

A Holistic Approach for Enterprise Agility

1. Introduction

Nowadays, organizations operate in highly turbulent environments having to cope with a frenetic pace of change (Rockart et al, 1996). Globalization and continual technological evolution are the main drivers of this turbulence. Other change factors include political issues, deregulation, consolidation in the business network, etc. (Oosterhout et al. 2006). As firms continuously sense opportunities for competitive action in their product-market spaces, it is agility which underlies firms' success in continuously enhancing and redefining their value creation in highly dynamic environments (Sambamurthy et al., 2003).

Indeed, agility has been recognized as a key characteristic of a modern enterprise. It has been therefore the concern of a plethora of researchers who have identified that agility is of a polymorphous nature and cannot easily be attained. To explore the concept of enterprise agility taking into consideration all necessary aspects, we propose an approach that is based on a viewpoint-oriented *Enterprise Architecture*. The term *Enterprise Architecture* as employed in this chapter is in contrast to enterprise architecture as perceived by IFEAD (<http://www.enterprise-architecture.info/ifead%20about.htm>) or Zachman framework (Zachman, 2004) where IT is considered the focus of attention. Our approach treats all perspectives, for example people, business process and information systems, as of equal importance. This is necessary for a proper examination of enterprise agility, as any partial approach will not be able to identify all the parameters necessary for an enterprise to be deemed agile.

Through this viewpoint-oriented architecture and the proposed approach, we provide a structured method for a holistic analysis of enterprise agility, aiming at helping researchers to identify issues or requirements for the attainment of agility. This chapter provides such an analysis through which a number of important agility issues are identified.

The chapter is structured as follows: Section 2 provides the literature review which leads to the deduction of useful conclusions regarding agility. Section 3 presents the viewpoint-oriented Enterprise Architecture and discusses the proposed approach. Sections 4 and 5 demonstrate the approach. Lastly, section 6 wraps up the chapter with some concluding remarks.

2. Literature Review

Enterprises able to respond efficiently to change are characterized by different terms in the literature, such as *flexible organizations*, *agile enterprises*, *adaptive enterprises*, *sense-and-respond enterprises*, and less often, *intelligent enterprises*.

The term *flexible organization* is introduced by Leeuw and Volberda (Leeuw and Volberda, 1996) who describe organizational flexibility through synonyms such as *mobility*, *responsiveness*, *agility*, *suppleness* and *litheness*. Based on system control theory, they have developed a definition for organizational flexibility according to which "*flexibility is the degree to which an organization possesses a variety of actual*

and potential procedures, and the rapidity by which it can implement these procedures, in order to increase the control capability of the management and improve the organization and the environment". Evans (Evans, 1991) denotes that flexibility is the ability to do something other than what was originally intended, emphasizing thus the ability to respond to unforeseen changes as well. Evans characterizes flexibility as a polymorphous concept and analyses it by relating it to other similar concepts, most notably *adaptability*, *agility*, *versatility*, *resilience* and *malleability*. Evans distinguishes two types of flexibility in terms of intention, namely *offensive* and *defensive flexibility*, and two types in respect to time, namely *ex ante* and *ex post flexibility*. Offensive flexibility concerns creating and seizing an initiative, while defensive means guarding against predatory moves or correcting past mistakes. Ex ante flexibility involves in advance preparation for future transformations, while ex post concerns adjustments that take place after a triggering episode has occurred. Golden and Powel (Golden and Powel, 2004) define flexibility as the capacity to adapt and specify four flexibility dimensions; *temporal*, *intention*, *range* and *focus*. The first denotes how long it takes for an organization to adapt and the second indicates whether the adaptation is proactive or reactive. Range denotes the options an organization has for expected as well as unpredicted changes. The distinction between flexibility for expected changes and flexibility for unforeseen changes has been also addressed in Carlsson (Carlsson, 1989). Lastly, focus specifies whether the flexibility is internal or external with regard to enterprise boundaries.

The term *agile enterprise* has been extensively used by Dove (Dove, 2005a) to characterize firms in terms of *knowledge management*, *value proposition skills* and *response ability*. Knowledge management concerns the timely awareness that a change should be made, both in a reactive and proactive manner. Value proposition skills regard the ability to effectively select the most appropriate among competing response alternatives. Response ability refers to the modification of business processes in real time. Response ability, besides change proficiency, requires a system response architecture structured as reconfigurable systems of reusable modules in a scalable framework, and an efficient change management process. Dove et al. (Dove et al., 1996) have defined four change proficiency metrics, namely *time*, *cost*, *robustness* and *scope*. Time and cost are self-explanatory. Robustness measures the quality of the change process. Scope indicates how much change can be accommodated. The term *agile enterprise* has been also used by Kubil and Nadhan (Kubil and Nadhan, 2005) and Henbury (Henbury, 1996).

The term *adaptive enterprise*, and more specifically *adaptive complex enterprise*, is introduced by Desai (Desai, 2005). Desai is also influenced by systems theory, and in particular from complexity theory. Complexity theory is based on relationships, patterns and iterations and specifies that the universe is full of systems which are complex and constantly adapting to their environment; hence complex adaptive systems. Haeckel (Haeckel, 1995; Haeckel, 1999) also suggests managing organizations as complex adaptive systems. Based on systems theory, he introduces the *sense-and-respond* enterprise to distinguish a modern organization model from that of the more traditional make-and-sell model. According to Haeckel, the behavior of sense-and-respond organizations can be represented by a four-phase adaptive loop; first, sense change in their environment and internal states, second, interpret this change in the context of their experiences, aims and capabilities, filtering opportunities from threats, third, decide how to respond and fourth, act according to their decisions. Haeckel believes that through the adaptive loop process, sense-and-respond firms can cope with rapid change in an uncertain environment. Haeckel

(Haeckel, 1999) relates agility with the sense-and-respond enterprise, based on the two dimensions suggested by this model. More specifically, following this dual perspective, a firm's agility can be distinguished to *sensing agility* and *response agility*. He defines sensing agility as a firm's capacity to rapidly discover and interpret the market opportunities through its information systems. Response agility relates to the organizational capability to effectively transform knowledge into action in response to the environmental signals. The terms *adaptive complex enterprise* and *sense-and-respond enterprise* are also used by Ramanathan (Ramanathan, 2005) to characterize firms that have embraced change and learned to operate in varying circumstances. Jeng et al. (Jeng et al., 2005) and Evgeniou (Evgeniou, 2002) have employed the term *adaptive enterprise* in a similar fashion.

In contrast to the aforementioned terms, the term *intelligent enterprise* occurs much more rarely in the literature. However, it has been also used to denote an enterprise that has the ability to easily evolve, following the changes of its ecosystem. Delic and Dayal (Delic and Dayal, 2003) claim that an intelligent enterprise is one that can behave like a biological system morphing into new forms whenever imposed by environmental changes, and bearing the characteristics of agility and adaptability. To achieve this, the enterprise should be able to sense its environment, understand the situation, exhibit learning behavior and create a feasible and effective plan to execute.

Our literature review reveals that the need for a new kind of enterprises able to cope with environments that are intensely competitive, highly turbulent and continuously innovative has been widely addressed, even though there is no standardized or common term to characterize them. Most prevailing terms are based on the concepts of *flexibility*, *adaptability* and *agility*. However, there is confusion regarding the relation among these concepts. Some researchers consider them synonyms or almost synonyms (Leeuw and Volberda, 1996; Evans, 1991). Others specify a dependency relationship between them. Evgeniou (Evgeniou, 2002), for instance, deems flexibility as a prerequisite for an adaptive enterprise. Dove (Dove, 2005b) on the other hand, differentiates flexibility from agility by stating that the former refers to the ability to respond to expected changes while the latter concerns unforeseen changes as well. This is in contrast to other researchers who employ the term flexibility both for expected as well as unforeseen contingencies (Evans, 1991; Carlsson, 1989).

Furthermore, there is apparently an overlap among different research approaches. For example, offensive and defensive flexibility defined by Evans (1991) correspond to active and passive flexibility respectively, specified in Leeuw and Volberda (1996). Likewise, knowledge management, value proposition and response ability introduced by Dove (Dove, 2005a) are very close to the interactive loop stages suggested by Haeckel (Haeckel, 1999). In particular, knowledge management corresponds to sensing and interpretation, value proposition maps to decision, and response ability corresponds to action. Temporal and intention dimensions of flexibility defined by Evans (Evans, 1991) are also stated in Golden and Powel (2004).

It should be noted that most researchers, although using different terms, they have recognized that the ability alone to adapt quickly and easily to change does not adequately delineate the profile of the enterprise that can thrive in highly dynamic environments. Therefore, they have extended the meaning of either flexible or adaptive or agile enterprise to include the capability to analyze information effectively and sense environmental changes in a timely manner, and make not only

reactive but even proactive movements based on efficient decision-making. Thus, they have designated a manifold interpretation to these terms.

In the remaining of this chapter, the term *agile enterprise* is adopted, as we regard that the meaning of the words flexibility and adaptability is narrowed to the ability to change. According to Oxford Advanced Genie Dictionary, the terms *flexibility* and *adaptability* are synonyms and mean the ability to change to suit new conditions or situations. In the same dictionary, the term *agility* is defined as the ability to move quickly and easily. As such, agility is a more appropriate word because it incorporates also the meaning of rapidity - a very important aspect. For example, a company may adapt to new market conditions in 10 years. This may render the company adaptable but by no way agile, as its response to change is far from fast. In addition, the word agility may be used in a broader sense to denote not only efficient response to change but also the ability for proactive movements in advantageous positions, implying not only responding to change but even causing change.

3. Enterprise Architecture

The attainment of an agile enterprise is a difficult issue. It requires effective knowledge management and learning capacity through data collection and analysis. It involves efficient decision making and quick deployment of a rigorous solution in response to environmental signals, enabled by flexible information systems. Therefore, agility as a property should characterize all aspects of a firm, such as employees, information, business processes, technology, etc. Consider for example an enterprise that has developed a ‘super agile’ IT infrastructure. Such an infrastructure has no value at all if personnel are unable to understand and adjust themselves to new circumstances. Likewise, efficient response to change will not be feasible if the necessary applications exist but the fast and effective communication between stakeholders is hindered due to an inflexible organizational structure. Consequently, an enterprise is agile only if it exhibits agility at any level from any perspective.

As already mentioned, to explore the concept of enterprise agility taking into consideration all necessary aspects, we propose an approach that is based on a viewpoint-oriented *Enterprise Architecture*, which treats all organizational perspectives as of equal importance. IEEE’s Recommendation Practice for Architectural Description of Software-Intensive Systems (IEEE 1471-2000) proposes that an *architecture* is a collection of *viewpoints*, i.e. architectural descriptions that concern each individual *stakeholder*. Each viewpoint is associated with a specific *view*. A view is a representation of a whole system from the perspective of a related set of concerns. This approach has been adopted by various initiatives (Zachman, 1999; ISO/IEC & ITU-T). The Open Distributed Processing Reference Model (RM-ODP), for example, is a conceptual framework established by ISO (ISO/IEC & ITU-T) for the specification of large-scale distributed systems. RM-ODP integrates aspects related to the distribution, interoperation and portability of distributed systems, in such a way that network/hardware infrastructure is transparent to the user. RM-ODP manages system internal complexity through the “separation of concerns”, addressing specific problems appearing during system development, from five generic and complementary viewpoints (namely *Enterprise*, *Information*, *Computational*, *Engineering* and *Technology*).

Similarly, IEEE recommendation can be applied in order to specify a viewpoint-oriented Enterprise Architecture. The introduced Enterprise Architecture, as presented

in figure 1, is considered from five distinct viewpoints, namely *people*, *organizational*, *business process*, *information technology* and *information*.

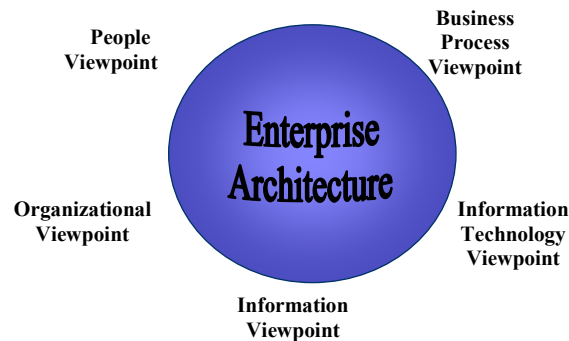


Figure 1. A viewpoint-oriented Enterprise Architecture

The identification of different viewpoints facilitates the procedure of agility analysis as it is easier through the ‘separation of concerns’ to focus on certain issues associated with a specific viewpoint. However, as these viewpoints are interrelated, analyzing enterprise agility by merely considering each view in isolation does not suffice. What is additionally required is the examination of view interrelations, resulting in the ‘integration of concerns’. As such, our analysis approach includes two phases:

- 1) *separation of concerns*: implications for enterprise agility are identified for each different view.
- 2) *integration of concerns*: implications for enterprise agility are identified from the interrelation between views.

In the remaining of this section, we present the enterprise architecture from each separate viewpoint.

3.1 People View

The enterprise architecture from the People viewpoint is depicted in figure 2. The role of the people within an enterprise environment, i.e. the information systems users or stakeholders has been extensively examined and analyzed in the literature. If what is deemed necessary is an “agile user”, he may be defined by the *knowledge* that he possesses, the *competence and technical skills* he can display relevant to the particular line of day-to-day work he undertakes in the organization plus the *culture* that he has.

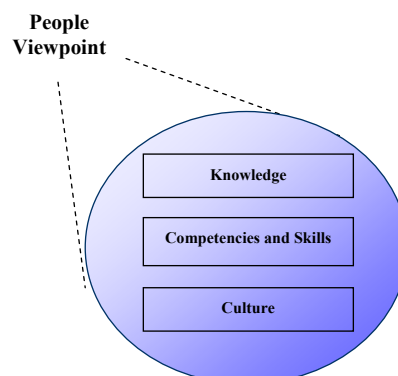


Figure 2. Enterprise Architecture from the People Viewpoint

Knowledge refers to a ‘dictionary’ of solutions to problems that he has to propose in a multitude of situations and the certainty that he has that these solutions will each time provide a satisfactory result. Although knowledge requires – and is the result –of extensive experience, competencies and skills are just the toolset needed to carry out the range of specific tasks that he is accountable for. Culture permeates a user’s worldview and hence informs his actions as it is a set of beliefs and assumptions regarding the possible ways each activity should be performed.

3.2 Organizational View

The enterprise personnel operate in accordance with the organizational structure of the enterprise. Thus, every employee has a specific *role* in the company (e.g. manager, secretary, etc.) and a specific relation to other employees based on the role *hierarchy* (e.g. the general director is senior to the director of every department). In addition, every employee acts according to the company’s *policies*, which are a set of rules defined by the company, governing its operations, as well as its employees’ actions. Lastly, the organizational structure includes also the division of the enterprise into specific *units*. The elements of the organizational structure as presented in figure 3, are interrelated. Indeed, regarding roles and role hierarchy, their relation is self-evident. Moreover, both, roles and their hierarchy are usually associated with specific policies. Policies may also be defined regarding the organization and collaboration between units. Units may be associated with specific roles (e.g., the inventory manager is the one who is in charge of the Inventory department; in this case unit represents a department).

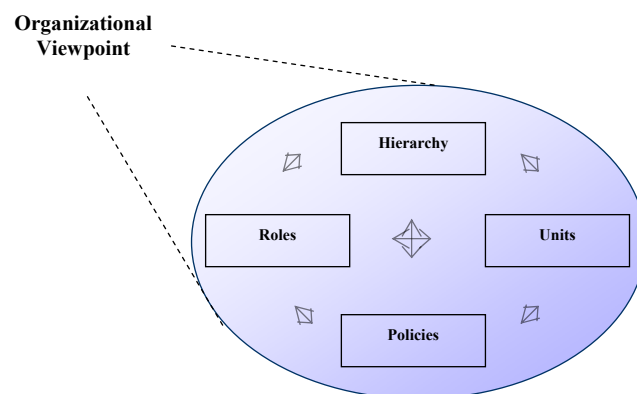


Figure 3. Enterprise Architecture from the Organizational Viewpoint

3.3 Information View

Information is the most valuable asset of a modern enterprise. The enterprise architecture from the Information viewpoint is depicted in figure 4. A fundamental component of information is its *structure*, i.e. grammar and syntax. *Content* can be generated using structure. Content is characterized by *semantics*, which is the meaning that content conveys based on various parameters such as context, for example, or the person that interprets it. As such, the same content may have multiple meanings.

The U.S. Office of Management and Budget (OMB) defines information as any

communication or representation of knowledge such as facts, data or opinions, in any medium or form, including textual, graphic, numerical, narrative or audiovisual forms (OMB A-130). Therefore, representation and communication aspects are also included in the information building block stack. The double arrow between them shown in figure 4 implies that there is a two-way dependency between representation and communication aspects. Indeed, in case of a graphical representation for example, information cannot be easily communicated by word of mouth. A printed form would be more appropriate in such a case.

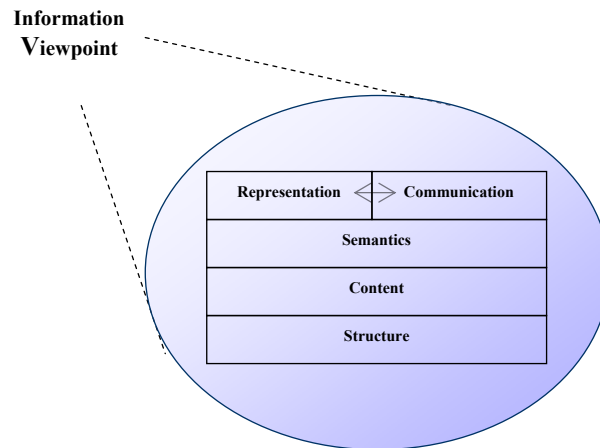


Figure 4. Enterprise Architecture from the Information Viewpoint

3.4 Business Processes View

Business processes constitute the heart of an enterprise. Presley et al. (Presley et al., 1993) define an enterprise as a collection of enterprise activities organized into a set of business processes, which cooperate to produce desired enterprise results. Enterprise business processes may span multiple corporations because apart from internal operations they may also include business-to-business transactions.

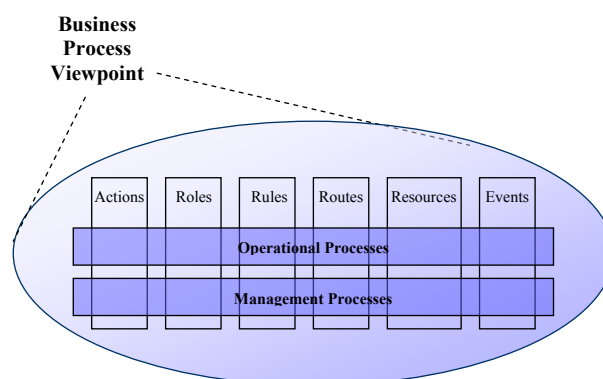


Figure 5. Enterprise Architecture from the Business Process Viewpoint

Figure 5 presents the basic entities involved in a business process description in a technology/methodology-neutral manner. As depicted in figure 5, a business process includes a set of *actions* which, as mentioned above, may regard internal operations or business-to-business transactions. Each action may be hierarchically decomposed to sub-actions. Actions are executed by actors (users, systems, etc.) that take over specific *roles*. The sequence and execution of actions are governed by *events* which

play the role of control signals, and *rules* which specify different paths of actions i.e. *routes*. During the execution of an action, each operational process both uses and produces *resources*. Resources involve anything which is necessary for the accomplishment of an action such as data, devices, and even people. The resources used represent the inputs of the process, while those produced represent its outputs. Every business process always has a final output which constitutes the purpose of its execution.

Additionally, business processes are distinguished into *operational* and *management* processes (Davenport, 1993). Operational processes are those that embody the execution of tasks comprising the activities of an organization. Management processes refer not only to those carried out by managers or conducted at management level of organizations, such as decision making. Instead, they are associated with information handling, coordination, and control procedures, ensuring the efficiency and effectiveness of primary operations, which are the focus of operational processes. As such, management processes are usually carried out by humans who are aided by decision support systems, while operational processes may be partly or fully automated.

3.5 Information Technology View

Nowadays, the operation of most enterprises is extensively based on Information Technology (IT). Figure 6 presents in a layered fashion the elements that compose the IT of an enterprise. Again, this is a technology-neutral description.

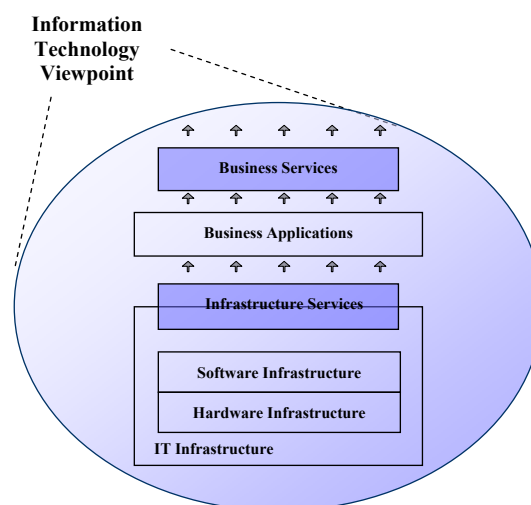


Figure 6. Enterprise Architecture from the Information Technology Viewpoint

As depicted in figure 6, the lowest layer is the *IT infrastructure*, which is distinguished into *hardware* and *software infrastructure*. Hardware infrastructure comprises all physical devices, such as computers - either servers or workstations - printers, scanners, etc., and the network equipment like switches, cables, routers, etc. On the other hand, software infrastructure, which is depended on hardware infrastructure, includes operating systems, middleware, network protocols and core data-processing applications, offering basic services such as communication, messaging, security, etc. Such basic services provided by both software and hardware are common to all enterprises independently of their type. Through these services, which are characterized as *infrastructure services*, IT infrastructure provides the

foundation to enable present and future *business applications* (Duncan and Bogucki, 1995). Business applications (e.g. CRM, ERP, etc.) along with the *business services* they provide, constitute the top layer. As opposed to infrastructure services, business services are enterprise-specific. Business services can be regarded as the crossing point between Business Process and Information Technology views, as business processes utilize for their implementation business services offered by IT.

Obviously, a service-oriented approach for the description of IT view is in consistency with the current trend which suggests a Service-Oriented Architecture (SOA) for IT. SOA is an architectural style whose goal is to achieve loose coupling among interacting services (IFEAD, 2007). A *service* is a unit of work done by a *service provider* to achieve desired end results for a *service consumer*. Both provider and consumer are roles played by organizational units as well as software agents on behalf of their owners.

4. Examining Enterprise Agility Implications through the Separation of Concerns

In this section, the implications of agility will be examined separately for each view. Through this analysis, several agility research issues will be outlined in regard to each view. These issues are summarized in Table 1 of Appendix A. More specifically, cells that have identical row and column names include issues that can be deduced from the first phase (separation of concerns) while the others include issues that can be deduced from the second phase (integration of concerns).

4.1 Agility Implications from the People Viewpoint

People are wary of change. As such, change is not easily instigated and one of the key challenges facing any change initiative is to manage the stress and the problems that will come with the change (Hammer, 1990). Agility in human IT infrastructure implies that employees have adopted the perspective that they work in an unstable environment where any change may occur at anytime, and that they have the competency and skills, the knowledge and culture to accept first and then cope with change efficiently. Organizations must search and examine or devise ways to implant a culture which not only accepts but assigns to change a value emphasizing its necessity regarding an organization's evolutionary path. In the same vein, organizations must seek ways to manage the corporate knowledge efficiently. In other words, to define, design and implement the mechanisms to collect, store and disseminate the knowledge that is produced daily and is one of the main survival tools of the post-modern organization.

In a dynamic environment, it is critical for the employees to operate having adopted the perspective that they work in an unstable environment where any change may occur at anytime. This means that agility in human IT infrastructure is a matter not only of the aforementioned skills and knowledge but also of a specific mentality.

4.2 Agility Implications from the Organizational Viewpoint

An enterprise, in order to be deemed agile, should be always willing to adjust its organizational structure, if market demands prove its function inefficient. Agility of organizational structure though, is often hindered due to conflicts arising from the

established relationships in the existing hierarchy. It should be realized however that agility in the organizational structure is critical for the overall enterprise agility. The way an enterprise is organised, affects the efficiency of decision making, as well as of activity coordination and execution.

Agility in the organizational structure is translated into the willingness to reconsider roles, role hierarchy and policies and to move on to changes if necessary, even radical ones, in order to improve company's operation and ensure thus competitiveness. Also, a company's operation is largely depended on the way departments collaborate, as it is quite common that an enterprise comprises several cooperating departments. For example, it may include a department responsible for acquiring raw material, another for production and another one for dispatching the products. As such, an agile enterprise should exhibit agility in the organization of the interdepartmental collaboration.

Developing an agile organizational structure is indeed a critical issue for the attainment of enterprise agility. The typical pyramid-like hierarchy, for example, exhibits less agility, since the functions and skills are distributed among departments (Fernandes and Duarte, 2005). In addition, coordination becomes difficult, as each of these departments has internal aims, which may create interdepartmental conflicts. As a result, clients' needs cannot be satisfied efficiently and with quality. However, as mentioned earlier, agile enterprises are oriented towards clients' needs and not internal interests. Process-oriented organization seems more appropriate for agile enterprises, since in such an organization all the necessary functions are embodied in the corresponding business processes that cross department boundaries and have the same objectives with the client's ones (Hammer, 1996). Such an organization however may need to be combined possibly with new roles and policies in order to ensure agility.

It should be noted that the organizational structure should facilitate the development of a business environment that is supportive of change but on the other hand it should ensure the required stability so that chaos can be avoided.

4.3 Agility Implications from the Information Viewpoint

Agility in the information domain concerns first of all its communication aspects. More specifically, agility in information denotes the efficient diffusion of information among stakeholders, as well as the easy discovery, at any time, of the required information. Also, the ability to represent the same information in different forms should be supported in order to be more easily understood by different target groups. Such capabilities lead to better control of activities and facilitate sensing agility through the knowledge acquired from the exploitation of information.

However, to facilitate knowledge management and value proposition (Dove, 2005a), the efficient acquirement of information does not suffice. It should be additionally ensured that information is of high quality. Quality of information is specified in terms of accuracy, timeliness, coverage and relevancy (Sanjay et al. 2004). Only if information is of high quality, can its meaning (denoted by the *Semantics* element in figure 4) be deemed reliable and hence valuable.

4.4 Agility Implications from the Business Process Viewpoint

The ability to respond rapidly to changing marketing opportunities by utilizing agile business processes is a key attribute of an agile enterprise (Goldman et al. 1995). Enterprise agility from the business process perspective means that the enterprise is able to adjust its processes easily, in a timely and cost-effective manner, and efficiently execute them, in order to meet new market demands. This presupposes flexibility to modify the *business process definition*. The business process definition is the formal and precise description of the elements composing a business process such as those presented in figure 5. As such, the business process definition should be agile itself, allowing even the radical change of the business process characterized by Davenport (Davenport, 1993) as *process innovation*. Currently, there are several approaches for business process definition using various modeling techniques, aiming at the attainment of agility (Bhat and Deshmukh, 2005, Lin and Orłowska, 2005, Ramanathan, 2005).

Modifying business processes easily implies high performance in their execution through their continual improvement, as well as their constant alignment with the objectives they are meant to satisfy. In an agile enterprise, a business process always reflects business objectives in a consistent manner. This presupposes a methodology or technique that will enable efficient analysis of all necessary parameters (strategic, market, customer-specific, etc.) which should be taken into consideration for the generation of a consistent business process definition.

Based on the Business Process View as presented in figure 5, we argue that agility in the business process definition means the ability to

- add new actions or delete actions that are no longer necessary,
- change process sequence by rearranging, eliminating or inserting routes,
- redefine roles in order for example to reflect changes in the organizational structure,
- modify rules so as to apply, for example, new regulations or new policies adopted by the company,
- handle events to ensure smooth flow of the business process,
- use alternative resources if those specified initially are not available, as well as map resources to roles in an ad hoc manner, as may be imposed by unexpected conditions.

The achievement of maximum agility however implies that the modifications mentioned above can take place at run time as well, i.e. while a business process instance is being executed. ShuiGuang et al. (ShuiGuang et al., 2004) proposed such a method. According to this method, a business process is composed of *general activities*, which are predefined in detail at design time and *flexible activities*, which are like a “black box”, representing an undetermined sub-process without detailed specification at build time. In other words, flexible activities encapsulate the uncertain sub-process at run time. At run time, depending on current circumstances, a flexible activity can be replaced by a concrete sub-process composed of selected activities from existing or newly added activities (constituting a pool of activities), based on selection and composition constraints.

Especially for management processes, agility has different implications. It basically means the capacity to sense environmental changes and make the right decisions at the right time. As such, management processes are mainly related to *sensing agility*

which denotes a firm's capacity to rapidly discover and interpret the market opportunities, in order to make not only reactive but also proactive movements and gain thus competitive advantage (Haeckel, 1999).

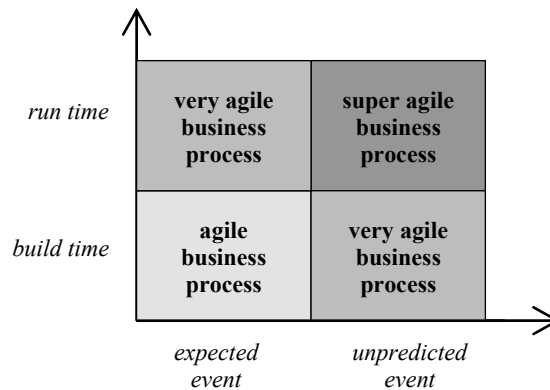


Figure 7. Scaling Agility in Business Processes

4.5 Agility Implications from Information Technology Viewpoint

IT agility is a critical factor for the success of corporation during periods of intense change, especially if agility in IT infrastructure acts as a foundation for overall IT flexibility (Davenport and Linder, 1994). The attainment of high IT flexibility presupposes a common IT infrastructure rather than separate IT platforms and services for separate business activities (Keen 1991, Rockart et al. 1996). In other words all information systems of a company should share a common IT infrastructure to enable high flexibility.

As presented in figure 6, the IT view is service-oriented. As such, we argue that an agile IT is able to always offer the required services. The ability to provide the required services at any time entails that new applications offering the desired services can be quickly and easily embodied into the existing infrastructure in a plug and play fashion. This in turn, implies that IT infrastructure has been deployed as a set of reusable and reconfigurable modules. Furthermore, the software and hardware infrastructure should provide for scalability as new applications are added and more users employ infrastructure resources. Reusability, reconfigurability and scalability have been identified by Dove (Dove, 2005b) as the three basic IT infrastructure principles with respect to agility.

Currently there are a number of emerging technologies promising agility like MDA, Business Process Management Systems, Grid Computing and others. Each of these technologies has a different target though, so the issue is how such technologies could be combined for the development of an agile IT bearing the characteristics of reusability, reconfigurability and scalability.

5. Examining Enterprise Agility Implications through the Integration of Concerns

As explained previously, approaching enterprise agility by considering each view in isolation does not suffice. As viewpoints are interrelated, it is those interrelationships that must be examined and analyzed. By doing so, the complexity of the issues at

hand is unearthed; a necessary first step to a true understanding of enterprise agility. Due to space limitations though, we examine only agility implications derived from the relation between IT and Business Processes views. However, examples of issues derived from the rest view interrelations are included in Table 1 of Appendix A.

5.1 Agility Implications derived from the relation between IT and Business Processes Views

Business processes are becoming more and more interlinked with IT. As such, agility in the former presupposes the existence of agility in the second. It is true that IT has been characterised as fundamental in enabling the redesign of business processes (Broadbent et al., 1999; Davenport, 1993). It should be stressed however that while IT is a potential enabler of business process change, it may also constitute a potential constraint or inhibitor (Grover et al., 1993). This is particularly true when the firm's IT infrastructure is inappropriate or inflexible (Brancheau et al., 1996) due to the existence of incompatible systems constructed to serve local needs. Such systems cannot easily achieve the level of seamless interoperability required putting thus limits on both process change and process integration. On the other hand, a tight integration among systems serving a specific business process may also constrain business process redesign, since even a small modification to the business process may require a great effort usually translated into time and money. Moreover such an infrastructure is frequently the outcome of significant investments. As a result, firms cannot easily replace these systems with new ones that will satisfy the new requirements. Besides, in intensely dynamic environments the frequency of change is sometimes so high that systems become obsolete before even their implementation is finished.

Obviously, agility in IT in terms of efficient business process integration and redesign dictates an appropriate architecture of IT infrastructure that is process-oriented so that IT can play an enabling role. An emerging technology enabling a process-oriented IT infrastructure is *Business Process Management* (BPM). BPM is the descendant of Workflow Management Systems (WFMC 2002). While business process management supports the main concepts of workflow, it bears however broader capabilities, supporting the flexible management of dynamic business change. For the achievement of true agility, BPM technology should be combined with agile business process modeling techniques as those mentioned in section 4.4.

The above discussion concerns mainly operational processes. However, IT infrastructure has implications for both operational and management processes (Mooney et al., 1996). Management processes are augmented by improved availability and communication of information, decision support systems, data warehouses and data mining systems. These technologies mainly contribute to sensing agility which, as explained earlier, denotes a firm's capacity to rapidly discover and interpret the market opportunities, in order to make not only reactive but also proactive movements and gain thus competitive advantage (Haeckel, 1999). As a result, effectively utilizing and embedding such technologies into the existing IT infrastructure so as to ensure agility in management processes, constitutes a significant issue for the overall enterprise agility.

6. Conclusions

Evidently the realization of an agile enterprise is a tough matter raising multiple research issues. Such issues can be more efficiently identified through a structured approach as the one presented in the chapter, which is based on a viewpoint-oriented enterprise architecture that ensures a holistic analysis of enterprise agility. Based on our analysis of agility through the enterprise architecture viewpoints, we identified a number of research directions which exemplify a fruitful area for further applied and theoretical work.

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Appendix A
Table 1. Enterprise Agility Issues

| | | | | | |
|-------------------------------|--|--|---|--|--|
| People | <p>What is the profile of an agile employee?</p> <p>How can the stress and the problems that will come with the change be managed?</p> | | | | |
| Organizational | <p>How can an organizational structure that facilitates people exhibit innovative energy be developed?</p> <p>How can employees be made receptive to continual organizational changes?</p> | <p>What is the optimum organization in terms of roles, hierarchical relations, policies and units for maximum agility in the enterprise operation?</p> <p>How can the balance between stability and agility be achieved?</p> | | | |
| Information | <p>How can a collaborative working environment based on sincere business relationships that will facilitate information communication be ensured?</p> | <p>How an enterprise should be organized in order to facilitate efficient diffusion of information?</p> | <p>How can useful information be distinguished from noise?</p> <p>How can efficient communication of information be ensured?</p> | | |
| Business Process | <p>What kind of training methods should be applied to help employees become adaptable to business process changes?</p> <p>How can methodologies be developed for business process transformation that consider also cultural issues such as norms and attitudes exhibited by the people involved in the process?</p> | <p>What are the characteristics of an organizational environment that fosters business process modification efforts?</p> | <p>How can information flow turbulence be managed in agile business processes?</p> <p>How can it be ensured that there will always be sufficient information to support a potential business process adjustment?</p> | <p>What methodology should be followed to efficiently analyze all necessary parameters in order to produce a business process definition that will consistently reflect business objectives?</p> <p>How can changes be supported both at build and run time?</p> <p>How can unpredictable changes be accommodated?</p> <p>How events be interpreted correctly to maximize sensing ability with regard to business opportunities?</p> | |
| Information Technology | <p>What are the requirements for IT so that it can exhibit a high degree of usability in a dynamic environment?</p> <p>What training methods could help employees to become agile in using new technologies?</p> | <p>How can seamless alignment between business and IT be achieved?</p> <p>Can organizational policies be formalized through an appropriate modelling language so as to increase efficiency in policy modification?</p> | <p>How can IT infrastructure ensure high information quality and quick information diffusion at the same time?</p> <p>How can it be ensured that IT is always aware of the information that goes around the enterprise?</p> <p>How can ensure information preservation be realized?</p> | <p>What kind of IT architecture can facilitate business process integration without inhibiting at the same time business process redesign?</p> <p>What are the restrictions imposed by IT to business process agility?</p> <p>How can agile business process modelling methods be aligned with process-oriented technologies?</p> <p>How can decision support technologies be embedded into the existing IT infrastructure so as to facilitate sensing agility ?</p> | <p>How can existing technologies be combined for the development of an agile IT?</p> <p>Is service oriented architecture suitable for the attainment of agility?</p> |
| | People | Organizational | Information | Business Process | Information Technology |