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# The Effects of Coordination Mechanisms and Tie Strength on the Adoption and Diffusion of Open Standards

*Research-in-Progress (Doctoral Consortium)*

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## Abstract

*Organizations today face a great challenge from the unpredictable, globalized and competitive business environment. One of the ways that organizations achieve competitive advantages is through the adoption of open standard inter-organizational systems (OSIOS) and its diffusion across supply chains. Despite the benefits that are promised by the adoption of OSIOS, its adoption has slowed down and there are increased cases of failure in OSIOS adoptions. In trying to understand some of its drivers, this study examines various factors relating to the social network theory and coordination theory with the assimilation of OSIOS. A survey questionnaire was administered, collected from 101 companies in China, and examined as a pilot study. Using partial least square analysis, we found that while extent of coordination mechanism plays a role in both adoption and diffusion, tie strength only affects the latter. Results are briefly discussed.*

**Keywords:** Interorganizational systems, open standard, OSIOS, adoption, assimilation, tie strength, coordination mechanisms.

## Introduction

Inter-organizational systems (IOS) are IT systems that are built and implemented to link the business processes of organizations by enabling the exchange of information between parties. IOS works by enabling partnering organizations to work together by sharing data (structured and unstructured) stored in repositories (Kumar et al. 1998). A similar category of technologies that is becoming popular and is significant in achieving the benefits mentioned is Open Standard Inter-Organizational Systems (OSIOS). OSIOS are IT standards that enable web-based information sharing among businesses supply chain (Nurmilaakso 2013). While IOS is typically implemented to connect a manufacturing firm and a supplier, OSIOS connects entire supply chains (Zhu, Kenneth L Kraemer, et al. 2006). OSIOS are developed by the open community using open standards e.g. xml, and are built on the Internet for information exchange between members of a supply chain (Venkatesh and Bala 2012).

Even with all that OSIOS promises, it is still suffering with slow adoption rates and development. For such a technology, its implementation is inherently complex and difficult as it can only be successful if it is not only adopted by a focal organization but also fully implemented among its supply chain partners (diffusion) (Oke and Idiagbon-Oke 2010). Consequently, OSIOS adoption and external diffusion is subjective to the characteristics of the relationship between the championing organization and its partners (Zhu et al. 2006). Similarly, because of network effects, the deployment of OSIOS requires mutual coordination with respect to these features (Lyytinen and Damsgaard 2011). For these reasons, this study explores OSIOS adoption and diffusion through the perspectives of embeddedness and coordination mechanisms.

Examining both OSIOS adoption and diffusion, particularly through the aforementioned perspectives, is important for several reasons. Firstly, because of the highly dynamic nature of supply chains, managing them effectively necessitates a high level of collaboration throughout the supply chain (Nelson et al. 2005). Secondly, supply chains are influenced by strong network externalities where investments in technological innovations are characterized by risk and uncertainty (Lyytinen and Damsgaard 2011). While adopters of OSIOS incur high costs and risk, they also gain significant benefits. Overall, it is still not clear what motivates organizations to actually invest in such complex and risky behavior.

## Theoretical Background & Hypotheses Development

### *Social Network Theory and the Embeddedness of Ties*

Embeddedness explains the relational ties and linkages between multiple entities, whereby an organization is seen as embedded amidst a structure of connections and ties (Kim and Choi 2015; Levin and Cross 2004). Borgatti and Foster (2003) suggest that ties are channels that give organizations access to resources, thus organizations develop and mobilize those ties to ultimately achieve some benefits. Relational ties and linkages can either be an arm's-length or embedded. Uzzi (1999 p. 483) defines arm's-length ties as those "characterized by lean and sporadic transactions", while embedded ties refers to those characterized by a cooperative nature, closeness, cohesion, and have a long-term orientation. The literature on embeddedness is rooted along two theories, Burt's (1992) structural hole argument which focuses on the benefits achieved from relationships characterized as weak ties and Coleman's (1990) network closure argument which pushes for strong ties. In this study, we focus of the latter.

Interorganizational ties are only useful if they provide organizations with access to quality new information or unique resources, and this can only happen amongst parties that have a strong embedded relationship (Kim and Choi 2015). Organizations with strong embedded ties will be more willing to exchange information as such ties improve understanding and obligation while

reducing risks and uncertainty. Some of the benefits of taking this approach and focusing on having few embedded ties rather than several arms-length ties is that organizations can manage their relationships much better so that they get more out of them, thereby also justifying the resources they allocate towards that end. This is however also impacted by the adoption of technologies like OSIOS as it reduces transaction costs and improves communication between organizational partners in the long run (Venkatesh and Bala 2012; Zhu et al. 2006). Similarly, in relation to coordination, having only few embedded ties means that organizations will have fewer coordination problems, a lesser number of coordination mechanisms will be required, and there will also be much less conflict (Chatterjee et al. 2002).

### *Coordination Theory and Coordination Mechanisms*

The coordination theory has been used to explore how activities of multiple organizations can be integrated so the organizations can work together towards achieving goals of mutual benefit (Im and Rai 2014; Lai et al. 2008). Coordination theory posits that within organizations that carry out tasks, it is important to generate alternate processes which first involve identifying the dependencies and coordination problems that is faced by the organization and then determining what coordination mechanisms can be applied to manage them. Coordination mechanisms as introduced by Malone & Crowston (1994) are activities that are put in effect to limit the coordination problems that arise in organizations. Coordination mechanisms ensure the reduction of coordination costs, better allocation of resources towards activities and tasks, and an efficient coordination structure (Chatterjee et al. 2002; Im and Rai 2014). Classic examples of coordination mechanisms include liaison roles, task forces, and integration.
An interorganizational relationship that is highly coordinated is one characterized by information sharing, performance monitoring, incentive alignment and collective learning (Simatupang et al. 2002). The development of an organizations internal and external coordination maximizes its potential of achieving competitive advantages and increased profitability (Wu et al. 2004). Previous research has shown interfirm coordination to influence internal and external levels of channel conflict (Webb 2002). Similarly, Chatterjee et al. (2002) found the influence of coordination on the adoption of e-commerce technologies to be significant. It has however not been tested in the context of OSIOS and whether it is affected by relational ties.

### *Organizational Ambidexterity*

Ambidexterity from the organizational research perspective mainly refers to an organizations ability to concurrently carry out two contrasting things (Gibson and Birkinshaw 2004). Some examples include simultaneously trying to achieve manufacturing efficiency and flexibility (Adler et al. 1999), global integration and local responsiveness (Bartlett and Ghoshal 1999), differentiation and low-cost strategic positioning (Porter 1996). Basically, an ambidextrous organizations is able to achieve efficiency in its ongoing operations and also adapt effectively to a continuously changing environment (Gibson and Birkinshaw 2004).

Organizational ambidexterity is a capability that is developed slowly over a period of time through the efficient interaction of different organizational contextual features (Ghoshal et al. 1997; Gibson and Birkinshaw 2004). It is also found that the effect of ambidexterity is seen because attributes of contexts themselves often leading to increased tensions when they do not improve simultaneous capacities of alignment and adaptability i.e. ambidexterity. However, this study only explores the effect of organizational ambidexterity as a moderator on the effects of tie strength and coordination mechanisms on OSIOS adoption and diffusion. We argue that ambidextrous organizations may be capable of adopting OSIOS even when they lack the typically essential relationship quality with their partners and when they do not have the

necessary coordinating mechanisms in place. Organizations may have strategies in place that inherently would make it difficult for them to adopt disruptive technologies. However, by developing their ambidexterity, they may be able to adopt OSIOS successfully. Based on the discussion above and our research model (Figure 1), and provide our hypotheses:

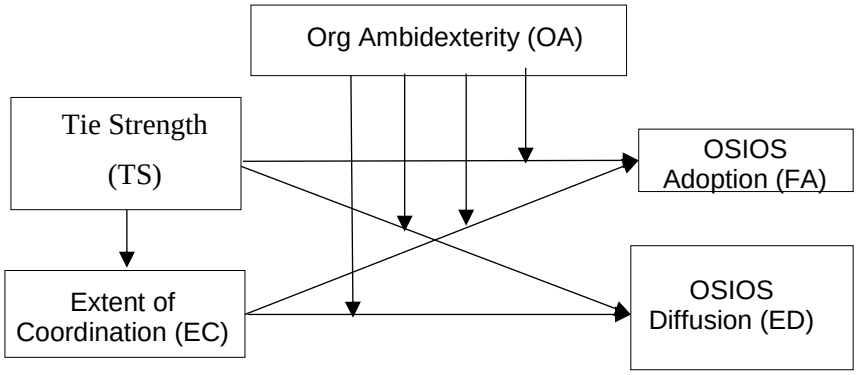


**Figure 1. Research Model**

*H1: Tie strength has a positive effect on the (a) adoption, and (b) diffusion of OSIOS.*
*H2: Tie strength has a positive effect on the extent of coordination mechanisms.*
*H3: Extent of coordination mechanisms has a positive effect on the (a) adoption, and (b) diffusion of OSIOS.*
*H4: Extent of coordination mechanisms mediates the effect of tie strength on the (a) adoption, and (b) diffusion of OSIOS.*
*H5: Organizational ambidexterity moderates the effect of tie strength on the (a) adoption, and (b) diffusion of OSIOS.*
*H6: Organizational ambidexterity moderates the effect of extent of coordination mechanisms on the (a) adoption, and (b) diffusion of OSIOS.*

## Methodology

### *Survey Development & Construct Measurement*

With regards to the instrument development process, it began with the identification of prior studies that had the relevant scales for the constructs in the study. The measures for adoption (Zhang et al. 2016), diffusion (Zhang and Dhaliwal 2009), tie strength (Kim and Choi 2015; Levin and Cross 2004), extent of coordination (Chatterjee et al. 2002), and organizational ambidexterity (Gibson and Birkinshaw 2004) were all reported to be valid and reliable measures. Therefore, we adapted them with slight modification to fit the specific context of study where necessary.

### *Data Collection*

The data used in this study was collected from manufacturing companies in China. The supply chain units of these companies served as the research unit for the study as is typical for studies relating to supply chain technologies. Targeted respondents were personnel whose job title was typically supply chain manager, or more senior executives as they would likely have a significant knowledge of the companies supply chain operations.

## Preliminary Data Analysis and Results

We have thus far collected 101 valid responses and use them to conduct a preliminary analysis to check for quality and validity. We employ smartPLS (Version 2) to examine our research

model and the collected data. PLS is our preferred tool for analysis as it has advantages over covariance-based structural equation modeling techniques such as AMOS and has been used in various fields including information systems (Gefen and Straub 2005).

### *Respondents Background*

The characteristics of the respondents and the companies are presented in Table 1. The table indicates that the companies represent a variety of industries. The majority of the companies appear to be large scale companies that have been in operation for 10 years and above. The respondents also appear to have been in in their companies for at least 6 but not more than 15 years, thus, indicating they are knowledgeable about the requested information.

**Table 1: Profile of companies and respondents**

| **Industry** | **N** | **%** | **Years of Operation** | **N** | **%** |
|---|---|---|---|---|---|
| Automobile | 9 | 8.9 | <1 Year | 0 | 0.0 |
| Chemical | 24 | 23.8 | 1-5 Years | 1 | 1.0 |
| Construction | 16 | 15.8 | 6-10 Years | 8 | 7.9 |
| Electrical/Electronics | 29 | 28.7 | 11-15 Years | 24 | 23.8 |
| Machinery/Equipment's | 11 | 10.9 | >15 Years | 68 | 67.3 |
| Others | 12 | 11.9 | | | |
| **Turnover** | **N** | **%** | **Employees** | **N** | **%** |
| <25 million | 1 | 1.0 | <160 | 0 | 0.0 |
| 25–100 million | 14 | 13.9 | 160-1,000 | 42 | 41.6 |
| 100-300 million | 13 | 12.9 | > 1000 | 59 | 58.4 |
| >300 million | 73 | 72.3 | | | |
| **Job Title** | **N** | **%** | **Job Tenure** | **N** | **%** |
| CEO/President | 2 | 2.0 | <1 Year | 0 | 0.0 |
| Senior executive/Vice President | 33 | 32.7 | 1-5 Years | 16 | 15.8 |
| IT Manager/CIO/CTO | 24 | 23.8 | 6-10 Years | 79 | 78.2 |
| Supply Chain/Operations Manager/ COO | 42 | 41.6 | 11-15 Years | 6 | 5.9 |
| | | | >15 Years | 0 | 0.0 |

### *Measurement Model Assessment*

Following the recommendations of Chin et al. (2012) we begin our analysis by examining the data for any common method bias that may distort any potential findings. The Harman's single-factor test was carried out on the data and was found to be 39.7% (Harman 1976). This falls very much below the maximum threshold of 50% as recommended (Podsakoff et al. 2003). We also looked for high correlations (>.90) among variables as recommended by Bagozzi et al. (1991). As seen in table 2 no such high correlations are present.

We proceeded to examine the reliability of the indicators used in the study. 4 items with loadings significantly lower than 0.7 were dropped since all items used in the study were reflective items. Internal consistency reliability was assessed using Cronbach's alpha and composite reliability. The variables all had values exceeding 0.7 in both cases as recommended except organizational ambidexterity (Nunnally 1978). We then examined for convergent validity by assessing the average variance extraction (AVE), which must be higher than 0.5 to be confirmed (Choi and Choi 2009). Organizational ambidexterity and tie strength (TS) were both below the threshold with 0.43. While these specific results are not up to the recommended minimum threshold, we still proceed to examine the structural model to fully understand the outcomes of our analysis.

**Table 2: Descriptive Results and Correlations**

| | AVE | Cronbach Alpha | Composite Reliability | R Square | ED | EC | FA | OA | TS |
|---|---|---|---|---|---|---|---|---|---|
| ED | 0.94 | 0.97 | 0.98 | 0.41 | 1 | 0 | 0 | 0 | 0 |
| EC | 0.70 | 0.89 | 0.92 | 0.46 | 0.61 | 1 | 0 | 0 | 0 |
| FA | 0.86 | 0.92 | 0.95 | 0.72 | 0.67 | 0.84 | 1 | 0 | 0 |
| OA | 0.43 | 0.50 | 0.72 | - | 0.57 | 0.40 | 0.50 | 1 | 0 |
| TS | 0.43 | 0.85 | 0.88 | - | 0.56 | 0.68 | 0.66 | 0.58 | 1 |

*ED: External diffusion, EC: Extent of coordination, FA: Adoption, OA: Organizational Ambidexterity, TS: Tie strength.*

### *Structural Model Assessment*

Being relatively satisfied with the measurement model, we then assessed the structural model to determine the acceptance or rejection of the hypotheses, the significance of the results, and the level of $R^2$ (Carte and Russell 2003). Because of the nature of the tie strength and organizational ambidexterity constructs, we modeled them as second order variables before performing a bootstrap with 500 subsamples. Table 3 shows the path coefficients and their significance. All hypotheses except (H1a, H5b, H6a, and H6b) were confirmed and $R^2$ values were found to be substantial for FA ($R^2$=0.72), and moderate for ED ($R^2$=0.41) and EC ($R^2$=0.46).

**Table 3: Hypotheses, Mediation, and Moderation Results**

| **H** | **Main Effects** | **β** | **T value** | **Y/N** | | **H** | **Mediation** | **Sobel T** | **β direct** | **β indirect** | **Y/N** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| H1a | TS - FA | 0.17 n.s | 1.47 | N | | H4a | TS-EC-FA | 5.48 | 0.66*** | 0.173n.s | Y full |
| H1b | TS - ED | 0.28** | 2.28 | Y | | H4b | TS-EC-ED | 3.36 | 0.56*** | 0.281** | Y Partial |
| H2 | TS - EC | 0.68*** | 8.64 | Y | | **H** | **Moderation** | **FA** | **ED** | **Y/N** | |
| H3a | EC - FA | 0.72*** | 7.64 | Y | | H5a | TS*OA | 0.19** | - | Y | |
| H3b | EC - ED | 0.42*** | 3.65 | Y | | H5b | TS*OA | - | 0.003 n.s | N | |
| | | | | | | H6a | EC*OA | -0.05 n.s | - | N | |
| | | | | | | H6b | EC*OA | - | 0.0049 n.s | N | |

*ED: External diffusion, EC: Extent of coordination, OA: Org Ambidexterity, FA: Adoption, TS: Tie strength,* H: Hypothesis, *β: Path Coefficient, *p< 0.05; **p< 0.01; ***p< 0.001; n.s: not significant.*

## Conclusion and Future Plans

To conclude, we remind readers that this is a work in progress and thus may change significantly in its final form. While we acknowledge the incompleteness of the arguments presented, we still find the results presented to be intriguing and highlight its potential to be developed further towards contributing to both theory and practice. The direct effects of the constructs were significant except for the influence of tie strength on adoption. However, organizational ambidexterity moderates this relationship significantly. The moderating effect of organizational ambidexterity on the other relationships were not significant. We also found that the extent of coordination mechanisms mediates the relationship between tie strength and adoption fully, but only mediates the relationship between tie strength and external diffusion partially. The small sample of 101 may have influenced the results and the significance of the findings. The sample restricted us from hypothesizing more relationships and developing a more complex research model.

At the point of writing this proposal, the student is in the 4th phase of his PhD timeline and is currently improving the survey instrument based on the analysis of this pilot study, and is expected to complete his study in about 12 months. The final dataset will also be collected from

Chinese industries and the companies will be selected from research partners and from appropriate OSIOS consortium like RosettaNet and from directories such as the Shanghai stock exchange. The fifth phase will be measuring the relationships between the constructs and variables. To do this, several statistical techniques will be applied. The statistical analyses to be carried include: (a) Cluster analysis; (b) Reliability Test; (c) Exploratory Factor Analysis (EFA); (d) Confirmatory Factor Analysis (CFA); (e) SEM; (f) Testing research model with industrial firms. The sixth and final phase will be the concluding phase of the PhD study where the author will write the thesis report. This phase will basically be the thorough discussion of all the phases leading up to it.

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