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# Using the view of Business Process Management (BPM) for process improvement in the shipping industry and offshore construction sector: a case study of the Rio Grande (RS) naval pole

## *Usando a perspectiva BPM para o aprimoramento de processos no setor da construção naval e offshore: estudo de caso no polo naval de Rio Grande (RS)*

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**Abstract:** The current study describes the mapping and analysis processes of a company in the Brazilian shipbuilding and offshore construction sectors, according to Business Process Management assumptions. As for methodology, applied research using a case study, where semi-structured interviews were conducted as data collection tools. As for the interview scripts, six process parameters were established and used for data collection, which was of qualitative nature. Creation of the flowchart, resorted to the standard flowgram tool ANSI, this allowed for detailed viewing of the activities that compose the process as well as a general view of the process.

**Keywords:** Process mapping; Process analysis; Shipping industry; Offshore; Process management and; Process parameters.

**Resumo:** *O presente trabalho descreve a proposta de mapeamento e análise de processos em uma empresa do setor de construção naval e offshore brasileira seguindo os pressupostos da Business Process Management. No que tange aos aspectos metodológicos, a pesquisa caracteriza-se como aplicada e foi conduzida por meio de um estudo de caso, tendo entrevistas semi-estruturadas como instrumento de coleta de dados. Para a realização do roteiro de entrevistas foram estabelecidos seis parâmetros processuais, utilizados para a análise dos dados, a qual ocorreu de forma qualitativa. A elaboração do fluxograma foi realizada por meio de ferramenta fluxograma padrão ANSI, o que permitiu a visualização minuciosa das atividades que compõem o processo, assim como uma visão geral do mesmo.*

**Palavras-chave:** *Mapeamento de processos; Análise de processos; Indústria naval; Offshore; Gestão de processos e; Parâmetros de processos.*

# 1 Introduction

Organizations may be analysed according to a set of processes (Gonçalves, 2000), that represent the functional relationship dynamics between both parties (Duckert, 2010). Different variables may interfere in this dynamic. From a diversity of technical process competencies, through to inherent psychological aspects of each individual (CMMI Product Team, 2010), with setbacks and losses, typical in any organization, along the way.

The search for better technologies, flexibility and results, has turned the process perspective increasingly into a focal point when developing organizational strategies (Baldam et al., 2014). Process Management, inserted in this context, proposes the

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analysis and mapping of processes to help solve the countless human, technical and technological issues that plague organizations. The good management of these processes implies a competitive advantage and generate benefit for the client.

According to specialized scientific literature, studies such as those by Müller et al. (2010), Carvalho et al. (2013), Schwaab et al. (2013), Souza et al. (2014) and Schimitz et al. (2014), among others, show that the use of process management methodologies is up-to-date and aims at increasing organizational performance and competitiveness.

The Brazilian offshore industry is in this context of needing to improve the performance of its processes. Even if the sector is currently facing a severe crisis, Brazil continues to lead in this industrial sector, with forecast investment of 116.2 billion dollars during the period 2016-2025 (Globaldata Energy, 2016).

Considering that production projects in such an industry are long-term, with high investment costs in supplies and equipment, a significant production cost (Cruz et al., 2015), then an efficient process management becomes essential for that industry's success (Machado, 2014).

As such, the issue that guides this study emerges. In what way can the structured mapping and analysis of organizational processes be operationalized, in the Brazilian shipbuilding and offshore construction sectors?

In light of this, the current study aims at mapping and analysing the processes of a company that performs in the shipbuilding and offshore construction Naval Pole of the Rio Grande (RS) city, resorting to process mapping methodology.

The main contributions of this study are:

i) to describe in context, in a contextualized manner, the process stages of shipbuilding and offshore construction industries and the stages for adding value;

ii) to propose a structured model for mapping processes in the shipbuilding and offshore construction industries, detailing stage sequences;

iii) to apply the mapping and analysis of processes to a singular context, of an offshore industry located in a Brazilian Naval Pole.

The article is organized into 7 sections. After the introduction, section 2 details processes in the shipbuilding and offshore construction industry. Section 3 lays out the theoretical assumptions the study is based on. Following, in section 4, research methodology is described. Sections 5 and 6, respectively describe the organizational intervention by way of process mapping and analysis. Finally, section 7 reaches conclusions, limitations and contributions of this study.

## 2 Shipbuilding and offshore industry processes

Shipbuilding in Brazil, during the period 1960-2000 went through the expansion, peak, crisis and recovery stages (Jesus & Gitahy, 2009). At the end of the 90's the need for Brazil to have its own shipbuilding industry emerged, in order to meet offshore demand. As such, beginning in the 2000's the sector began to be a priority to the Brazilian government (Rocha, 2015). Up to the present it is still an important element in economic growth, possessing a strategic function due to gigantic impact generated such as: high job and income growth; regional development as well as development of companies operating in that industry and opportunities for developing innovation and technology processes into products and processes (Campos & Pompermayer, 2014; Dickel, 2015).

Besides Government, other participants in the production chain of the shipbuilding sector are the ship owners that profit from merchant vessels; shipyards that co-ordinate the construction process of vessels; direct and indirect suppliers of raw materials, parts and components and multilateral institutions (Brasil, 2002).

Shipbuilding may be viewed as a process that begins when there is a need for a vessel to conduct a certain activity. In that process, a few stages encompass activities relating to decision making and administrative processes (design, hiring, planning, etc.), leading up to the massive collection of parts and mounting activities necessary for building the vessel (Storch et al., 1995). As it encompasses several stages, an effective integration between participants and existing processes is necessary, thus generating competitive advantage (Moura, 2008).

In most ship orders, product customization occur according to client demands, as such the production process may vary; however, normally a specific number of stages are carried out (Storch et al., 1995), as shown in Table 1.

The macro process of shipbuilding appears simple in principle; however, in practise it becomes complex, as it needs managerial competency, organization and logistics for conducting the production stages (Stopford, 2009). According to Storch et al. (1995), the importance of management and process integration is paramount, as well as a high commitment to administrative processes, even being an industry that involves such a large number of operational processes. For this reason, productivity in this sector is highly dependent on managerial skill and organization (Stopford, 2009).

**Table 1.** Shipbuilding stages.

| Stage | Description |
|---|---|
| I. Requisite Development | Client demands and considerations regarding details, costs and the vessel's function are met. |
| II. Concept/preliminary design | Basic vessel characteristics from demands determined in stage I. |
| III. Contract Project | Based on the preliminary project, with detailed description of budget aspects, a contract is drawn. |
| IV. Contracting | Hiring of the shipyard that will build the vessel is done, taking into consideration factors such as cost, delivery date and performance requisites. |
| V. Planning and detailing project | Building schedule is defined. |
| VI. Construction | 1st level: Processes relating to purchasing raw materials and needed components as well as parts manufacture.<br>2nd level: Processes relating to product and component fusion, which originates sub-blocks or units.<br>3rd level: Processes relating to production of hull blocks (created by fusion of parts).<br>4th level: Processes relating to building that involves joining of blocks at the end of the vessel assembly stage. |

Source: based on Storch et al. (1995).

Furthermore, based on Stopford (2009), a shipyard must have efficient information management systems that develop production plans and control raw materials. Thus, information technology plays an important role in optimizing and managing processes in an integrated way. The Enterprise Resource Planning (ERP), stands out as one of the most used systems by naval industries aimed at totally integrating all its sectors (Pereira & Laurindo, 2007). In Brazil, ERP systems are known as Integrated Business Management Systems that provide control and support for all corporate processes, including administrative, operational, sales and production processes (Padilha et al., 2004); however, its implementation has been seen as problematic (Martins et al., 2013). Meanwhile, one of the advantages of process mapping is to offer better results from the use of information technology (Laudon & Laudon, 2014).

It is not easy to study the naval industry, as it is difficult to measure productivity and turn over (Stopford, 2009). Coupled with that are the aspects presented here such as a diversity of participants with differing interests, multiplicity of complex processes, the use of digital management systems and oscillation in industry success, varying between peaks and crisis. However, this hardship makes it challenging to study and more specifically in the current case study, the aim is to contribute to the field literature, analysing behaviour of an administrative process conducted in the naval industry.

## 3 Process mapping

Generally, a process can be defined as a group of activities that transforms resources or inputs (raw materials, labour, information, etc.) into results or outputs (products or services) (Biazzi et al., 2011). Still, it is necessary to introduce a few process concepts and their characteristics, in order to best understand them (Table 2).

On several occasions, the flow of information linked with an organization's interdepartmental processes is complex, resulting in a scarce control over its activities and negatively influencing the organisation's internal and external clients (Carvalho et al., 2013). As such, process evaluation is relevant for the organization to endure and grow, guaranteeing its quality and continually improve its processes while simultaneously providing the organization with supplying high-quality services and/or goods to its clients (Franken et al., 2014). As such, process mapping as an analytical management and communication tool enables a better understanding of existing processes within the organization and to eliminate, or simplify, those that are redundant or need changes, allowing for a cost reduction in product and service development, besides improving the overall organizational performance (Hunt, 1996).

The main stages of mapping processes are: (a) identify the goal of the process, the clients and expected results; (b) register the process by means of interviews and conversations and (c) transfer information to a visual representation. The mapping allows for a definition of key activities and performance

**Table 2.** Process concepts and characteristics.

| Author (s) | Concepts/Characteristics |
|---|---|
| Davenport (1993, p. 6) | It is a "[…] specific ordering of work activities in time, with a beginning, an end, entrance and exit, all clearly identified: a structure for action […]" |
| Association of Business Process Management Professionals Brasil (ABPMP, 2013, p. 35) | It is an "[…] aggregate of activities and behaviours conducted by humans or machines to achieve one or more results […]" |
| Baldam et al. (2014, p. 3) | It is a "[…] set of interlinked, or interactive, activities that transform inputs into outputs […]" |
| Davenport & Short (1990) | Are characterized by having internal or external clients and being interfunctional as they cross over departments in their organizational structure and may occur between organizational sub-units. |
| Smith & Fingar (2003) | Are characterized by, being complex and having extension (size and/or duration); being dynamic; can be widely distributed (that is, execute multiple applications on several technological platforms); they are programmable, when speed and accuracy are crucial; technologically dependent; depend on human judgement and rely on human intelligence; aren't always easily understood (generally they are neither conscious nor explicit) and require coordination. |

Source: Based on the authors.

measures, visualization of how and why resources are consumed, identifying improvement opportunities, serving as a training platform, communicating what is happening and having a vision of how tasks are carried out in more general processes (Hronec, 1994; Longaray, 1997). There are countless mapping and process analysis tools and methodologies, with the main ones being: Flowchart; Integrated Computer Aided Manufacturing Definition (IDEF) and Business Process Management (BPM) (Mello et al., 2002; Lacerda et al., 2011).

## 3.1 Flowchart

The flowchart is one of the most commonly used tools for process mapping, it graphically describes ongoing processes or those proposed by the organisation, showing the sequence of activities through symbols, lines and words, giving way for improvement of such processes (Harrington, 1991). The author highlights the existence of four types of flowcharts: block diagram; functional flowchart; geographic flowchart; standard ANSI flowchart (American National Standards Institute).

Pinto (2007) complements Harrington's (1991) line of thought, stating that the standard flowchart provides greater detail as it uses standard symbols according to ANSI regulation (Table 3).

## 3.2 IDEF

IDEF is an approach used for modelling, description and analysis of systems and it is composed of 16 techniques, in which each one of them has its own specific application goal (Silva & Pereira, 2015). The 16 notations are shown in Table 4.

Among these techniques, IDEFO (Integration Definition for Function Modelling), is one of the most popular in business process modelling as it enables a clear, detailed and precise, graphic representation of a complex set of activities, actions and operations. It describes both the data and linked information as well as other associated elements to those factors, such as inputs, control, mechanism and outputs (IDEF, 1993; Oliveira & Rosa, 2010; Silva & Pereira, 2015).

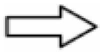
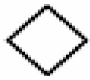
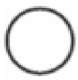
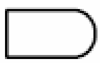
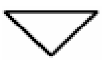
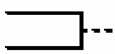
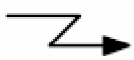
This tool uses in its symbology rectangles that express functions as activities, actions, processes and operations, and arrows that indicate resources or information that may be translated into inputs, mechanisms, controls and outputs (IDEF, 1993). This is, clearly shown, in Figure 1.

The "control" element is linked with necessary conditions for producing the output, that is, something that influences or directs how the activity functions (eg: rules). The "mechanism" element is linked with the means used to conduct the activity (eg: people, IT tools). As for the "input" element, all the data or objects are transformed by the activity into an output. Finally, the "output" element is all the data or objects produced by the activity (IDEF, 1993).

## 3.3 Business Process Management (BPM)

The goal of BPM is to manage the complexity of managerial processes that encompass diverse activities, people and resources such as technology, aiding in the integration and co-ordination of such aspects (Handysoft Global Corporation, 2003). We have

**Table 3.** Symbology for flowchart construction – ANSI.

| Symbology | Meaning |
|---|---|
|  | **Operation (rectangle):** An activity is described in it to show it |
|  | **Movement / Transport (thick arrow):** shows physical movement between locations. |
|  | **Decision Point (Diamond):** Represents the point of the process where a decision must be made, where the following sequences of activities shall depend on the taken decision. |
|  | **Inspection (large circle)** Shows that the process flow is interrupted so that quality of outputs may be evaluated. It may also show the point in which an approval signature becomes necessary. |
|  | **Printed Document (rectangle with wavy background):** Shows the exit of an activity with information registered in paper. |
|  | **Hold (round sided rectangle):** Is used, when a person, item or activity needs to wait for the following programmed activity to be executed. |
|  | **Storage (triangle):** Represents a storage condition under control and an order or requisition is needed to remove the item for the following activity. |
|  | **Annotation (open rectangle):** Registers any additional information regarding the symbol to which it is linked. |
|  | **Flow direction (arrow):** Shows the direction and sequence of the process stages. |
|  | **Transmission (interrupted arrow):** Identifies the occurrence of information transmission. |
|   | **Connection: small circle.** A small circle with a letter indicates that the exit of that part of the flowchart shall be used as an entrance in another flowchart. |
|  | **Limits (elongated circle):** Shows the beginning and end of the process. |

Source: Adapted from Harrington (1991).

**Table 4.** IDEF Techniques.

| Abbreviation | Classification |
|---|---|
| IDEF0 | Function Modelling |
| IDEF1 | Information Modelling |
| IDEF1X | Data Modelling |
| IDEF2 | Simulation Model Design |
| IDEF3 | Process Description Capture |
| IDEF4 | Object-Oriented Design |
| IDEF5 | Ontology Description Capture |
| IDEF6 | Design Rationale Capture |
| IDEF7 | Information System Auditing |
| IDEF8 | Using Interface Modelling |
| IDEF9 | Scenario-Driven IS Design |
| IDEF10 | Implementation Architecture Modelling |
| IDEF11 | Information Artifact Modelling |
| IDEF12 | Organization Modelling |
| IDEF13 | Three Schema Mapping Design |
| IDEF14 | Network Design |

Source: Adapted from Michel & Costa (2002).

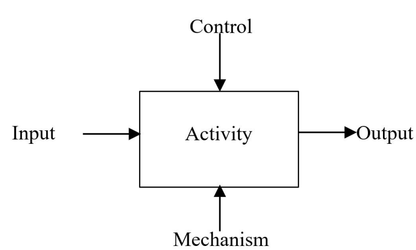



**Figure 1.** Elements of IDEF0. Source: Adapted from IDEF0 (IDEF, 1993).

witnessed an expressive academic and practical growth of BPM applications focused both on process modelling and information system implementation, as well as in managing the organization as a whole (Iritani et al., 2015, Longaray et al., 2015).

Baldam et al. (2014) conducted a Unified BPM Cycle that allows for mapping, analysis and redesign of processes. The stages of this cycle are:

1) Planning the BPM: the aim here is to define BPM activities that will contribute to reaching strategic and operational goals the organization has, creating conditions for conducting BPM. This stage involves factors such as: understanding of internal and external environment; maintaining process governance; defining strategies, goals, and approach to promote change; preparing the classification structure for activities/processes; defining management of processes to be implemented; selecting, understanding and prioritizing processes; suggesting needed resources for the next stage; forming work teams; preparing for possible problems that arise during BMP planning and realigning planning;

2) Analyzing, modelling and optimizing processes: encompasses the organization's understanding in which studied processes are inserted, generating information about the current process and/or the proposal for a future process. In this stage businesses are analysed, processes are modelled and optimized, change is managed, process implementation is detailed, and BPM planning is realigned;

3) Implementing process: This stage encompasses activities such as detailing and execution of implementation, forming an implementation team, co-ordinating necessary resources with installations, equipment and software, co-ordinating tests and/or solution pilot, training the executing team, checking if it is necessary to improve execution processes and in case it is, implementing the improvement and managing change during the implementation stage;

4) Monitoring process performance: includes general control of processes, using performance indicators and statistical methods. Includes registry of performance for processes in time, the conduction of audits to implemented or modified processes, the conduction of organisation maturity analysis and the planning and distribution of performance monitoring data.

Furthermore, Baldam et al. (2014) state there is not always the need to follow all stages of the cycle as that depends on the necessity and goal to be reached.

Once established the context concerning Flowchart methodologies, of the IDEF and BPM, Table 5 seeks to summarize the main distinctions between those process-mapping tools.

In light of the three possibilities described in this section and considering the scope of the current research and project limitations, we chose to use ANSI and BMP Flowchart tools to map the process described in the unit that analyses the proposed case study.

# 4 Methodology

The current case study is based on methodology proposed by Roesch (2013), being classified as to the goals of the project, method (layout), collection and data analysis techniques.

When it comes to the goal of this project, it is applied research, as in accordance with Roesch (2013, p. 127) such a type of research has as a main goal "[…] generation of potential solutions for

**Table 5.** Tools and methodology of process mapping.

| Tool/ methodology | Characteristics | Objective | Focus | Application | Application duration | Complexity of application |
|---|---|---|---|---|---|---|
| **Flowchart** | Use of standard graphs and symbols | Present steps and events that occur during execution of a process | Process | All types of organization | Short | Low |
| **IDEF** | Definition of inputs and outputs, process restrictions and interactions, use of the set of IDEF techniques | Allow for a complete and complex analysis of processes | Process | All types of organization | Medium | Medium |
| **BPM** | Use of a 4-stage cycle | Complete understanding about the process and its redesign. | Process | All types of organization | Long | High |

Source: Drawn up by the authors.

human problems […]". As such, the main goal of the current project is to analyse part of the processes of an organization in the shipbuilding and offshore construction sectors, located in Rio Grande do Sul, identifying points that could be improved. As for the methodological approach, it is characterized by a qualitative research, as this methodology allows for greater ease in describing the complexity of problems, understanding and classifying dynamic processes, presenting contributions in the change process, creating or forming opinions and allowing greater depth to be reached (Roesch, 2013).

As for the chosen outline, that work is considered a case study, as it seeks to acquire a deep and detailed knowledge of part of the processes of the unit under scrutiny. Data was collected through interviews, intent on gaining a better understanding of process execution, searching for evidence on them. Data analysis was conducted via interpretation and attribution of significance to what was exposed in the interviews. Data was also collected via official corporate documents, such as their manual and computer systems used by the corporation as well as direct observation.

## 5 The case study: description of proposal and analysis unit

In order to achieve the purposed goal for this project and based on the theoretical referential presented in section 2, a sequence of stages was established for conducting the organizational intervention process (case study), as per Figure 2.

Study of the environment of the process to be mapped is inserted in (naval and offshore industries)

Stage (a) of Figure 2, is composed by a brief explanation of the history of shipbuilding and offshore construction sectors in Brazil followed by the demonstration of the macro process of shipbuilding

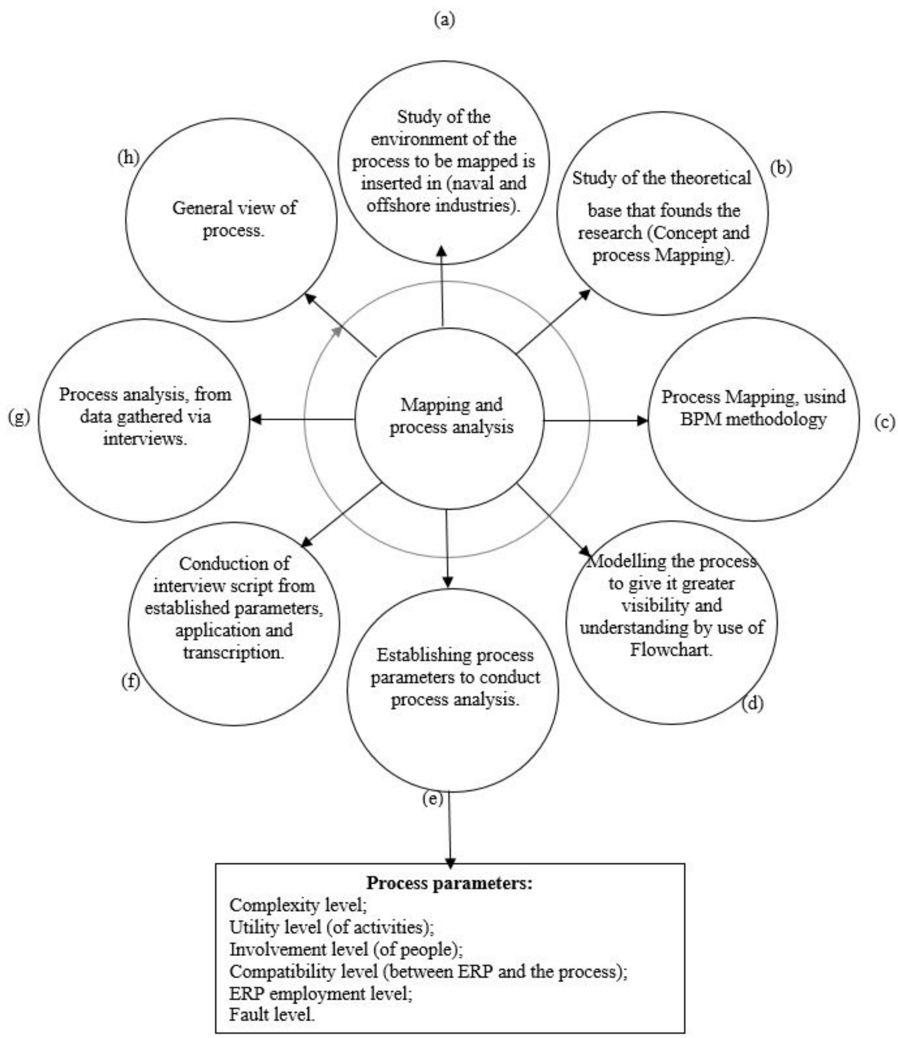



**Figure 2.** Process mapping and analysis model. In Figure 2, ERP is the abbreviation for *Enterprise Resource Planning.* Source: Drawn up by the authors.

and how information technology is inserted as per what is exposed in section 2. In (b), firstly a few process concepts and characteristics are presented. Following which process mapping is exposed, what is its purpose and what are its stages. Finally, a few tools and process mapping methodology are demonstrated. That dimension is located in sections 3, 3.1, 3.2 and 3.3.

In stage (c) BPM methodology is identified as the methodology used for conducting the analysed process mapping. Section 3.2 presents the aim of using BPM with the intent of mapping processes and its implementation stages. As for section 5, it is shown how that methodology was used to conduct process analysis in this study.

Stage (d) represents the process-modelling, one of the stages of BPM, conducted via flowchart tool. In section 3.1 the functioning of this tool is presented, through exposing symbology for standard ANSI flowchart construction.

In section 5 the use of this tool in this study is exposed and its application is shown in Figure 3.

In (e) we draft the process parameters that served as a base to creating the interview script and data analysis. These parameters are described in Table 6, in section 6.

After setting up parameters and process modelling through the flowchart (Figure 2), which enabled a more clear vision regarding process activities, it was possible to draw up the interview script. This part of the study is located in section 6 and is represented by stage (f) of Figure 2.

Stage (g) reflects data analysis, that is, process view in light of each determined parameter, beginning with evidence suggested by each interviewee. That analysis is presented from section 6.1 to 6.6.

Finally, stage (h) of Figure 2 addresses the presentation of a compilation of interviewee proof, enabling a general view of the process. This may be identified during the conclusion in section 7.

After presenting what was done to reach the goal of this study, it is now worth conducting a brief presentation of the research analysis unit. The organization was created in March 2010, is located in Rio Grande do Sul and performs in the naval industry and offshore construction sectors. The organization owns the greatest dry dock in South America and two portals of 600 tonnes and 2000 tonnes (considered the largest in the world). It provides engineering consultancy and construction management services with a greater focus on oil platforms, it allows for building two hulls simultaneously, with a monthly processing capacity of 11000 tonnes/month. With all sectors centralized in the same location, which represents 559000m$^2$ (Foster et al., 2013), the structure comprises both administrative sectors as well as operational sectors (that include workshops). Considering the analysed shipyard follows a physical positional arrangement, because construction of hulls occurring in the dry docks and the workshops (Building, Mechanics, Electronics, Outfitting, sheet metal processing, Mounting and submounting, Painting, Tubing, among others) are located around it. For the first 3 years, administrative sectors were apart from operational sectors until the year 2014 when they were rearranged and re-fitted, to the shipyards needs. As such, the administrative sectors got closer to operational sectors and stock points in order to improve intersector information, which originated improvements in worker efficiency, minimizing production setbacks and improvement of shipyard performance as a whole.

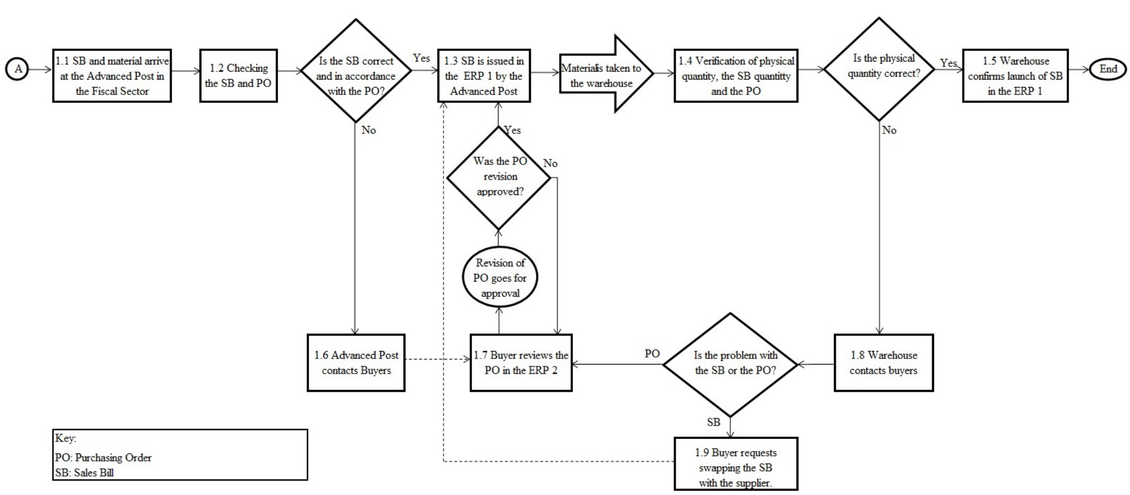



**Figure 3.** Flowchart for the Process of receiving Sales Bills (SB) and Material. In Figure 3, PO is the abbreviation for Purchasing Order, SB is the abbreviation for Sales Bill and ERP stands for *Enterprise Resource Planning.* Source: Drawn by the authors.

**Table 6.** Summary of activities in the Process of receiving Sales Bills and Material.

| Ativities | Predecessor | Successor | Responsable | Duration of Execution |
|---|---|---|---|---|
| 1.1. Arrival of SB and material in the Advanced Post of the Fiscal Sector | Referent to the previous process not analysed in this study. | 1.2 | Administrative Assistant | Automatic |
| 1.2. Verification of SB and PO | 1.1 | 1.3 or 1.6 | Administrative Assistant | Up to 30 min. (Relative to quantity of items in the SB and PO) |
| 1.3. SB is launched in ERP1 by the Advanced Post | 1.2 or 1.9 | 1.4 | Administrative Assistant | On average 15 minutes (Relative to the quantity of items in the SB) |
| 1.4. Verification of physical quantity and quantity in the SB and PO | 1.3 | 1.5 or 1.8 | Warehouse | Up to 8 hours (relative to quantity of materials) |
| 1.5. Warehouse confirms launch of SB in ERP 1 | 1.4 | End | Warehouse | Automatic |
| 1.6. Advanced Post contacts buyers | 1.2 | 1.7 | Administrative Assistant | Automatic |
| 1.7. Buyer reviews the PO in ERP 2 | 1.6 or 1.8 | 1.3 | Buyer | Relative to the detected problem |
| 1.8. Warehouse contacts buyers | 1.4 | 1.7 or 1.9 | Warehouse | Automatic |
| 1.9. Buyer requests changing the SB with the supplier. | 1.8 | 1.3 | Buyer | Relative to supplier mood |

Source: Drawn up by the authors.

As such, one observes that for its correct functioning, there are countless processes necessary for conducting operations. Therefore, the following processes were analysed: conducting Requisition of Materials (RM); conducting Purchasing Orders (PO) and receipt of Bill of Sales (BS) and materials that occur in that order, through the Engineering, Warehouse, Supplies and Fiscal sectors.

Beginning with data analysis, greater relevance was observed in the receiving of Sales Bills and materials due to the depth in the interviewees' reports, thus allowing for a richer analysis. Therefore, intent on presenting the generated contributions in a clear and objective manner, in line with limited space, the decision was made to only demonstrate the analysis of the indicated process. Note that all procedures and analysis that we shall demonstrate were also conducted with other mentioned processes.

To reach the goal purposed by this research, the BPM methodology was used, to map and analyse the process, generating information concerning the current state of the same (as is), intent on capturing the knowledge of how the work is done (Baldam et al., 2014). Together with the BPM, an ANSI Standard Flowchart tool was used to model the process in a graphic way, allowing for clarity and ease of visualization of process activities, enabling the identification of flaws, duration of execution, setbacks, among other aspects that could be improved. The flowchart was drawn through direct observation during the second semester of 2014, verifying in loco all activities, process tasks, and from evidence collected during interviews. Therefore, beginning with the presented details, Figure 3 shows the flowchart for the receiving process of Sales Bills and Materials, followed by Table 6, which contains data from activities included in this process.

## 6 The case study: data analysis

Upon presentation of the process modelling, that enabled a clear view of activities, it is necessary to highlight guidelines referent to data analysis. As such, in order to analyse the studied process, parameters were created (Table 6) that played a fundamental role in driving the study's data analysis. Starting with the defined parameters it was possible to detail in a profound way, the collected data resorting to a semi-structured interview technique, conducted by the authors, based on a script composed of open questions based on the parameters. These questions were drawn up from activities identified in the flowchart (Figure 3) and the determined parameters (Table 7).

**Table 7.** Process parameters.

| Parameter | Description | Evaluation |
|---|---|---|
| Complexity Level | Complexity due to range of stages to conclude something, depending on the level of complexity may create difficulties. As such, this parameter shall evaluate the complexity of activities. | - No complexity;<br>- Low complexity;<br>- Medium complexity;<br>- High complexity. |
| Utility Level (of the activities) | Utility is about how useful something is. As such, this parameter shall evaluate the utility of activities for concluding the process. | - No utility;<br>- Low utility;<br>- Absolute utility;<br>- High utility. |
| Involvement Level (of people) | Involvement is about the compromise people have with the activities they are performing. As such, this parameter shall evaluate peoples' involvement in activities and the process. | - Not involved;<br>- Little involved;<br>- Involved;<br>- Very involved. |
| Compatibility Level (between ERP and the process) | Compatibility is about the state of things that are in agreeance. As such, this parameter shall evaluate the compatibility between the used ERPs in the process and the organization. | - Not compatible;<br>- Little compatible;<br>- compatible;<br>- Very compatible. |
| ERP employment level | ERP is a system the presents and manages processes and data from the company sectors. As such, this parameter shall evaluate the frequency of ERP use in the process. | - Infrequent;<br>- Little frequent;<br>- Frequent;<br>- Very frequent. |
| Level of flaws | Flaws come from errors that occurred in processes. As such this parameter shall evaluate the flaws in the process generated by inputs and outputs that are missing, redundant or illogical. | - No flaw;<br>- Little flaw;<br>- A few flaws;<br>- Many flaws. |

Source: Drawn up by the authors.

It is also necessary to demonstrate interviewee data and the manner in which they will be identified during data analysis (Table 8). It is important to note that each interview had an average duration of half an hour and they were conducted during the month of July 2014. After that, each interview was transcribed.

After which, data analysis referent to functioning of activities in the mapped process, enabling visibility of the points that limit final process capacity, through evidence quoted by the interviewees. Note that conduction of the analysis seeks to reflect such aspects in accordance with process parameters defined in the study. Therefore, the analysis is presented referring for each evaluated parameter.

## 6.1 Level of complexity

Concerning the complexity parameter, evidence quoted in the interviews showed, (Table 9), that the reported complexity is given by the non-fulfilment of the process in a correct way. With many exceptions, through the need of material knowledge, due to the use of 2 ERPs that are flawed in integrating their information, generating difficulty in conducting the process.

## 6.2 Utility level (of activities)

For the parameter of activity use, activities have high utility. Some interviewees stated that activities related to receiving of materials, launching of SB in the system and verifications between SB and PO were of higher utility. As such, evidence on this parameter collected by interviews is shown in Table 10.

## 6.3 Involvement level (of people)

Considering the parameter for people involvement with their activities, it was shown by interviewees (Table 11) that many people are committed to their activities, intent on keeping the process flowing correctly. However, there are also people that are not as involved as they do not worry about the process, or about the problems occurring during the process, letting them slide. Lack of commitment was also mentioned on behalf of the approvers, where an interviewee states that full approval of a PO would be conducted late.

## 6.4 Compatibility level (between the process and ERP)

Regarding the compatibility parameter for ERPs used in the process, by way of evidence reported in the interviews (Table 12), the inferral was made that

**Table 8.** Interviewee Information.

| Interviewee | Id | Position | Sector |
|---|---|---|---|
| 1 | E1 | Administrative Assistant | Tax |
| 2 | E2 | Technical support | Warehouse |
| 3 | E3 | Buyer | Supplies |

Source: Drawn up by the authors.

**Table 9.** Evidence for the Complexity Level Parameter.

| Id | Evidence |
|---|---|
| E1 | The process is quite practical and of low complexity. E1 states that nothing would be changed in the process, but often due to some urgency, the process is not completed, exceptions are made. What I would change is that, I would not open any exceptions. E1 alleges, "[…] *there is no way of decreasing the existing bureaucracy as it is essential*". |
| E2 | The process is of medium complexity, as it requires "[...] *material knowledge on behalf of who receives and verifies* […]" "[…] *for staff who already have this know-how, this brings no issues, but when new staff with little experience are concerned there are difficulties which imply longer time to verify materials... this can delay the process*". |
| E3 | The process is of high complexity due to "[…] *the company employing two ERP systems to work... with a lot of flaws in their integration* […]", furthermore he states that "[…] *the company's systems are too static... generating delays in receiving of SB and in receiving merchandise*". He states that systems are too bureaucratic and with two parallel systems where only the purchase sector uses one and the other is shared by the rest of the organization. |

Source: Drawn up by the authors.

**Table 10.** Evidence of the Utility Level Parameter.

| Id | Evidence |
|---|---|
| E1 | All of the process activities have full utility. E1 states, "[…] *none has greater importance or utility than the other, for each stage exists for a reason*". |
| E2 | All the activities have high utility for process conclusion. E2 states, "[…] *the highest point should be receiving and the second should be its conclusion in the system, with other activities being of equal weight in utility, by maintaining that part constant, the rest should keep flowing*". |
| E3 | Activities conducted in this process have high utility, but the most useful activity is verification of SB and PO to check they are in accordance with other activities, having the same level of utility. |

Source: Drawn up by the authors.

**Table 11.** Evidence for the Level of People Involvement Parameter.

| Id | Evidence from interviews |
|---|---|
| E1 | A few people are a little involved and others very involved in following procedure. According to it "[…] *sometimes people deviate from procedure due to orders given from above* […]" and in other cases "[…] *due to sectors having different goals the trend is for each department to direct procedure in a way that makes his tasks easier* […]", thus *"originating inter sector clashes*". In some cases, "[…] *due to needing materials not done earlier in the process, implying a deviation in the procedure* […]", such as when *"when the supplier is authorized to deliver supplies without the purchase being authorized in the system"* when the materials reach the shipyard, the procedure is compromised as if it does enter it won't be possible to register it in the system and stock won't be updated. |
| E2 | "[…] *people are committed to their activities* […]", "[…] *they are focused on concluding the receiving process as quick and correct as possible, both the verification part as well as the launching part and even material delivery.... the auditor tries to interrupt when errors are detected in the PO, contacting the warehouse immediately, who in turn give their feedback as quick as possible,.... we have an open management style that I believe makes people want to do the right thing*". |
| E3 | "[…] *most people are committed to their activities, but a minority is not involved*". For E3, those who are not committed would "[…] *rather not deal with the problem themselves, are not worried about the process*". As for those who are committed "[…] *want to see the problems solved as they want to see the organization prosper*". He also stated that a certain lack of commitment on behalf of the approvers, where "[…] *complete approval of a PO takes at least 40 days*". |

Source: Drawn up by the authors.

**Table 12.** Evidence for the Compatibility Level Parameter.

| Id | Evidence |
|---|---|
| E1 | "*Regarding tax entries, the system is compatible, as only one is used... however when considering other issues such as PO or stocks where one system has to communicate with the other generating flaws... together they are not compatible*". When the "[…] *non-integration of PO in one of the systems occurs it stops the PO from being approved* […]", primarily preventing materials from entering the shipyard. "*The materials stock is controlled by one computerized system and the tax entries for the SB are done in another system that often does not share information with the othe*r". For E1, systems enable visualization of information by several sectors and that facilitates the conduction of activities: however, "*the obtained information is not reliable*". |
| E2 | The organization has "[…] *a huge problem, as procurement works with one computerized system, the tax department with another and the warehouse uses both systems and as such needs to have an interface, working perfectly, but there are many flaws with this interface... the systems are good independently, but as a working pair not at 100%*". "*When (integration) works, one can instantly get figures for materials, reports, material costs, verify minimum and maximum stocks… but one cannot overly depend on them as these are not 100% accurate. Each time a report is issued, it must be verified… This is why we normally work with excel spreadsheets to double check*". To improve system integration "*it is easier to modify one systems rather than the other*"… regarding the system subject to change, the organization uses different data bases, whereas the system which will not be altered has a single data base" for all its units. This has direct consequences on "[…] *supplier payments… causes double the work load in several sectors… causing the process to be lengthier*". Finally, he states, "[…] *independently they (systems) are compatible, but as a set, there are flaws with their integration, thus are not very compatible*". |
| E3 | "*One or the other (system) is compatible, but together they are delaying this process as often they do not communicate with each other. Those systems together do not help at all*". "*Their lack of integration slows down financial approval, as often the PO does not migrate from one system to the other, where the approval takes place*". That implies a delay in the flow of this and the next processes, a delay and lack of financial approval of Pos, a delay in materials receiving… delays in supplier payments". |

Source: Drawn by the authors.

when the activities do not need data integration among the systems to be conducted, the ERPs are compatible, such as in the case of SB launch activity in the system for instance. However, when system integration is required, such as when, completing the PO or stock related activities, the systems are incompatible with the process due to flawed integration among them, generating unreliable information, causing rework and delays both in the flow of this process and other processes as well as with material receiving and with payment of suppliers.

## 6.5 ERP employment level

Regarding the ERP employment parameter, in the conducted activities, interviewees reported using it frequently when conducting their activities. However, they alleged, material arrives with SB that do not match their PO and even so it enters the shipyard as a matter of emergency, thus forcing the process to not go according to plan, correctly in the system until it is altered by the buyer. According to an interviewee, there are more project materials related processes being updated and revised than any other processes. Next is Table 13 with evidence on this parameter, obtained through interviews.

## 6.6 Level of flaws

Regarding the parameter for flaw occurrence, in accordance with interviewee reports (Table 14), we gather that the biggest culprits for flaws to occur are the lack of integration among systems and diligence of supplies, the urgency of material use and delays in POs approval, causing supplies to enter the yard unregulated, that is, without being logged into the system, causing double the workload in several sectors, unreliable information, double-counting of materials, thus double payments. Furthermore, interviewees stated that at the end of 2015, a few flaws were occurring, but only months before there were countless flaws, mostly related to project materials, in which 80% of SBs with this type of material had been re-drafted. An interviewee who said he reviewed countless processes that involved 1200 SBs confirms that high number of revisions. As such, more than 300 POs were drafted in about 40 days. However, there was no support from the approvers, as only 10 OCs were totally approved.

This data shines a light on negative points in the process, where a few have been mentioned in previous parameters, such as flaws with system integration and the lack of commitment on behalf of approvers that take their time when approving POs. Furthermore, the interviewees exposed other points that hinder the

**Table 13.** Evidence for the ERP Employment Level Parameter.

| Id | Evidence |
|---|---|
| E1 | ERP use is "*very frequent*". However, when "[…] *supplies arrive without a valid PO, they should not make it into the shipyard, unless there is an order form someone higher up saying those supplies should enter, in which case the supplies do enter the shipyard and the invoice is launched in the system at a later stage, after the process is normalized*". E1 states the use of ERP for tax entries is of high importance as "[…] *they are integrated... it will provide information for other sectors*". |
| E2 | ERP use is "*frequent*", however, when "[…] *supplies are of high importance or of extreme urgency... and we receive a SB with 100 items and one of them is faulty we cannot register that SB... as such we set up an excel spreadsheet to show this... and finally when this is sorted, the SB is entered into the system*". For E2, the use of systems is fundamental, "[…] *as anything done in parallel (in Excel) is subject to failure, whereas the system is subject to investigation and audits*". For E2, the reason ERP is not so used is "[…] *the urgency in using the materials. For consumer goods and office supplies, 95% is used in the system as they tend to be national suppliers, thus the process is normalized swiftly. Whereas project supplies are mostly imported and by the time someone checks to find something wrong with them they are already in the yard... 30% to 35% are carried through a parallel process to be normalized later*". Finally, he states "[…] *the impact is extremely high... as they are dealing with tax documents, with tax benefits, and any mistake is subject to penalties and fines for the organization and for the person who conducted that process*". |
| E3 | "*I always conduct my activities in the system*". ERP use is "*very frequent*". For E3, their use when conducting POs is fundamental. |

Source: Drawn by the authors.

**Table 14.** Evidence for the Flaw Level Parameter.

| Id | Evidence |
|---|---|
| E1 | "*What I can identify as a flaw is the non-fulfilment of the procedure... many exceptions are made, causing flaws to occur*". "*It is quite common to have approvers travel to China on work and when that happens they do not approve. Therefore it is quite common to have expired payment orders that were not registered in the system… generating delays in supplier payments*". "*Should supplies be received while the PO has not been yet approved, it will physically be in the warehouse, but it will not exist in the system, as what informs the system is the entry of the note, thus there is a massive loss of information throughout all sectors*". Furthermore, "[…] *when the PO is sent to the supplier without having been approved, he will receive it again by email, automatically through the system.... then what happens is the supplier sends the materials again. Then, the supplies are duplicated in the warehouse, the system and in payments as well*". As such, E1 suggests the "procedure must be followed.... the supplier must receive the PO after it has been approved." Finally, E1 states "[…] *currently there are a few flaws, but a few months ago there were many flaws… less than six months ago, consumption materials had few mistakes, but project materials saw about 80% of its invoices be reviewed and altered*". |
| E2 | "*As well as existing flaws due to lack of integration among systems, there is also a lack of diligence, of materials exiting from the supplier to us*". "*Most suppliers do not schedule their deliveries and deliver them at will... this generates us having to chase around the POs and most times the PO has not even been drawn up yet*". E2 suggests that *not only flaws in integration must be solved, there must be a better diligence or the transport must be paid for by the organization. The cost may be a bit higher, but materials will come with a quality certificate that most times does not exist...that would solve around 90% of issues at receiving ... in national materials the supplier could send a copy of the SB and the corresponding PO so that an initial count could be done... and for international materials there should be someone verifying in the country of origin. Since when this material is received with divergences, these are extremely difficult to solve*". Finally, E2 states "[…] *there are some flaws, but more flaws occur with platform application materials where as they occur very rarely with consumption materials*". |
| E3 | "*The flaws that can be seen are a function of the use of both systems and the delay of PO approvals... generating difficulties in merchandise receiving, SB registry and supplier payments*". E3 states he took part in the "*war room*" for a period of between 35 to 40 days, where processes that involved 1200 SBs were normalized and updated and more than 300 PO had to be done. After 60 days, only 10 Pos had been fully approved and the remaining ones were waiting for approval by the organization's leadership. According to E3, "[…] *the organization should choose one single system ... and thus simplify bureaucracy within the approval process... because if the process is to be counted from its beginning when the Materials Requisition was made (Materials Requisition - activity from a previous process than the one analysed in this study), between both systems, may lead to up to 9 approvals*". |

Source: Drawn by the authors.

process, such as breaching procedures causing flaws to occur from within and the lack of diligence with materials. These facts not only negatively impact the process, but also complicate things for the supplier, who may receive his payment increasingly delayed. Intent on minimizing these flaws, the interviewees suggested that: flaws with system integration could be solved or the choice should be made to use only one system; simplify bureaucracy with approvals; always follow the correct procedure, without exceptions; and a better expedition of both national and international materials, especially the latter, as they generate a greater number of errors within their activities.

Analysing those parameters according to Key Performance Indicators (KPI), the evidence points to both a direct and indirect impact on the shipyard's performance. Now for putting KPI into context, that technique uses indicators that represent the essential aspects for organizations to achieve their target performance by means of effective processes (Parmenter, 2007). As examples of these indicators, there are: Efficiency; Effectiveness; Capacity; Productivity; Quality; Profit; Rentability; Competitiveness; Effectivity and Value. As such, upon analysis of the impact each of the established parameters has on the shipyard's performance, one notes that:

a) the level of complexity reported by the interviewees and the reason for such complexity to exist, affects both the effectivity indicator, which is the junction of efficiency and effectiveness, when staff are conducting tasks, as well as the process quality;

b) the utility and execution of each task involved in the process, which is important for process execution according to the interviewees, affecting both efficacy as well as efficiency;

c) the lack of involvement and commitment that was verified, mainly by the PO approvers, implies a deficiency in the process efficacy, as well as hinders the buyers' productivity;

d) the lack of integration among ERPs is one of the facts that most negatively impacts the shipyards' performance indicators, as they hinder the process effectiveness, its quality, staff productivity (staff that uses ERPs) and the shipyard's profits;

e) the use of ERP by the staff is a must, both for process quality as well as effectivity and for staff productivity;

f) flaws found in the process suggest a great negative impact on several performance indicators, such as process effectivity, staff capacity and productivity, quality of task execution and shipyard profitability.

## 7 Concluding remarks

The aim of this study was to analyse process behaviour in an organization from the shipbuilding and offshore construction sector. Identification of points to be improved, via parameters established through research, use of process mapping tools and methodology. This goal was fully accomplished at the moment all stages shown in Figure 2 were demonstrated, conclusion of the mapping process and receiving of the SB and Material from the analysis unit through BPM methodology linked with flowchart tools, thus enabling together with data from interviews, the analysis of activities within the process and the specification of points to be improved, based on defined process parameters. Methodology was a case study, of applied nature, with a qualitative approach, where data collection was conducted through direct observation. This allowed for the creation of the flowchart for the studied process and an incursion into the unit object of the case study, by means of interviews, where data concerning the process activities was collected. By cross-referencing that data with parameters established in the study it was possible to reach the goal of this study, drawing up analysis charts for the researched process.

Research allowed to make use of the interviews and process mapping to comprehend the flow of activities and the manner in which these are executed. This enabled a general view of the process, where the following was shown:

a) process complexity is due to not engaging in the process in a correct manner, by the need for specific knowledge and the use of two ERPs in parallel;

b) all activities in the process have considerable utility, specifically activities related to materials receiving, SB registry in the system and verification between SB and PO;

c) there are people involved in the process execution as well as people who are not involved, the lack of commitment on behalf of the approvers of POs;

d) when activities do not require data integration among ERPs for them to be carried out, the systems are compatible; however, in cases where systems integration is necessary they are incompatible with the process as their integration is flawed;

e) The use of ERP for conducting activities is frequent; however, exceptions do occur, especially in activities related to "project materials";

f) The main cause for occurrence of delays during the process are a lack of integration among computerized systems, standardization of process execution, diligence of materials and delays with PO approvals. Furthermore, another contribution from the study was the elaboration of process parameters: complexity level; utility level (of activities); involvement level (of people); compatibility level (between ERP and the process); ERP-employment level; Flaw level. These parameters can be used in other studies for evaluating other process activities.

The main contributions of this study are:

i) In section 2, the contextual description of process stages in the shipbuilding and offshore construction sectors and their stages of value adding;

ii) In section 5, the proposal of a structured model describing the sequence of stages for process mapping (Figure 2);

iii) In sections 5 and 6, the application of mapping and process analysis in a singular context, an offshore industry located in a Brazilian Naval Hub.

This study's limitation is within the fact that it is a case study, specific solely to the organization, who is the object of study and even, only analysing that organization, it was not possible to verify all corporate processes, due to their multiplicity.

Even if the ANSI Flowchart tool enabled the characterization of the studied process, the IDEFO notation is recommended for modelling business processes, since it is capable of indicating both the existence of IT tools, such as the ERPs, through a "mechanism" element such as the rules established by means of "control" element for their integration. As a suggestion for future research, beginning with data analysis, the process could be redesigned, with the application of another BMP Cycle stage. Furthermore, this study could be replicated in another environment of the same organization under scrutiny and in other organizations where the same process parameters that were established could be used.

## References


Association of Business Process Management Professionals Brasil – ABPMP. (2013). *BPM CBOK: guia para o gerenciamento de processos de negócio – corpo comum de conhecimento*. Retrieved in 2019, September 3, from http://c.ymcdn.com/sites/www.abpmp.org/resource/resmgr/Docs/ABPMP_CBOK_Guide__Portuguese.pdf

Baldam, R., Valle, R., & Silva, H. P. (2014). *Gerenciamento de processos de negócio – BPM: uma referência para uma implantação prática*. São Paulo: Elsevier.

Biazzi, M. R., Muscat, A. R. N., & Biazzi, J. L. (2011). Modelo de aperfeiçoamento de processos em instituições públicas de ensino superior. *Gestão & Produção*, 18, 869-880. http://dx.doi.org/10.1590/S0104-530X2011000400013.

Brasil. Ministério do Desenvolvimento, Indústria e Comércio Exterior. (2002). *Desenvolvimento de ações de apoio à cadeia produtiva da indústria naval e marinha mercante: anexos* (p. 36). Brasília: Ministério do Desenvolvimento, Indústria e Comércio Exterior. Retrieved in 2019, September 3, from http://docplayer.com.br/7597073-Ministerio-do-desenvolvimento-industria-e-comercio-exterior-a-n-e-x-o-s.html

Campos, C. A. S., No., & Pompermayer, F. M. (2014). *Ressurgimento da indústria naval no Brasil (2000-2013)*. Retrieved in 2019, September 3, from http://www.ipea.gov.br/portal/images/stories/PDFs/livros/livros/livro_ressurg_da_ind_naval.pdf

Carvalho, A. B., Abreu, I. M. C., & Pedrozo, I. F. (2013). Fluxograma como ferramenta de aperfeiçoamento e de controle em instituições públicas. *Revista de Administração da UFSM*, 6, 373-393.

CMMI Product Team. (2010). *CMMI for development, version 1.3* (Relatório técnico). Pittsburgh: Software Engineering Institute, Carnegie Mellon University. Retrieved in 2019, September 3, from http://www.sei.cmu.edu/reports/10tr033.pdf

Cruz, L. V., Santos, C. J. M., & Souza, M. E. (2015). Criação e otimização de modelos de processos em indústrias de construção naval para embarcações de pequeno porte. In *Anais do Encontro Nacional de Engenharia de Produção*. Rio de Janeiro: ABEPRO. Retrieved in 2019, September 3, from http://www.abepro.org.br/biblioteca/TN_STO_206_225_26769.pdf

Davenport, T. H. (1993). *Process innovation*. Boston: Harvard Business School Press.

Davenport, T. H., & Short, J. E. (1990). The new industrial engineering: information technology and business process redesign. *Sloan Management Review*, 31, 11-26.

Dickel, D. G. (2015). *Modelagem para mensuração da inovação no setor de construção naval e offshore brasileiro* (Dissertação de mestrado). Universidade Federal de Santa Maria, Santa Maria. Retrieved in 2019, September 3, from https://repositorio.ufsm.br/bitstream/handle/1/8357/DICKEL%2c%20DEISE%20GRAZIELE.pdf?sequence=1&isAllowed=y

Duckert, G. H. (2010). *Practical enterprise risk management: a business process approach*. USA: John Wiley & Sons. http://dx.doi.org/10.1002/9781118269060.

Foster, M. G. S., Alonso, P. S. R., Dan, E., Jr., & Cima, F. M. (2013). *Retomada da indústria naval e offshore do Brasil 2003-2013-2020: visão Petrobras*. Rio de Janeiro: Petrobras.

Franken, D. A., Hammes, J., Polacinski, E., Lorenzett, D. B., Godoy, T. P., & Godoy, T. P. (2014). Controle estatístico de processos em uma empresa de agronegócios. *Revista de Administração da UFSM*, 7(3), 389-402. http://dx.doi.org/10.5902/198346597727.

Globaldata Energy. (2016). *Production and capital expenditure outlook for key planned upstream projects in the global offshore industry – Brazil leads globally with staggering pipeline of planned projects*. Retrieved in 2019, September 3, from https://www.oilandgas360.com/q2-2016-production-and-capital-expenditure-outlook-for-key-planned-upstream-projects-in-the-global-offshore-industry-brazil-leads-globally-with-staggering-pipeline-of-planned-projects-research-and/

Gonçalves, J. E. L. (2000). As empresas são grandes coleções de processos. *Revista Administração de Empresas*, 40(1), 6-19. http://dx.doi.org/10.1590/S0034-75902000000100002.

Handysoft Global Corporation. (2003). *Business process management and its value to the enterprise*. Vienna: Handsoft. Retrieved in 2019, September 3, from http://www.iknowgroup.co.nz/whitePapers/handysoft_bizflow_wp_bpm.pdf

Harrington, H. J. (1991). *Business process improvement*. New York: McGraw Hill.

Hronec, S. M. (1994). *Sinais vitais: usando medidas de desempenho da qualidade, tempo e custo para traçar a rota para o futuro de sua empresa*. São Paulo: Makron Books.

Hunt, V. D. (1996). *Process mapping: how to reengeneer your business process*. New York: John Wiley & Sons.

IDEF. (1993). *Integration definition for function modelling (IDEF0)* (Federal Information Processing Standards Publication, Vol. 183). Retrieved in 2019, September 3, from http://www.idef.com/wp-content/uploads/2016/02/idef0.pdf

Iritani, D. R., Morioka, S. N., Carvalho, M. M., & Ometto, A. R. (2015). Análise sobre os conceitos e práticas de gestão por processos: revisão sistemática e bibliometria. *Gestão & Produção*, 22, 164-180.

Jesus, C. G., & Gitahy, L. M. C. (2009). Transformações na indústria de construção naval brasileira e seus impactos no mercado de trabalho (1997-2007). In *Anais do I Congresso de Desenvolvimento Regional de Cabo Verde*. São Paulo: APDR. Retrieved in 2019, September 3, from http://www.apdr.pt/congresso/2009/pdf/Sess%C3%A3o%2039/79A.pdf

Lacerda, D. P., Rodrigues, L. H., & Silva, A. C. (2011). Avaliação da sinergia entre a engenharia de processos e o processo de pensamento da teoria das restrições. *Production*, 21(2), 284-300. http://dx.doi.org/10.1590/S0103-65132011005000019.

Laudon, K. C., & Laudon, J. P. (2014). *Management information systems* (11th ed.). São Paulo: Pearson.

Longaray, A. A. (1997). *Reengenharia de processos: os casos da Tintas Renner S.A. e do Grupo Gerdau* (Dissertação de mestrado). Universidade Federal de Santa Catarina, Florianópolis. Retrieved in 2019, September 3, from http://repositorio.ufsc.br/xmlui/handle/123456789/77249

Longaray, A. A., Munhoz, P. R., Albino, A. S., & Castelli, T. M. (2015). Use of bpm to redesign the container handling process: a Brazilian retroportuary terminal case. *Independent Journal of Management & Production*, 6(3), 667-686. http://dx.doi.org/10.14807/ijmp.v6i3.294.

Machado, F. B. (2014). *Construção naval e offshore no Brasil*. ABNAV. Retrieved in 2019, September 3, from http://abenav.org.br/web/wp-content/uploads/2014/08/1120-FERNANDO-BORTOLLI.pdf

Martins, H. C., Martins, M. D., Muylder, C. F., Gonçalves, C. A., & Dias, A. T. (2013). Configuração das imagens ideativas, planejamento e redução de riscos: a implantação do sistema ERP em uma instituição pública de ensino. *Revista de Administração da UFSM*, 6, 353-372.

Mello, C. H. P., Silva, C. E. S., Turrioni, J. B., & Souza, L. G. M. (2002). *ISO 9001:2000: quality management system for production and service operations*. São Paulo: Atlas.

Michel, B. A., & Costa, C. A. (2002). *Método de representação de processos em forma de fluxo - IDEF0* (Caderno Didático. Grupo de modelagem de informações para suporte ao desenvolvimento de produtos. MISDP). Caxias do Sul: UCS.

Moura, D. A. (2008). *Análise dos principais segmentos da indústria marítima brasileira: estudo das dimensões e dos fatores críticos de sucesso inerentes à sua competitividade* (Tese de doutorado). Universidade de São Paulo, São Paulo. Retrieved in 2019, September 3, from http://www.teses.usp.br/teses/disponiveis/3/3135/tde-25092008-120620/pt-br.php

Müller, G. L., Diesel, L. & Sellitto, M. A. (2010). Análise de processos e oportunidades de melhorias em uma empresa de serviços. *Produção online*, 10(3), 524-550. Retrieved in 2019, September 3, from http://producaoonline.org.br/rpo/article/view/241/716

Oliveira, J. N. D. & Rosa, L. C. (2010). Modelagem de processos IDEF: modelo descritivo da cadeia produtiva do biodiesel. *Revista Gestão Industrial*, 6(2), 159-174. http://dx.doi.org/10.3895/S1808-04482010000200009.

Padilha, T. C. C., Costa, A. F. B., Contador, J. L., & Martins, F. A. S. (2004). Tempo de implantação de sistemas ERP: análise da influência de fatores e aplicação de técnicas de gerenciamento de projetos. *Gestão & Produção*, 11, 65-74.

Parmenter, D. (2007). *Key Performance Indicators (KPI): developing, implementing, and using winning KPIs*. Hoboken: Wiley.

Pereira, N. N., & Laurindo, F. J. B. (2007). A importância da tecnologia da informação na indústria de construção naval: um estudode caso. *Production*, 17(2), 354-367. http://dx.doi.org/10.1590/S0103-65132007000200011.

Pinto, J. B. A., Fo. (2007). *Gestão de processos de negócio: uma adaptação da metodologia Rummler-Brache baseada numa aplicação real* (Dissertação de mestrado). Universidade Federal de Pernambuco, Recife. Retrieved in 2019, September 3, from https://repositorio.ufpe.br/handle/123456789/1367

Rocha, A. (2015). *Cenário da construção naval brasileira*. SINAVAL. Retrieved in 2019, September 3, from http://sinaval.org.br/wp-content/uploads/Cen%C3%A1rio-da-Constru%C3%A7%C3%A3o-Naval-Brasileira-Balan%C3%A7o-e-defesa-do-setor.pdf

Roesch, S. M. A. (2013). *Projetos de estágio e de pesquisa em administração*. São Paulo: Atlas.

Schimitz, C. C., Silva, L. & Pacheco, D. A. J. (2014). Proposta de redesign de processos em instituições de ensino: estudo de caso. *Revista Espacios*, 35, 22-32. Retrieved in 2019, September 3, from http://www.revistaespacios.com/a14v35n10/14351023

Schwaab, B. G., Weber F. Z., Balsan, L. A. G. & Moura, G. L. (2013). Mudanças a partir do mapeamento e gestão por processos. *Revista UNIABEU*, 6, 97-112. Retrieved in 2019, September 3, from http://revista.uniabeu.edu.br/index.php/RU/article/view/612

Silva, D., & Pereira, J. L. (2015). Modelação de processos de negócio: análise comparativa de linguagens. In *Anais da Conferência Associação Portuguesa de Sistemas de Informação* (pp. 327-346). Lisbon: APSI. Retrieved in 2019, September 3, from https://repositorium.sdum.uminho.pt/bitstream/1822/39183/1/CAPSI2015_DS_JLP.pdf

Smith, H., & Fingar, P. (2003). *Business process management: the third wave*. Tampa: Meghan-Kiffer Press.

Souza, F. S., Pedrini, D. C., & Caten, C. S. (2014). Proposta de fluxograma orientativo para aplicação de índices de capacidade. *Gestão & Produção*, 21, 882-894.

Stopford, M. (2009). *Maritime economics* (3rd ed.). London: Routledge.

Storch, R. L., Hammon, C. P., Bunch, H. M., & Moore, R. C. (1995). *Ship production: Cornell maritime press*. Maryland: Centerville.