AN INFORMATION PROCESSING PARADIGM OF IT INNOVATION ADOPTION

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ABSTRACT
Recent research suggests that there may be other, more granular factors that influence the adoption of innovations like cloud computing by organizations. In the current study, organizational adoption of cloud computing is investigated by examining specific aspects of the classical diffusion theory as they are framed in the context of the information processing paradigm. The authors argue that various aspects of an organization and its respective environment create different information needs and influence the adoption and the diffusion of information technology (IT) innovation. An empirical study is conducted to test the model. The results show that the business process complexity, organizational culture and the compatibility of the current information system all contributes to the organization’s adoption decision. This study serves as a preliminary effort to investigate how the information processing requirement affects firms’ attitude to adopt IT innovation.

Keywords
IT innovation, adoption, information processing, cloud computing

INTRODUCTION
In today’s ordinary course of business within global organizations, massive computing capacity is a tool by which businesses may uncover additional opportunities and is a prerequisite artifact to the development of technology-driven competitive advantage (Liu and Orban, 2008). Cloud computing may offer a means by which organizations may leverage heretofore unavailable information technology capacity for a fraction of the traditional resource commitment. Cloud computing is a virtualized computing resource that is dynamically reconfigurable to support various degrees of organizational need all of which allows for an optimum systems utilization (Vaquero, Rodero-Merino, Caceres and Lindner, 2008). A review of the published research on cloud computing reveals that most studies either focus on exploring the architectures and applications of the cloud environment, or propose lists of opportunities and obstacles for firms considering cloud computing (Armbrust et al., 2009; Fox, 2009). In general, no research has examined the critical aspects of diffusion of cloud computing from a grounded theory perspective. Therefore, this study originates with the intention to examine cloud computing from the aforementioned perspective.

Previous research within the domain of classical diffusion theory indicates that characteristics perceived to be specific to an innovation like cloud computing, might provide a basis for explaining differences that facilitate the adoption of cloud computing among organizations (Rogers, 2003). Moreover, recent research suggests that there may be other, more granular factors that influence the adoption of innovations by organizations. Melville and Ramirez (2008) suggest that researchers examine technology innovations from the information processing requirement perspective. The authors argue that various aspects of an organization and its respective environment create different information needs and influence the adoption and the diffusion of information technology (IT) innovation. In the current study, we investigate organizational adoption of cloud computing by examining specific aspects of the classical diffusion theory as they are framed in the context of the information processing paradigm. Therefore, the general research question examined in this study is: how do an organization’s information processing requirements and information processing capabilities affect an organization’s intention to adopt cloud computing as a component of an overall information technology infrastructure?

CONCEPTUAL FRAMEWORK
An innovation, like cloud computing, may be defined as an idea, practice, or an object perceived as new by an individual or group (Rogers, 2003). According Roger’s (2003) innovation diffusion theory, the characteristics of an innovation include 1) relative advantage, 2) compatibility, 3) complexity of an innovation, 4) trialability, and 5) observability. Only the first two listed items are included in this research study due to the time and resource limitation. Relative advantage is the degree to
which an innovation is perceived to be better than a previously accepted idea. Compatibility is the extent to which a potential adopter perceives an innovation to be consistent with existing norms, experiences, and needs.

According to the information processing view (IPV), organizational decision-making is a process governed by uncertainty (Melville and Ramirez, 2008). In the context of the IPV, uncertainty is associated with inadequate knowledge related to decision-making (Karimi, Somers and Gupta, 2004). Within the organization, a lack of requisite knowledge to support decision-making may be the result of inefficiencies in the organization’s information processing requirements, information processing capacities, or some combination of both of the aforementioned constructs. Information processing requirements represent the organizational need for new or additional information to support decision-making in the face of uncertainty (Galbraith, 1977). Similarly, information processing capacities address the organizational ability to utilize new or additional information in the decision-making process (Tushman and Nadler, 1978).

Recent IS research suggests that one way organizations attempt to enhance organizational information processing requirements and information processing capacities is through the adoption of innovation information technology (Karimi et al., 2004; Melville and Ramirez, 2008; Mendelson and Pillai, 1998; Wang, 2003). In this study we assert that both the information processing requirements and the information processing capacities represent refined constructs of elements of the classical innovation diffusion model - compatibility and relative advantage. We characterize information processing requirements and the information processing capacities of the firm within the respective overarching constructs of compatibility and relative advantage from classical diffusion theory based on the previously discussed literature. Therefore, our generalized research model for this study is presented in Figure 1.

![Figure 1. The Information Processing View Framed in a Classical Diffusion Perspective](image)

According to the information processing view, organizations need to obtain information to lower the threat of uncertainty coming from the inner and outside environment and make correct decisions (Van de Ven and Ferry, 1980). Melville and Ramirez (2008) suggest that at the industry level, organizational task complexity can be analyzed by two dimensions: process complexity and supply chain complexity. The organizational environment can be illustrated by the speed which new products, processes and organizational structures are introduced in the industry (clock speed). Although the present study is conducted at the organizational level, we can still use the term of process complexity and supply chain complexity to reflect the complexity of the organizational task by changing their boundaries from industry to organization. Business process complexity reflects the dynamic of operating procedures of an organization. We define supply chain complexity as the degree of interaction within an organization’s supply chain boundaries, which is needed to accomplish these operations; therefore it considers the cooperation within a company as well as between upstream suppliers and downstream buyers (Melville and Ramirez, 2008). However we could not use the clock speed of the industry to describe the organizational environment at the firm level, thus we use organizational culture to replace it. Organizational culture displays the profile of a company which represents the organizational environment where all organizational tasks are completed (Leidner and Kayworth, 2006). In this paper, we consider organizational culture as one of the information processing requirement drivers, and divide organizations according to their level of entrepreneurship. The hypotheses here are:

H1: The higher firms’ business process complexity, the more likely they will adopt cloud computing.

H2: The higher firms’ supply chain complexity, the more likely they will adopt cloud computing.

H3: The higher level of entrepreneurship, the more likely firms will adopt cloud computing.
We define information processing capacities as the ability to satisfy the different information processing needs of the current information system that is used by the organization. In this research, because we target a single technology (cloud computing), it allows a much more focused characterization of the system information processing capacities. As we mentioned earlier in this paper, cloud computing is featured by its on-demand scalable computing power, rapid deployment, reduced support infrastructure, and low cost. Based on these characteristics, we find compatibility and application functionality reflect the relative advantages of cloud computing which attract the organization to adopt it. Compatibility means that the system is designed with different modules, which are sharable and reusable. The compatibility allows data or program can be used by any other system, regardless of manufacturer, make, or type. We define application functionality as the degree of functional integration and knowledge embedment of the system. It is the application parameterization which allows the system to be adapted to incremental changes without changing the application software. We can assume that if the current information system infrastructure contains relatively high levels of compatibility and application functionality, it prevents the company from adopting cloud computing. And these two dimensions are used to analyze the information processing capacities of the current information system. The hypotheses here are:

H4: The higher compatibility of firms’ IT systems, the less likely they will adopt cloud computing.

H5: The higher application functionality of firms’ current IT systems, the less likely they will adopt cloud computing.

RESEARCH METHODOLOGY

Instrument

The instrument used in this research was adapted from several previously instruments. The items for measuring process complexity were adapted from van Hoek’s (1998) research about the virtual integration of the logistics. Perona et al. (2001) conduct a study about the integrated logistic chain management in Italian white goods industry, which contains observed complexity-related variables. After contacting with the author, we obtained the items and adapted them for our study to measure the supply chain complexity. Items for measuring the organizational culture were adopted from Bradley et al.’s (2006) research of information system success in different cultural environments. In Byrd and Turner’s (2000) study, compatibility is described as the ability to share different types of information across various information system components. This study adopted the full scale for directly. After scanning the literature, no suitable measurement was found for application functionality, therefore, we developed 7 items with a 5-point Likert scale to capture it. The intention to adopt cloud computing was adopted from Venkatesh and Bala’s (2008) measure of user’s behavior intention in the technology acceptance model. In total, 22 questions are used to measure the five relationships under investigation in this study. Four items measure the business process complexity, three items measure the supply chain complexity, two items measure the organizational culture, seven items measure the compatibility, six items measure the application functionality, and three items measure the intention to adopt cloud computing. Furthermore, we use firm size and IT department size as control variables (Teo, Wei and Benbasat, 2003).

Data Collection

A survey was developed to test the 5 research hypotheses. A pilot test was conducted to validate the content validity. The questionnaire was sent to MBA students at a large southeast university and feedbacks were collected. The items were adjusted and then sent out again for collecting data. The data collection was facilitated through three national industry organizations: manufacturing, retail, and transportation industries. In total, 1,232 organizations were contacted to solicit participation via email. Three hundred and forty individuals completed the initial questionnaire survey. After a thorough review of the surveys submitted, 289 were deemed to be complete and therefore usable. Fifty-one surveys were not completed correctly and were removed from the sample. Of the 289 surveys retained, 187 responses were from firms in the manufacturing sector, and 102 responses came from retail organizations.

Data Analysis

Before heading to analyze the data, the reliability of the instrument was tested. After screening the data, the fifth item for measuring compatibility was taken out due to the zero variance in responses. The second item for measuring the supply chain complexity and the seventh item for measuring the compatibility were also eliminated because of the negative correlation with the rest items. Cronbach’s alpha of each measure is provided in Table 2. The results show that the reliability of each the scale is at least acceptable (Cronbach’s alpha > 0.7) (Nunnally, 1967).

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In order to examine the 5 hypotheses, multiple regression analysis was performed. Results are provided in Table 3. Here, the dependent variable was the intention to adopt cloud computing system; the independent variables were the business process complexity, supply chain complexity, organizational culture, application functionality, and compatibility. In order to control the effects of the predictors, we also included size of the firm and the IT department as control variables in the analysis.

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Business Process Complexity → Intention</th>
<th>Supply Chain Complexity → Intention</th>
<th>Organizational Culture → Intention</th>
<th>Application Functionality → Intention</th>
<th>Compatibility → Intention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficients</td>
<td>- 0.64</td>
<td>- 0.037*</td>
<td>3.935*</td>
<td>0.271</td>
<td>-4.544*</td>
</tr>
<tr>
<td>Support</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*: p<0.001

Table 3. Hypotheses Results

The overall regression model was significant (F=29.488, p<0.001). Three significant relationships were found. The business process complexity (b=- 0.64, p<0.001), organizational culture (b= 3.935, p<0.001), and compatibility of the current system (b= -4.544, p<0.001) have a significant relationship with the organization’s intention to adopt cloud computing. We also noted negative but not significant effects of supply chain complexity and application functionality of the current system on the dependent variable. These findings are reasonable and will be discussed in the next section.

DISCUSSION AND CONCLUSION

The results show that the business process complexity and compatibility of current information system have a negative relationship with the intention to adopt cloud computing while the organizational culture plays a positive role. No significant effect is found of supply chain complexity and application functionality. Although not all the findings are consistent with the original hypotheses, it is reasonable because these results come along with the theory of outsourcing as well as the specific characteristics of cloud computing.

One of the outsourcing strategies is identifying and controlling the core of the value chain, while outsourcing all other activities (Lee, Miranda and Kim, 2004). In complex production processes, there are strong technical interdependencies between what firms manufacture in house, and what they require from their upstream suppliers, such as materials, components, machine, and software (Miozzo and Grimshaw, 2005). Thus, these relationships and processes are very knowledge intense and crucial to the survival of the firm. As a result, firms would tend to keep these knowledge and information in house, and thus develop different parts of their IT structures, capabilities and skills in order to maintain the linkages between their IT provision and business prerequisites because these are tied to the firm’s core competence.

The positive effect of organizational culture supports the original hypothesis that high level of entrepreneurship would have a positive effect on the firm’s intention to adopt. Formal firms tend to be more rigid, stabilized, and they tend to follow the market trend rather than leading it. Their need of information processing is more predictable and stable. The entrepreneurial firms are more aggressive and would like to dig out the market opportunity and move ahead of their competitors. In order to achieve this goal, they will have a higher and more dynamic information processing requirement. This would contribute to the adoption of a new IS, in our case the cloud computing, because IS in cloud is easier to scale the capacity based on its features.

The negative relationship between the current system compatibility and intention to adopt cloud computing suggest that if the current system information processing capacity could satisfy the firm’s needs, it could be less likely to move into the cloud. Although according to the feature of cloud computing service, the pay-per-use pricing model and little IT hardware investment could save the cost on the system. However, firms need to consider the switching cost of moving the current system into cloud. Thus, firms with higher information process capacity of the current information systems could less likely switch to cloud computing.
In sum, although the literature suggests that information processing requirements would push firms to adopt new information systems, however, due to the special feature of cloud computing, centrally controlled by vendor, and the consideration of keeping the core business in house, firms would less likely adopt cloud computing if they have a very complex business process. The results also indicate that organizational culture would contribute to the information processing requirement which would influence the decision of cloud computing adoption. Furthermore, if the system’s current information process capacity is high, the firm would less likely adopt a new system. These results extend the innovation diffusion theory by framing it into the context of information processing paradigm and providing a comprehensive means to better understand the innovation diffusion phenomenon.

REFERENCES