FUNCTIONS OR FLEXIBILITY?
THE ROLE OF AGILITY IN BUSINESS SOFTWARE

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ABSTRACT
Change is a key driver in today’s societies and forces businesses to adapt to their competitive environment with increasing speed. At the same time, modern enterprises require complex business software systems to manage their operations, and those complex systems formalize business processes and constrain agility. While research on ERP selection has included flexibility, adaptability or agility as criteria, these have not been thoroughly defined, and the resulting tension between functional scope and agility has not been dissolved. Drawing upon and expanding digital options theory, the paper examines the role of IT as a generator of options and non-options and develops a basic framework for business software agility.

KEYWORDS
Agility, Business Software, Enterprise System, ERP, Flexibility, Digital Options

1. INTRODUCTION AND OVERVIEW

In today’s turbulent environment, the ability to cope with unforeseen events represents a key element of competitiveness (Goldman et al., 1995). In a technology-based business environment, however, business agility requires matching IT agility. The powerful business software systems enterprises use to achieve their efficiency targets represent both an asset and a barrier to agility: On the one hand, the systems’ functional richness have brought businesses unprecedented ability to store, process and share information and automate business processes. On the other hand, the systems’ enormous complexity also limits their ability to react to change, that is, their agility.

The aim of this paper is to contribute to the understanding of business software agility in the context of the ERP selection process and the creation of digital options. This is achieved by (1) analyzing ERP selection criteria with an emphasis on functional fit and agility; (2) discussing the digital options framework and pointing out that digital options are, as defined, static in nature; and (3) defining business software agility and its basic framework.

Business Software

Business software applications, broadly defined as software that serves to support business processes (Schubert, 2007) are essential to modern businesses. Specifically in the form of enterprise resource planning (ERP) systems, they are “typically the largest, most complex and most demanding information systems implemented by firms” (Grabski et al., 2011). An ERP system “is a business management system that comprises integrated sets of comprehensive software, which can be used, when successfully implemented, to manage and integrate all the business functions within an organization” (Shehab et al., 2003).

Thus, they encompass purchasing, manufacturing, customer relationship management and logistics, as well as accounting and controlling. Davenport (1998) claims they represent “the most important development in the corporate use of information technology in the 1990s”. Especially business models of large organizations, which require complex supply and manufacturing networks, benefit from enterprise resource planning systems. Historically, business software applications initially covered the field of financial
accounting and controlling (Grabski et al., 2011). As the functional scope extended to other business areas, systems became increasingly complex and expensive to develop and maintain. Therefore, many enterprises ceased developing their solutions in-house and instead started to implement standardized ERP products offered by software vendors (Scheer and Habermann, 2000). Among ERP systems’ key benefits are (Gupta, 2000; Nah et al., 2001):

- Significant reductions of inventory (15% - 35% in the manufacturing sector)
- Business process automation and integration
- Sharing of data and practices across the enterprise
- Generation and sharing of data in real time

However, standardized business software applications also pose challenges. In order to address a large market, an ERP system’s functional scope has to meet a large number of potential customers’ requirements, encompassing diverse functional areas, industries and geographical regions. To use an ERP system, an organization first has to adapt the system to fit its individual needs (Davenport, 2004). Thus, ERP implementation projects are expensive endeavors: Customers often spend between three and seven times the software’s license price to adapt the product to their needs in time-consuming consulting projects (Scheer and Habermann, 2000). Because the level of customizing is a key impact of the overall implementation cost, many enterprises adopt an ERP system’s best practice processes as their own, effectively adapting their organization to fit the ERP system. ERP vendors offer several packages of pre-configured solutions for varying customer industries and organization sizes to shorten implementation times and ease the introduction of best practices (Scheer and Habermann, 2000). Thus, the options for customers are multifaceted and often not transparent, and enterprises use a variety of ways to select the right software. In their comparison of large enterprises and small and mid-sized businesses (SME), Bernroider and Koch (2001) identified several characteristics of the ERP selection process:

- The majority of companies use a formal model to support decision-making
- Smaller organizations mostly use only static models
- Large organizations also use dynamic models
- Approximately one-half of the companies estimate the cost of their decision-making investment

Key decision-making structures include:

- Top-management with minimal participation of other groups (17.6%)
- Centralized selection driven by IT or organizational department with little participation of other groups (10.9%)
- Participation of several groups, including those affected by the implementation (35.3%)
- Structures representing a mix of the above, and others (36.1%)

2. BUSINESS SOFTWARE AGILITY

Function versus Flexibility: Business Software Agility and ERP Selection

Selecting business software is a complex, strategic, multi-criteria activity not completely transparent (Stefanou, 2001). In their review of enterprise resource planning research, Shehab et al. (2004) have examined seven studies of the ERP selection process and the criteria involved. The criteria identified include duplicates and can be summarized into fourteen different criteria (see Table 1, below), covering diverse aspects of an ERP selection. Among these criteria, functional fit, that is the aspect of functional scope and how well this scope addresses the perceived requirements, has been mentioned most often in the studies analyzed. Mentioned equally often, the criteria of costs, vendor implementation support, and integration and supply chain fit all follow a close second. Integration and supply chain fit concerns the requirements of the enterprise’s own customers and suppliers and issues of integration and interfaces to other systems, while the vendor’s market position, ranked fifth, addresses issues such as the vendor’s financial stability and market share. Agility, encompassing flexibility and adaptability, follows ranked sixth, mentioned in less than half the studies, and equally often as the enterprise’s corporate strategy, and the quality of the system’s upgrades.
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which is determined by the option's
infrastructure that shapes a firms' capacity to launch frequent and varied competitive actions."
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dimensions of (1) process reach; (2) process richness; (3) knowledge reach; and (4) knowledge richness. The qualities of reach and richness, however, result from how deeply technology is integrated with business. Sambamurthy et al. (2003) associate high process

<table>
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<th>Table 1. Frequency of ERP Selection Criteria</th>
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<td><strong>Criterion</strong></td>
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<td>Functional fit</td>
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<td>Vendor implementation support</td>
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<td>Costs</td>
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<td>Integration and supply chain fit</td>
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<td>Vendor market position</td>
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<td>Quality</td>
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<td>User interface</td>
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Source: Adapted from Shehab et al., 2004

In their study of the ERP selection process, Bernroider and Koch (2001) compared selection criteria of large enterprises to those of small and medium-sized enterprises (SME). They found that large companies value good support, followed by process improvement, with the software’s adaptability and flexibility ranking third in frequency of being mentioned as a very important criterion. SME, however, most often found adaptability to be very important, followed by increased customer satisfaction and good support. While flexibility is ranked second in the research of Everdingen, et al. (2000), with a narrow lead over cost, its importance is drastically lower than the criterion of fit. In their survey of more than 2000 ERP decision-makers, system-related criteria were also separated from vendor-related criteria. Among vendor-related criteria, functionality, again, ranks highest, followed by quality of product and speed of implementation. Everdingen et al. conclude “The results show the most important criterion used in selecting an information system is the best fit with current business procedures [emphasis added]”. This implies that current functional scope requirements determine ERP selection, and that agility is of lower importance.

Digital Options and Non-Options

The strong focus on an ERP product’s fit with current business procedures contradicts the common paradigm of change as the key driver of modern business. Hypercompetition, a term coined by D’Aveni (1994), is caused by global competition, technological change, shortened product life cycles and changes in customer demand and loyalty, and it increases the speed of change business are exposed to. Practitioners share this view: In his 1999 monograph, Gates posits “the 1980s were about quality, the 1990s were about reengineering, . . . the 2000s will be about velocity.” Goldman et al. (1995) call for agility as the necessary capability to confront and exploit the turbulent business environment. Their understanding of business agility is that of a business capability that includes flexible organizational structures, an entrepreneurial culture, lifelong learning and enabling systems and infrastructure. In this view, complex information systems are, like other information technology assets, an options generator and a means to achieve agility. Similarly, Sambamurthy et al. (2003) state that “agility is vital to the innovation and competitive performance of firms” and determines the competitive actions a firm has at its disposal. They define three types of agility: customer, partnering, and operational agility, which, together, constitute overall agility. They argue that IT impacts firm performance because it contributes to business agility by playing a role as a digital options generator, explaining that a digital option is “a set of IT-enabled capabilities in the form of digitized enterprise work processes and knowledge systems”, and they determine the options’ contribution by assessing the four dimensions of (1) process reach; (2) process richness; (3) knowledge reach; and (4) knowledge richness. Thus, as Sambamurthy et al. (2003) conclude, “the value-added role of IT lies in enabling a business infrastructure that shapes a firms’ capacity to launch frequent and varied competitive actions.” This understanding implies that a digital option always has a positive contribution to business agility, the extent of which is determined by the option’s reach and richness. The qualities of reach and richness, however, result from how deeply technology is integrated with business. Sambamurthy et al. (2003) associate high process
reach with “processes that tie activity and information flows across departmental units, functional units, geographical regions, and value network partners (e.g., suppliers)”. Thus, the higher the integration is, the higher the reach, and, ceteris paribus, the better a digital option’s contribution to agility. The digital option’s dimensions are determined by IT investment level, IT capabilities (IT infrastructure and human capital) and entrepreneurial alertness (strategic foresight and systemic insight). Thus, IT’s contribution to business agility ultimately rests upon (1) IT investment; (2) IT infrastructure; (3) IT human capital; and (4) timely awareness.

Figure 1. Digital Options and (Business) Agility (Adapted from Sambamurthy et al., 2003)

Sambamurthy et al. (2003) concede that path-dependencies apply to prior learning, investment or experience, but claim that in light of this path-dependency, the options represent an economical advantage. However, it can be argued that the options themselves result from path selection, and, therefore, are path-dependent. Thus, an option’s creation process includes choosing a new set of constraints, or non-options.

**Functional Fit and the Automation Trap**

In light of path-dependency and non-options, the limitations of the digital options framework become apparent: generating options by maximizing, for instance, IT investment and process reach, can lead into an automation trap, in which information technology limits options and constrains business agility. According to Sambamurthy et al. (2003), IT capabilities consist of “the quality of the IT infrastructure (global connectivity and reliability) and IT human capital (appropriate technical and business skills), and the nature of IS/business partnerships.” These factors, however, also depend upon IT investment, making the level of investment, potentially, the most important factor in the digital options framework, because it also determines functional fit, by allowing purchase of more sophisticated products, or larger customization efforts. Following the paradigm of maximum process reach and pursuing a focus on current functional requirements to guide IT investment can result in powerful, deeply integrated business software systems, which are optimized to meet the requirements of a status quo. However, these requirements are the currently perceived requirements the organization is aware of. Even in formalized selection processes, relevant change can occur after the analysis has been completed. But when an IT investment decision has been taken, the ability to adapt significant elements gradually decreases with the project’s progress. In the process of implementation, non-options become increasingly fixed.

Figure 2. The Paradigm of Reach and Richness

Whether this situation constitutes a necessary trade-off or a business risk depends on several factors: Firstly, the nature of the business model plays a central role in determining the role of business software
applications. For instance, a multinational chemical company with long product lifecycles will require deep integration of manufacturing, supply chain management and customer relationship functions in order to streamline their value chain and control inventory. For such a company, ERP is the price of entry for running a business (Shehab et al., 2004). Other researchers have contributed different findings. In their case study of niche companies, Olsen and Sætre (2007) argue that niche companies “thrive on being special, in product line, in their ability to customize products, in their agility or in customer-relation management.” They conclude that an ERP solution will come into conflict with these idiosyncrasies. Secondly, the speed of change affects how enterprises define their IT strategies. Olsen and Sætre (2007) argue the business environment has moved from static to dynamic, and business process change implies software change. Hence the ability to control core software is critical, and Olsen and Sætre even suggest proprietary development as a possible alternative. Thirdly, the nature of change is relevant to determine which aspect of software agility is addressed. For instance, a process change may impact software functionality, whereas product innovation may require a change in technology, and changing organizational structures and tasks may benefit from a changed architecture. Service-oriented architecture offers a potential solution to the agility challenge of complex IT architecture: Choi et al. (2010) point out that “one of the major objectives of SOA is to improve IS agility.” Building architecture with business processes and their components in mind delivers a higher level of agility, and helps to standardize processes and process building blocks. When fully realized, a service-oriented architecture can fulfill unforeseen requirements, as long as they are composed of foreseen elements. However, SOA also requires additional efforts, including (1) the definition of business processes in the form of services; (2) dealing with fundamental and complex design challenges; and (3) committing a larger upfront investment. Thus, SOA can provide a solution for large enterprises, which are able to dedicate the resources to invest in a large-scale SOA-project. These organizations also need a thorough understanding of their business processes, their IT architecture and technology. Small and mid-sized businesses often do not have the resources or skill-set to conduct such a complex project (Hau et al., 2008). Although ERP solutions based on SOA can potentially address the needs of SME if deployed as adaptable mash-ups in an outside-in approach, they are currently not available (Castro-Leon et al., 2007). SOA can form the foundation of software agility, but it is unlikely to address all of the challenges involved, unless service components completely encompass aspects of user interface and business logic, as well.

**IT Capabilities and Business Software Agility**

Business software agility, as a complement of business agility, is more than the sum of digital options, which are limited to reach and richness. In this respect, the framework of Sambamurthy et al. presents digital options as capabilities in the form of digitized assets. While these options result in business agility, they themselves do not equal business software agility. They are the result of investment decisions, and the examples Sambamurthy et al. provide, e.g. Ebay’s sales process or Accenture’s knowledge management system, are IT assets. In their review of agility, flexibility and responsiveness, Bernardes and Hanna (2009) distinguish the terms. Whereas the flexibility is the ability to react to expected change within defined constraints, agility is the ability to respond to unforeseen change in an unpredictable environment. Bernardes and Hanna further specify agility as the „ability of the system to rapidly reconFigure [sic] (with a new parameter set)“. This understanding implies that agile business software must to cope with unexpected change in various dimensions, such as quantities, velocity, organizational structure or business processes. Therefore, business software agility is enabled by functional, architectural and technological capabilities. These are generated using IT capabilities (e.g., human capital and infrastructure), which result from IT investment.

![Figure 3. Business Software Agility Framework](image-url)
Like digital options, business software agility is path-dependent and includes limitations. Unlike digital options, it is not limited to the status quo of process and knowledge reach and richness. Whereas digital options represent a system’s current, implemented capabilities, business software agility encompasses the ability to adapt and reconfigure to demonstrate new capabilities in the future.

3. CONCLUSION

This paper has aimed at contributing to the understanding of business software agility. It has discussed the tension between the ERP selection criterion of functional fit and the criterion of agility, concluding that the focus on current, perceived requirements may lead enterprises to select functionally powerful but complex systems that limit their future agility. By examining digital options theory, the paper has identified a limitation of the digital options framework. Following the agility definition of Bernardes and Hanna (2009), business software agility is established as the ability to reconfigure in the face of unforeseen change. To depict the relations, a basic business software agility framework was presented.

The paper has several limitations: It is the result of theorizing and requires empirical evaluation. Additionally, it presents a preliminary result from an ongoing study. As such, it constitutes a starting point for further research. By critically reviewing digital options theory and ERP selection criteria, it offers a different perspective on the subject of agility. By linking business agility and business software agility, it addresses the role of agility within the field of business software. While this may seem trivial, it actually requires IT to adopt a role and perspective different from being an options generator for business agility.

REFERENCES


