BUILDING INFORMATION TECHNOLOGY CAPABILITIES: A CASE STUDY OF THE DEVELOPMENT OF AN INTEGRATED MANAGEMENT SYSTEM

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ABSTRACT

Information Technology capabilities are organizational skills which enable the IT function deliver value to the various activities of the company. This paper aims to analyze how some important IT capabilities such as internal relationship and technical skills were built during the design, implementation and dissemination of an integrated management system in a Brazilian public University, between the years 2004 and 2009. It was developed a cognitive map based on SODA methodology, identifying those feedback loops relevant in this process. It was possible to understand the whole process through a map categorization, which showed: how the integrated systems were designed based on the top management vision; the process of scope stretching which led to the development of new modules based on users participation; its widespread adoption based on the institution credibility; the learning mechanisms performed by IT; and the organizational adjustments in the IT group which were necessary to maintain the development of technical capabilities and internal relationship. The analysis of this successful case can shed some light over the process of capabilities creation process.

1. Introduction

Several studies aim to understand how the resources of Information Technology (IT) generate value for organizations (Bharadwaj, 2000; Wade and Hulland, 2004), since most of these resources are seen as commodities readily available on the market (Carr, 2003; Mata, Fuerst, and Barney, 1995). On the other hand, IT skills have been identified as responsible for the operational and financial performance of organizations (Bharadwaj, 2000; Liang, You, and Liu, 2010; Stoel and Muhanna, 2009).

Capabilities are characterized as the know-how that enables organizations to perform the relevant activities to their survival and competitiveness (Dosi, Nelson, and

Winter, 2000). Actually, IT capabilities such as internal relationships and technical capacity (Barney and Clark, 2007; Ross, Beath, and Goodhue, 1996), are organizational skills that allow IT effectively deliver services using resources that are complementary (Bharadwaj, 2000; Ravichandran and Lertwongsatien, 2005).

Despite the importance of organizational capabilities in general and in particular those of IT, few studies explore its formation over time (Ouyang, 2010; Pandža *et al.*, 2003; Pregelj, 2013; Priem and Butler, 2001; Zhai, Shi, and Gregory, 2007). Those who deal with it, usually adopt the perspective of life cycle (Van de Ven, 1992) to explain how such organizational skills are created, developed, become mature and are discontinued (Helfat and Peteraf, 2003; Pregelj, 2013).

From this point of view, the context and characteristics related to each life cycle phase are identified, without an explanation of how underlying factors relate each other to better understand the resulting behavior of the organizational structure. Thus, identifying the "dominant logic" of the organizational policies that led to the construction of IT capabilities can support the development of new capabilities in other organizations facing challenges whose similar capabilities are required.

This article aims to investigate how IT capabilities, internal relationship capacity and expertise were built during the design, implementation and dissemination of an integrated management system in a Brazilian public university, between the years 2004 and 2009. The system analysed was so successful that since 2009 it has been implemented in other public organizations, currently being under implementation in more than 30 organizations through cooperation agreements.

2. IT Capabilities

Broadly speaking, if an organization has some capability, this means that this organization is able to perform activities through the mobilization of resources (Amit and Schoemaker, 1993; Grant, 2010). Capabilities can still be characterized as the know-how that enables organizations to perform activities such as the development of new products (Dosi *et al.*, 2000). Thus a superior performance in a given activity implies the existence of specific capabilities (Amit and Schoemaker, 1993).

Moreover, the ability to perform activities in a satisfactory and reliable way implies in the existence of some capability (Helfat and Winter, 2011). This reliability is reflected in the performance pattern shown by routine activities (Winter, 2003). A capability is considered satisfactory if its resulting activities reach the desired standards, despite the opportunities for improving performance (Helfat and Peteraf, 2003). Thus, a series of activities can be considered as arising from a capability when their performance is satisfactory in several different situations (Schreyögg and Kliesch-Eberl, 2007).

The existence of a capability can be recognized in some patterns of behavior that characterize them, once to maintain a certain capability it is necessary to continuously perform its activities. Thus, the routines can be considered capabilities building blocks (Collis, 1994; Dosi *et al.*, 2000; Helfat and Peteraf, 2003; Winter, 2000), being responsible for its embodiment (Nelson and Winter, 1982). Under this point of view, organizational routines are patterns of regular and predictable behavior with a persistent characteristic that determines organizational behavior and they can be inherited, mutate and selected. So, they can be defined as repeated and recognized standards of interdependent actions taken by multiple actors (Feldman and Pentland, 2003).

Capabilities are built internally in organizations (Schreyögg and Kliesch-Eberl, 2007; Teece, Pisano, and Shuen, 1997), unless when acquisitions or alliances occur

(Helfat and Lieberman, 2002), and it takes time for it to present satisfactory results through the performance of its activities (Grant, 2010; Leonard-Barton, 1992; Winter, 2012). Their idiosyncratic characteristics make it difficult to be emulated (Cool, Dierickx, and Costa, 2012; Makadok, 2001).

The IT capability is recognized as the most appropriate factor to explain the contribution of IT resources on organizational performance, and it can be defined as the set of practices carried out by the organization to mobilize and develop IT resources in combination with other resources and capabilities (Bharadwaj, 2000; Liang *et al.*, 2010; Stoel and Muhanna, 2009). The IT capability enables the IT function to provide services for the organization (Ravichandran and Lertwongsatien, 2005) and identify systems that meet organizational needs and develop them effectively (Ross *et al.*, 1996).

IT capabilities can be classified as internal or external (Hulland, Wade, and Antia, 2007; Stoel and Muhanna, 2009). External capabilities are skills that help the organization to identify and adapt itself to cope with environmental changes, such as external relationship capability (Day, 1994; Ethiraj *et al.*, 2005; Feeny and Willcocks, 1998; Wade and Hulland, 2004), capability to respond to environment (Rapp, Trainor, and Agnihotri, 2010; Wade and Hulland, 2004) and capability for planning and changing the IT (Bharadwaj, 2000; Ravichandran and Lertwongsatien, 2005; Wade and Hulland, 2004). On the other hand, internal capabilities help the organization to provide reliable products and services while minimizing unnecessary costs. Among others there are internal relationship capability (Bhatt and Grover, 2005; Feeny and Willcocks, 1998), technical capability (Barney and Clark, 2007; Hulland *et al.*, 2007; Mata *et al.*, 1995; Piccoli and Ives, 2005) and research and development capability (Wade and Hulland, 2004).

The internal relationship capability is the capability to promote a long lasting relationship between the experts in the organization's IT function and the users of technology, like managers of organizational units (Bharadwaj, Sambamurthy, and Zmud, 1999). It is based on the establishment of an ongoing and extensive dialogue between the IT function and the user community, leading to the emergence of trust and risk sharing behavior (Bhatt and Grover, 2005). The internal relationship capability is also important for the emergence of an understanding of the IT potential by users as well help them and IT specialists to work together and ensure the satisfaction and sense of ownership by both (Feeny and Willcocks, 1998).

By analyzing the effects of IT resources and capabilities on the performance of the insurance companies in the United States, Ray et al. (2005) found that the IT capability most valuable, rare and difficult to imitate, was the one based on the shared knowledge and common understanding between the IT group and customers relationship managers, and it proved to be critical to the performance of the customer services processes.

In another study, Bhatt e Grover (2005) classify internal relationship skills as competitive advantage sources, since they are valuable, are heterogeneously distributed across companies and are difficult to be transferred between different organizations. In addition, they follow a learning by doing dynamic making them very specific skill which were developed over the years.

The IT technical capability is related to the know-how required to design and develop effective information systems using the technology available and the know-how to use, implement and manage that knowledge to produce goods and services (Barney and Clark, 2007; Hulland *et al.*, 2007; Piccoli and Ives, 2005). Thus it is associated with the knowledge about programming languages and database development environments, architectural standards for communication protocols and operating systems, for example.

Being the IT technical skills explicitly coded and due to the high mobility of skilled people from organizations, the IT technical capability is often not considered to

be responsible for competitive advantage in organizations, since they do not obey the resource heterogeneity assumption (Barney and Clark, 2007; Mata et al., 1995).

On the other hand, some skills related to IT technical capabilities are difficult to be imitated, such as the mastering of knowledge assets at the corporate level, necessary for encoding the organizational business rules, and the technology integration skills, which are specific for each organization (Wade and Hulland, 2004).

3. Method

This research was performed using the qualitative method of case study. The case analyzed was selected for its importance and rarity.

First the main historical events related to the development of the integrated system were identified and the process of design and diffusion occurred between the years 2004 and 2009 were analyzed.

To do so, 23 professionals with relevant role in the system development were interviewed. The interviews were recorded, transcribed and coded using the NVivo software.

After that, we designed a qualitative model by adopting the methodology SODA (Strategic Options Development Analysis), in order to clarify the dynamics of the process. The adoption of SODA can be justified by the need to capture the causal logic in the relationship between the variables (Georgiou, 2011). This approach has already been adopted in other studies, when it was used to support system dynamics models (Howick, 2003; Lane and Olive, 1998). Following that, each SODA map was built on a single unified cognitive map.

Through the analysis domain SODA methodology proposed by the main map and constructs based on historical categorization been identified, the map is divided into areas for better understanding. The resultant map of feedback loops were identified and related to the construction of IT skills.

Finally the maps were merged in just one map and the constructs were clustered for better understanding. The feedback loops were identified and related to the construction of IT skills.

4. Building IT Capabilities

The integrated management system analyzed in this research is mainly composed of three main systems: one to support the academic activities of teaching, research and extension; the other to support the administrative activities of finance, assets and contracts; and a third that perform human resources work processes. All of them are enhanced and maintained by the team members of the university's IT sector.

Between 2004 and 2007, such system was in development and its first modules were made available to the academic and administrative sectors of the University.

Later, between 2007 and 2009, the systems have been enhanced through new modules. During this period it was identified the need to build technical capabilities, by the development team, and the development of internal relationship capability by the development team and technical support staff.

In the context of this research, technical capability is defined as the organizational ability to develop new features and fix bugs in the system at the expected time with quality. The internal relationship capability is defined as organizational skills to support the effective use of systems by other units.

Figure 1 below displays the merged cognitive map, presenting in its top the construct that is system development goal: Systems support to the activities of the University.

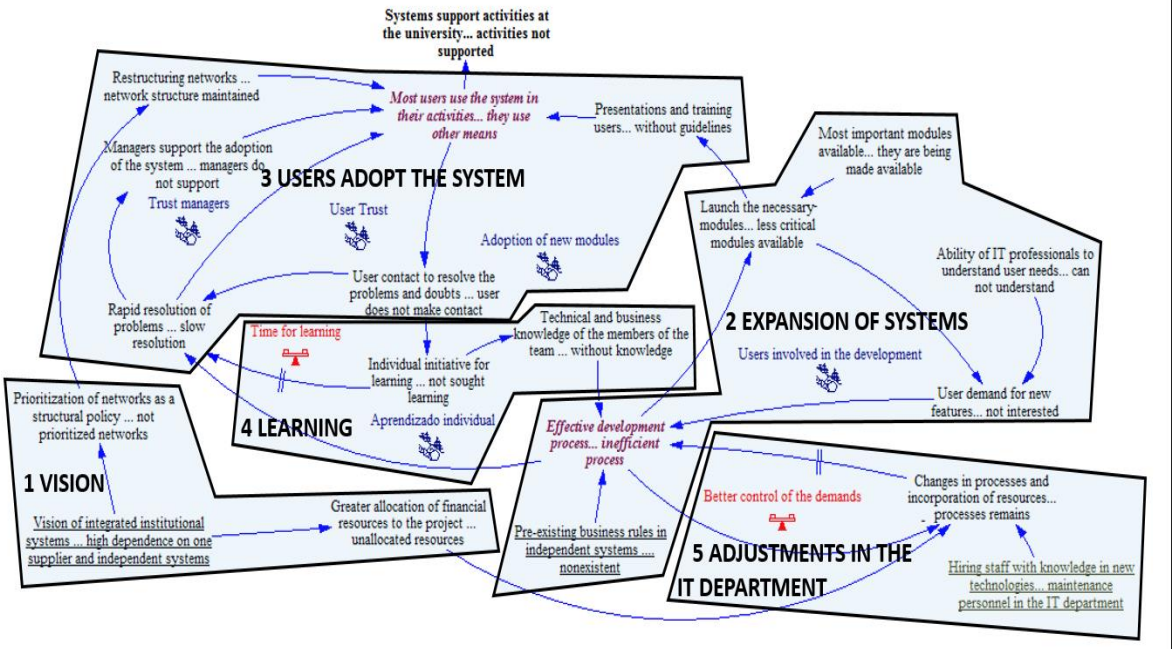

Figure 1: The dynamic for the construction of technical and internal relationship capabilities

Overall, we identified two relevant constructs for achieving this goal, through SODA domain analysis method (Ackermann and Eden, 2010).

One is related to the objective on the map, since to achieve the objective of system supporting effectively most of the University activities, it was necessary that its use was spread in users daily activities (6 relations).

Another relevant construct is the effective development process (7 relations), involving the workflow from the arrival of a new demand (for development of a new module or request for error correction or clarification of doubts) until this demand is met. This process basically involved the IT sectors responsible for both service users and systems development, involving routines belonging to the two IT capabilities analyzed in this work.

There were also identified six feedback loops responsible for the dynamic behavior inherent to the process, four of reinforcement and two of balance. The map was further divided into five areas for better understanding: view definition (1), systems scope of expansion (2), the largest user adoption (3), the need to search for learning by members of the IT industry (4) and organizational adjustments in the IT sector (5). Each area is presented in Figure 1.

4.1. Vision Definition (area 1)

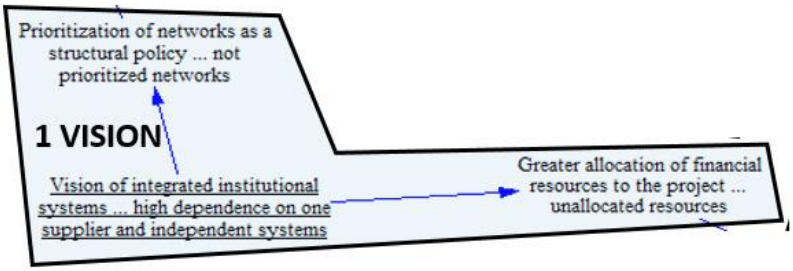

Figure 2 – Vision Definition

Two main aspects defined the senior management vision to support the development of the system. First was the feeling of heavy dependence on an external supplier, which made it difficult to make changes and improvements to the system (1999-2000). Another aspect was the large number of independent systems that the University had at that time, making it difficult to generate reliable management reports (until 2006).

These aspects have led senior management to support the development of its own integrated system, to be developed by the organization's IT sector, which implied in a huge allocation of financial resources to acquire more infrastructure and to hire more people for the IT sector.

They also tried to raise funds from the federal government to investment in the expansion of their networks so systems would have greater availability. These senior management initiatives took place throughout the period in which the systems were being developed and were essential to their success (2002-2007).

4.2. System Scope Expansion (area 2)

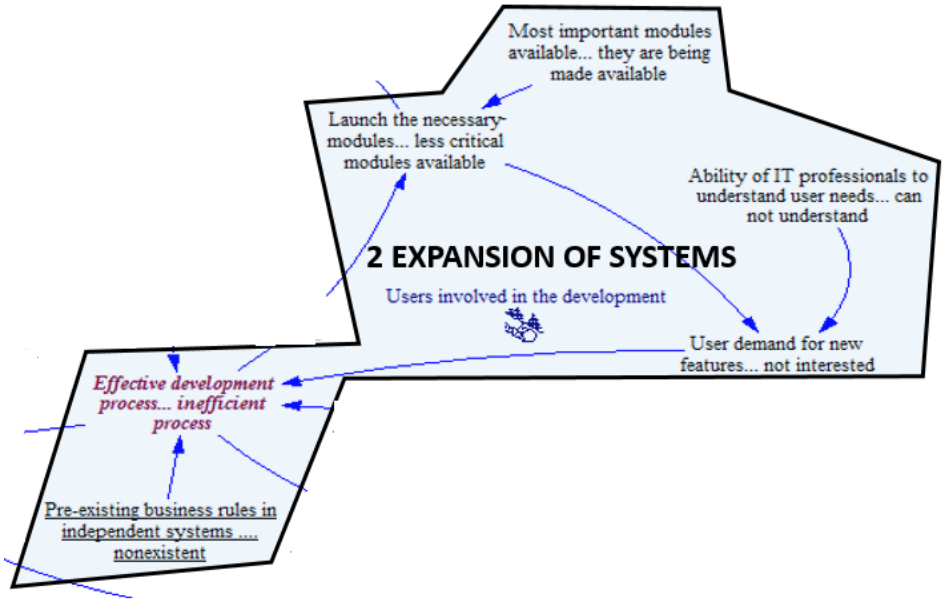

Figure 3 – System Scope Expansion

To be adopted at the university as a whole, it was necessary that the development of the system new modules got involved the users from several areas of the organization who had good knowledge about the work processes in their area.

This is explained by the reinforcing loop Users Participate in Development. In that context, the IT sector launched new modules based on requirements pooled with users so that other users became aware of their advantages, and it triggered more requests for new modules in other areas.

This loop is responsible for the improvement of the system scope, and its strength reinforced by focus of the IT sector in investing in the developing of the main modules, those ones which would be used more intensively. In addition, the skills of the staff responsible for gathering the costumers' requirements had been proved to be an important factor in this context. This dynamic was identified as source for construction of technical capabilities.

4.3. Systems Adoption (area 3)

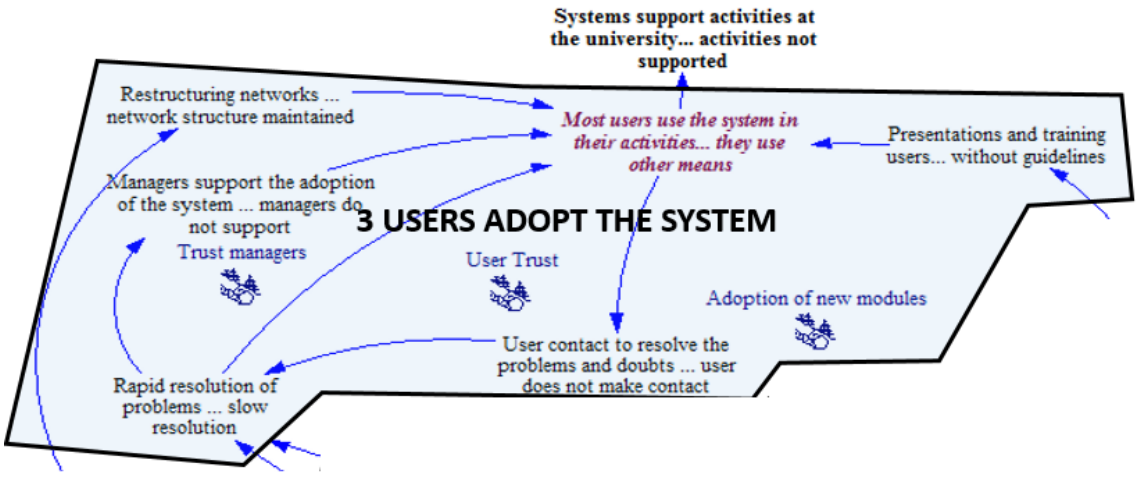

Figure 4 – System Adoption

From 2006, after launching new modules, the University began to establish a training policy for the main users groups. The goal was that employees could incorporate the use of the system in their daily activities. At that time, senior management had achieved major expansion of the University computer networks, increasing the performance and availability of the deployed systems. These factors, enhanced the relationship among the early users and the IT staff to solve problems they faced. As the IT sector quickly responded to such demands for problem solving, it led to an increase credibility (trust) from the users and the University managers.

4.4. Demand for Learning (area 4)

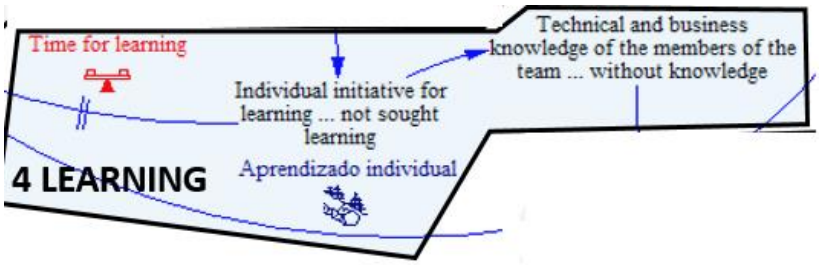

Figure 5 – Demand for Learning

To keep the agility and quick response to the problems posed by users, the IT staff had to study and research about the many problems presented. This process contributed to the development of their technical and business expertise (related to business rules), improving development process. This dynamic is captured by the individual learning reinforcement loop.

This loop was responsible for the accumulation of process knowledge (about the business processes supported by the system worked), and of technical knowledge (about architecture, code systems and database structure are implemented). This learning was responsible for reducing the response time to users requests.

The knowledge search was performed by individual motivation, once there was no specific enforcement from the IT managers. It is noteworthy that this accumulation of knowledge proved to be the fuel for development of technical capabilities and internal relationship capability.

4.5. Organizational Adjustments in IT Department (area 5)

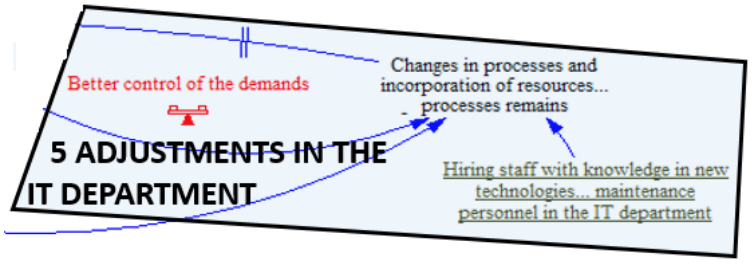

Figure 5 – Organizational Adjustments in IT department

When the demands for new features and bug fixes or clarification of doubts were too busy, decreasing the effectiveness of the development, the IT managers invested on

the acquisition of new resources (technological, human, physical, organizational) and in the restructuring of the development process itself, generating changes that led to the return of the effectiveness of the development process.

This dynamic of organizational adjustments in the IT department is accounted for initiatives such as the creation of new teams in the IT area, new positions, creation of new steps in the implementation process, such as approval and quality testing, for example, and incorporation of new technological tools, such as the creation of a whole process control system.

Similar to the dynamics presented in the previous section, these adjustments proved to be necessary to the development of technical capabilities and internal relationship, characterized by intense trials on how to improve the process of development and changes in routines and processes, activities that characterize the development of capabilities (George, 2005; Pregelj, 2013).

The following table 1 exhibit the role of the categories identified in the creation and development of technical capabilities and internal relationship:

Category	**Role in Capabilities Building**
Vision Definition	Definition of the right context for the creation and development of technical and internal relationship capabilities when financial resources were allocated for the acquisition and expansion of IT infrastructure assets (networks, for example) and hiring IT professionals
System Scope Expansion	Intense exercise of technical capacity activities for the implementation of new features in the system and internal relationship capability activities through interaction with specific user groups for requirements specification
Systems Adoption	Intense exercise of the internal relationship capacity activities through interactions with a larger universe of users of the systems (clarification of doubts, for example) in addition to performing of technical capacity activities by time constraints to meet the demands
Demand for Learning	Incorporation of new technical and business knowledge, important resources used in the improvement of the activities of the technical and internal relationship capabilities
Organizational Adjustments in IT Department	Development and changes in human, technological, organizational and physical resources, used in the improvement of the technical and internal relationship capabilities

Table 1 - Identified Categories and their Role in Building Capabilities

5. Conclusion

This article aims to show how the internal relationship of IT and technical capabilities were built during the design, implementation and dissemination of an integrated management system in a Brazilian public University, between the years 2004 and 2009. It was thus drawn up a cognitive map based on SODA methodology, which was relevant to capture the understanding of the respondents of the dynamics involved in this phenomenon.

Considering that this was a successful process, being currently implemented in other Brazilian organizations since 2009, it is possible to identify the best practices in the construction of relevant IT capabilities which permitted the systems to support much of its activities. In addition, it was possible to contribute to the literature on organizational capabilities, to detail how the development process occurred.

Currently, in the strategy area, much of the research focused on dynamic capabilities is based on studies that ignore procedural aspects on the creation and development of capabilities.

The next step in this research is to develop a simulation model using System Dynamics, to get insights about the dynamics of capabilities creation and about the dynamics of technology diffusion.

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