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INTERORGANIZATIONAL SYSTEM AMBIDEXTERY CAPABILITY AND ITS ROLE IN THE INFORMATION TECHNOLOGY RESOURCE-PERFORMANCE RELATIONSHIP

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Abstract

In this paper, we investigate the notion of organizational ambidexterity in using interorganizational system (IOS) in supply chain context. IOS ambidexterity is defined as a firm’s capability of simultaneously pursuing exploratory and exploitative use of IOS. In order to understand the implication of IOS ambidexterity in IT resource-constrained firms, this paper draws on theories in resource-based view and organizational ambidexterity literature. Based on data collected from 375 firms and PLS analysis, this work empirically confirms that a firm capable of using IOS in a more ambidextrous way tends to experience greater performance improvement and that different types of IT resources exhibit differing influence patterns on IOS ambidexterity and performance. An additional analysis is performed to understand the moderating role of IT resources in the IOS ambidexterity-performance linkage.

Keywords: IOS, ambidexterity, exploration, exploitation, information technology resources, firm performance
1 Introduction

In recent years, leading firms have started to emphasize the value of optimizing supply chain processes and facilitating collaboration among supply chain members. Therefore, interorganizational systems (IOS) are evolving into a critical technological platform where supply chain partners can streamline their interfirm processes, share operational and strategic information, and enhance their intelligence regarding market and customers. These changes emerging in the global supply chain landscape suggest that IOS are used by firms for both exploitative and exploratory purposes as was pointed out by Subramani (2004).

Although exploitation and exploration are relatively new concepts in IS field, they have received a great deal of attention in strategy and organization literature (for a review of the literature, refer to Raisch and Birkinshaw 2008). According to the notion of organizational ambidexterity proposed by Tushman and O’Reilly (1996), an ambidextrous firm has the capability of both exploiting existing competences and exploring new opportunities, thereby achieving a high level of performance and competitiveness. Despite the popularity and usefulness of the “ambidexterity” theory, there exists some disagreement regarding what the term means (Cao, Gedajlovic, and Zhang 2009). On one hand, exploitation and exploration were initially conceptualized as two ends of a single continuum and thus, the trade-offs between the two over limited resources are unavoidable. It is therefore deemed as desirable for firms to achieve a balance between the two (March 1991, Sidhu et al. 2007, Smith and Tushman 2005). On the other hand, exploitation and exploration can be characterized as independent activities, orthogonal to each other. In this regard, ambidexterity has been treated as the firm’s capacity to pursue and achieve high levels of exploitation and exploration simultaneously (Gupta et al. 2006, Jansen et al. 2006, Lavie and Rosenkopf 2006).

This paper seeks to investigate the ambidexterity hypothesis in the supply chain context. We define IOS ambidexterity as a firm’s capability to leverage IOS for both exploitative and exploratory purposes. IT use for exploration and exploitation parallels the fundamental ‘automating’ and ‘informating’ motives for using information systems (Subramani 2004). Although Subramani (2004) has shown that suppliers can benefit from exploitative and exploratory use of supply chain management systems, not much is known about the nature of ambidextrous use of IOS and the relationship between ambidexterity and firms’ competitive capabilities and performance. To fill this research gap present in the related literature, we do the following: (1) explore the meaning of exploitation, exploration, and ambidexterity constructs in our specific research context and (2) investigate the effects of ambidexterity and IS resources on firm performance, based on resource-based view (RBV) of firms (Barney 2001, Bharadwaj 2000, Wade and Hulland 2004). We view the ambidextrous use of IOS as an important class of IT capabilities and show that IOS ambidexterity as an IT capability mediates the relationship between IS resources and firm performance. For this, we draw on the notion of a hierarchy of capabilities (Grant 1996, Bharadwaj 2000) and demonstrate that firms which are capable of leveraging IT resources to develop IOS ambidexterity enjoy significant performance gains.

This work contributes to the literature in the following ways. First, it focuses on the subject of ambidexterity in IOS and supply chain contexts. Despite its significance in understanding the dynamics involved in organizational learning, ambidexterity has little been discussed in this area. Second, despite its importance, there has been little research done on the relationships among IT resources/capabilities and firm performance (Wade and Hulland 2004). Drawing on RBV and organizational ambidexterity theories, this paper sheds light on understanding the mediating or moderating effects of IT resources and IOS ambidexterity on performance in the IOS and supply chain context. In the remainder, this paper presents the research model, data collection and methods, and data analysis and discussion, followed by concluding remarks.
2 Research Model and Hypotheses

The related literature has viewed ambidexterity as an important capability contributing to firm performance (Gibson and Birkinshaw 2004, Jansen et al. 2009, O’Reilly and Tushman 2008). Consistent with this view, this paper treats IOS ambidexterity as an IT capability, which can be defined as a firm’s ability to mobilize and deploy IT-based resources in combination with other resources and capabilities (Bharadwaj 2000). Borrowing the concept of organizational ambidexterity from the organization and strategy literature (Gupta et al. 2006, Jansen et al. 2009, O’Reilly and Tushman 2008, Raisch and Birkinshaw 2008), we define IOS ambidexterity as simultaneous pursuit of exploitation and exploration which refers to the routines and processes by which organizations mobilize, coordinate, and integrate dispersed efforts and resources to develop and utilize IOS for exploitative and exploratory purposes. In this regard, IOS ambidexterity requires implementing effective ways of simultaneously pursuing exploitative and exploratory use of IOS which compete over limited IT-related and other firm resources.

Premised on RBV, we propose that IOS ambidexterity is an IT capability which can be established and enhanced by an effective application of relevant IT and management resources. RBV research in IS field suggests that IT-related resources and capabilities affect firm performance (Bharadwaj 2000, Wade and Hulland 2004). Based on this, we argue that IOS ambidexterity mediates the positive relationship between IT-related resources and firm performance. This contention implicitly assumes a hierarchy of capabilities (Barua et al. 2004, Bharadwaj 2000, Rai et al. 2006) where outside-in, spanning, and inside-out IT resources influence IOS ambidexterity as a higher-order IT capability.

Examples of exploitive IOS use include electronic distribution of request for proposal to suppliers, electronic transmission of purchase orders, and electronic payment settlement while analysis of point-of-sales and product return data to enhance market intelligence and communication with product designers and retailers to improve products’ appeal are examples of exploratory use of IOS (Subramani 2004). Exploitive use of IOS thus enables firms to improve and incrementally refine existing supply chain processes, resulting in efficient processes and lower cost, while explorative use allows them to create new supply chain capabilities and achieve a greater understanding of complexities and uncertainties surrounding the supply chain environment.

Ambidexterity defined as simultaneous pursuit of exploration and exploitation has been conceptualized in two different ways in the organizational innovation and strategic management literature. A firm is ambidextrous if it scores high on both exploration and exploitation, or if it puts a relatively equal emphasis on both dimensions (Cao et al. 2009, He and Wong 2004). The former is referred to as the combined dimension (CD) of ambidexterity while the latter as the balanced dimension (BD) (Cao et al. 2009). Both CD and BD are shown to have positive effects on firm performance (Cao et al. 2009, He and Wong 2004). Similarly, we propose that an IOS ambidextrous firm with CD and BD is likely to achieve greater performance than firms focusing on one at the expense of the other.

Hypothesis 1. IOS ambidexterity is positively related to firm performance.

In this paper, we consider market responsiveness, managerial IS knowledge and IS infrastructure which correspond to outside-in, spanning, and inside-out resources in the Wade and Hulland’s typology of IT resources (2004). Inside-out resources tend to be internally oriented, being deployed from inside the firm in response to market and environmental uncertainties while outside-in resources in contrast are externally oriented, and used to create flexible and durable customer and supply chain partner relationships. Market responsiveness is an outside-in resource that allows firms to undertake strategic changes when necessary by focusing on anticipating future market requirements and devising solutions to environmental challenges through collection and dissemination of external information and market intelligence across relevant organizational units (Day 1994, Wade and Hulland 2004). Market responsiveness can be defined as the quickness of reaction to market signals and has been shown to be a key capability of a firm in information-intensive environments (Zaheer and Zaheer
Firms can be responsive to market changes by developing IT capabilities to collect important market information, transform it into outputs of greater worth, and distribute them to partner organizations.

A successful deployment and operation of IOS requires alignment between IT and business strategy, coordination of the IT and functional departments and integration of outside-in and inside-out capabilities. These managerial abilities are a type of human IT resources (Bharadwaj 2000) that belongs to spanning capabilities, involving integration of both market-related (external) and internal analyses. IS knowledge of top management and functional managers have been frequently cited in IS literature as an important resource of a firm that affects performance through acquiring external market intelligence and integrating it with internal activities (Liang et al. 2007, Mitchell 2006, Lubatkin et al. 2006). We thus treat managerial IS knowledge as a spanning resource that facilitates integration of inside-out and outside-in resources.

A firm’s IT infrastructure has been regarded as a key source of competitive strength which determines the flexibility a firm enjoys in business planning (Bharadwaj 2000, Keen 1991, Wade and Hulland 2004). An integrated IT infrastructure that spans the entire organization and links key suppliers and customers requires a considerable amount of time and efforts to become fully operational. From the RBV perspective, we consider that outside-in, inside-out, and spanning resources represented by market responsiveness, IT infrastructure, and managerial IS knowledge in IOS context are valuable and rare resources and therefore posit that they have positive impact on firm performance.

Hypothesis 2. IT resources are positively related to firm performance.

An ambidextrous use of IOS requires that a wide variety of internal and external activities be supported not only by well integrated IT infrastructure but also by outside-in resources such as market responsiveness. Market responsiveness represents strategic flexibility in terms of developing and assimilating IOS in such a way that firms can make strategic changes and alter the current process in response to market changes. Managerial knowledge about IOS is expected to serve as an important resource for IOS ambidexterity through their integrative role in helping to create organizational mechanisms that are conducive to ambidextrous use of IOS. We therefore propose a positive relationship between the three IT resources and IOS ambidexterity.

Hypothesis 3. IT resources are positively related to IOS ambidexterity.

The following figure depicts the research model of the present study.

![Figure 1: The research model](image)

3 Data Collection and Methods

Data for this study were drawn from a survey of 400 Chinese firms regarding their IT resources, IOS uses, and performance gains since the introduction of IOS to their organizations. Three hundred seventy five firms out of the 400 are used in statistical analysis, and some summary characteristics of these firms include the following: size – 30.67% fewer than 100 employees, 29.60% between 100 and
499, and 13.1% between 500 and 999; industry – 22.40% manufacturing, 12% computer/IT, 16% retail/distribution; time since IOS introduction – 8% less than one year, 51% between one and two years.

Survey items are all adapted from the past literature and measured on a 7-point Likert scale ranging from “strongly disagree” or “not at all” to “Strongly agree” or “extremely”. Measurement items for Performance improvement (PERF) includes questions regarding improvements since the IOS introduction in terms of customer service, inventory management, operational cost, cycle time, partner relationship, product innovations, profitability (Subramani 2004, Zhang et al. 2009). Exploitative use of IOS (EXP_T) is measured by proportions of total partners interacting through IOS, total partner transactions done through IOS, and overall interactions with partners carried out through IOS (Zhang et al. 2009). Exploratory use of IOS (EXP_R) is measured with questions regarding the extent to which IOS is used to understand trends in sales and customer preferences, integrate functions with the partner’s organization, and leverage expertise to create new business opportunities (Subramani 2004). Measurement items for the three IT resources are as follows: for market responsiveness (MR), IOS based strategic flexibility, fast IOS based solution to business opportunities, quick reaction to market changes with IOS support; for IT infrastructure (INFRA), adequacy of IOS architectural flexibility, efficiency and reliability of IOS operations, appropriateness of data and platform standard of IOS; for managerial IS knowledge (MK), top management and functional management’s commitment to IOS use, top management and functional management’s knowledge in role of IOS in supply chain improvement, top management and functional management’s belief in importance of IOS in firm success. As control variables, we used time since the introduction of IOS, the number of employees, and revenue.

In this study, we treat CD and BD as two separate ways of operationalizing ambidexterity, rather than viewing them as the two components of the higher-order ambidexterity construct. We calculated CD of IOS ambidexterity by multiplying the average scores of exploratory and exploitative uses of IOS (EXP_R*EXP_T). We obtained BD by taking 0.5 - 0.5 – x where x is the proportion of exploratory use in total IOS use (= exploratory use + exploitative use). BD increases up to 0.5 and then decreases as the firm uses IOS for exploratory purposes to a greater extent. We chose to use 0.5 as the balance “criterion” and this is consistent with the operationalization of BD in terms of absolute difference between EXP_R and EXP_T. We however note that a different optimal mix of exploration and exploitation may exist and the optimal mix may vary according to organizational and environmental factors.

4 Data Analysis and Discussion

We checked for internal consistency of all constructs used in this study using Cronbach’s alpha and confirmed that they are all greater than 0.7. We also assessed construct validity via exploratory factor analysis using principal component analysis using Varimax rotation and found that the measurement items were highly loaded on the theoretical constructs.

We perform a series of regression analyses to explore the mediating role of IOS ambidexterity between IT resources and performance, and the results are presented in Table 1.

<table>
<thead>
<tr>
<th>Mediator: IOS ambidexterity</th>
<th>Independent Variable: IT resources</th>
<th>IV→DV</th>
<th>IV→M</th>
<th>IV + M → DV</th>
<th>Indirect effect: p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD</td>
<td>MR</td>
<td>0.379**</td>
<td>0.547**</td>
<td>0.335**</td>
<td>0.446**</td>
</tr>
<tr>
<td>INFRA</td>
<td>0.512**</td>
<td>0.479**</td>
<td>0.249**</td>
<td>0.552**</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Table 1. Results of regression-based mediation effect tests

Overall, the result in Table 1 shows that the relationships of IT resources with both IOS ambidexterity and performance improvement are significant and positive. This table also indicates that (1) IV → DV is significant, (2) IV → M is significant, and (3) both IV and M are significant in IV + M → DV. This, according to the three-step procedure by Baron and Kenny (1986), demonstrates that CD and BD partially mediate the effect of IT resources on PERF. Significance of this indirect effect that BD and CD have on PERF can also be statistically verified by the p-values obtained from by Sobel test (1982). These results verify all three hypotheses and further suggest that the mediation effect of IOS ambidexterity on the relationship between IT resources and performance is significant.

We used SmartPLS to gain a fuller understanding of the relationships among the proposed constructs. The research model was run as two separate models, each with a different operationalization of IOS ambidexterity. Figure 2 depicts the research model tested and the PLS results can be summarized as below:

1. CD appears to be a more useful indicator of IOS ambidexterity than BD in terms of explaining firms’ performance improvement from the use of IOS.

2. Different IT resource types have differing impact on performance.
   A. Investment in outside-in and spanning resources enhances IOS ambidexterity.
   B. Inside-out resources affect performance directly, not indirectly through IOS ambidexterity.

1. The numbers in pairs represent path coefficients and $R^2$ for CD (BD).
2. ** significant at 1%; * significant at 5%
The PLS results show that CD explains better than BD the proposed relationships among IT resources, IOS ambidexterity, and performance, indicating that CD is a more useful indicator of IOS ambidexterity than BD. When measured by BD, IOS ambidexterity is not significantly associated with performance and does not mediate the relationship between IT resource and performance. When IOS ambidexterity is represented as CD, the three IT resource types exhibit different patterns in affecting the final dependent variable, performance. IS infrastructure (inside-out resource) has only direct impact on performance while managerial IS knowledge (spanning resource) influences performance only through IOS ambidexterity (CD in this context). As IS infrastructure is basic structures that are required for a successful operation of IOS, it can serve as a necessary condition but not necessarily as a sufficient condition for IOS ambidexterity. In contrast, market responsiveness (outside-in resource) influences performance both directly and indirectly through IOS ambidexterity. This suggests that firms can enhance IOS ambidexterity by developing outside-in and spanning resources, and that inside-out resources may not have significant impact on IOS ambidexterity. This does not necessarily mean that inside-out resources are not important at all but rather that a firm’s capability of simultaneously pursuing exploratory and exploitative use of IOS can mostly benefit from its investment in developing outside-in and spanning IT resources.

We additionally examine potential moderation effects of IT resources on the relationship between ambidexterity and performance. The reason for examining contingencies of ambidexterity is that exploration and exploitation are completely different logics and compete for firm’s scarce resources (Cao, et al. 2009; He and Wong 2004; March 1991). For instance, Cao, Gedajlovic and Zhang (2009) show that the impact of ambidexterity on performance is strongly associated with such factors as organizational size and environmental munificence which are indicative of the amount of internal and external resources available to firms. The RBV literature in the IS field also suggests that IT resources may interact with other resources in their relationship with performance and competitive position (Wade and Hulland 2004). Given the discussion above, we explore the contingency effect of IT resources on the IOS ambidexterity-performance linkage. The following tables summarize the PLS results of six models, each of which involves IOS ambidexterity, one of the three IT resources, and its interaction with IOS ambidexterity.

### Table 3. PLS analysis of interaction between CD and IT resources

<table>
<thead>
<tr>
<th>Paths</th>
<th>IT Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>* CD → Performance</td>
<td>MK</td>
</tr>
<tr>
<td></td>
<td>INFRA</td>
</tr>
<tr>
<td></td>
<td>MR</td>
</tr>
<tr>
<td>8.44**</td>
<td>8.38**</td>
</tr>
<tr>
<td>5.56**</td>
<td></td>
</tr>
<tr>
<td>7.13**</td>
<td>7.22**</td>
</tr>
<tr>
<td>14.41**</td>
<td></td>
</tr>
<tr>
<td>1.44</td>
<td>3.09**</td>
</tr>
<tr>
<td>3.64**</td>
<td></td>
</tr>
<tr>
<td>-2.13*</td>
<td>-0.70</td>
</tr>
<tr>
<td>-1.10</td>
<td></td>
</tr>
</tbody>
</table>

### Table 4. PLS analysis of interaction between BD and IT resources

<table>
<thead>
<tr>
<th>Paths</th>
<th>IT Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>* BD → Performance</td>
<td>MK</td>
</tr>
<tr>
<td></td>
<td>INFRA</td>
</tr>
<tr>
<td></td>
<td>MR</td>
</tr>
<tr>
<td>2.12*</td>
<td>2.00*</td>
</tr>
<tr>
<td>2.08*</td>
<td></td>
</tr>
</tbody>
</table>
Table 4. PLS analysis of interaction between BD and IT resources

<table>
<thead>
<tr>
<th>IT Resource → BD</th>
<th>2.06*</th>
<th>2.90**</th>
<th>2.09*</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT Resource → Performance</td>
<td>5.07**</td>
<td>6.49**</td>
<td>11.44**</td>
</tr>
<tr>
<td>IT Resource*BD → Performance</td>
<td>0.05</td>
<td>0.27</td>
<td>0.59</td>
</tr>
</tbody>
</table>

From this analysis, we observe that managerial IS knowledge is the only resource type that moderates the relationship between IOS ambidexterity (measured in CD) and performance and also that the corresponding path coefficient is negative. This indicates that CD contributes more to performance for the firms with less managerial IS knowledge, implying that concurrent maximization of both exploratory and exploitative use of IOS can be more beneficial when top and functional managers are less capable of integrating and coordinating external and internal IT-related tasks and activities. Conversely, this may suggest that in an attempt to enhance performance, firms with greater managerial IS knowledge achieve and maintain an optimal mix between the two, instead of maximizing the combined use. This discussion leads to a call for research efforts to conceptualize “an optimal mix” which may differ from “a balanced pursuit” of exploration and exploitation as represented in BD. We also concur with He and Wong (2004) that, when operationalized as achievement of “balance” erroneously, BD may classify firms that are balanced at low levels as ambidextrous. Future studies are required for a more thorough conceptualization and operationalization of BD.

5 Conclusion

In this paper, we investigate the notion of organizational ambidexterity in the IOS and supply chain context. Drawing on theories in RBV and the framework of a hierarchy of capabilities, this study examined the relationship among IT resources, IOS ambidexterity, and firm performance improvement. The research framework included market responsiveness as outside-in, managerial IS knowledge as spanning, and IT infrastructure as inside-out resources. The PLS results confirm that leveraging IT resources in general has direct impact on performance in the presence of IOS ambidexterity measured as CD in the research model. At the same time, our results show that investment in outside-in and spanning resources enhances IOS ambidexterity while the hypothesized linkage between the inside-out resource and IOS ambidexterity was not supported. When IOS ambidexterity is operationalized as balanced use of IOS (BD) for exploratory and exploitative purposes, the ambidexterity construct fails to explain its proposed relationships with IT resources and firm performance. An exploration of interaction between IT resources and IOS ambidexterity reveals that the interaction effect is quite limited. We only found that interaction between managerial IS knowledge and CD is significant and negative. Future research topics may include reconceptualization and operationalization of “balanced ambidexterity,” investigation of contingency variables for the IOS ambidexterity-performance relationship, examination of a more comprehensive list of IT resources and their relationship with IOS ambidexterity, among others.

References


