Business Intelligence and Contribution of Entrepreneurial Information Architecture

Sílvia Fernandes[1]

[1] CIEO – Research Center for Spatial and Organizational Dynamics, Faculty of Economics, Univeristy of Algarve, Campus de Gambelas, 8005-139 Faro, Portugal
Sfernan@ualg.pt

Abstract. We are witnessing the need for a quick and intelligent reaction from organizations to the level and speed of change in business processes. The arising problems can be: from wrong lasting information; systems not fully used or explored; slow reaction to change; etc. This requires two main confluent action methods: people to synchronize their visions, ideas and strategies in the whole organization; and, in that context, select the information that strictly answers to the performance factors at the right moment. The proposed methodology turns to the potential of approach to the entrepreneurial architecture as well as to the potential of the information system in order to integrate the data and resources needed for that performance. The modeling of an information architecture of the company and its business helps in the identification of critical information, the one which is according to the mission, prospects and business success factors.

Keywords: information systems, business process, critical information, business intelligence, entrepreneurial architecture.

1 Introduction

Since the transition from the industrial society to the information society, it has been necessary to organize and select data in enterprises. This organization gave rise to new values, equal to or more important than the traditional ones, such as information and knowledge. Technology has made so much difference that its association with human capital has made this emerge as a greater potential. The joint exploration of these two dimensions (technological and human) is actually the basis for organizational innovation. Emergent information technologies are the platform for the company's ability to develop information systems that meet the new requirements of management. For example, the increasing ability to control large volumes of information in huge databases, such as the *data warehouses* using advanced tools for debugging these data (*data mining*), responds to an even more dynamic and varied public.

The two central issues that significantly determine the success of a company are business processes and information systems. These issues are closely related as the main purpose of a corporate information system is to support the business process in

an effective and efficient way. It is then necessary to rethink the ways how to present products or services and seek for different dissemination channels. Facing these challenges, companies should develop new solutions to maintain or enhance their competitive position in the market.

The roles that information society and knowledge management play are absolutely relevant and complementary in current business scenarios. Connectivity, mobility, real-time reaction and innovation are some of the keywords in today's vocabulary. The sustainable competitive advantage is found in a company's ability to channel the critical information to generate the business intelligence that enables it to constantly rethink its goals and methods to meet its needs in real time. An international consultant for innovation (Basadur, researcher and founder of the enterprise *Basadur Applied Creativity*) said that many companies have good ideas or initiatives, 'but not at the right time'. Given the pace of present change and business instability, companies have to deal well with real-time business events. This requires that organizations and professionals adopt new attitudes and ways of using their information systems for managing business intelligence to address numerous emerging events.

2 Tendencies in Information Systems

In Portugal, the companies (mostly small and medium-sized) invest little in information systems and technologies due to their limited financial and organizational capacity. Then, they rarely adopt new ways of managing the business intelligence to address the numerous emerging events. One form of innovation these companies should bet on, especially those with a culture of customer service, is the creation of a platform based on technological tools easy to use, such as CRM (Customer Relationship Management systems), CMS (Content Management Systems) and ERP (Enterprise Resource Planning systems). These tools, converging on well planned platforms, contribute to the implementation of new business ideas, design of new products and services, improvement of existing processes and creation of new ones. Given this enormous potential, which may lead to a total reconfiguration of an organization, entrepreneurs should not only be familiar with this type of infrastructures, but also get involved from the very beginning of their adoption covering everyone in the organization.

The ERP systems, for example, have followed the financial systems which automatically processed invoices and other reports from the balance such as income statements according to the legislation. Analyzing the process of decision support, it was found that managers make decisions based on many other documents and data to know what products they can offer, what amount, what is the best way of distribution, the best location for shopping, how to organize the transport, etc. And adding to this, the enormous amount of data that result from having a *website* which leads to use new tools for database management with advanced statistics, especially based on data and process integration. The ERP can do this work, allowing greater product information trace, from the moment of the order until knowing its stock level. Information flows become more rapid, complete and correct, contributing to a better inventory

management and a greater consistency with the customer's order. Some companies have resisted the adoption of an ERP system due to the time of adaptation/conversion from existing systems to the ERP, which has become too extensive in some cases.

This explains why some companies do not want to adopt ERP systems as these can disrupt their normal activities (Vasilev and Georgiev, 2003). Currently, technology companies are committed to put into their ERP new modules tailored to the business reality of several sectors (industry, health, banking, commerce, etc.) to turn them more flexible and complementary. Unlike departmental systems, the ERP are multifunctional, covering different levels and functions in the organization. They are integrated systems, making the information flow easily between different areas and departments to be shared by different processes (Figure 1). The information is then accumulated in a single huge repository (*data warehouse*), which is available to all business units at all functional levels. Managers have all the information they need more accurately and in real-time (Laudon and Laudon, 2004).

For example, this type of system allows issues such as: immediately inform customer if the product he ordered is in stock; maintain customer informed of the whole processing course of his order; easy production communication with the financial area to know new production plans, etc. Departmental systems, in contrast, create much fragmentation of data which results in expensive and complex links that proliferate in companies as these systems function separately by departments. The ERP systems, by consolidating the available data, help to eliminate unnecessary or redundant links, having a positive impact on the efficiency of business performance.
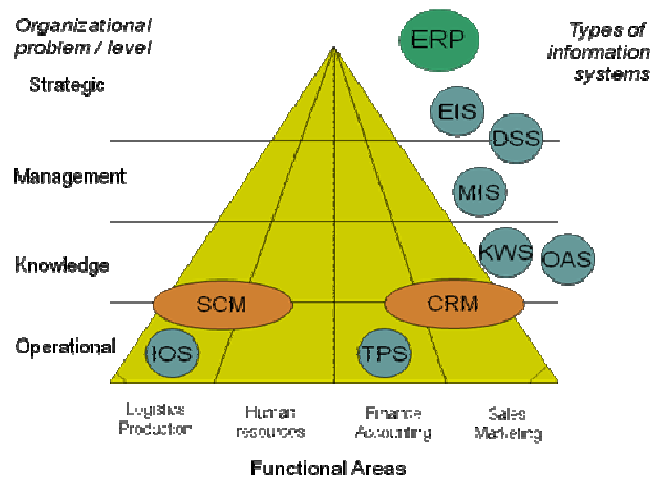
Fig. 1. ERP and their degree of integration compared to other enterprise information systems.

Combining CRM tools, which consist of analytical functions to manage the relationships with clients, the ERP can consolidate information from different sources or channels of communication (phone, email, Web, *wireless* points) to answer questions such as: what is the value of a certain client for the company; who are the most loyal customers; who are the most profitable ones; etc. Companies can use the

answers to those questions for acquiring new customers; improve their products and services; customize them according to customers' preferences; etc. The CRM techniques are used to select and combine key information, from different points of view, to help companies create unique services and successful innovations. CRM processes can, by means of advanced techniques like *data mining*, capture profiles and behaviors that were not perceived before. These tools have become effective in engaging a customer to the point of waiting for the goods or services that he previously outlined (Vasilev and Georgiev, 2003).

3   Business Intelligence Imperatives

The expansion of the internet platform and the exponential amount of customers and employees that it brought to companies in promoting and selling their products, has led to a need for tools that could help to cope with this trend. The major challenge is keeping the same patterns of relationship in interacting with more customers and stakeholders. The multiplying effect of this aspect, from a growing number of companies placed online, brings the need to compete more in real time. This justifies the increased adoption of the integrated information systems previously mentioned such as ERP, CRM, among others. Companies should consider the implementation of these tools from a strategic perspective, for fully exploration of their potential straightly in line with business needs for better business event monitoring.

As said before, the main purpose of a corporate information system is to support the business processes in an effective way. And within this overall problem, there are a number of important sub-problems whose solution contributes substantially towards the solution of the overall problem. In this context, there is a persistent problem in companies, related to an increasing amount of unnecessary information or misinformation that lasts for a long time, damaging their daily performance and their relationships with customers and employees. There are two main factors leading to this problem: - one refers to the fact that there are many new information systems and technologies in organizations (such as mobile ERP and electronic CRM, SCM) whose potential is far from being fully explored, either in themselves or integrated with other existing systems; - other factor is that people work differently, one from another, differing in terms of: training, willingness to work with technologies, willingness to cooperate with others, among other individual differences.

These factors raise the need for a work model in which people can synchronize their 'visions' throughout the organization and together, within the same mind-set targets, for answering instantaneously the information strictly needed. Therefore, this paper aims to propose a methodology to analyze this problem, which can be referred as an approach to critical information systems. It should be understood here as a 'critical information system', the platform of tools of business intelligence (relational databases, ERP, CRM, *data warehouse*, *data mining*, intranet, etc. - Figure 2) combined to filter only the data that match business success factors at the right time. It is not the system that is critical, such as systems supporting areas like medicine, security or others which deal with risk or critical time lags. In the approach under study, critical is the information obtained through data and processes that are event-

oriented, giving executives the right answers to decide in real time. This should be the main objective to consider when structuring metadata in the company's databases. A *data warehouse* is the most appropriate 'data center' for this, because it normally contains data from all departments and functions in the organization. Separate databases get in trouble for lacking uniformity, being from different manufacturers, and lacking integration incurring in errors, delays, repeated data and more staff than it is necessary. The present approach to critical information systems requires an action to be taken at the level of information architecture in order to link the 'performance profile' (based on the performance indicators of the information system) with the 'competitive profile' (based on the performance indicators, or critical success factors, of the business).
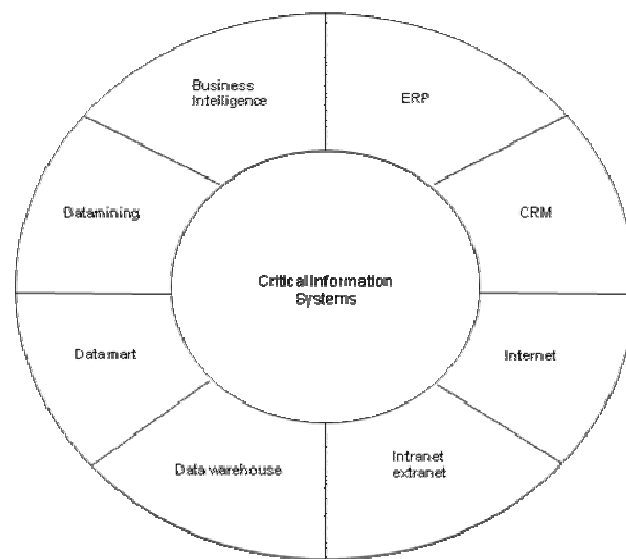
Fig. 2. Technologies and tools for real-time business intelligence.

Legend: 'Business Intelligence' - this dimension in Figure 2 includes forecast analysis, performance analysis, production reporting, *benchmarking*, *text mining*, among other analytical tools.

The concept of critical information system considered here (center of Figure 2) is a platform of tools and methodologies for business intelligence, taking advantage of relational databases, ERP, CRM, *data warehouse*, *data mining* and intranets, managed or combined to select the data that match business success factors at the moment of decision. This is real time business intelligence, as the process of delivering the right information about business operations as they occur. In this context, real time means a too short time to answer after the business event occurred. While traditional business intelligence generally presents historical data for manual analysis, real time business intelligence compares current business events with historical patterns to automatically detect problems or opportunities. This automated analysis capability will enable

corrective actions to be initiated or business rules to be adjusted to optimize business processes. An approach to event driven architectures is to increase the refresh cycle of an existing *data warehouse* to more frequently update the data. These real time data warehouse systems can achieve by real time update of data, where the data latency is typically in higher ranges of time. Facing the current market instability and its informational asymmetries, changing business models and processes, there is a growing need for immediate responses to which should contribute the ideas and competences from everyone in the organization. The entrepreneurial information architecture can play an important role in structuring the alignment between individuals and business process changes.

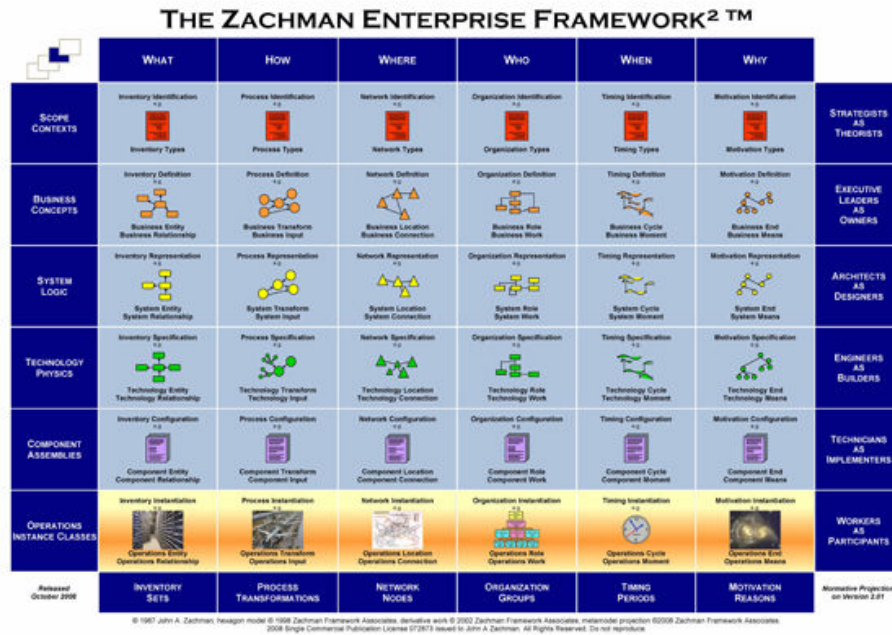## 4 Entrepreneurial Information Architecture

Given the growing need for immediate responses to which should contribute the initiatives and information from whole organization, communication is desirable and necessary to transfer knowledge. One of the stages in the knowledge creation model of Nonaka and Takeuchi (1995) is 'socialization', which arises from tacit knowledge exchange between individuals. The shared experiences and their articulation consolidate knowledge, creating shared mental models and trust forms. Nonaka said that knowledge is created by individuals and the organization has a role in expanding the knowledge created by its individuals and "crystallize" it as a part of the organizational knowledge network.

Systems analysts and engineers are those that deal more with the need to synchronize views in dialoguing with the entities that request them for systems development. For this dialogue, they use models to represent the reality they need to appreciate, through a structured design (architecture) to quickly explore and find the solution. Accordingly, *ontologies* have been increasingly used as they are models that represent a set of concepts within a domain and the relationships between them, in order to make inference on the objects of the domain. *Ontologies* generally describe individuals, classes, attributes and relationships. They are used in artificial intelligence, web semantic, software engineering and information architecture as forms of representing knowledge about events. Given the speed of emergency and change in business processes, new computing paradigms should be increasingly addressed using entrepreneurial architecture approaches. Next section concerns the contribution that entrepreneurial information architecture can have to the under discussion methodology, in which the increasing need for modeling data and process flows is implicit. The aim is to better discern and act at the linkage between 'performance analysis' (indicators of corporate information systems performance) and 'competitive analysis' (indicators of company's performance which are its business success factors).

4.1 Assessment of Some Models

Entrepreneurial information architectures can contribute to the present methodology, in what Zachman's framework proposes (see Zachman International website):

crossing the prospects of the company's management with the support given by information systems and processes (his approach has also served internal IS creation). The resulting matrix of this crossing exercise has the following structure (Figure 3):

Fig. 3. The Zachman's entrepreneurial information architecture.

Legend: *What?*: data and relationships between them;
How?: processes (functional description);
Where?: network (components location in the company);
Who?: who performs the job, leadership chain, participation level;
When ?: when events occur;
Why?: motivations, purposes, goals, strategies.

Another architecture is the EAP model (*Enterprise Architecture Planning*) by Spewak and Hill (1992) proposing the layers and components that answer to four key issues (Table 1):

Table 1. The approach of EAP's entrepreneurial architecture.

Phase	Plan/method
1. Starting point	How is the work done now and what methodology is used
2. Where are we today?	Current knowledge base about the business and information used to manage it
3. Where do we want to be?	Data necessary to support sustainable business
4. How to get there?	Required implementation and migration plans

Another model is from the Center for Organizational Engineering (Caetano *et al.*, 2007) whose main objective is to model the definition of criteria to align business processes with the information and supporting IS/IT. The resulting model consists of a set of 5 layers or perspectives: *Technology*, *Application*, *Information*, *Business* and *Organization*. This architecture is based on three concepts: entities, roles and activities. Entities are the components that make up the organization (people, machines, places, etc.). Roles are the observable behaviors of entities and the activities reflect how a set of entities collaborate to reach a result.

There are several other models of entrepreneurial architectures, such as the EUP (*Enterprise Unified Process*), an extension of the RUP (*Rational Unified Process*) from Ambler *et al.* (2005), doing a comprehensive and complete collection of these aspects. However, one should note that generically the nature of descriptions in these models focus on the questions raised by the Zachman's matrix and the EAP method of Spewak and Hill. Their questions, through an iterate procedure, could help assess the linkage under discussion: between the perspectives of company's management and the support given by the IS. Among the mentioned models, the EAP and the EUP methodologies pay attention to social, human and cultural factors for the success of their application. But all the mentioned models consider the 'organizational change' factor as an external force, resulting from environmental or technological changes which affect business requirements.

5 Conclusion and Future Research

The entrepreneurial information architecture of a company and its business, easy to understand and communicate, can help the identification of the critical information, consistent with the company's mission, objectives and business success factors. It is mainly modeled with objects such as: activities (functional and cross-functional, internal and external); resources (functional and cross-functional, internal and external) and products (internal and external). It then supports information systems management as it helps the identification of requirements for those systems according business needs. However, given the heterogeneity of those objects and data that characterize them, one of the most pressing problems has been the conversion between structured and unstructured data.

On this subject, the authors Carvalho and Ferreira (2001) carried out a survey for technological tools assessment, related with knowledge management and conversion between tacit and explicit knowledge, discussing their internalization or outsourcing. Some of these tools are: knowledge portals (corporate *intranets* and *extranets*); knowledge maps (lists of "who knows what": skills/profiles); EDM (Electronic Document Management: cataloging, indexing, etc.); OLAP (Online Analytical Processes for data normalization); *Data mining* (advanced techniques to explore large amounts of data looking for consistent patterns); qualitative analysis tools; among others. In this context, the *Web2* platform, a concept that means the second-generation of community-based web services involving social networks, may well provide models and methods on the subject of *ontologies* and enterprise information architectures. Although this term seems to be connoted with a new version for the

Web, it does not refer to any technical specification update, but to a change in the way it is perceived by users and developers as an environment for interaction and sharing, which encompasses numerous visions and motivations today.

One of the trends in modern computing architectures is *SOA - Service Oriented Architecture*. This kind of architecture may have an important role in critical information architectures and systems, since it is designed to flexibly provide the right services, not just at the right time, but also at the right level of generality. The 'service' orientation relates to the objectives of: reducing the customer's effort to use the service and thus the impact of change; re-using the service without having to go through the source code and ensuring that the service is usable throughout the whole organization (and even re-designable together). Another current trend is *cloud computing*, an architecture in which a service is resolved or provided through several computers that may not function in the same place. Forming a "computing cloud" they share tools, services, software and information through the interconnection of different systems via internet, instead of having these resources locally (in internal servers). Thus, companies will not spend much time maintaining their systems, data, applications and information. Then they will have more time to focus on managing the connection intended to be better in organizations, between the perspectives of a company's business and the support given by its information system.

Future research on the approach covered in this paper will focus on analyzing the results from a survey application and the inclusion of new levels/issues in it, mostly related with the computing trends on socializing communication channels such as the *Web2*, *SOA* architectures and *cloud computing*. In order to test the proposed methodology, a survey should be implemented to collect the necessary data. The selected sample should focus on firms within the same sector, since there are several factors (external and internal) influencing different sectors, which lead to biased results and conclusions. Recalling the methodological issue under discussion - act on the connection between the 'performance analysis' (indicators of the information system performance) and 'competitive analysis' (indicators of a company's performance, or its business success factors) - the necessary data should focus particularly on knowing: what information systems and technologies those firms have; what are their critical success factors; if those systems and technologies are helping to meet them; if they use entrepreneurial information architecture approaches; if their systems are planned to obtain real time critical information; if some of their systems are not being fully explored and what functions are affected; and if they are using any *cloud services*.

References

1. Ambler, S., Nalbone, J., Vizde, M.: Enterprise Unified Process: Extending the Rational Unified Process. Prentice Hall, New Jersey (2005)

2. Caetano, A., Sousa, P., Vasconcelos, A., Pereira, C., Tribolet, J.: Enterprise architecture modeling with the UML 2.0. In: Rittgen, P. (ed.) Enterprise Modeling and Computing with UML. Idea Group Inc, Hershey (2007)
3. Carvalho, R, Ferreira, M.: Using Information Technology to Support Knowledge Conversion Processes. Information Research. 7, 1, 1--24 (2001)
4. Laudon, C., Laudon, J.: Management Information Systems: Managing the Digital Firm, 9th edition. Prentice Hall, New Jersey (2004)
5. Nonaka, I., Takeuchi, H.: The Knowledge-Creating Company. Oxford Press, New York (1995)
6. Spewak, S., Hill, S.: Enterprise Architecture Planning: Developing a Blueprint for Data, Apllications and Technology. John Wiley & Sons, New York (1992)
7. Vasilev, J., Georgiev, G.: Tendencies in the Development of ERP Systems. In: International Conference on Computer Systems and Technologies. Economical University of Varna, Bulgaria (2003)
8. Zachman International, http://zachmaninternational.com/index.php/home-article/13#maincol