BALANCING MODULARITY AND KNOWLEDGE IN DESIGNING AGILE ORGANIZATIONS
The Case of Outsourcing

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Abstract: The ability to innovate is of increasing importance for organizations to increase their competitiveness. Since organizations are becoming increasingly dependent on information technology (IT) to support their operations, IT nowadays plays a crucial role in stimulating innovation in organizations. It has also been shown that IT offers opportunities to organizations to increase their agility. In this paper, we argue that in order for organizations to innovate with IT, design parameters are needed which can be governed by organizations. Our focus in this paper is on how modularity and knowledge can be used as design parameters. Although the importance of knowledge has been widely acknowledged in literature, organizational modularity has received far less attention. We will demonstrate that attention to both design parameters is essential to innovate with IT. We focus hereby on an application within the context of IT outsourcing. We provide a framework that has a strong theoretical foundation which illustrates how the concepts of modularity, knowledge, outsourcing, agility, and innovation are related to each other.

1 INTRODUCTION

The ability to innovate is of increasing importance for organizations to increase their competitiveness. Several authors have indeed argued that the ability to innovate successfully will to a large degree determine the competitiveness of organizations (Hamel, 1998). In today's increasingly volatile environments, organizations must be able to respond quickly to their environment in order to innovate successfully (Teece et al., 1997; Eisenhardt and Martin, 2000). By being able to detect changes in its environment and to respond to these changes in an effective and swift manner, an organization can become more agile. Agility can be considered a measure of an organization's ability to change and adapt to its new environment (Neumann and Fink, 2007).

Organizations are becoming increasingly dependent on information technology (IT) to support their operations. As a result, IT nowadays plays a crucial role in stimulating innovation in organizations (Brynjolfsson and Saunders, 2010). It has indeed been shown that IT offers opportunities to organizations to increase their agility and flexibility (Neumann and Fink, 2007; Sambamurthy et al., 2003).

Lately, it has been argued that organizations should be designed. An organization designed using design rules can be more agile and is therefore better able to react to changes in the environment. This issue is explored in the *Enterprise Architecture (EA)* domain. Unfortunately, current EA models and artifacts have a descriptive, rather than prescriptive nature. In addition, it is not fully clear yet which design rules exist. We therefore argue that a strong theoretical basis is required to identify design parameters that can be governed by organizations. In this paper, we discuss how *modularity* and *knowledge* can be used as design parameters. Both knowledge and modularity represent hands-on design parameters that can be governed by organizations. We illustrate this within the context of IT outsourcing. IT outsourcing is an interesting topic, since it offers many opportunities, but at the same time it may also pose some threats to organizations. We will demonstrate that attention to both design parameters is essential to innovate with IT. In addition, it will be shown that both modularity and knowledge are strongly interrelated and that organizations need to find a balance between both design parameters. To this end, we provide a framework that has a strong theoretical foundation which il-

lustrates how the concepts of modularity, knowledge, outsourcing, agility, and innovation are related to each other.

2 BACKGROUND

In this section, we briefly introduce the concepts of modularity and knowledge.

2.1 Modularity

Modularity is a concept from systems theory that has been used in several domains. A common theme underlying the concept of modularity in each of these domains is agility and flexibility (Sanchez and Mahoney, 1996; Baldwin and Clark, 2000). The idea behind modularity is that a system should be composed in such a manner that all components are loosely coupled. To this end, system elements that must intensively interact with each other should be isolated in a separate module to ensure that changes to this module do not have an influence on the rest of the system. Communication between modules is managed by well-defined interfaces (Baldwin and Clark, 2000). The concept of modularity has, amongst others, been used in software engineering and product design. More recently, modularity has also been used with respect to the design of organizations (Tiwana, 2008; Campagnolo and Camuffo, 2010; Sanchez and Mahoney, 1996; te Winkel et al., 2008). This research area investigates how organizations can be constructed using loosely coupled autonomous organizational units that allow organizations to adapt more quickly to changing environments (Sanchez and Mahoney, 1996; te Winkel et al., 2008).

2.2 Knowledge

The importance of organizational knowledge has been acknowledged in several fields, including management and information systems (Teece et al., 1997; Eisenhardt and Martin, 2000; Kogut and Zander, 1992; Attewell, 1992). It has been noted that activities such as skill acquisition, the management of knowledge, and know-how and learning are key strategic issues (Teece et al., 1997). Knowledge is also considered a particularly important dynamic capability that allows organizations to compete in volatile markets (Eisenhardt and Martin, 2000; Kogut and Zander, 1992; Grant, 1996). Some scholars even consider knowledge to be the most important resource of an organization (Grant, 1996). Hence, it is important that organizations invest in further expand-

ing their knowledge base. This is emphasized by the absorptive capacity theory which starts from the assumption that external sources of knowledge are critical to guide the innovation process within organizations. Organizations will differ in their ability to exploit this external knowledge and will therefore exhibit different patterns of innovation. The higher the organization's absorptive capacity, the greater the organization's ability to create new knowledge (Cohen and Levinthal, 1990). Exposure to outside sources of knowledge is crucial to the innovation process within organizations, since the organization can then combine this external knowledge with the internally available knowledge and put it to new use (Cohen and Levinthal, 1990). This requires that some knowledge transfer takes place from the environment to the organization (Cohen and Levinthal, 1990; Kogut and Zander, 1992).

3 OUTSOURCING

In this section, we will show how organizational modularity and knowledge can be used as design parameters and how they can impact an organization's agility and ability to innovate. We illustrate this within the context of IT outsourcing decisions.
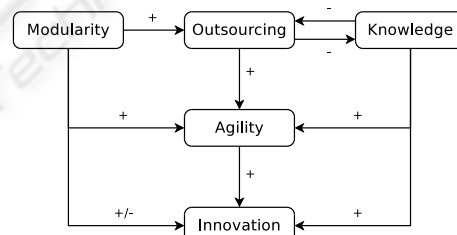

Figure 1: Theoretical framework.

The theoretical framework developed in this study is shown in Figure 1. This framework can be used to balance the modularity and knowledge design parameters with respect to the outsourcing decision. In this framework, it can be seen that there is a positive link between the use of outsourcing and the agility of the organization. Previous studies have indeed suggested that the use of outsourcing can increase the agility of organizations (White et al., 2005; Mason et al., 2002). Through the use of outsourcing, organizations can become more flexible since they can gain access to specific knowledge possessed by the service provider, without having to invest in a learning process. Conversely, when specific expertise is no longer needed by the organization, outsourcing contracts can be relatively easily terminated without having an impact on the internal human resources. By being more

agile, organizations increase their ability to innovate, as it allows them to react more quickly to changes in the environment (Sambamurthy et al., 2003; Eisenhardt and Martin, 2000). We will now discuss how modularity and knowledge influence the outsourcing configuration and innovation.

3.1 Modularity and Outsourcing

Previous literature on product modularity indicates that there is a positive link between modularity and the use of outsourcing (Frigant and Talbot, 2005; Sako, 2003; Campagnolo and Camuffo, 2010). In order to be able to outsource certain tasks to external organizations, some degree of modularity is required (Campagnolo and Camuffo, 2010; Sako, 2003). This ensures the definition of clear interfaces that allow efficient communication between the customer and service provider which form a basis for the outsourcing contract (Baldwin and Clark, 2000). Relatively few studies have investigated this link with respect to organizational modularity. The few studies so far suggest that modularity also has a positive effect on the use of outsourcing in such contexts (Tiwana, 2008; Campagnolo and Camuffo, 2009). This can be explained by the fact that some level of organizational modularity is required to be able to outsource certain tasks to a service provider. Moreover, the more loosely coupled the organizational structure, the easier it is to outsource certain components. Nevertheless, additional research on this topic is required.

3.2 Modularity and Innovation

Several studies have explored the impact of modularity on innovation. However, the exact nature of the relationship is not very clear. Some studies have suggested that modularity has a positive impact on innovation. Those studies have argued that modular product architectures provides increased flexibility, thereby allowing organizations to innovate with respect to product features that are important to customers such as speed, convenience, and customization (Baldwin and Clark, 2000). In addition, modular structures are preferred over integrated structures when flexibility and rapid innovation are important (Baldwin and Clark, 2000). Other authors have warned that modularity can also have a negative impact on innovation. It has been noted that increased modularity generally reduces the need for knowledge sharing between customer and service provider, given the increased codification of knowledge and the specification of standard interfaces (Tiwana, 2008). This reduction in the degree of knowledge sharing

may become an obstacle to innovation, since the customer may have insufficient knowledge of—and control over—the activities of the service provider. Finally, although higher modularity may facilitate the identification of emerging technologies, organizations may lack the absorptive capacity to assimilate it and to innovate (Cohen and Levinthal, 1990). The link between organizational modularity and innovation has received very little attention in literature. One of the very few studies on this topic suggests the presence of a positive link (te Winkel et al., 2008). It has also been noted that modular organizational forms are more likely in industries with a higher number of product, process and organizational innovations (Campagnolo and Camuffo, 2009). Hence, the exact relationship between modularity and innovation is not fully clear.

3.3 Knowledge and Innovation

Literature provides strong evidence for the positive influence of knowledge on innovation (Cohen and Levinthal, 1990; Wheeler, 2002; Fabrizio, 2009; Kogut and Zander, 1992). The importance of internal knowledge, and the need for organizations to expand their knowledge base forms the basis of the absorptive capacity theory (Cohen and Levinthal, 1990). Organizations with a higher absorptive capacity will be able to recognize the potential of emerging technologies more quickly, and adopt them before their competitors to innovate (Cohen and Levinthal, 1990; Wheeler, 2002). Having a broad knowledge base also facilitates the identification of new opportunities by making connections between different pieces of information that have not been made before. The absorptive capacity theory therefore considers external sources of knowledge to be critical in guiding the innovation process within organizations. Although external knowledge can be obtained through outsourcing, the organization still requires a minimum level of internal knowledge to recognize opportunities for the organization to innovate (Cohen and Levinthal, 1990). Otherwise, it is fully dependent on external parties to support its innovation process. In today's information economy the production of information goods becomes increasingly important (Brynjolfsson and Saunders, 2010). Since the production of information goods relies on IT, innovation becomes increasingly a knowledge-intensive activity.

3.4 Knowledge and Outsourcing

Knowledge and outsourcing can influence each other in two ways. First, the availability of internal knowledge can have an effect on the outsourcing configu-

ration. If sufficient internal knowledge is available, the need for outsourcing may be small. Conversely, if specific knowledge that is required by the organization is not available internally, this knowledge can be obtained from service providers (Tiwana, 2008). Second, the outsourcing configuration can also have an effect on the knowledge base of the organization. If the organization decides to outsource certain activities that were previously performed in-house, the organization risks loosing the knowledge related to those activities (Earl, 1996). Conversely, if the organization decides to cancel an outsourcing contract and to perform these activities in-house, the organization will have to (re)acquire the necessary knowledge to perform these activities. Some scholars have indeed warned about the potential negative impact of outsourcing on organizational learning, the competence of the internal IT staff and the loss of innovative capability (Earl, 1996). Outsourcing a set of activities may reduce the organization's ability to bring those activities back in-house at a later time. If the organization decides to reverse its decision to outsource a set of activities, this means that the organization will have to invest in a process of organizational learning since the knowledge required to perform these activities has to be reacquired. The ease with which this process of organizational learning can take place depends on the absorptive capacity of the organization (Cohen and Levinthal, 1990). Once an organization ceases to invest in absorptive capacity, it will become difficult to acquire external knowledge in the future, even if this knowledge was once present in the organization (Earl, 1996). In the extreme case, this may even create a situation in which the organization is locked out from future opportunities (Cohen and Levinthal, 1990). The longer it takes the organization to complete this learning process, the lower the ability of the organization to react to changes in its environment. As a result, the agility of the organization decreases and so does the ability of the organization to innovate.

4 DISCUSSION

In this paper, we developed a comprehensive framework that integrates the results from previous studies and that provides a better understanding of the various relationships between modularity, outsourcing, knowledge, agility and innovation (see Figure 1). This framework provides one possible explanation for the conflicting evidence with respect to the impact of modularity on innovation. Although a positive relationship exists between modularity and outsourcing, the use of outsourcing may have a negative effect on the knowledge base of the organization. This will have a negative impact on the agility of the organization and its ability to innovate. Whether this negative impact on innovation will take place, depends on how both modularity and knowledge simultaneously impact innovation. Hence, organizations should consider both effects when making outsourcing decisions.

Both modularity and knowledge are therefore important design parameters. Organizations can make strategic decisions to make changes with respect to both parameters in order to increase their agility and ability to innovate. Evidently, some trade-off will have to be made with respect to both parameters. We have provided an example of how such evaluation can take place within the context of outsourcing. It is important to note that our framework does not intend to assign a priority to modularity and knowledge, or even agility and innovation. Rather, organizations should decide on the importance of these parameters within the organization-specific context and depending on their strategy. Based on the goals of the organization, they should find a balance between the design parameters of modularity and knowledge.

Outsourcing is an important topic to study in this regard. In the past, outsourcing has primarily been used to externalize non-core and non-knowledge-intensive activities (e.g., programming). Currently, outsourcing is increasingly used for highly knowledge-intensive activities that affect the core of the organization. For example, service providers are gaining knowledge about the business processes of organizations. The outsourcing of business processes requires highly modular structures, but this may imply that little knowledge transfer takes place between customer and service provider, and as a result valuable knowledge leaves the organization (Earl, 1996; Tiwana, 2008). In discussions with informants in Belgian organizations, we have noted that several organizations are loosing valuable knowledge about their IT infrastructure and their business processes. This is an issue that has been understudied in literature with respect to innovation, and current management tools and frameworks pay too little attention to this issue.

Our findings have important practical implications. It is commonly known that European organizations are—on average—smaller than US organizations. Eurostat statistics show that 98.7% of European organizations have less than 50 employees. Even when omitting so-called micro-organizations with less than 10 employees, organizations between 10 and 49 employees still represent 84.2% of the European organizations with 10 or more employees (Eurostat, 2010). We have learned from meetings with

informants in Belgian organizations that in many of these organizations, no internal technical IT staff is present, with the exception of one person who is responsible for making decisions with respect to IT. Frequently, this person also has other responsibilities. This especially applies to organizations that do not make intensive use of IT. As a result, all activities related to IT are outsourced to a local service provider. Given the lack of internal resources, this service provider will provide the organization with an IT infrastructure and will continue to maintain it, while no knowledge is being transferred between both organizations. Hence, the organization does not learn about the opportunities IT could offer to the organization, and its ability to innovate with IT remains limited. Traditionally, literature has suggested a positive link between organization size and innovation, due to the fact that large organizations have more resources that can be used to innovate (Rogers, 2003). However, it has recently been argued that smaller organizations may be more agile and better able to react to changes in the environment (te Winkel et al., 2008). When organizations grow, they may adopt a bureaucratic organizational structure. This structure may slow down their ability to change, or even kill innovative ideas that arise within the organization and that are not in line with the strategy of the organization. We therefore argue that many small organizations in Europe have much unrealized potential to innovate with IT by not having sufficient internal knowledge.

In large organizations, there is an increasing trend towards the outsourcing of IT. Various—legitimate—reasons exist for this: increasingly modular structures that facilitate outsourcing, the lower cost of offshore developers, and a lack of skilled domestic labor. However, if all IT-related activities are outsourced, this also means that valuable knowledge leaves the organization, and the absorptive capacity of the organization decreases. We are aware of large organizations in Belgium in which only a few (1–3) persons are still knowledgeable about the IT infrastructure. Evidently, this seriously restricts the ability of the organization to innovate with IT, and poses a considerable risk if that person leaves the organization.

Both scenarios imply that organizations develop little IT knowledge, or even loose their existing IT knowledge. As previously noted, IT is becoming increasingly important to support the innovation process in organizations (Brynjolfsson and Saunders, 2010). This implies that organizations should try to adopt new IT that may offer opportunities to the organization to innovate. However, it has been shown that the adoption of IT is frequently knowledge-intensive (Attewell, 1992). It is reasonable to expect that this will certainly apply to IT that allows organizations to truly innovate. In order to adopt knowledge-intensive IT, organizations must engage in a process of organizational learning (Attewell, 1992). Organizations with a higher absorptive capacity will be able to move more quickly through the learning process, and will therefore be able to react more quickly to the environment by innovating with IT. However, both scenarios described above imply that organizations have a low absorptive capacity. This considerably limits their ability to identify, assimilate and exploit emerging technology that becomes available on the market (Wheeler, 2002; Cohen and Levinthal, 1990). Hence, organizations with little internal IT knowledge are in this respect rather limited in their ability to innovate. As a result, they tend to take a more reactive stance with respect to new technology by relying on the judgment of service providers, rather than proactively exploring the opportunities of new technology.

This suggests that—rather than begin provided with black-box IT solutions—organizations should seek to learn form their service provider. Such alternative outsourcing models include co-sourcing alliances and transaction exchanges. Research has shown that although the success rate for both are higher than for traditional outsourcing arrangements, the organization must exhibit a higher maturity in terms of its modular enterprise architecture (Ross and Beath, 2006). This further illustrates that the design parameters of modularity and knowledge should be considered simultaneously.

5 CONCLUSIONS

In this paper, we have argued that in order for organizations to innovate with IT, design parameters are needed which can be governed by organizations. We have focused on the role of knowledge and modularity as hands-on parameters that have a strong theoretical foundation and that can be controlled by organizations. Our results imply that managers should find a balance between both design parameters to assess their impact on the agility of the organization and its ability to innovate with IT.

This study has two important contributions. First, we have developed a comprehensive framework that integrates literature on modularity, knowledge, and innovation within the context of outsourcing. Second, we have shown that both modularity and knowledge are essential design parameters for constructing organizations. We have further shown that both knowledge and modularity are strongly interconnected within the context of outsourcing and how they

both simultaneously influence innovation.

Our study provides several opportunities for future research. The framework developed in this paper can provide a basis for future empirical studies to study how organizations consider the influence of modularity and knowledge in their strategy for innovating with IT. In future research, we also intend to further validate this framework to investigate how managers take into account knowledge and modularity in making decisions on IT outsourcing.

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