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Importance Of Absorptive Capacity Attributes In Radio Frequency Identification Supply Chain Initiatives

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COLLABORATION WITH RFID SYSTEMS

IMPORTANCE OF ABSORPTIVE CAPACITY ATTRIBUTES IN RADIO FREQUENCY IDENTIFICATION SUPPLY CHAIN INITIATIVES

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Abstract

This study explores if firms using RFID are characterized by higher levels of selected absorptive capacity attributes. Data from 37 firms is used to test the key proposition. The data confirms that firms complying with RFID mandates have higher levels of absorptive capacity attributes than their noncompliant counterparts.

Keywords: *Supply chain management, Radio frequency identification, Absorptive capacity capabilities, IT system deployment outcomes*

1 INTRODUCTION

Suggesting the importance of the absorptive capacity concept in today's supply chain management literature is appropriate because of the next level of competition that firms need to be able to respond to. Cultivating competitive advantage, for a large part, depends on the firm's ability to convert knowledge into capabilities to respond to environmental demands (Lane & Lubatkin, 1998). This challenge becomes even more onerous in turbulent environments where a lack of organizational learning capacity could account for a firm's inability to adopt important emerging technologies (Huber, 1996). This study also invokes the dynamic capabilities perspective in assessing a firm's current state of "fitness" as it tries to meet marketplace challenges. The dynamic capabilities perspective (DCP) refers to the capability of firms to renew its competences in terms of its organizational resources in order to align themselves with environmental business demands (Teece, Pisano, & Shuen, 1997; Eisenhardt & Martin, 2000).

This study looks at firms' responses using the absorptive capacity attributes to the mandates of key institutions to comply with the use of radio frequency identification (RFID) at the case and pallet levels to make their supply chain initiatives more efficient and competitive. In this particular situation, the pressure on suppliers to use RFID is the major technological change and marketplace challenge that must be met. It, therefore, behooves suppliers to renew their competences in order to participate in their hub firm's supply chains that are now seeking higher levels of streamlined operations. It stands to reason that suppliers that readily cooperate with channel masters requiring RFID are exhibiting a willingness to learn and thus, are more likely to develop absorptive capacity capabilities. The key research question of this study, therefore, is to explore if firms complying with RFID mandates from their channel masters are characterized by higher levels of absorptive capacity attributes compared to the other firms which are not complying with such mandates.

2 ABSORPTIVE CAPACITY (AC) CONCEPTS

Zahra and George (2002) define "absorptive capacity" as "…a set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability. (2002, p. 186)" Firms that develop their absorptive capacity depend on the

outside environment for obtaining new knowledge and operate as an "open system," constantly interacting with potential sources of new information (Nonaka & Takeuchi, 1995).

3 AC CONCEPTS USED IN THIS STUDY

In 2005, Malhotra, Gosain, and El Sawy conducted a study that explores how firms engaged in supply chain networks configure their business processes and IT infrastructures to build absorptive capacity to acquire, assimilate, transform, and exploit information resources. They worked with the group of concepts to represent the application of absorptive capacity attributes within a supply chain context, which they operationalized as well and tested in the study: (1) integrative interorganizational process mechanisms enabling acquisition and assimilation consisting of: (a) joint decision making; (b) interorganizational business process modularity; and (c) standard electronic business interfaces; (2) partner-interface-directed information systems: enabling assimilation and transformation: (a) memory systems for interorganizational activities and (b) interpretation systems for interorganizational information; (3) rich information exchange: mediating absorptive capacity outcomes: (a) extent of coordination information exchange; (b) breadth of information exchange; (c) quality of information exchange; and (d) privilege information exchange; and (4) absorptive capacity outcomes: (a) operational efficiency and (b) market knowledge creation. In this study, the questionnaire items for all absorptive capacity attributes were borrowed from the study conducted by Malhotra, Gosain, and El Sawy (2005).

3.1 Joint Decision Making

Jansen, Van Den Bosch, and Volberda (2005) also articulate the concept of the need for organizational mechanisms associated with coordination capabilities for absorptive capacity that include participation in decision making. This concept is being extended within the context of supply chain partnerships. The focal firm's efforts to invite key supply chain partners participating in the RFID system implementation in the decision making process allow the focal firm to receive knowledge from these partners (i.e., external sources) and enhance the performance of the system. Joint decision making/social connectedness are operationalized using the items developed by Malhotra, et al. (2005) for "joint decision making."

3.2 Routinization

Jansen, Van Den Bosch, and Volberda (2005) also articulate the concept of the need for organizational mechanisms associated with systems capabilities supporting absorptive capacity which include the concept of "routinization." By routinizing tasks, the firm is able to spend just enough and not excessive attention to them in the process of transforming inputs into outputs (Galunic & Rodan, 1998; Perrow, 1967). Repetitive and structured tasks that usually do not deal with unexpected transactions are ideal for routinization (Hage & Aiken, 1967; Perrow, 1967; Withey, Daft, & Cooper, 1983).

In this study, routinization is expressed in a number of ways: a) use of interorganizational business process modularity, b) use of standard electronic business interfaces, and c) the exchange of coordination information.

3.2.1 Interorganizational business process modularity

Using interorganizational modularized business processes is one way to facilitate the conduct of routinized operations. By breaking up interrelated business processes into subprocesses making up the modular supply chain process architecture, trading partners can undertake their respective tasks independently and simultaneously, thus, enhancing expeditious performance across the chain. In the meantime, the use of standard electronic process interfaces and information exchange can undergird the coordination protocols required to make these arrangements work (Grant, 1996; Sanchez & Mahoney, 1996; Von Hippel, 1998).

3.2.2 Standard electronic business interfaces

An important requirement to enable the exchange of information among firms is the use of standard electronic business interfaces to handle the interoperability of both the data and business processes. In terms of the data, standards form the foundation of the data architecture needed to define the structure of the data and the relationships among data entities in order to achieve data consistency, a key requirement for interorganizational data sharing (Van Den Hoven, 2004).

3.2.3 Coordination information exchanged

Firms also need to exchange coordination information assuming that the IT infrastructure is already properly in place. A classical problem in the supply chain involves the "bull whip effect," or the amplification of the variability of order information communicated in the supply chain causing problems (Moyaux & Chaib-draa, 2007). It has been suggested that to reduce the "bullwhip effect," the customer firm needs to communicate both the original demand information and subsequent revisions to it to the supplier firm.

3.3 Interpretation systems

After collecting a considerable amount of information across trading partners, there is a need to organize, rearrange, process, and interpret this information in multiple ways in order to serve the needs of the specific end user groups and the business applications they maintain related to the value chain's collective efforts (Boland, Tenkasi, & Te'eni, 1994; Jarvenpaa & Ives, 1994). One important tool is "data mining," or the process of analyzing data to reveal useful patterns and relationships hidden in the data (Rupnick, Kukar, & Krisper, 2007). Data mining makes use of statistical, pattern recognition, and machine learning methods (i.e., involving use of neural networks, linear discriminant analysis, linear regress, decision tree induction, k-nearest neighbor, Bayesian classification, etc.) to enable data analysis and the discovery of insights embedded in the data (Spangler, Gal-Or, & May, 2003).

3.4 Memory systems for interorganizational activities

A similar term used in academic literature is "organizational memory," or the saving, representation, and sharing of corporate knowledge (Croasdell, 2001) that can be used by members of the firm in carrying on regular operations and responding to environmental challenges as well (Stein, 1995; Huber, 1991; Walsh & Ungson, 1991; Pralahad & Hamel, 1990). This knowledge is spatially distributed in a chain of linked business processes, roles, and artifacts of the focal firm and its trading partners (Stein & Zwass, 1995) and can be embedded in electronic datawarehouses, databases, filing systems, and manuals, could support multiple interrelated tasks spanning diverse corporate environments (Ackerman, 1996).

3.5 Partner interaction

In the context of knowledge management within organizations, Chen (2004) uses the concept of "partner interaction," which is defined as the extent to which the partnering firms interact with each other in terms of trust, adjustment, and conflict. Prior studies have recognized the importance of trust to the alliance performance during the interfirm cooperation period (Casson, 1991; Buckley & Casson, 1988; Larson, 1991). In this study, "partner interaction" will be operationalized in terms of the following constructs: joint decision making (discussed in section 3.1), exchange of privileged information, quality of information, and breadth of information.

3.5.1 Privileged information exchanged

Typical information exchanges among supply chain trading partners, especially in arms-length transactions, involve the sharing of standard business generic information such as point-of-sale, sales,

inventory availability information, among others, that affect the joint operational activities among the firms. As trading partners move closer to each other, the nature of the information exchanged also changes and they are far more willing to share "privileged" information that is specific to the trading partner (Malhotra et al., 2005). In order to provide the receiving firm insights that will enable it to innovate and mutually restructure their competencies and business processes (Uzzi & Lancaster, 2003).

3.5.2 Breadth of information exchanged

A firm's ability to respond expeditiously to environmental demands depends on its capability to deliver new products or services faster, track customer trends in real time, and "reinvent their role in value creation networks" (Malhotra et al., 2005). To achieve "breadth of information," firms should share more than the standard, transactional, operational data and be willing to exchange information that informs trading partners of higher-level issues such as changes in marketplace conditions, shifting customer tastes, new product/service attributes, emerging technologies, competitive opportunities, among others (Anand, Manz, & Glick, 1998; Child & Faulkner, 1998; Austin, Lee, & Kopczak, 1997; Fites, 1996).

3.5.3 Quality of information exchanged

Another attribute of the information exchanged among trading partners is its "quality." In investigating the relationship between knowledge and work performance, Lee and Strong (2004) considered the information quality attributes of relevancy, timeliness, accuracy, and completeness as relevant. O'Brien (2001) looks at the time, content, and form dimensions of information quality. The time dimension refers to timeliness, currency, and frequency; the content dimension refers to accuracy, relevance, completeness, conciseness, performance, and scope; and, finally, the form dimension refers to clarity, media used, order, and manner of presentation.

3.6 Absorptive capacity outcomes

The absorptive capacity attributes in this study will be associated with two outcomes, operational efficiency and market knowledge creation (Malhotra et al., 2005).

3.6.1 Operational efficiency

Miles and Snow (2007) tracked the pattern of evolution of supply chains, key central organizing units in global industries, through the decades and found that in the first period of their development, their primary focus was on making operations more efficient. Attaran (2007) looks upon RFID as a major form of technology to cut supply chain costs, and improve retail supply chain communication, and increase a firm's return on investment.

3.6.2 Market knowledge creation

Miles and Snow (2007) also noted that in the second period of their evolution, the focus has shifted from operational efficiency to the achievement of effectiveness as trading partners shared ideas and expertise on how to manage the entire chain and in the more recent time, how to ensure supply chain performance at the industry level. This change in trend is associated with "market knowledge creation" in this study.

4 PROPOSITION TO BE TESTED

This study, therefore, looks at the capability of firms to step up to the latest challenge of digital business transformation via the deployment of RFID in their supply chains using their absorptive capacity assets. Compliance with RFID mandates from a firm's channel master indicates the willingness of trading partners, in this case the suppliers, to collaborate in digital business transformation initiatives requiring

synchronized deployment of emerging technologies such as RFID. Also, in such early pilot projects, the channel master invests in considerable education and sharing of technology and expertise to ensure a well-orchestrated implementation of RFID. Recognition of the value of cooperating with the channel master, therefore, exhibits willingness to pursue organizational learning to develop one's absorptive capacity capabilities. This study, therefore, intends to test the following proposition:

Hypothesis 1: Firms complying with RFID mandates will exhibit higher levels of absorptive capacity attributes than noncompliant firms.

5 RESEARCH METHODOLOGY

Data for this pilot research study was collected using a survey questionnaire administered online to members of the Council of Supply Chain Management Professionals (CSCMP). The data analyzed for this paper was drawn from a convenience sample of 37 organizations that have experience implementing RFID. Two groups of respondents were designated according to those positively responding to RFID mandates and those firms that implemented RFID, anyway, without responding to such mandates. Survey respondents were asked to indicate their perceptions of the importance of the nine absorptive capacity attributes using multiple items per construct. Seven-point Likert scales were used with minimum-maximum anchoring points appropriate to the construct being measured.

6 FINDINGS

6.1 Data Measurement Properties

The internal consistency of the items constituting each construct was assessed using Cronbach's alpha and the results are in conformance with Nunnally's (1978) guidelines of getting values of .70 or above. Generally speaking, the items have internal consistency. To establish convergent and divergent validity, the item-to-total correlations of the constructs were examined and, in general, the specific items have a stronger correlation with the construct than with other items (Rai, Patnayakuni, & Seth, 2006).

6.2 Sample Profile Description

There are a total of 37 firms included in the convenient sample of firms that have RFID experience. About 32.43 percent of the firms had less than 1,000 employees and 64.86 percent had more than 1,000 employees. The following profile shows the membership of the firms in different industry sectors: service (54.05 percent), manufacturing (40.54 percent), and retailing (2.70 percent).

6.3 Means and Standard Deviations for Absorptive Capacity Attributes

The following are the means and standard deviations for each of the absorptive capacity capabilities. The top five capabilities in descending order are interorganizational business process modularity (BusProcess1and2) (mean=5.3962, S.D.=1.23688); quality of information (QualInfo1and2) (mean=5.2162, S.D.=1.86912); use of memory systems for interorganizational activities (Memory1and2) (mean=5.1892, S.D.=1.74544); use of standard electronic business interfaces (Interface1and2) (mean=5.1486, S.D.=1.12339); and joint decision making (DecisionMake1and2) (mean=5.0116, S.D.=3.17452).

The results of the t-tests and discriminant analysis both confirm the proposed hypothesis.

6.4 T-Test Results

T-tests were ran to explore differences in the extent to which the different absorptive capacity capabilities were valued and used by respondent firms in their relationship with the focal trading partner (Table 1). Firms that responded to RFID mandates assigned higher mean values to the following

capabilities compared to firms that were not complying with such mandates: use of memory systems for interorganizational activities (Memory1and2) (mean for complying firms=5.7941; mean for noncomplying firms=4.5789); use of interpretation systems for interorganizational information (Interpretation1and2) (mean for complying firms=4.9020; mean for noncomplying firms=3.7895); breadth of information exchanged (BreadthInfo1and2) (mean for complying firms=5.0441; mean for noncomplying firms=3.6316); quality of information exchanged (QualInfo1and2) (mean for complying firms=5.8235; mean for noncomplying firms=4.5789); privileged information exchanged (PrivilegedInfo1and2) (mean for complying firms=5.1765; mean for noncomplying firms=3.5263); and coordination information exchanged (CoordInfo1and2) (mean for complying firms=5.0882; mean for noncomplying firms=3.2105).

6.5 Discriminant Analysis

Discriminant analysis was also conducted to assess whether the nine variables (DecisionMake1and2, BusProcess1and2, Interface1and2, Memory1and2, Interpretation1and2, BreadthInfo1and2, QualInfo1and2, PrivilegedInfo1and2, and CoordInfo1and2) could distinguish firms that are complying with RFID mandates from those which are not. The Wilks' lambda value is significant at .594, chi-square value=15.345, $p<.10$, which indicates that the model including these nine variables was able to significantly discriminate between the two groups of firms. The resulting standardized function coefficient figures suggest that coordination information exchanged, use of memory systems, privileged information exchanged, and quality of information exchanged contribute the most to distinguishing firms complying with RFID mandates from those that are not. The classification results show that the model correctly predicts 88.2 percent of firms that are complying with RFID mandates and 78.9 percent of firms that are not complying with such mandates. Overall, 83.3 percent of the original grouped cases were correctly classified. It is noteworthy to mention that although breadth of information exchanged and use of interpretation systems do not contribute very much to the discriminant function, both are moderately highly (i.e., negatively) correlated with the overall discriminant function.

6.6 Multiple Regression (Predicting System Deployment Outcomes)

The multiple regression procedure was undertaken taking into account the fact that only 26 firms in the dataset of 37 firms had actual experience dealing with external trading partners in their RFID system implementation. While the literature suggests different thresholds for the number of cases per independent variable in a multiple regression, this study chose to use the criterion of having at least five cases per independent variable considered (Garson, 2007). The independent variables chosen for the multiple regression models were those that had the lowest correlations among themselves and the highest correlations with the dependent variables. The absence of multicollinearity problems among the combination of independent variables was also considered.

Multiple regression was conducted to determine the best linear combination of independent variables that would predict the first system outcome, operational efficiency. The combination of joint decision making and privileged information exchange significantly predicted operational efficiency, $F(2,23)=3.457$, $p<.05$, with privileged information exchange both significantly contributing to the prediction and contributing more to the prediction than joint decision making as suggested by the beta weights (Table 2). The adjusted R squared value was .231, indicating that 23.10 percent of the variance in operational efficiency is explained by the model.

Multiple regression was also conducted to determine the best linear combination of independent variables that would predict the other system outcome, market knowledge creation. The combination of use of interpretation systems for interorganizational information, coordination information exchanged, and use of standard electronic business interfaces significantly predicted market knowledge creation, $F(3,22)=6.144$, $p<.01$, with interpretation systems used and use of standard electronic business interfaces significantly contributing to the prediction of market knowledge creation as

indicated by their beta weights (Table 3). The adjusted R squared value was .456, indicating that 45.60 percent of the variance in market knowledge creation is explained by the model.

7 CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

The study advanced a key proposition that firms complying with RFID mandates will be distinguished from those firms not complying with such mandates in terms of absorptive capacity attributes. This proposition was confirmed using both T-tests and discriminant analysis. Additional analyses were conducted using the absorptive capacity attributes to predict the outcomes, operational efficiency and market knowledge creation. Using multiple regression, it was found that joint decision making and privileged information exchanged both significantly predicted operational efficiency. In seeking market knowledge creation, however, the importance of having appropriate interpretation systems in place emerges, along with coordination information exchanged and the use of standard electronic business interfaces.

Since data was obtained from a small convenience sample of firms that participated in an RFID pilot study, the findings cannot be generalized to the larger population of firms. After a representative sample is obtained in future efforts to replicate this study, alternative data analysis methods could be applied for more rigorous testing. For one, it would be interesting to apply the moderated regression procedure to see if compliance with RFID mandates is an effective moderator between absorptive capacity attributes and the two system outcomes, operational efficiency and market knowledge creation. Logistic regression can also be used to determine which absorptive capacity attributes distinguish those firms that comply and those that do not in seeking both operational efficiency and market knowledge creation.

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Variable	Mean	Std. Dev.	T	df	p
Memory1and2*			2.274	24	.032
Complying	5.7941	.84887			
Non-complying	4.5789	2.14905			
Interpretation1and2			1.849	34	.073
Complying	4.9020	1.69871			
Non-complying	3.7895	1.88958			
BreadthInfo1and2			2.492	34	.018
Complying	4.7253	1.56878			
Non-complying	3.2632	1.91017			
QualInfo1and2*			2.170	34	.040
Complying	5.8235	.96730			
Non-complying	4.5789	2.28074			
PrivilegedInfo1and2			2.727	34	.010
Complying	5.1765	1.48893			
Non-complying	3.5263	2.05800			
CoordInfo1and2*			3.242	30.336	.003
Complying	5.0882	1.30187			
Non-complying	3.2105	2.11684			

*The t and df for these variables were adjusted because variances were not equal.

Table 1. Comparison of the Absorptive Capacity Capabilities of Study Respondent Firms Which Complied with an RFID Mandate by a Trading Partner and Those that Did Not

Variable	B	SEB	Beta
Joint Decision Making	.194	.224	.176
Privileged Information Exchange	.320	.173	.377*

Note: R^2=.231; F(2,23)=3.457, p<.05; *p<.10

Table 2. Multiple Regression Analysis Summary for Joint Decision Making and Privileged Information Exchange Predicting Operational Efficiency (N=26)

Variable	B	SEB	Beta

Interpretation Systems Used	.834	.136	.330*
Coordination Information Exchanged	.201	.126	.286
Standard Electronic Business Interfaces	.333	.172	.314*

Note: R^2=.456; F(3,22)=6.144, p<.003; *p<.10

Table 3. Multiple Regression Analysis Summary for Interpretation Systems Used, Coordination Information Exchanged, and Standard Electronic Business Interfaces Predicting Market Knowledge Creation (N=26)