relies on the ability of open standards to provide efficient and low cost connection of additional traders in the market, which is referred to as the brokerage effects [29]. Apart from brokerage effects, integration effects can also be achieved from adopting IOIS through enhanced quasi-vertical

integration between organizations [27, 32]. Integration effect allows for closer coordination and more efficient communication between companies, which can lead to better monitoring of business partners thus reduce the costs caused by agency problems [29, 41]. It has been argued that there is a trade-off between network effects and interaction effects. To attain an integration effect, companies have to give up the benefits that can be gained from trading in an open market with many business partners [19, 32]. Tight integration requires investments that are highly relationship-specific which serve as commitment to improve credibility in business relationships. However, the specific investments can also become the hostages of the certain relationship that will constrain the participants from trading with more partners [2, 10]. Therefore, to gain integration effects, companies must forgo the benefits of greater networks, which can explain why some companies have chosen to establish electronic connections with only a few selected partners.

Integration effects are important for companies in collaborative relationships to achieve efficient collaboration with business partners. For firms with arm's length supply chain relationships, tight integration is not essential as the transactions between business partners are normally short-term and do not require business process cooperation. Therefore, this study posits that:

H5: integration effects have positive effects on the open standards IOIS adoption decisions for firms with collaborative supply chain relationships.

3.4. Personal Guanxi

Compared with supply chain relationships that are based on formal relational contracts, guanxi are personal relationships that involve informal exchanges of favors and information. Guanxi deeply roots in local cultures and significantly affects the way to conduct business activities in East Asian countries. While interfirm relationships are time discrete that the exchanges of goods and products will end once transactions are finalized, guanxi are long-term continuous states among individuals that occur with favor exchanges which are not specific for any certain transactions [24]. At organizational level, informal personal relationships constitute valuable channels to gain information about other companies [26]. Guanxi can also promote inter-organizational sharing by improving mutual trust [4], which is a significant factor for successful electronic collaboration where data security and information leakage are of great concern [36]. Improved trust can also promote electronic commerce by reducing the moral hazard problem that can be caused by information asymmetry [30]. Empirical results show that trust positively affects the continuity of electronic linkages in Taiwanese motor industry [40]. Therefore, by improving mutual trust, guanxi will facilitate the adoption of open standards IOS in collaborative firms, which leads to the next proposition:

H6a: guanxi have positive effects on the open standards IOIS adoption decisions for firms with collaborative relationships.

However, the prevalence of guanxi might restrict the diffusion of IOIS in small non-dominant companies with arm's length relationship. For these companies, implementing IOIS represents expensive initial investments and maintenance fee. Personal relationships are preferred to be economic substitutes of electronic linkages for efficient information sharing. For example, in Taiwanese notebook industry, small supplier rely heavily on guanxi which perform like neural network that can update and share timely demand and inventory information to avoid supply shortages. The efficiency of guanxi thus restricts the promotion of RossetaNet among the small supplier despite the support from the dominant focal firms and the local government [15]. Based on these discussions, the study thus posits that:

H6b: guanxi have negative effects on the open standards IOIS adoption decision for non-dominant firms with arm's length relationships.

3.5. Conceptual Framework

Drawing from the theories and discussions in the prior sections, a framework(Figure.1)is built for the future analysis of open standards IOIS. The framework mainly focuses on factors that arise from inter-organizational context including institutional forces (organizational interactions with the external environment), network effects and integration effects (influence of information technology on interfirm relationships), and guanxi (informal relationships among individuals). Additionally, this study posits that the influence of these factors will unfold differently for companies with different types of supply chain relationships (i.e., buyer/supplier dominant arm's

length relationship, buyer/supplier dominant collaborative relationship, independent reciprocal arm's length relationship, interdependent reciprocal collaborative relationship) and will consequently lead to different adoption decisions.

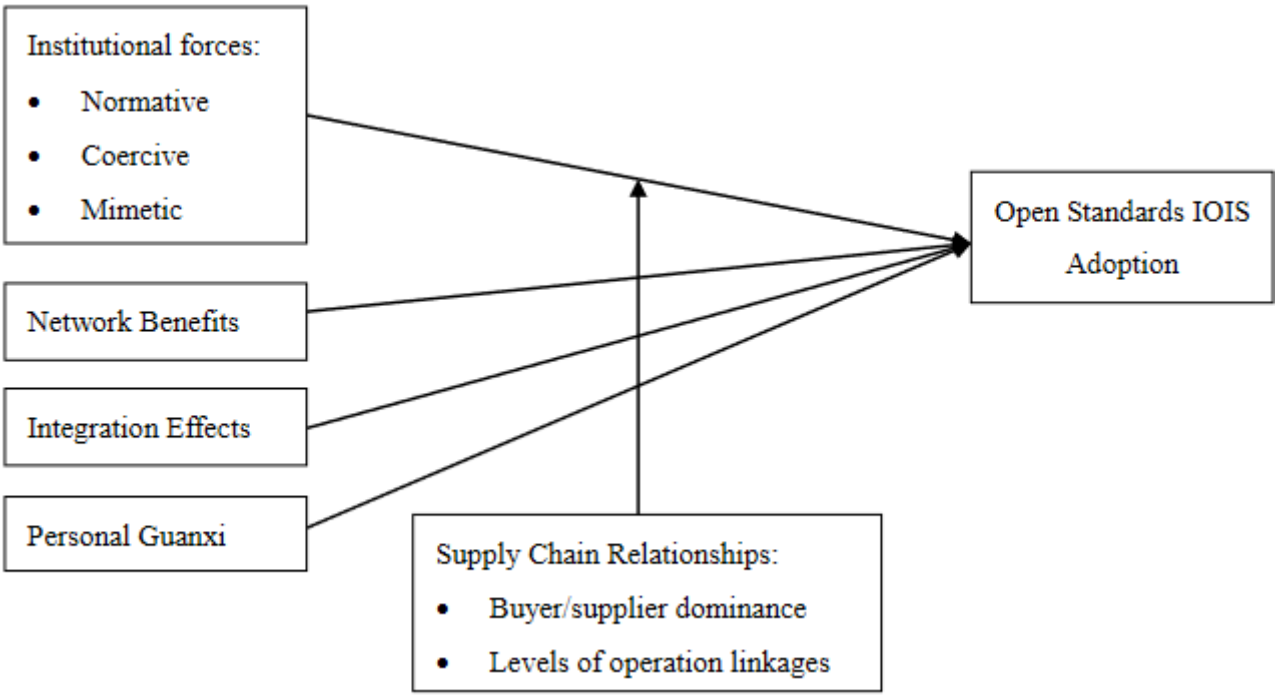

Fig. 1. Conceptual Framework

4. Conclusion

This study highlighted the importance of inter-organizational relationships in companies' decisions to adopt open standards inter-organizational information systems (IOIS). Organizational interactions with the external environment will lead to institutional pressures on organizations that compel them to make organizational changes. Meanwhile, organizations will seek to establish more external connections to gain more network benefits. This study incorporated both institutional forces and network effects together and addressed the differences between them that previous empirical studies failed to consider in constructs and measurements design. In addition, this study is the first to incorporate how the trade-off between network effects and integration effects will affect companies' adoption decision of open standards IOIS while most of the previous studies put emphasis solely on the importance of higher openness for inter-organizational electronic connections based on open standards. Apart from considering the influence arising from formal inter-organizational relationships, this study also incorporated personal guanxi, the informal relationships between individuals,into the model because of the prominent influence guanxi have on the way to conduct business inAsian countries. It is proposed that guanxi will lead to different adoption decisions for companies indifferent supply chain relationships. Integrating all the factors, a conceptual framework is presented for the future analysis of the adoption decisions of open standards IOIS. We hope that this framework and the propositions will provoke future research of open standards IOIS adoption and diffusion.

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