

Comparative analysis of the main business processes of building companies in civil construction

Análise comparativa dos principais processos de negócio de empresas do subsetor de edificações da construção civil

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Abstract: The work aims to present the study of the business processes of small building companies. The study led to the development of a basic model of business processes. For this, we applied the multiple case study method as main technique to identify the common processes among the companies studied. The study included five building companies of the city of Curitiba, Paraná, Brazil. Data were collected through semi-structured interviews, document analysis and direct observations in loco. Based on the information obtained, the business process modeling was developed using BPMN notation (Business Process Modeling Notation). Thus, the study allowed the development of a basic model that presents the best practices based on the PCF model (Process Classification Framework), in view of, adequate and compatible with the reality of the organizations that work in the subsector of buildings. The framework obtains a unique view of the processes, presenting the main activities of each business process, with the intention of transmitting a single language within the company.

Keywords: Business processes; Process mapping; Basic model of business processes; Subsector of buildings.

Resumo: O presente trabalho teve como objetivo principal apresentar o estudo dos processos de negócio de empresas de pequeno porte do subsetor de edificações. A partir do estudo dos processos desenvolveu-se um modelo básico de processos de negócio. Para tanto, utilizou-se o método de estudo de casos múltiplos como técnica principal para identificar os processos comuns entre as empresas estudadas. Participaram deste trabalho cinco empresas do subsetor de edificações da cidade de Curitiba, Paraná, Brasil. Para coletar os dados realizaram-se entrevistas semiestruturadas, análises de documentos e observações diretas in loco. Com base nas informações obtidas desenvolveu-se a modelagem dos processos de negócio utilizando a notação BPMN (Business Process Modeling Notation). Assim, o estudo possibilitou elaborar um modelo básico que apresenta as melhores práticas pautado no modelo PCF (Process Classification Framework), porquanto adequado e compatível com a realidade das organizações que atuam no subsetor de edificações. O framework obtém uma visão única dos processos, apresentando as principais atividades de cada processo de negócio com o intuito de transmitir um único linguajar dentro da empresa.

Palavras-chave: Processos de negócio; Mapeamento de processos; Modelo básico de processos de negócio; Subsetor de edificações.

1 Introduction

The construction industry is widely recognized as a complex and competitive environment, which makes a sector strategically important for the capacity to build infrastructure and buildings in which most other sectors of the economy depend, it is considered a major contributor to global economic growth (Nordin et al., 2011; Potts & Ankrah, 2013). It is notable that in both developed and developing countries the importance of the construction industry

has been increasing in the last years, in view of, accompanied by major changes such as globalization, the technological evolution, the growth of the sector, among other factors that contribute to a considerable increase of the competition (Horta & Camanho, 2014). Due to competitive changes, managers are continually seeking the adoption and implementation of appropriate strategies for the management area (Ali et al., 2013; Jin & Deng, 2012).

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However, there is research in academic area pointing as inefficient the productivity levels of the construction industry and emphasize that in general the industry is behind other industries in terms of improvements, management, and even by include complicated processes (Fulford & Standing, 2014; Hiremath & Skibniewski, 2004; Taylan et al., 2014). Companies of infrastructure construction and building industries are facing huge pressure to strengthen and enhance all processes due to wide competition (Viljamaa & Peltomaa, 2014).

According to Hola (2015), recent research shows that civil engineers are responsible by most micro and small construction companies, since these professionals have extensive knowledge in the area of project design and construction site, however, have less knowledge in business management and business process management. Also, according to the author, there is another factor that most small businesses face, the need to implement management systems, by the fact that it is very expensive and the businessmen can not acquire them. On the other hand, the literature discusses the interest in business process management in construction companies, but knowledge of the process approach and the advantages by applying best practices are still negligible (Hola et al., 2012).

This article aims to present the study of the business processes of small construction companies, more specifically, the subsector of buildings. Based on the study of the processes, it was possible to develop a basic model of business processes. The model aims to aid construction companies in identifying the activities that are part of a process and how these activities are interconnected to achieve the final result, thus they can eliminate the non-value added, in order to reduce process cycle time, making them more effective.

Therefore, this work was elaborated from multiple case studies. The identification and representation of the common business processes of the companies studied were carried through the BPMN notation (Business Process Modeling Notation), has been this one of the methods used to know with detail and depth all the operations that occur within the organizations. The study involved five small businesses which operate in real estate development and services in the field of construction.

The justification of this work discovers in the important contribution of auxiliary the companies in this sector to the organization and formalization of its business processes. Therefore, the model elaborated in this work is a good starting point for the companies of the subsector of buildings to analyze how the processes are structured. As the companies identify and analyze the processes, they are already on the way to continuous improvement. During the development of this research it was observed what

actually happens in the construction environment of the day to day, it has been a good way to find out that to manage business processes, firstly, it is necessary to visualize them end to end and document them, to be able to define work patterns, avoid redundant processes, or even design new processes.

Thus, the model and process mappings, relevant practical examples, contained in this study, besides motivate the interest of building companies, can also induce other industries to perform modeling to conceptualize its processes and know the sequence of work activities, thus creating its own business process architecture.

The development of the study is structured in four phases. Firstly, the state of the art that which approach definitions of subjects of the literature and a brief survey of researches related to the subject of this work. Thus, initially, it is presented the definition of business processes and the PCF model (Process Classification Framework) with its characteristics. Following is the choice of methodological approach and the procedures adopted for the development of the research. The third phase presents the results obtained through the research analysis. And finally ends the study with the conclusions and suggestions for future work.

2 Bibliographic review

This section is divided into two subsections. The first presents definitions about process modeling, and also, the business process model that had its first version created in 1992. The second subsection presents a brief review of some construction studies, which are related to the theme of this research.

Adding value to business processes has become increasingly important to organizations, resulting in better responsiveness to competitive environments by providing significant value to the operation of a business (Jimenez, 2009; Leopold et al., 2012; Vergidis et al., 2012). Therefore, process modeling is becoming more and more popular (Aguilar-Savén, 2004). For Caetano et al. (2012) and Holt & Perry (2010), the process modeling produces abstract descriptions of business processes, making it a fundamental asset for companies, since they allow to identify the complexity, adding the understanding of documents, improving communication, as well as accomplish analysis and engineering through multiple paradigms, languages and techniques.

The processes of a company are complex and can be numerous, which requires a general framework of the organization that describes the behavior of the processes. A detailed view of the processes is important to understand the flow of tasks in the business process (Lodhi et al., 2009). The company needs to design its processes to better serve the customer, as well as streamline its coordination

with internal and external suppliers (Hongtao et al., 2006). A process model can provide a comprehensive overview of a process, allowing than an organization can be analyzed and integrated through its sets of processes, then is given the importance of correctly modeling its business processes, transforming them into formal representations (Aguilar-Savén, 2004; Smirnov et al., 2009).

For Holt & Perry (2010), the graphical representation contained in a process model not only shows the activities and departments of a system and the relations between them, but also what the system seems and what it does, although, not as it does. The business process models are developed using methodologies or modeling languages, also known as modeling techniques or notations (Zur Muehlen & Indulska, 2010; Weske, 2007). Studies show that BPMN notation (Business Process Modeling Notation) is the most used among researchers and analysts to graphically represent business processes (Cardoso & Aalst, 2009).

Process models can be specialized, resulting in reference models, for example, (Process Classification Framework), this reference model offers a wealth of information to organizations to increase its level of process orientation (Brocke & Rosemann, 2010b).

2.1 PCF model of american productivity and product center

The first version of the PCF model (Process Classification Framework) was developed in 1992 by American Productivity and Product Center (APQC). This model contributes to organize the knowledge of the best practices applied in the business processes of various industrial sectors, such as automotive, aerospace, banking, pharmaceutical, telecommunications, educational and petroleum (O'Leary, 2007; APQC, 2015).

The initial design of the PCF (Process Classification Framework) involved more than 80 organizations with a strong interest in promoting the exchange of information in the United States and around the world. Among the 80, the following companies are: Boeing Company, International Business Machines Corporation (IBM), United States Navy (U.S. Navy), Ford Motor and Ensco International (Dumas et al., 2013; Valle & Oliveira, 2009). The PCF reference model (Process Classification Framework) offers a variety of information for organizations to increase the level of orientation of business processes. However, the PCF (Process Classification Framework) is not a reference to be used in company process management analyzes (Brocke & Rosemann, 2010b).

Valle & Oliveira (2009) report that the PCF (Process Classification Framework) is an architecture for process improvement. This architecture allows

organizations to understand its internal activities through a systemic view, and not in the traditional form, in other words, by a functional hierarchical vision. Figure 1 illustrates the PCF model (Process Classification Frameworks), with the main categories of processes that the model covers.

In PCF architecture (Process Classification Framework) the groups of processes decompose in process; processes in subprocesses; the subprocesses in activities. Valle & Oliveira (2009) presents the functional decomposition of the processes of the PCF architecture (Process Classification Framework) in the following way:

- 1) Category: It is the highest level within the PCF architecture, being indicated by integers (5.0 and 6.0);
 - 1.1) Process groups - first functional decomposition: all items of PCF architecture are numbered with one decimal digit (5.1 and 6.1);
 - 1.1.1) Process - second functional decomposition: All items within the PCF architecture are numbered with two decimal digits (5.1.1 and 6.1.1);
 - 1.1.1.1) Activity - last functional decomposition: All items within the PCF architecture are numbered with three decimal digits (5.2.1.1 and 6.3.1.1).

Functional decomposition can be understood as classification of processes, because it does not stop being a way of dividing them into smaller classes within a given hierarchy.

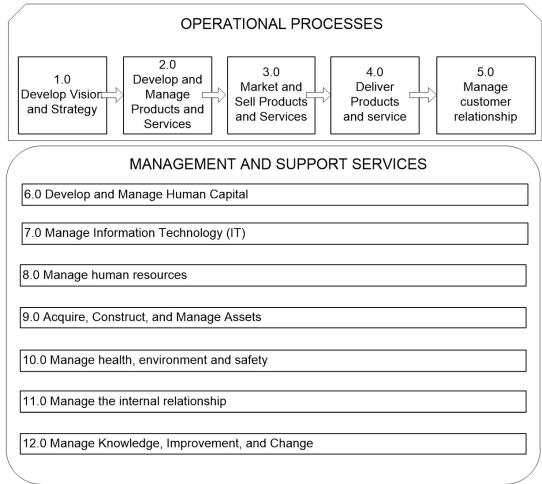


Figure 1. PCF Architecture (Process Classification Framework). Source: APQC (2015).

2.2 Studies related to the theme of this research

Bremer & Lenza (2000) present a reference model for business process for Production Management. The model developed by the Integrated Logistics Group of the Advanced Manufacturing Nucleus of USP of São Carlos was destined to companies that assemble its final products to order. To develop the model the authors used as reference the ARIS architecture (Architecture of Integrated Information System). Bremer & Lenza (2000) point out that the company can adhere an initial solution of business processes by means of a reference model, however, the company needs to determine which are the processes that most identify with its operations, as also, with what degree of detail the organization will build its own model. The company, in front of its routine activities can develop a particular model prioritizing each of its views of the model.

Song & Choi (2011) suggested a Sustainable Business Process Management model (SBPM), which allows the continuous improvement of the business processes of companies in the civil construction sector. The research analyzed the critical need to adopt BPM (Business Process Management) to deal with the change of paradigms related to process management in the construction industry. The Sustainable Business Process Management model (SBPM) visualizes the business process, establishes human resources, and relates systems to tasks in a process-oriented way.

The research developed by Laitinen (1999) presents a model based on the management of construction processes. The author's goal was to study how data management of a data from a main contractor can be improved, in order to provide a better value to the customer and obtain greater economic output. The research focused on information management reengineering methods using product modeling as a supporting technology. Therefore, Laitinen (1999) used IDEF-0 (Integration Definition Methods 0) as a key methodology to describe the process of information management throughout the lifecycle of the construction process.

3 Research method

The present research originated from a qualitative investigation to study the business processes of the civil construction industry. As the construction sector is very diverse, was analyzed the category of building construction which includes buildings built with proposed residential, institutional, educational and shopping centers.

The focus of the work was to identify the main business processes of small businesses of the subsector of buildings, more specifically, make an analysis to find what is common between the processes of

the companies of this sector. From this idea it was observed which are the best practices most applied in the operation of the processes of the investigated companies. The results were structured and presented in the form of process models, in order to arrive at a basic model that presents the best practices.

Therefore, the methodological approach to conduct development work is needed to achieve the results reliable and valid (Gil, 2009). With regard to aspects methodological, aspects, this section describes the research design to develop the study. According to Gil (2009) and Yin (2010), to conduct a work it is necessary to define a research strategy guided in sequence of activities to be performed.

In this sense, from the definition of the objective of this study, were elaborated the procedures for work development. Firstly was realized a survey of the bibliographic review that approaches important points on subjects related to the theme of this work, as well as the identification of some previous studies that are closely related to this study.

The following, is described the procedures performed to explore the business processes of the companies investigated. As a specific investigation strategy, the multiple case study technique was applied, this technique is the most adequate for the research objective, and also it is characterized a qualitative and exploratory study, as suggested by (Gil, 2009; Yin, 2010). According to Creswell (2010), the qualitative research process covers the issues and procedures that emerge data typically collected in the participant's environment, it also covers the analysis of data inductively constructed from the particularities for the themes, and also the interpretations made by the researcher about the meanings of the data collected.

Initially, the unit of analysis was chosen, and at this stage it was selected, as already pointed out, small companies of the sub-sector of buildings. This choice is based on the discussion that most Brazilian companies in the construction sector are micro and small. These are companies present greater difficulties in relation to the its management system, due to some variables such as the unpreparedness of managers, scarce financial resources, little support and incentive government, restricted access to new management technologies and lack of internal organization (Fulford & Standing, 2014).

For Fulford & Standing (2014) there has been recently an increase in collaboration for improvements in the construction industry, however, there are still many challenges and complexities to be overcome. Therefore, the main focus for the selection of the companies was to find construction companies that worked in the sub-sector of buildings. Thus, companies were selected based on the following criteria: size, location and specialty. The companies investigated, with a total of five, work in real estate and services

development, are located in the city of Curitiba, Paraná, Brazil.

The case studies that are part of this research were not statistically selected. They were selected as advised by the theory on the subject. According to Gil (2009), although it is not possible to speak of an ideal number of cases, usually four to ten cases are used.

The form of data collection was accomplished as Miguel (2007) suggests, using multiple sources of evidence, such as semi-structured interview, documentary analysis, direct observations in loco. The semi-structured interviews were conducted with the use of a research protocol, but with the freedom of adding new questions by the researcher. According to Yin (2010), the protocol is a way to increase the reliability of the case study research, besides guiding the researcher in the accomplishment of the data collect. The documents provided by most companies, such as PBQP-H (Brazilian Habitat Quality and Productivity Program) documents, activity control worksheets and flowcharts, allowed for the collect of more information and even corroborate some information obtained during the interviews.

As Yin (2010) recommends, firstly, a pilot case study was conducted. For Yin (2010), this method helps to refine the data collect plans, about the content of the data and the procedures to be followed. Therefore, in the first company studied, the pilot case study was applied, so that the method could be tested, so that the questionnaire presented difficulties and deficiencies and could be improved for later applications. The evidence used in this stage of the research included interviews with managers and professionals, besides direct observations in the company.

During the conduction of the pilot case there was the recording agreement of the interview, and yet, notes were made during the meeting, which lasted about one hour and thirty minutes. In general, after the pilot study, some reformulations were realized in the data collect instrument (questionnaire), being necessary to obtain a better interview performance in the next companies. The improvements applied were basically in the preparation of the interviews and the time needed to gather the information. A primary point was to reduce the meeting time for not to lose the focus of data collection, which would last for approximately one hour, if necessary there would be another interview in the same company, since that it does not exceed the time delimited.

Following, aiming an initial understanding of situation of the companies, the modeling of the business processes of each company was graphically elaborated, allowing the visualization of the flow sequence of the main activities performed in each process. The BPMN language (Business Process Modeling Notation) was used to represent the process

modeling, using the Bizagi Software, to describe in a graphical environment the business processes in an agile and simple way. In this stage, the initial version of the process modeling was obtained, which was successively adjusted with new information provided during the validation of the modeling by the professionals interviewed.

After represent graphically the business processes, it was the turn to perform the validation of the informations that were collected. In essence, the validation act must include, exclude and/or change activities in a mapping. The validation process was initially carried out with the interviewee that provided the information and then with people who have the authority or decision-making power over the processes. In this step, changes were made to leave the mapping the closest to reality.

As the interviews were carried out and the processes modeling were validated, initiated the individual description of the cases investigated. All the information gathered during the interviews were individually described in order to accomplish a comparative analysis between the business processes of the companies. Therefore, for a better understanding, this phase was to filter the similar information among the companies studied. Thus, the information has been grouped and named by setting a standard to reduce the number of business process models. Chart 1 summarizes the methodological steps that conducted the work.

3.1 Notation and software for business process modeling

According to Cardoso & Aalst (2009), Pavani & Scucuglia (2011), Valle & Oliveira (2009), among the notations, to design the processes, more known today to be used as workflow languages are: BPMN Process Modeling Notation, UML Activity Diagrams, Business Process Execution Language (BPEL), IDEF-0 (Integration Definition Methods 0), EPC (Event Process Chain) and Petri nets.

Among the most used software for to make modeling processes are: BizAgi, Visio Professional/Microsoft, ARIS Toolset (Architecture of Integrated Information Systems), YAWL (Yet Another Workflow Language) and WoPed (Workflow Petri Net Designer). These tools present significant market acceptance, both in terms of the content of the tools and the market dynamics (Valle & Oliveira, 2009; Maranhão & Macieira, 2010; Pavani & Scucuglia, 2011).

In 2004, the BPMI (Business Process Management Initiative), a non-governmental organization, created version 1.0 BPMN (Business Process Modeling Notation). For such purpose, the BPMI (Business Process Management Initiative) had the support of the main Information Technology companies in the

Chart 1. Designing of the research for the development of the work.

PHASES	DESCRIPTIONS
Bibliographic research	After defining the objective, the bibliographic research was elaborated, which represents the theoretical basis for the development of this work.
Choice of methodological approach	The methodological approach provided a specific direction to develop the procedures realized with the case studies. As a specific research strategy, was applied the multiple case study.
Choice of cases	The focus for the selection of the companies was to search for constructors what worked in the subsector of buildings. Five small companies that operate in real estate development and service provision participated in this work, and are located in the city of Curitiba, Paraná. As a way of protecting the privacy of the companies studied, it was decided not to identify them. Thus the companies are denominated in this work as Companies A, B, C, D and E.
Data collect	The sources of evidence used to carry out the case studies were: semi-structured interviews, direct observations on the spot and document analyzes, such as process map, activity control sheet and documents related to the certification of the Brazilian Quality and Productivity Program of Habitat (PBQP-H).
Process modeling	The BPMN language (Business Process Modeling Notation) was used to represent the process modeling, using the Bizagi Software, to describe in a graphical environment the business processes in an agile and simple way. In this step the initial version of the mapping of the processes was obtained, which was successively adjusted with new information provided during the validation of the mapping.
Validation of modeling	The validation process was initially accomplished with the respondent which provided the information and then with people that have the authority or decision-making power over the processes. In this stage changes were made to leave the modeling the closest to reality.
Describe the cases studied	As the interviews were accomplished and the models were validated, the description was started of individual case. All the information collected during the interviews was described separately in order to carry out a comparative analysis between the companies.
Comparative analysis comparativa	For better understanding, the information was grouped and named, sought this step to establish a standard to reduce the number of diagrams representing business processes. This procedure sought to filter similar information among companies studied.

Source: Elaborate by the authors.

world (International Business Machines, Management Information Systems, Oracle, Microsoft, Rational, among others). In 2005 the BPMI (Business Process Management Initiative) joined the OMG (Object Management Group), also a non-governmental organization, which controlled the UML (Unified Modeling Languages). The associations sought to join forces to standardize methods and tools for business processes, thereafter, in 2009, they created BPMN 2.0 (Maranhão & Macieira, 2010; OMG, 2011).

The BPMN notation technique (Business Process Modeling Notation) is specific to business process modeling, and since its existence has been evaluated by the academic community and has been widely supported by researchers (Brocke & Rosemann, 2010a; Cardoso & Aalst, 2009).

According to Lu et al. (2010) and Pavani & Scucuglia (2011), the BPMN language (Business Process Modeling Notation) is a modern notation, adopting a symbology pattern that solves a series of gaps of previous modeling. This notation has several elements, the basic ones are only four (Figure 2): Flow objects, Connection objects, Swimlanes (Pool and Streaks) and Artifacts (Weske, 2007; Maranhão

& Macieira, 2010; Carrara, 2011; OMG, 2011; Mendoza et al., 2012).

4 Research analysis

This section introduces business process models. Each model shows a series of practices accomplished in each process, and for a better understanding, similar activities were grouped separately among the companies, so a comparative analysis of the main processes was realized.

Based on the case studies were identified relative similarities between business processes. Most companies internally carry out processes such as prospecting for new constructions and business, coordination and planning of projects, preparation and analysis of budget, process of purchase of materials and services, sales and marketing, financial management, human resources (HR) management, management of construction site. On the other hand, companies opt for outsourcing project development, legal services, accounting services, health management and work safety. The following sub-items present

the main common business processes identified in the companies research.

4.1 Process description: prospecting for new construction and business

Figure 3 shows the main activities that are part of the process of prospecting new constructions. The management for prospecting new constructions is the responsibility of the same department of “Companies A, B and D” (Direction). These companies have common characteristics in relation to the stages of basic planning for a new constructions. The “Companies C and E” are similar because they do not do market research, they are service providers, so they go through the process of “requesting a budget”.

It was observed that the feasibility study for companies is an indispensable instrument for the decision making of investment. Being of great importance to the success of real estate business.

The budget realized on the preliminary project is to estimate the construction cost the closest to reality, thus reducing the financial risks of the enterprise. To do this, these companies accomplish a parametric budget, based on data from previous or ongoing developments.

In an overall analysis of the companies research, can note that before starting to execute projects, the market research and especially the feasibility study of the building must achieve an advanced stage of data collect and analysis, that allows the manager a mature decision about the continuity or not of the building.

4.2 Description of the process: coordination and planning of projects

Figure 4 illustrates the main activities that are part of the coordination process and project planning. In this process it was found that the companies

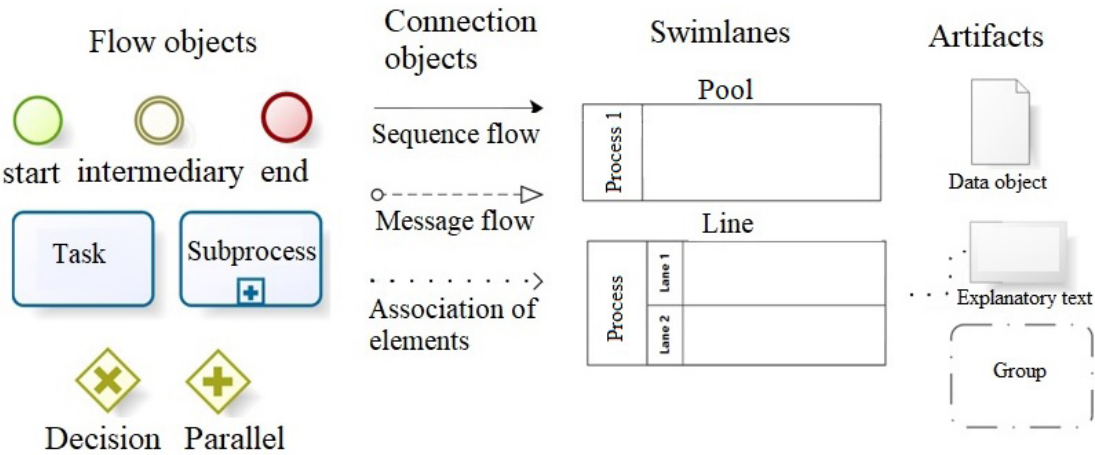


Figure 2. Basic elements of BPMN notation for modeling processes. Source: Adapted from Mendoza et al. (2012).

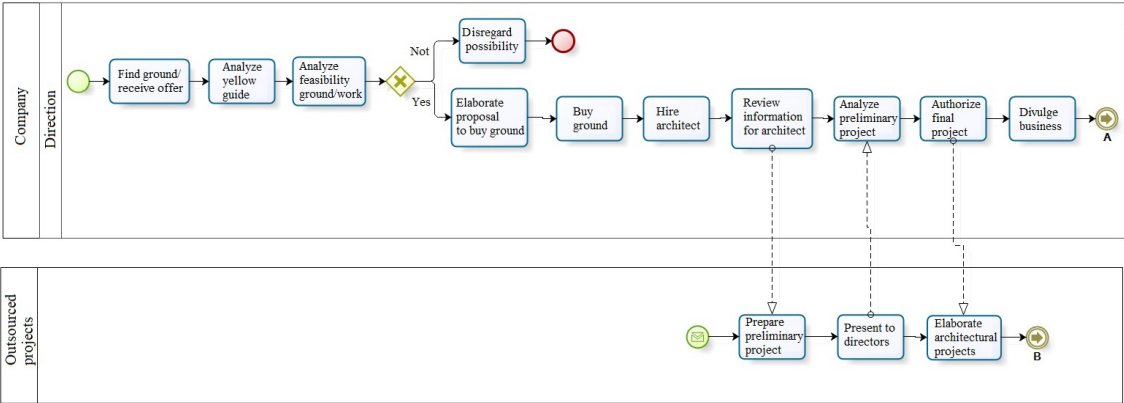


Figure 3. Process for prospect new constructions. Source: Elaborate by the authors.

researched outsource the projects for the execution of construction.

From the executed projects the companies researched accomplish the planning to manage the building. Planning involves the definition of a series of activities to be performed, for example, to elaborate schedules of activities to be performed with established start and end dates, determining the necessary resources and detailing the costs of each stage of work. The compatibilization of projects is a common feature among the companies researched.

It was observed that those responsible for preparing the construction planning firstly consult the engineers and those in charge of construction, to obtain a better estimate of the duration of each activity based on the experiences that those responsible have acquired in constructions anteriorly executed.

4.3 Description of the process: budget preparation and analysis

Figure 5 presents the sequence of the main activities of the elaboration and analysis budget process. In order to determine the cost of executing the buildings,

the companies accomplish a survey of the costs of resources used in the execution of the construction (materials, equipment, labor, services, etc.).

The companies researched unite all the necessary information contained in the executive projects and after defining the composition of the unit prices can execute the closure of the budget. The closure is usually performed by the Directors, as are the Directors that define the rate of IBE (Indirect Benefits and Expenses). The final sales value presented to the customer is not shared with other employees before the proposal presented. The activity schedule is a way to monitor and control the work performed on the site, being also used, to monitor and evaluate progress in meeting the objectives set out in the budget. Follow up at the construction site of the companies is usually realized weekly.

Companies execute the minimum necessary to accomplish budgeting process, which involves budget for execution, budget for proposal, budget for contract and budget for complementary services, the last is carried out in “Companies C and E”, for being service providers, in this case the clients wish to perform services beyond those established in the contract.

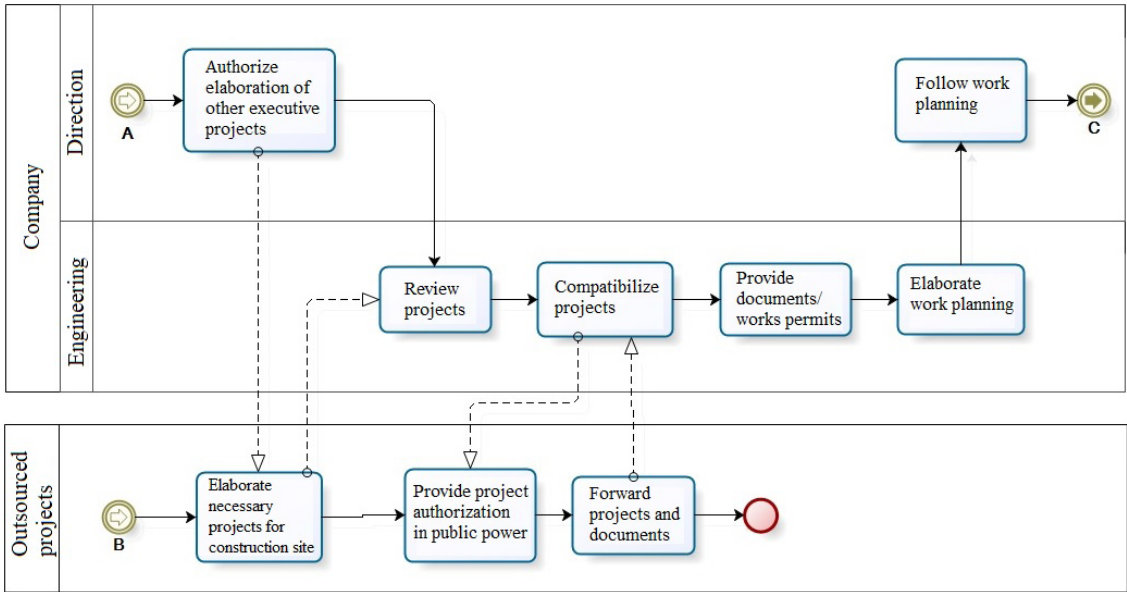


Figure 4. Coordination and planning of projects. Source: Elaborate by the authors.

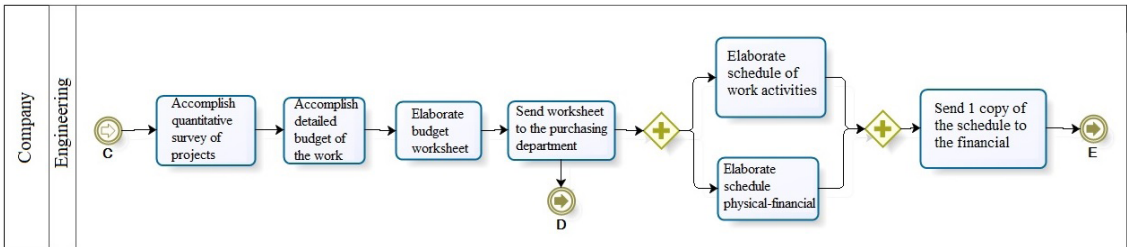


Figure 5. Budget process. Source: Elaborate by the authors.

4.4 Description of the process: purchasing process

The main activities of the purchasing process carried out in the companies researched are described in Figure 6. It is observed that in most of the time the responsibility of making price quotations of materials and services, and also making the purchase, is centralized in the same department between the companies (purchasing department). Independently of the complexity of the process the companies studied use the purchase order as a purchase document for the purpose of recording and filing costs.

In general, the companies researched have some process of control related to purchases, for example, the planning of purchase takes into account the physical schedule of the construction site, as well as the cash flow. Another factor is the centralization of the purchase that entails a certain degree of organization, maintaining a greater control of acquisitions of materials, thus facilitating the decision making.

Another factor observed in the companies is that the agent responsible for the price quotation is also responsible for emission the purchase order. Thus, it

presents greater control in the flow of information, when the purchase order is sent to the supplier, construction department and the financial department also receive a copy sent by e-mail by the purchasing department, thus, the interested parties have access to the purchasing information to be able to carry out its schedules.

4.5 Description of the process: marketing and sale

The activities of this process are illustrated in Figure 7. The buildings of “Companies A, B and D” are sold at “fixed price”, normally the sell occurs before beginning the production cycle, that is, sale at the plant. The companies researched do not carry out the sale before the projects are approved in public agencies and to register the property in a registry office. After the launch of the buildings for sales, begins the monthly monitoring process to analyze the financial condition of the companies and consumer market.

The beginning sales process of the “A, B and C” is similar, because it is the Directors who have the sales contact with the clients, they are

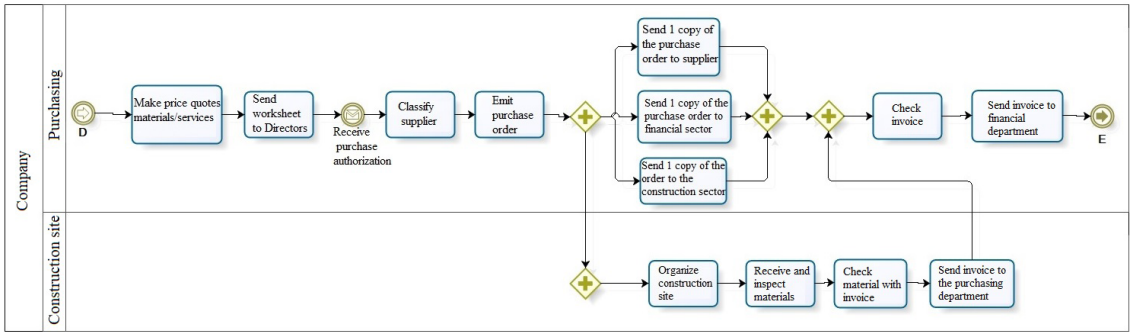


Figure 6. Purchasing process. Source: Elaborate by the authors.

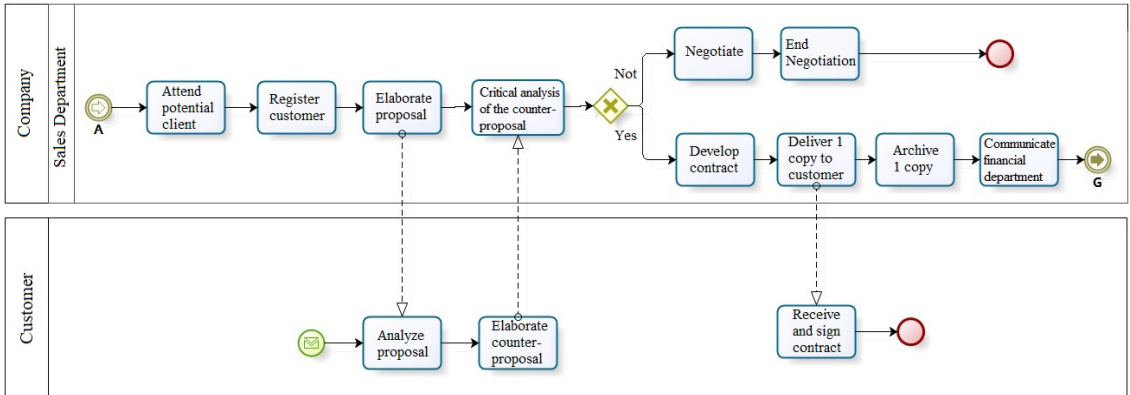


Figure 7. Sales process. Source: Elaborate by the authors.

the ones who present the proposal and receive the counter-proposal. Now the “Company D” has the specific sales department for this purpose, the Director of this department is responsible for the sales process. “Company E” has the commercial department to carry out the sales process. A similar point between “Companies C and E” is the receipt of proposal of construction of the clients, so that they can accomplish the sale process.

4.6 Description of the process: financial management

Figure 8, presents the main activities related to the financial process management. The five companies studied have similar characteristics in this process. With the information obtained from interviews with those responsible for the financial process, it was noted that “Companies A, B, C, D and E” have the financial department.

Note that in the financial department the following activities are carried out: launch of accounts payable and receivable, make charges to customers, follow up the billing statement, monitor update of bank balances, separate the fiscal documents and send them to the accounting, file the documents after being counted, and follow the physical-financial schedule for cost control.

All the financial process is performed internally, this department reports directly to Direction of the companies studied. The financial department of each investigated company develops financial cost reports applied to the company to improve the planning, control and decision making of the Directors. Based on report to Directors of each company compares the

actual costs with the costs that the company planned in the elaboration of the budget.

4.7 Description of the process: Human Resources management (HR)

The main activities applied in the human resources department (HR) of the companies studied are presented in Figure 9. In “Companies A, B, C and D” this process works similarly. In general, this process includes the activities of selecting candidates, registering employees, controlling payrolls, elaborate rescission contractual, request to the financial department to pay employees, file payrolls and rescission contract. It is observed that only “Company E” outsources the human resources process.

As for the control of employee hours in companies, it is performed through the daily point card. The cards are checked by each responsible of the team and passed on to the human resources department (HR), are realized the calculations of the hours worked. Notes that it is not the responsibility of the human resources department (HR), develop training for employees. Usually the trainings are given by the engineer at the construction site.

4.8 Outsourced processes

The processes that are not part of the organizational structure of the companies studied are: elaboration of executive projects, accounting, legal and work safety. “Company E” highlights an outsourced process more, the process of human resources. As for the executive projects the companies only perform coordination, analysis and reviews of projects.

In general, companies have argued that the option for outsourcing is mainly aimed at reducing social

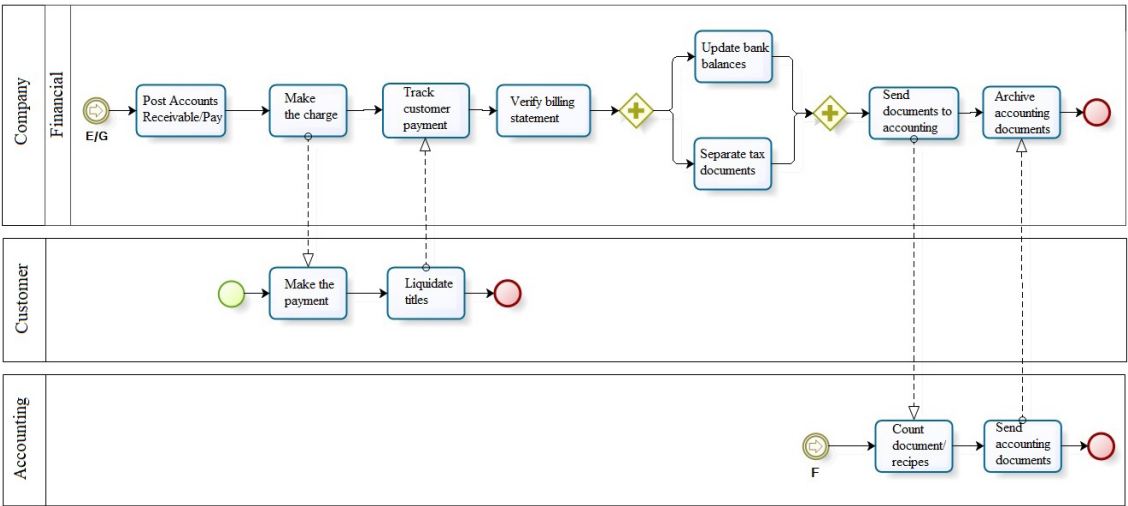


Figure 8. Financial management. Source: Elaborate by the authors.

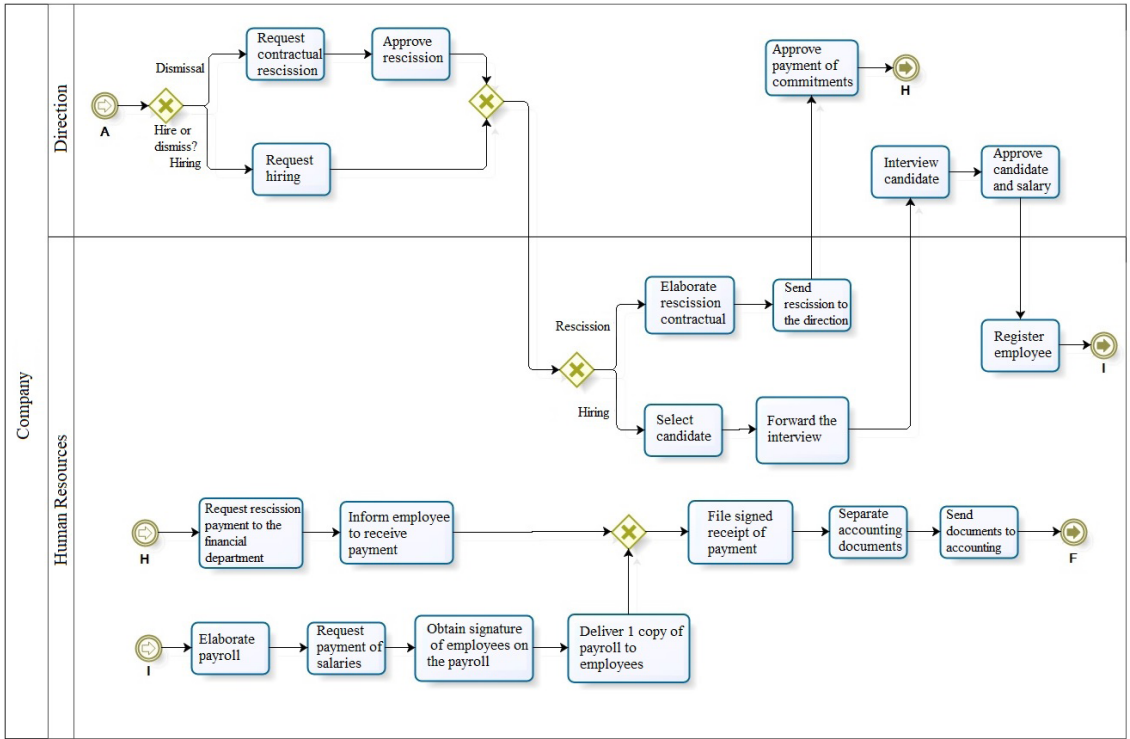


Figure 9. Human resources management. Source: Elaborate by the authors.

charges and administrative costs, and also, to avoid the idleness of labor at times when they do not have constructions that demand determined services. The cases studied were oriented to the understanding of the main activities that make up the business processes. The comparative analysis showed the existence of similarities among the processes, which can serve as a basis to develop a basic model that presents guidelines on how to apply the best practices in companies of the construction sector.

5 Identification of business processes

During the study it was observed that few employees have a vision of the whole, and managers who theoretically have this vision do not manage very well the conflicts that sometimes occur between departmental boundaries. In general, the companies studied do not have a unified view of its business processes, each department has its own understanding of the activities.

The study showed that there are no significant differences compared to other companies in some fundamental processes, such as human resources management and financial management. It was noted that the development of a business strategy is a process carried out informally. In general, the direction establishes a strategy to be followed by the company. Business processes such as project coordination and

planning, commercialization of buildings, budget preparation and analysis, acquisition of materials and services, execution of constructions, after-sales services, management of outsourced services, health management, the environment and work safety and the prospecting of new buildings are typical of the small companies of the sub-sector of buildings.

Based on the results of this study and on the PCF model (Process Classification Frameworks) it was possible to present a first version of a future reference model for business processes of companies of the subsector of buildings. The initial model developed in this study gives an overview of the classification of processes, so that it can help companies in this sector to clearly define best practices.

Figure 10 shows the elaborate model that, basically, led to what can be called the basic model for improving the business processes of construction companies. It is considered as a starting point to analyze how its processes are currently structured.

For each process of the model it is possible to associate the main macro-activities that can be conducted. Chart 2 shows the layered decomposition, being essential to be able to understand in detail the processes associated with its macro activities. Processes: it is the highest level within the model, being indicated by integers number (for example, 1 to 12); Macro-Activities: All items in the model

Chart 2. Main processes associated with its macro-activities.

OPERATIONAL PROCESSES	
1. DEVELOP VISION AND STRATEGY	1.1 Identify market opportunities 1.2 Identify new ways of adding competitive advantage
2. COORDINATE AND PLAN PROJECTS	2.1 Monitor project execution 2.2 Review executive projects 2.3 Make projects compatible
3. ELABORATE AND ANALYZE BUDGET	3.1 Quantitative survey of executive projects 3.2 Survey of materials and services 3.3 Price quotation of resources 3.4 Assemble the budget worksheet of the construction 3.5 Insurance, fees and taxes during construction
4. SELL BUILDINGS	4.1 Elaborate proposal and present it to the customer 4.2 Receiving and analyzing counter-proposal's customer 4.3 Close buying and selling negotiation 4.4 Sign the contract
5. ACQUIRE MATERIALS AND SERVICES	5.1 Accomplish price quotation for materials and services 5.2 Select Suppliers 5.3 Emit purchase order
6. EXECUTE AND MANAGE CONSTRUCTION SITE	6.1 Elaborate schedule of activities 6.2 Mobilize construction staff 6.3 Receiving material at the construction site 6.4 Organize construction site 6.5 Executar the construction 6.6 Deliver the building
7. AFTER SALES SERVICE	7.1 Maintenance of the building
MANAGEMENT AND SUPPORT SERVICES	
8. MANAGE HUMAN RESOURCES	8.1 Selecting Candidates 8.2 Register employees 8.3 Control Payroll 8.4 Elaborate contractual rescission
9. MANAGE OUTSOURCED SERVICES	9.1 Manage executive projects 9.2 Manage accounting services 9.3 Manage legal services
10. MANAGE HEALTH, ENVIRONMENT AND SAFETY	10.1 Manage periodic exams 10.2 Manage the work environment 10.3 Manage work safety
11. MANAGING FINANCE AND RESOURCES	11.1 Provide accounts receivable and payable 11.2 Track billing statement 11.3 Forward documents to accounting
12. PROSPECT NEW BUILDINGS AND BUSINESSES	12.1 Carry out market research 12.2 Analyze feasibility of new building 12.3 Elaborate preliminary project

Source: Elaborate by the authors.

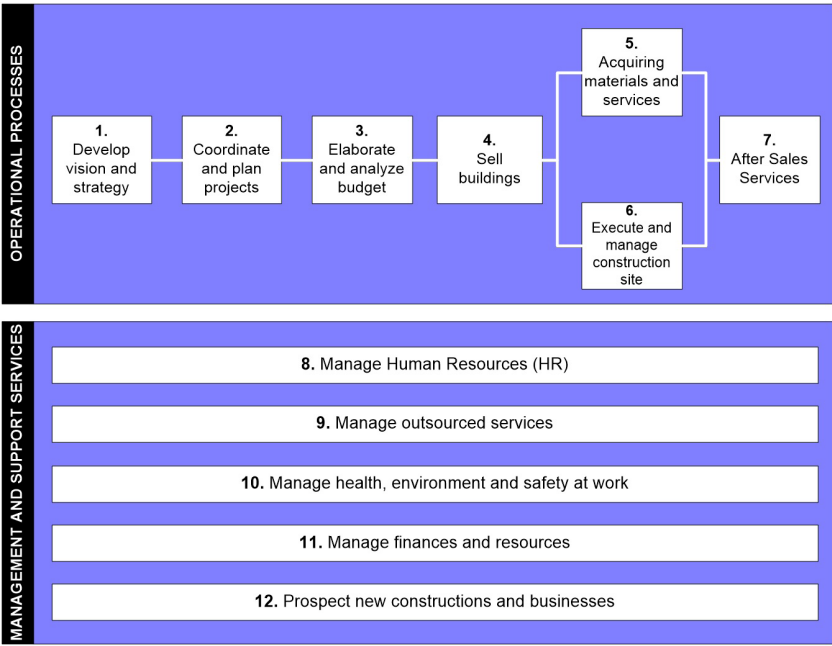


Figure 10. Basic model of business processes for construction companies. Source: Elaborate by the authors.

are in decimal digits (for example, 1.1 to 12.3). Chart 2 composes the main activities becomes an available medium to create a library of activities applied in each business process of the companies of the subsector of buildings.

The model identified in this work can guide the companies of the sub-sector of buildings to define the classification of the processes, for presenting only what activities can be accomplished. However, the model does not specify procedures, neither methods that should be adopted for company management and performance evaluation criteria. The model obtains a unique view of the processes, presenting the main activities of each business process, with the intention of transmitting a single language within the company.

6 Conclusions

From on bibliographical researches, direct contact with the builders and also the analysis of the results obtained, it was possible to achieve the objective of studying the business processes of small companies of the subsector of buildings, aiming to develop a basic model of processes for companies of this sector. The model presents the best practices based on the PCF model (Process Classification Framework), however, adequate and compatible with the reality of the organizations that work in the subsector of buildings.

Front to the informations collected, based on the interviews conducted with the companies participating in the research, the basic model summarizes the main

business processes: (1) Develop vision and strategy, (2) Coordinate and plan projects, (3) Elaborate and analyze of budget, (4) Sell buildings, (5) Acquiring materials and services, (6) Execute and manage construction site, (7) After sales service, (8) Manage human resources, (9) Manage outsourced services, (10) Manage health, environment and safety, (11) Manage finances and resources and (12) Prospect new constructions and businesses.

In terms of contribution this study can become a starting point for companies in the building subsector to analyze how its processes are structured. It is a useful reference by taking the point of view of end to end processes, describing the activities of a sector as a whole, already in this stage, the process with the biggest weaknesses will appear. Having thus, the opportunity to analyze all work in a sequence of connected activities. Decomposition of business processes is essential to be able to create a specific model which presents the best practices, focusing on continuous improvement.

The transmitted method in this research was through the process of learning by doing, therefore this study shares the procedures that have been learned in theory and practice about business process mapping, so that a basic model can be created to transmit information, removing of the construction managers the vision of individual processes. It is worth mentioning that companies from other economic sectors can use the concepts described here to create its own business process architecture.

The study is limited to a basic model of business processes that was developed from mapping the activities applied in construction companies. However, the model presented in this paper does not specify methods that should be adopted for company management as a whole, neither performance evaluation criteria. The model is an initial step toward achieving a basic level of understanding, organization and stability of business processes.

Finally, the basic model of processes developed in this study is in the same line of research of Hola (2015), in terms of activity levels and process classification. The work entitled "Identification and evaluation of processes in a construction enterprise" makes use of the tool ISO 9001, which consists of the identification, analysis and evaluation of the processes. Guided by ISO 9001, a process model was developed in the form of a matrix that allows standardization of processes, regardless of whether it is a process of a company or technical area. Hola (2015) highlights that in this way a database is built as standard for the construction industry in particular, it can be a very valuable source of information, as well as can be applied in the management, to measure the efficiency of the processes and its continuous improvement.

Thus, having observed the amplitude and relevance of the theme, this study identified some suggestions for future work:

- Apply this research in a larger number of companies to have more robust results, allowing the development of a specific reference model for construction companies.
- Detail the process of planning control of construction sites, identifying which are the problems that occur in terms of time and activity;
- With the mappings of this research to use BPM practices (Business Process Management), that is, to apply a continuous life cycle of BPM activities.

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