JISTEM - Journal of Information Systems and Technology Management
Revista de Gestão da Tecnologia e Sistemas de Informação
Vol. 9, No. 3, Sept/Dec. 2012, *pp.563-584*
ISSN online: 1807-1775
DOI: 10.4301/S1807-17752012000300007

MANAGEMENT PRACTICES AND INFLUENCES ON IT ARCHITECTURE DECISIONS: A CASE STUDY IN A TELECOM COMPANY

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ABSTRACT

The study aims to analyze the IT architecture management practices associated with their degree of maturity and the influence of institutional and strategic factors on the decisions involved through a case study in a large telecom organization. The case study allowed us to identify practices that led the company to its current stage of maturity and identify practices that can lead the company to the next stage. The strategic influence was mentioned by most respondents and the institutional influence was present in decisions related to innovation and those dealing with a higher level of uncertainties.

Keywords: IT Architecture, Enterprise Architecture, Institutional Theory, Strategic Choice Theory.

Manuscript first received/*Recebido em* 20/07/2011 Manuscript accepted/*Aprovado em*: 15/08/2012

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1. INTRODUCTION

The development of information technology (IT) and its wide use in all sectors of the organizations and society require managers to continually rethink the strategy of how to use it properly in order to achieve the corporate goals.

For Ross, Weill and Robertson (2008), IT architecture (or enterprise architecture)[1] is one of the basis for building a technology infrastructure and digitized business processes to enable the flexibility and agility necessary for the companies today. The authors define IT architecture as a set of policies and technical choices that reflect the needs for standardization and integration of technologies and information systems for the viabilization of the business strategies of the company.

With respect to the results arising from the correct construction and management of IT architecture, Kappelman (2010) presents the survey data from SIM - Enterprise Architecture Working Group (SIMEAWG) which involved more than 370 companies from various sectors, sizes and countries. This research identified the main goals and benefits of information technology (IT) architecture: improve the interoperability of information systems (IS), better use of IT, alignment between IT and business investments, more efficient use of IT resources and faster response to changes.

The decisions associated with the management of IT architecture are related to a larger set of IT decisions that can be classified into five categories (Weill & Ross, 2004): principles, architecture, infrastructure, applications and investments. The responsibilities for its implementation should be assigned to this set of IT decisions, which should be shared between the business and technical areas at the different levels of the organization, thus making up the IT governance model in the company.

Despite being initially associated with the IT area in the organizations, the decisions related to IT architecture then become, according to the context and needs described above, a fundamental element in the maintenance of corporate strategies. Ross *et al.* (2008) found in case studies that companies with more developed architectures within a range of four stages of maturity (silos, standardized, optimized and modular) claimed to have greater success in achieving strategic goals and higher average return on invested capital.

All these factors are related to the decision-making in IT architecture and have gained prominence in the specialized media, especially with new methodologies for the development, deployment and integration of systems. Although the subjects IT governance and IT architecture rely on a reasonable number of published studies, most of them present normative models for their implementation, and few seek to analyze how the decision-making processes on IT architecture occur in the corporate reality (Radeke, 2010).

A considerable part of the IT research focuses on the design, deployment and use of artifacts that represent tangible solutions to real problems. Therefore, the search for theoretical principles in knowledge areas outside the scope of technology contributes to the theoretical and practical enrichment on the subject through the integration between the areas of IT knowledge and organizational studies.

[1] The original definition of the term in Ross *et al.* (2008) is "enterprise architecture". However, in this paper we chose to use the term "IT architecture" to avoid confusion with other management areas and because it seems to be the preferred term for publications in Portuguese.

The two areas will benefit from the integration and both can be understood as overlapping fields of study rather than mutually exclusive (Orlikowski & Barley, 2001). This possibility is particularly interesting for the study of IT architecture decisions, which, as previously mentioned, should involve both technological and organizational aspects simultaneously and is a field in which there is a strong influence of reference market models and need for standardization.

A possibility for that is the neoinstitutionalist theory (Powell & DiMaggio, 1991), which emerged as a counterpoint to the organizational theories that treated managers and organizations as rational players. By including the institutional theory in IT studies, it is possible to develop a more comprehensive understanding about how technology is intertwined in interdependent social, economic and political networks (Orlikowski & Barley, 2001).

The purpose of this study is to *analyze the IT architecture management practices associated with their degree of maturity and the influence of institutional and strategic factors on the decisions involved.* The analysis used the model of Ross *et al.* (2008) for the maturity of the architecture management and the institutional and strategic choice theories as distinct lenses to observe the decisions made by managers. The empirical part of this study consists of a qualitative survey of exploratory and descriptive nature that uses the case study method, conducted in a company that formalized the IT architecture management.

Due to the confusion that exists in the definition of IT architecture and because it is a concept not yet stabilized (Hämäläinen, 2008; Radeke, 2010), this same lack of maturity is also reflected in studies on this subject. In addition, we conducted a search in Proquest database in July 2010, the data collection period, and later in July 2012, for studies related to the terms in English of information technology and architecture combined with the terms influence, factors or decision. There were no studies about influences on IT architecture or decisions on IT architecture, although there are studies on architecture, decisions or influences on management alone with goals and approaches very different from this paper.

Therefore, exploratory studies are important for raising new hypotheses, factors and variables. This paper has the following secondary goals, associated with the main goal and the case study: 1) Identify the stage of maturity of the IT architecture management in the organization studied; 2) identify management practices that can help the organization move forward in its stage of maturity of IT architecture; and 3) check if there is a prevalence of influences of institutional or strategic factors in the justifications given by the managers for the decisions on IT architecture considered important to the organization.

2. LITERATURE REVIEW

2.1 Information Technology Architecture

For Radeke (2010), the term "IT architecture" does not have a universally accepted definition yet. The definitions found in the literature suggest several ideas associated with it: planning, governance, innovation, vision, principles, standardization, integration, policies and compliance with the business strategy (Zachman, 1997; Tapscott & Caston, 1995; Cullen & Leganza, 2006; Ross *et al.*, 2008).

Ross (2003) states that IT architecture is the logic of organization for applications, data and infrastructure technology that reflects the integration and standardization requirements of the company's operating model, embodied in a set of policies and technical choices that intend to enable the business strategy of the company. According to the author, IT architecture covers four dimensions: business architecture, information architecture, application architecture and technology architecture. Cullen and Leganza (2006) complement this definition by stating that IT architecture is a function of planning, governance and innovation.

Business architecture is characterized by activities or tasks that comprise the major business processes identified by the holders of the processes (Ross *et al.*, 2008). Information architecture consists of a series of tools that adapt the resources to the information needs. It makes the connection between behavior, processes, specialized personnel and other aspects of the company such as administrative methods, organizational structure and physical space. Information architecture increases the possibility of data being used efficiently (Davenport, 1998).

According to Spewak (1992), application architecture is the definition of how applications will make data management and the provision of information to people who perform the business functions. The applications allow access to the data in the proper format at an acceptable cost. Finally, technology architecture is the definition of the types of technologies or platforms that will support the business in a data sharing environment. The technology platforms provide the means to collect data, transport, store, process and deliver to customers or users.

Currently, a great variety of approaches for the management of IT architecture is being studied, developed and applied by the industry and the academic community. The following can be mentioned, among others: enterprise architecture (EA), service-oriented architecture (SOA), service-oriented enterprise architecture (SoEA), integration architecture and software architecture (SA). However, there is no consensus on the meaning of these approaches, that is, their concepts are not yet stabilized.

Therefore, there is no agreement about the relationship between them and there are discussions about the existence of overlaps such as the confusion as to whether SOA is part of enterprise architecture or the opposite. Likewise, there is no consensus on the definition of enterprise architecture or IT architecture (Hämäläinen, 2008). Figure 1 shows the various components of IT architecture used to compose the definition of architecture in this study.

As noted in the definition of Ross *et al.* (2008), the integration and standardization requirements of the company's systems are essential aspects of IT architecture and compose the framework of motivations for adopting policies for their management. Thus, this research was based on the expectation that managers would associate IT architecture with integration and standardization in some of the architectural dimensions.

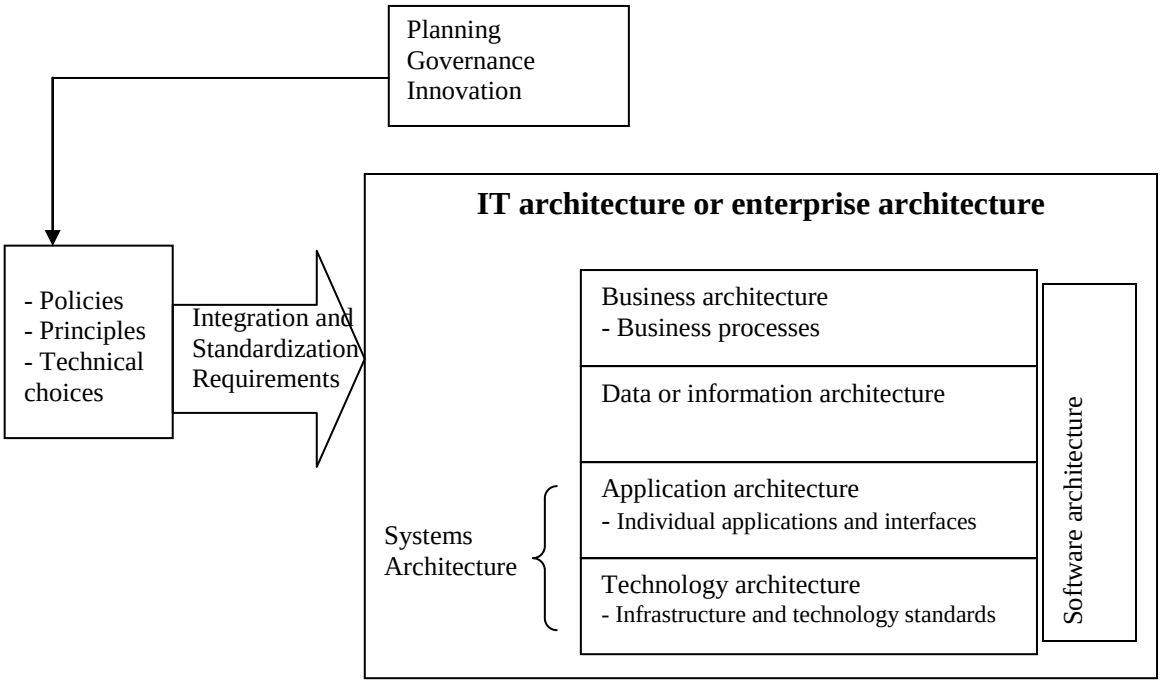

Figure 1 - Definition of IT architecture in this study

Source: Prepared by the authors based on Cullen and Leganza (2006), Ross *et al.* (2008) and Hämäläinen (2008).

2.2 Management of Information Technology Architecture

To better understand the management of IT architecture, it is possible to analyze it from the perspective of the stages of maturity. Ross *et al.* (2008) evaluated the strategies of architecture management of dozens of large companies in various countries around the world, classifying them into four stages of maturity regarding their level of development and control:

- Business silos architecture – The companies seek to maximize the needs of each business unit or functional needs independently, which causes a subdivision and the non-integration of the various initiatives of systems existing in the company.
- Standardized technology architecture – It provides efficiency through the standardization and centralization of technology management.
- Optimized core architecture – There is a standardization of data and processes in the company as a whole.
- Business modularity architecture – The companies manage and reuse components freely according to the needs of business processes aiming to preserve the global standards and enable local differences.

Table 1 summarizes the discussion presented by Ross *et al.* (2008).

Table 1 - Changes associated with each new stage

	Business Silo	**Standardized Technology**	**Optimized Core**	**Business Modularity**
IT capacity	Local IT applications	Common technical platforms	Processes or data shared across the enterprise	Business process modules that can be coupled
Business goals	ROI of local businesses initiatives	Reduced IT costs	Cost and quality of business operations	Promptness to sell: Strategic Agility
Funding priority	Individual applications	Shared infrastructure services	Enterprise applications	Reusable business processes components
Main administrative capacity	Management of changes through technology	Design and update of standards: funding of common services	Definition and measurement of core business processes	Administration of reusable business processes
Who defines the applications	Local business leaders	Leaders from business and IT units	Senior management and process leaders	IT, business and industry leaders.
Key IT governance issues	Measure and communicate value	Establish local, regional and global responsibilities.	Align the project priorities with the architecture goals	Define, assign and fund business modules.
Strategic implications	Local and sectoral optimization	IT Efficiency	Operational efficiency of the business	Strategic Agility

Source: Adapted from Ross *et al.* (2008)

In the research they conducted, Ross *et al.* (2008) found that only 6% of companies were in the fourth stage of maturity (modularity), while 34% were in the third stage (optimized core), 48% in the second stage (standardized) and 12% in the initial stage (silos). It was also found in the companies surveyed that those with more mature architecture claimed to have a greater success in achieving the strategic goals and higher average return on invested capital.

According to Ross *et al.* (2008), companies advance in the stages of maturity by changing their patterns of investments in IT and by implementing new IT architecture management practices, formalizing the organizational learning on how to leverage the IT capacities and adopt changes in the business processes. The evolution of the IT architecture management practices is shown in Table 2, which relates them to the stages of maturity.

In the business silos stage, the resources are optimized locally to generate value. As the standardization of technology occurs in the second stage, the formal processes of review and centralized decisions are needed.

In the third stage, with the standardization of data and processes, IT starts receiving a greater attention from the strategic and business areas, and there is a need for a greater participation of the executives and the creation of IT architecture teams in full time. Finally, in the fourth stage, business modularity, the critical practices are focused on the communication of IT architecture goals and the evaluation of change initiatives supported by it.

Regarding the process of decision making of IT architecture, Pulkkinen (2006) points out that, although it is divided into four hierarchical dimensions (business, information, application and technology), it is not necessary that decisions occur sequentially (first define the business architecture and then the information, application and technology) because, for example, the technology architecture may allow changes in the business architecture. The author proposes to divide each one of the four dimensions into three levels of abstraction, also hierarchized: organization level, level of domain (representing business units, processes or departments), and level of individual information systems.

Table 2 – Evolution of IT architecture management practices

IT architecture management practices	**Business Silos**	**Standardized Technology**	**Optimized Core**	**Business Modularity**
Assessment of returns on IT investments	X	X	X	X
Standardized methodology for IT projects	X	X	X	X
Architects in project teams		X	X	X
IT steering committee		X	X	X
Process of exceptions to architecture		X	X	X
Formal process of architectural compliance		X	X	X
Architectural renewal process included in the IT budget		X	X	X
Centralized funding of enterprise applications		X	X	X
Centralized standard team		X	X	X
Holders of general processes of the company			X	X
Declaration of the guiding principles of enterprise architecture			X	X
Commercial leadership in project teams			X	X
Supervision of enterprise architecture by senior executives			X	X
Managers of IT programs			X	X
Central diagram of enterprise architecture				X

IT architecture management practices	Business Silos	Standardized Technology	Optimized Core	Business Modularity
Post-implementation evaluation				X
Formal process of technology research and process of adoption of new technologies				X
Enterprise architecture team in fulltime				X

Source: Adapted from Ross *et al.* (2008)

Finally, it is necessary to consider the existence of role models for the management of enterprise architecture. These models provide guidelines for the definition and implementation of the architecture and its management processes, which in principle can help make this process more secure and well defined.

2.3. Institutional Theory and Strategic Choice Theory

The institutional theory and strategic choice theory were selected as a lens for analyzing the IT architecture decisions, since they reflect two contrasting human behavior, determinism and voluntarism, usually placed in opposing groups in various classifications of organizational theories (Oliver, 1997; DeSanctis & Poole, 1994; Vicente-Lorente & Zúñiga-Vicente, 2006).

They are also distinguished because one represents the socio-political behavior to obtain legitimacy and the other represents a rational behavior to obtain efficiency. (Mehta, 2005). For Zucker (1987), there are two definitions of the term "institutional" which may be "a rule-like, social fact quality of an organized pattern of action (exterior)" or an "embeddeding in formal structures, such as formal aspects of organizations that are not tied to particular actors or situations".

DiMaggio and Powell (1983) identified three mechanisms of institutional influence:

- Coercive - Consists of formal or informal pressures made by other organizations due to dependency or cultural expectation.
- Mimetic – Result from the use of a standard response adopted by companies to uncertainties. The use of management models is an example of this mechanism.
- Normative – Associated with professionalization, such as the formal education legitimized by the university knowledge base and professional networks to disseminate models.

According to the strategic choice theory, the strategic factors would be the determinants of the choices that the holders of power within the organizations make in the course of strategic actions. Miles and Snow (1978) argue that the organizational behavior is only partially predetermined by the environmental conditions and that the choices of senior management are critical determinants of the organizational structure and processes. For Child (1997), the decision-making extends to the environment in which the organization operates, to the performance standards that must be evaluated in view of the economic pressures and to the design of the organizational structure itself.

Although the business choices are many and complex, Miles and Snow (1978) propose that they can be viewed as responses to three groups of problems of organizational adaptation:

- Entrepreneurial problem – the management's acceptance of a particular product and market domain through the allocation of resources
- Engineering problem - involves the creation of a technical or organizational system that solves the entrepreneurial problem
- Administrative problem – involves the reduction of the uncertainty of the organizational system to solve the entrepreneurial and engineering problems faced by the company.

Vicente-Lorente and Zúñiga-Vicente (2006, p. 95) present a form of comparison between the institutional and strategic perspectives, which differ in their assumptions on how the strategic change occurs. In the adaptive or strategic approach, the strategic change is a rational reaction of managers who implement new strategies when they notice misalignment between the organizational and environmental characteristics, while in the institutional or inertial perspective, the management has a more passive role in the process of transformation.

Another way to distinguish the two views, institutional and strategic, would be through the type of rationality used. Oliver (1997) makes a theoretical comparison between the institutional determinants based on resources. The strategic choice theory could be identified as economic rationality and the institutional theory would use the normative rationality.

To achieve the objectives of this study, the management practices of the organization of the case study were analyzed according to the theoretical reference of the IT architecture concept and its stages of maturity. The maturity levels of Ross *et al.* (2008) helped in the classification of the current situation of the company. With respect to the strategic and institutional influences on decisions, the institutional theory and the strategic choice theory were the basis for the categorization of the justifications used.

3. METHODOLOGY

According to the classification of Vergara (1998), this research is qualitative of exploratory and descriptive nature. The exploratory research is used when there is little systematic knowledge accumulated and it is descriptive because it describes its characteristics. The sources used are the literature, the field survey and the case study conducted in a company that formalized the IT architecture management.

Usually, the case study is the preferred strategy when there are questions such as "how" and "why", since, in this situation, the researcher has little control over the events and the focus is the current event within the context of the actual experience (Yin, 2003). According to Benbasat *et al.* (1987), case studies are appropriate to solve problems where the theory is in the early stages of formation and the players experience and the context of the action are the foci.

Thus, this method meets the objectives of this research, since the intention is to understand the process by which organizations decide on IT architecture and how the

institutional and strategic factors influence this process. During the development of the study protocol, there was the explanation of the data collection process through the definition of the unit of analysis, the criterion for selecting the company, the respondents, the set of interviews, the preparation of the data analysis report and the validation process of the results.

With regard to the unit of analysis, Yin (2003) admits that case studies may involve more than one. In this case study, there will be two different units of analysis. With respect to the objective of identifying and understanding the IT architecture management practices, the unit of analysis is the organization studied. To attain the goal of identifying the influences of institutional and strategic factors, there will be a subdivision in which the units of analysis will be the different decisions regarding architecture.

Benbasat *et al.* (1987) reinforces the need to present the context and the chain of evidence. The reader should be able to track the entire process, from the goals and research protocol to the data collected and results. Therefore, this paper will present the context in which the research was conducted, both regarding the organization and the data collection, and the steps that were followed, as well as the data collected, so that the reader can follow the chain of evidence.

The organization was selected for being a representative case of a company with private equity and that already has a formalized policy of IT architecture. The contact with the company was performed through the relationship network of the authors and it was considered appropriate to the study for being a large company, on a business sector heavily dependent on technology and information systems with its own IT department and quite structured.

The respondents were selected for being involved in any decision on IT architecture or for having access to the arguments used in the choices. We included managers from the IT and business areas, totaling seven people (four managers, two directors and the CIO).

The information was collected through interviews and document analysis that had two purposes: to collect general data on IT management and specific data on the decision-making process of IT architecture regarding the scope in which the respondent is involved. Data collection and interviews were conducted between the periods from March to May 2010 at the company headquarters in São Paulo. The seven interviews lasted on average one hour and thirty minutes each and were conducted by one of the authors. In addition to the interviews, we consulted the company's website and internal documents.

Two sets of semistructured interviews were used: one containing questions about the company's data, data from the IT area, data from the IT architecture of the organization (history and development, major changes, current components) and its management (IT governance process, architecture management practices adopted, senior management support, existing problems), applied only to the primary IT manager; and another containing questions about the justifications and obstacles found in decisions on IT architecture (related to the business, information, applications or technology dimensions) of which the respondent had participated or had knowledge, and it was applied to all respondents. The managers themselves chose the most important events according to their perception and after that we collected information about the decisions.

For the analysis of data regarding the first and second secondary goal, we analyzed the history of the IT architecture management, important events that caused it to reach the current stage and actions that may potentially contribute to advancing to the next stage. The stages of maturity of the IT architecture of Ross *et al*. (2008) and its characteristic management practices also served as the basis for the analysis.

For the analysis of data relating to the third secondary objective, each one of the decisions cited in the interviews was classified according to the type of architecture involved (business, information, application and technology) and were identified through the analysis of the researchers using the theoretical framework, the institutional or strategic influences present in each one of them. For each decision, we collected the justifications, obstacles and results.

After that, each justification was classified according to their possible influence, that is, they were categorized as institutional and their sub categories (mimetic, coercive and normative) or as strategic and their corresponding subcategories (administrative, engineering or entrepreneurial problem). With this information, we analyzed the existence of dominance of some type of influence (institutional or strategic) on each decision. Obviously, there were decisions and justifications on which the categorization or determination of dominance was not very clear; however, with the help of other context information, it was possible to classify them or at least mention that there was more than one type of influence.

Although the two types of influences are considered antagonistic, according to Hrebiniak and Joyce (1985), the analysis of a particular factor as to its institutional origin or strategic choice should not be treated as if they were mutually exclusive categories. There is the possibility of analyzing whether there is dominance of one of them within the acceptance of the existence of a continuous line between the two extremes.

After the preparation of the organization data and analysis report, it was sent to the contact in the company in order to check its suitability, as a measure to reduce inconsistencies in the data analysis by the researchers.

4. CASE STUDY RESULTS – DATA PRESENTATION AND ANALYSIS

4.1 The Company's Background and the History of IT Architecture

4.1.1 The Company and its IT Area

The telecom company, which will be called ALPHA in this paper, is a national privately owned company that offers Pay TV, broadband Internet and VOIP services to the Brazilian market.

The business risks are the high level of competition, the rapid obsolescence of the technology investment, the high churn rates, the non-exclusive operating licenses, the additional expenses for new government regulations, the increased programming cost, piracy, the dependence on third-party services for customer service and the extensive government regulation.

The organization has gone through several changes in its capital structure since the beginning of operation in the 1990s, such as acquisitions, divestitures, changes of

shareholder control, structuring of subsidiaries in Brazilian cities and the trading of shares in the stock exchange in the United States and Brazil. In 2010, the company's annual gross revenue totaled approximately R$ 4 billion and it has 15 thousand direct employees, and 12 thousand indirect employees. For each one of the three services offered, there are approximately 3 million subscribers.

The company's IT unit is divided into two boards that respond to the CIO (Chief Information Officer): the Board of Systems Development and the Board of Infrastructure and Production, which manage the deployment and operation of the systems. In the IT area, there are 132 direct employees and 621 outsourced employees. The management of IT Security also reports directly to the CIO.

The process of IT governance is similar to the archetypes of most companies in which the architecture standards and the infrastructure are the responsibility of the IT unit (IT monarchy model), while decisions on IT principles, applications and investments involve other units (duopoly model and federal). This analysis was conducted by crossing the five types of decisions and who makes them, according to the model proposed by Weill and Ross (2004). From then on, we compared with the most popular governance models (business monarchy, IT monarchy, feudal, federal, IT duopoly and anarchy) to reach the conclusion that it is similar to most companies.

4.1.2 Evolution of the IT Architecture

Between 2002 and 2004, an outsourced consulting firm was hired, which identified the need to improve the final consumer experience during the events in which consumers have contact with the company, such as in the sales process, installation, maintenance, billing and cancellation. Then, we defined the main macroprocesses of the organization. In late 2006, several important projects in IT architecture were initiated: the implementation of the TM Forum frameworks - the eTOM; the deployment of the Service Oriented Architecture (SOA); and the certification of the Sarbanes-Oxley act (SOX).

The TeleManagement Forum (TM Forum) is an association of the telecom industry focused on providing certification services, training and benchmarking, which created three models of best practices in architecture: business processes architecture - enhanced Telecom Operations Map (eTOM); application architecture - Telecom Application Map (TAM); and information architecture – Shared Information Data Model (SID).

The eTOM aims to be a process structure that can assist in the business modularity, define responsibilities, be a source of common approach to solve a problem of process design and ensure the interoperability between suppliers' solutions. According to the maturity levels of the architecture of Ross *et al.* (2008), it can be said that the eTOM proposes to provide a base for the company to achieve the business modularity stage, as it attempts to enhance the flexibility of the organization.

In addition, the TAM offers a common vision of the applications according to their functional requirements and is interconnected with the eTOM and SID. Its goals are to establish criteria to delimit the scope, facilitate the application integration and standardize the terminology. Finally, the SID intends to be an information model regardless of platform, language or protocol, standardizing interfaces and specifying the relationship between entities and their attributes.

In 2007, the company decided to adopt the eTOM to guide the decisions on business architecture in the company. Until then, the business demands were transformed into functional requirements without a formal planning of the process architecture evolution, there was no area for corporate processes within the company that would map the existing processes and define future scenarios. Therefore, the eTOM was adopted, with the purpose of structuring the decision-making processes of IT architecture. It is worth it to point out that these best practice models are still under construction and are not mature yet. Thus, all these promises are theoretical and the extent of their benefits depends largely on the unrestricted adoption by the industry.

The decision for adopting the SOA was due to the fact that the systems of the company ALPHA by 2006 were developed in a client-server platform with little modularity and offered no flexibility to meet the demand changes. Moreover, due to the various acquisitions of companies in the previous years, there was a need of integration with legacy systems, performed through middleware systems, but focusing on the solution of the technological problem rather than on the understanding of the function of the systems for the business processes. In 2010, after the implementation of the SOA, the IT architecture can be represented as in Figure 2, where the systems are divided according to their function in the business.

In Figure 2, the systems on the block "channels" are applications that interface with the end customer, such as the Internet and VRU (voice response unit), automated answering system by phone. The BSS system (Business Support System) deals with customers and processes such as orders, payments and accounts. It is the system of business support system that involves the CRM system (customer relationship) and the billing system.

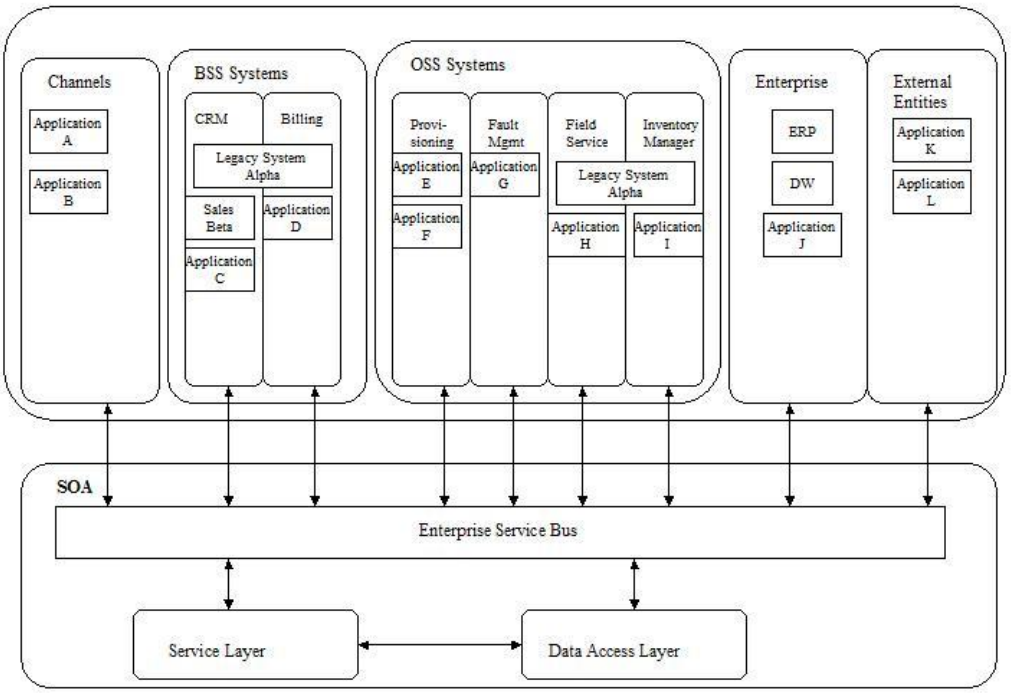

Figure 2 - IT Architecture of the telecom company in 2010 (prepared by the authors)
Source: Prepared by the authors.

The systems of the OSS block (Operations Support System) support the operation and deal with the telecommunications network, including applications such as provisioning (network configuration to provide services to a new subscriber or to a specific client), field service, fault management and network inventory. The external entities are the interfaces with partner companies such as billing services, credit validation and other companies that also offer services to the end customer. A layer of SOA allows that the implemented features are offered as services connected via the enterprise service bus, which provides interfaces for the communication between applications.

With the implementation of SOA, and the introduction of new systems and new philosophy of integration, the visualization of the applications function became clearer and oriented to the company's processes. That is, even though some of the major legacy systems still exist, they are seen differently by managers, relating IT with the compliance of the business needs rather than a strictly technological vision.

It can be considered that the search for SOA and best practice models of the TM Forum was motivated by initiatives offering new products to the final consumer and by growth prospects. In addition, the SOX certification became mandatory in this company because it has stocks in the U.S. stock market. Thus, it is possible to identify specific events in the evolution of architecture, such as the adoption of SOA, formalization of the process area with the adoption of eTOM, the hiring of the consulting firm that led to the deployment of macroprocesses and the Sarbanes-Oxley certification.

All these events demanded great efforts from several departments and a constant sponsorship from the senior management. It is also possible to notice a few evidences of continuous evolutions of architecture. In the process of adoption of SOA, for example, changes in processes had to be implemented gradually so that they were successful. As new projects were emerging, the new architecture was built, because the legacy systems are usually not replaced immediately.

4.2. Management of the IT Architecture

In the IT architecture scope, the management is decentralized into three managements within the IT structure. The planning and support management is responsible for the architecture hardware, software and database management. The architecture management is responsible for the application and data modeling architecture. A third management for IT security is responsible for managing the security architecture. With regard to the business architecture, the design of the processes is the responsibility of the organizational development (OD) board interfacing with IT in the Management of Business Processes.

The first column of table 3 shows the IT architecture management practices identified by Ross *et al.* (2008) and the second column indicates whether or not they were found in the organization.

Table 3 – IT architecture management practices identified in the telecom company

IT architecture management practices	**Practice identified in the organization?**
Assessment of returns on IT investments	Yes
Standardized methodology for IT projects	Yes
Architects in project teams	Yes
IT steering committee	Yes
Process of exceptions to architecture	Yes
Formal process of architectural compliance	Yes
Architectural renewal process included in the IT budget	Yes
Centralized funding of enterprise applications	It depends on each application
Centralized standards team	There is more than one architecture team
Holders of general processes of the company	Yes
Declaration of the guiding principles of the enterprise architecture	Yes
Commercial leadership in project teams	Sometimes, no.
Supervision of enterprise architecture by senior executives	Yes, to stimulate adoption.
Managers of IT programs	Yes
Central diagram of enterprise architecture	Yes
Post-implementation evaluation	No
Formal process of technology research and process of adoption of new technologies	There is no formal process, but there are individuals responsible for technological research.
Enterprise architecture team fulltime	Yes

Source: Adapted from Ross *et al.* (2008) with data collected in the telecom company.

The IT architecture management practices of the organization include regular meetings between managements and within each management. A technical architecture committee meets once a week and includes all managers involved with business, information, applications and technology architecture. The decisions are published in the company's internal website, which includes manuals, best practices, standards and policies. This internal website started being developed three years ago and all documents were created by the architecture team in collaboration with the departments affected.

One of the reasons for the documentation is to communicate drawings and standardization to outsourced companies. An architect follows each project and develops an architecture document that goes through the approval process. Exceptions to the architecture must be approved and documented, that is, designs that eventually do not follow general standards or principles may be approved, provided that they are registered and justified so that a correction process can be implemented later if necessary. There is also a department for quality control in the IT area, which uses software to check for the compliance with standards and inconsistencies, especially in programming languages.

Thus, following the classification of Ross *et al.* (2008) regarding the maturity levels of IT architecture, we can conclude that the organization is in the stage of

optimized core. The reason for this classification is that the company has data centralization and individuals responsible for macroprocesses who interact with various departments of the company, although this organization has practices that are common of companies between the stage of standardized technology, optimized core and business modularity as detailed in Table 4.

In addition, the SOA enabled a greater agility in the changes made in the systems and the TM Forum models seem to claim to obtain higher gains through standardization, including the processes, which can lead the company to the final level of maturity, business modularity. The concept of modularity in this company still focuses more on the reuse of IT application routines than on the business process modularity.

Table 4 – Comparison of the telecom company with the stages of maturity

	Business Silos	**Standardized Technology**	**Optimized Core**	**Business Modularity**	**Practices in the telecom company**
IT capacity	Local IT applications	Common technical platforms	Processes or data shared across the enterprise	Business processes modules that can be coupled	The organization has macroprocesses and there was data centralization.
Business objectives	ROI of local businesses initiatives	Reduced IT costs	Cost and quality of business operations	Promptness to sell: Strategic Agility	Flexibility and costs are two important aspects.
Funding priority	Individual applications	Shared infrastructure services	Enterprise applications	Reusable components of business processes	Enterprise applications
Main administrative capacity	Management of changes through technology	Design and update of standards: funding of common services	Definition and measuremen t of core business processes	Administration of reusable business processes	The company has macroprocesses
Who defines the applications	Local business leaders	Leaders from business and IT units	Senior management and process leaders	IT, business and industry leaders.	There are relationships with partners and industry, but the applications are defined by process and IT leaders.
Key IT governance issues	Measure and communicat e value	Establish local, regional and global responsibilities.	Align priorities of projects with the architecture goals	Define, assign and fund business modules.	Align priorities of projects with the architecture goals
Strategic implications	Local and sectoral optimization	IT Efficiency	Operational efficiency of the business	Strategic Agility	Operational efficiency of the business

Note: The first five columns are from Ross *et al.* (2008) and the last is the data collected in the telecom company. Cells in gray correspond to the current situation of the company.

4.3 IT Architecture Decisions and Strategic and Institutional influences

Table 5 summarizes the decisions related to IT architecture spontaneously mentioned by the managers and the year in which they were implemented. The decisions were classified as to their respective scopes and levels following the classification of scope of Ross *et al.* (2008) (business, information, application, technology) and the levels proposed by Pulkkinen (2006) (organization, domain and systems). The justifications spontaneously provided by the managers were classified as strategic or institutional influence, according to the justifications that were most prevalent. The last column of Table 5 shows what kind of influence excelled in each decision.

Table 5: IT architecture decisions reported by the managers in the company ALPHA

	Year	**IT Architecture Decision**	**Scope/Level of Architecture**	**Most important influence**
1	2010	Contract with suppliers to manage the network instead of directly hiring connections.	Technology / Organizational	Strategic
2	2010	Internet access control for employees	Application / Domain	Strategic
3	2010	Virtualization of servers in one application	Technology / Systems	Strategic
4	2006	Change of programming language (from .Net to Java)	Application / Domain	Strategic
5	2010	Centralization of the access control to various systems	Application / Organizational	Strategic
6	2008	Implementation of the PMBOK Methodology for IT Projects	Business / Organizational	Institutional / Strategic
7	2010	Hiring third party services based on business items	Application and Technology / Organizational	Strategic
8	2006	Adoption of SOA	Application and Technology / Organizational	Institutional / Strategic
9	2007	Sarbanes-Oxley certification	Business / Organizational	Institutional / Strategic
10	2010	Adoption of the best practices model for the IT architecture management of TM Forum	Business, Application and Information / Organizational	Institutional / Strategic

Source: Prepared by the authors.

Table 6: Institutional Influences on IT architecture decisions across the company ALPHA

Institutional mechanism	**Description of the Justification Given by the Managers**	**Decision where the influence appears**
Coercive	Compliance with SOX	Internet access control and centralized access control, PMBOK methodology
	Requirement of the American stock exchange	SOX
	Opinions of the company's employees	SOA
	Legitimize the work and spread it	TM Forum Framework
Mimetic	Previous experience of the manager within the organization or in other organizations	Internet access control, PMBOK methodology
	Market trend	Virtualization, TM Forum Framework
	Support from suppliers and consulting firms	Virtualization, SOA, SOX
	Adopted by the industry	Outsourcing of business items, TM Forum Framework
	Cases of other companies	SOA, TM Forum Framework
	Considered modern	TM Forum Framework
Normative	Consensus in the area of activity	Centralized access control, TM Forum Framework

Source: Prepared by the authors.

Table 7: Institutional Influences on architecture decisions across the company ALPHA

Adaptation Problem	**Description of the Justification Given by the Managers**	**Decision where the influence appears**
Entrepreneurial	Strategic relationships with suppliers	Change of programming language to Java (for a non-proprietary).
	Flexibility	SOA, Hiring based on business items
	Support the growth/evolution	TM Forum Framework, change of programming language
Engineering	Increased capacity	Network management contract. Internet access control, SOA
	Increased productivity	Virtualization
	Improved performance	Change of programming language
	Reuse	SOA
	Process standardization	PMBOK Methodology, TM Forum Framework
	Tool for guiding	TM Forum

Adaptation Problem	**Description of the Justification Given by the Managers**	**Decision where the influence appears**
	Integration	SOA
Management	Cost Reduction	Network management contract, Internet access control, virtualization, hiring based on business items, SOA
	Facilitate management/operation	Network management contract, virtualization
	Employees and IT control	Internet access control, SOX
	Accurate information	Internet access control, SOX
	Reduced time	Centralized access control, SOA
	Reduced bureaucracy	Centralized access control
	Monitoring	Centralized access control

Source: Prepared by the authors.

Table 6 shows the justifications given by the managers of the company ALPHA for the various decisions described in Table 5 that were related to institutional influences, classified according to the mechanisms proposed by DiMaggio and Powell (1983). The justification appears in the second column and the decisions for which they have been mentioned are shown in the third column of the table.

Table 7 shows the justifications given by the managers for the various decisions described in Table 5 that were related to influences of strategic choice, classified according to the adaptation problems proposed by Miles and Snow (1978) (entrepreneurial, engineering and administrative).

In the decisions 1, 2, 3, 4, 5 and 7 shown in Table 5, the strategic motivations were identified as dominant. These decisions had a more limited scope with familiar tools to the managers and mature market solutions. On the other hand, the decisions 6, 8, 9 and 10 indicated a prominence to the institutional influences, especially the adoption of TM Forum frameworks (decision 10). Since all decisions had at least one strategic motivation, it can be concluded that the strategic arguments were more mentioned than the institutional arguments.

An interesting fact is that the decisions involving innovation, greater risks and more comprehensive with organizational amplitude indicated a greater presence of institutional factors, mainly related to the mimetic mechanism where companies tend to adopt similar practices, as defined by DiMaggio and Powell (1983).

The company ALPHA represents a typical case of an organization that has formalized its IT architecture and is in a stage of maturity that can be considered advanced. It is possible that this may be related to the industry in which it operates, given the management level of maturity of its competitors, suppliers, customers and professionals. The reason for this is that several institutional arguments appear in the decisions, suggesting that the mimetic mechanism of resembling to others is present. Furthermore, as described in documents provided to investors, monitoring technology is one of the priorities and the company believes it can become a risk if it is not well monitored.

5. CONCLUSIONS

This study allowed us to illustrate, through a case study, the aspects of IT architecture management and the emphasis on strategic arguments in the decisions related to it. The practices that may potentially help the company advance in its maturity of IT architecture management were identified: definition of macroprocesses, centralization of data and adoption of the industry's standardization model such as TM Forum.

The telecom company was successful with the implementation of macroprocesses and the centralization of data, because it allowed it to evolve to the stage of optimized core, by having a greater control of the core processes. In addition, the implementation of SOA allowed a greater flexibility to the systems and, with the adoption of process standardization models of industry associations such as eTOM, it is possible that the telecom company evolves to the next stage of business modularity with this tool.

Oliver (1988) showed in a quantitative study that the strategic influences stand out in the organizational decisions; however, his research included decisions from the entire company and not just from the IT unit. This study used a different methodology to try to obtain the corroboration of this result and was able to show in the case study presented that the strategic influences are also more mentioned in the decisions on IT architecture.

Perhaps, the most interesting revelation identified is the fact that the institutional influences, mainly mimetic, are present in decisions involving innovation and that deal with a higher level of uncertainty, usually at the organizational level. Thus, resuming Zucker (1987) on the institutional theory, there was a rule of a social fact of external action with organized pattern or something embedded in formal structures that is not bound to particular situations or players, that is, there are management decisions aimed at obtaining legitimacy.

With respect to the strategic influences, the control of outsourced activities was identified as an important motivator of several initiatives, benefiting further the control of internal activities. In addition, the resolution of administrative and technical problems arising from the company's growth also motivated actions in IT architecture. Therefore, the operational structure and growth perspective can be important issues in the decision-making process of IT architecture in the company.

If, on the one hand, following trends can be beneficial for the companies to minimize risks, on the other hand, following the market trend, an institutional mimetic mechanism, could be inconsistent for an organization whose strategic plan includes overcoming dominant competitors using IT.

As a limitation of this study, we can mention the fact that it is a single case study, which in principle prevents its generalization. The company studied, however, was chosen for presenting a comparatively high degree of formalization in its IT architecture management, as it is an exemplary case that allows the generation of new hypotheses, factors and variables to enable further studies.

Another limitation refers to the process of categorization of the justifications into institutional or strategic, which occurred through the categorization made by the researchers of the ideas present in the spontaneous responses of the managers. However, in an analysis of responses with a further questioning, it can be noted that institutional

arguments may represent expectations for strategic results, though it was not explicit at first.

A recommendation for future studies is the follow up of a complete decision-making process and the collection of information from respondents outside the organization such as suppliers, consultants, customers or partners. This analysis from several perspectives can provide a more complete view of the complexity of the subject of study.

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