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Assessing the impact of BPM in Cement Industry: Evidence from Angola

Irineu Ucuassapi Calulu

Project presented as partial requirement for obtaining the Master´s degree in Information Management

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By

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I hereby declare having conducted this academic work with integrity. I confirm that I have no used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledge the Rules of conduct and Code of Honor from the NOVA Information Management Schools.

Lisbon, 15/07/2023

To Irineia Calulu and Marciana Calulu

ABSTRACT

The current study exhaustively explores the impact of BPM in the Cement Industry, evidence from Angola. From what was possible to find out, there is a lack of information and even practical cases of BPM application in the Cement Industry. The case of Angola, a country in full growth and, after the post-war period, many companies and factories operating in this sector emerged, the need for the product grew exponentially and the supply of cement, fortunately, accompanied the demand over time, if it weren´t for Angola, today, a self-sufficient country in this matter. If, on the one hand, the cement market has been growing significantly, the same cannot be said of information and documentation regarding the use of the BPM methodology in this sector. It is a controversial situation, considering the size of the sector, the enormous number of processes and high-value information, where BPM techniques can help minimize day-to-day waste, increase revenue and productivity. This project presents an integrative application of BPM methodology, techniques, and tools in a cement industry, in Angola, with the aim of improving existing processes, specifically the sales process, ensuring the proper application of the methodology for the success of the project.

Keywords: BPM; Cement Industry; Cement Market; Sales Process

Sustainable Development Goals (ODS):

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LIST OF ABBREVIATION AND ACRONYMS

BPM	Business Process Management
BPMN	Business Process Model & Notation
BPMS	Business Process Management System
BPR	Business Process Reengineering
BPA	Business Process Automation
BVA	Business Value-adding
CRM	Customer Relationship Management
CD	Commercial Department
CSFs	Critical Success Factors
CO2	Carbon Dioxide
DASIAS	Diagnosing-Analysing-Solving-improving-Anchoring-Studying
DFD	Data Flow Diagram
DI	Digital Innovation
FD	Finance Department
HFO	Heavy Fuel Oil
ITIL	IT Infrastructure Library
IETF	Internet Engineering Task Force
KPI	Key Performance Indicator
MBWA	Management by Walking Around
NVA	Non- Value-adding
OMG	Object Management Group
ROI	Return Over Investment
SO	Sales Order
SA	Sales Authorization
SOA	Service-Oriented Architecture
SPC	Statistical Process Control

UML	Unified Modelling language
VA	Value-adding
WfMC	Workflow Management Coalition

1. INTRODUCTION

In recent years, we have seen exponential growth in the use and research of the Business Process Management (BPM) field. Around the world, many organizations have already adopted the methodology with satisfactory results.

In Africa, although numerous organizations are already adopting the methodology, technique, and tools of BPM, there is still a long way to go in the effective application of BPM, particularly in the case of Angola and in the Cement Industry, where this research will be applied. This study presents an integrative approach and application of BPM methodology, techniques, and tools, in all the dimensions of the business process, in the Cement industry in Angola-Africa. This research also shows, how the adoption of BPM will improve the performance of this organizations, based on the adequacy of the BPM lifecycle. In this regard, BPM is a management discipline that treats business process as assets (ABPMP, 2013). A business process is a set of logically interrelated activities within an organization that the execution of contribute to the achievement of the business objectives (Hammer and Davenport, 1990). BPM is the way in which customer requirements get transformed into actual goods and services (Trkman et al., 2021). It is important to understand the benefits that the implementation of BPM can bring for this Cement organization in terms of improved productivity, adequate control of performance, cost reduction, and improvement of customer satisfaction, among many other benefits. While BPM can potentially provide considerable benefits to a company, these benefits are often not realized to the full extent (Malinova and Jan Mendling, 2018).

BPM has evolved into a comprehensive management discipline focusing on organizational processes at the centre of interest (Rosemann and Von Brocke, 2010). In this context, it's important to understand the cement market in Angola. The Cement industry in Angola is booming, the difficulties encountered during and in the post-war period. In a country completely under construction, cement mainly was imported at the time, with Angola having only one cement factory, Companhia de Cimentos de Angola (Secil Lobito). Currently, Angola has five factories and, according to Ministry of Industry and Commerce, until December 2022, Angola has an installed production capacity of 8.460.000 tons of cement per year, a value that is above the current needs of the country, making the country self-sufficient. The level of use over installed capacity by 2022 is around 31%, far below the installed capacity in the country. This must be related to the global financial crisis that the country is going through, leading to a downturn in the construction sector, which has forced companies to adjust their production to the search. In 2022, a total of 2.622.224,12 tons of cement were sold, with the average sale price set at 55.566,74 AOA/Ton.

At this stage, we'll present the focus of this Project, which is the Cement industry in Angola, identify the problem, and define the process. For this Project, the company is Fábrica de Cimento de Angola, founded in 2009 in the South of Angola. Currently, the company has more than 800 employees distributed in different areas such as Operations, HR, finance, IT, logistics and shop floor and faces several problems related to the Sales Process. The main problems faced by Fábrica de Cimento de Angola in its sales process are the control of payments made by customers, payment approval time, delivery time of products to customers, inventory control, lack of online sales, and bureaucratic and lengthy invoicing processes. Based on this scenario, Fábrica de Cimento de Angola needs in the first phase to redesign a group of activities of its Sales Processes to achieve the following goals:

- Reduce operations costs;
- Improve customer service;
- Improve operational efficiency;
- Improve Customer Satisfaction;
- Increase Sales.

The structure of the document starts with an introduction defining the BPM and the context of the company and process, followed by a Theoretical Background focused on a literature review. After that, the Framework with the research methodology will be presented, followed by the results of the research and their implications for the business. Then, the report finishes with the limitations and future work of the Project, before the conclusions.

2. THEORETICAL BACKGROUND

2.1. CONSTRUCTION/CEMENT INDUSTRIAL SECTOR

The history of Angolan Cement is old and begins before independence, still in the 20^{th} century around the 1950s, more precisely in 1952, in which the pioneer was Secil Lobito, at this time under the name of Companhia de Cimentos de Angola, having undergone several transformations over time. Despite its age, the factory, now 49 percent owned by the Angolan state, is equipped with modern equipment, except for the filling lines, where the work is still manufactured.

The Angolan Cement Industry has grown exponentially over the last 14 years, a period corresponding to peacetime. The country's reconstruction needs immediately placed it at the Centre of priority areas for public and private investments. The biggest investment in the sector was made in the town of Bom Jesus, in Luanda, where the Chinese giant CIF installed a factory with two assembly lines, one for clinker and the other for cement. The second largest investment was made by Nova Cimangola, also in Luanda, which, in order to face the challenges of reconstruction, modernized its infrastructure, increasing its production capacity. Today, the two factories together represent more than five million tons of cement from the 8.460.000 annual tons that the country can produce. The Kwanza-Sul cement factory, with a capacity for 1.330.000 tons of Clinker and 1.400.000 tons of cement annually, is one of the major investments made in the sector. Finally, Secil Lobito the oldest and the smallest one currently with a production capacity of 260.000 tons of cement.

Now, we can see details of the production capacity of the following emerged of factories:

- ✓ **Nova Cimangola**
- ✓ **Cif**
- ✓ **Fábrica de Cimento do Kwanza-Sul (FCKS)**
- ✓ **Cimentfort**
- ✓ **Secil Lobito**

The Table 1 below shows the total production capacity per factory unit, and the total production, while the Table 2 represents the total installed capacity in Angola.

Cif, Nova Cimangola and Fábrica de Cimento do Kwanza-Sul are integral clinker and Cement production plants, while **Cimentfort** and **Secil Lobito** are millers. That is, they are dedicated exclusively to grinding clinker with additional materials resulting in Cement. For the clinkerization process, the fuel **Cif** and **Fábrica de Cimento do Kwanza-Sul** uses is Fuel Ordoil Normal (HFO), while **Cimangola** uses Mineral Coal. The Cement Plants produce Normal Portland Cement of the 42.5 and 32.5 Mpa type (resistance to 28 days), shipping in bags, big bags, and bulk tanks. To all the Provinces of the national territory, guaranteeing quality per internationally recognized norms. The geographical location of the Cement Plants Located in Angola is illustrated in the Figure 1**.** The Cement produced is used for small, medium, and large buildings, dams, bridges, roads, cement derivatives and artefacts, among others.

Table 1. Total Production Capacity

Designation	Installed Capacity 2022(Ton)	Total Cement Sales 2022(Ton)	Level of use YTD (%) over/ Installed Capac YTD	Level of use YTD (%) over/ Installed Capac. TT
CIF	3.600.000			
NOVA CIMANGOLA	1.800.000			
FCKS	1.400.000	2.303.312	47%	27%
CIMENTFORT	1.400.000			
SECIL	260.000			
TOTAL	8.460.000			

Table 2. Installed Capacity

Installed Capacity of Cement Plants	Level of use of equipments	Commercialization of cement in the last 4 years
✓ **Clinquer : 6.500.000 tn/ano** ✓ **Cimento : 8.460.000 tn/ano**	✓ 2019: 29% ✓ 2020: 23% ✓ 2021: 25% ✓ 2022: 27%	✓ 2019: **2.417.417** tn/ano ✓ 2020: **1.908.231** tn/ano ✓ 2021: **2.080.568** tn/ano ✓ 2022: **2.703.312** tn/ano

(Adapted from: www.Cemnet.Com/Global-Cement-Report/Country/Angola**)**

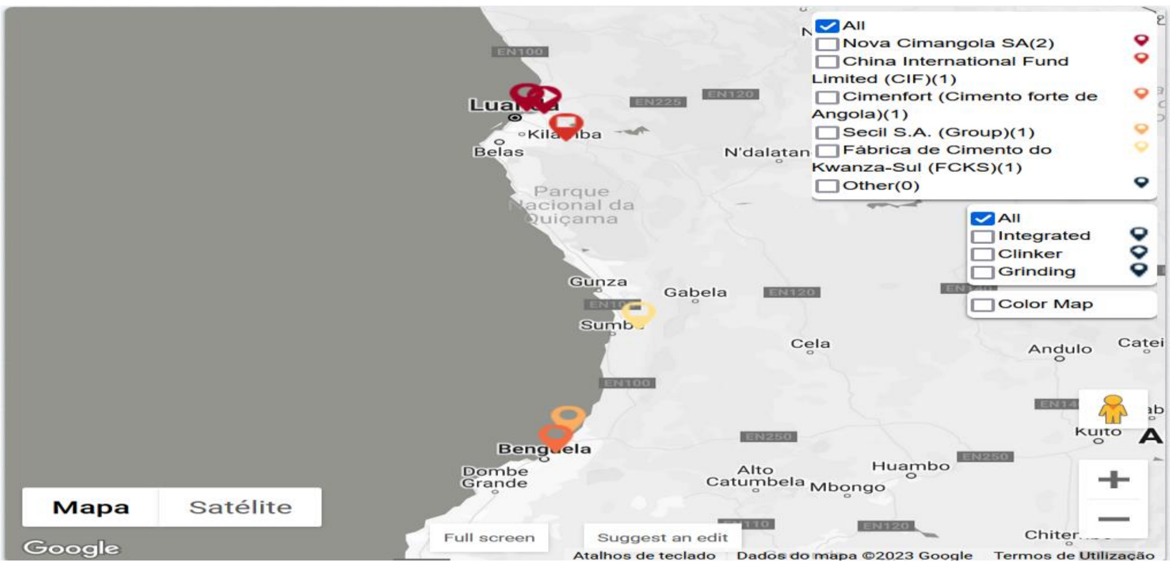

Figure 1. Geographic localization on the map of Angola

2.1.1. Fábrica de Cimento de Angola

Fábrica de Cimento de Angola is a company founded in 2009 in the south of Angola. Cement Factory is a private company incorporated under Angolan law, headquartered in the south of Angola, whose corporate purpose is cement manufacture. The idea of the creation of the factory was born, like many undertakings, the findings of a need. A group of daring men with enterprising minds found that cement was an indispensable raw material for rebuilding a country destroyed by the long years of war. At that time, the country only has two cement factories with insignificant capacities in the face of a considerable and growing demand.

2.1.1.1. Fábrica de Cimento de Angola Mission, Vision, and Values

The Table 3 below shows the Fábrica de Cimento de Angola Mission, Vision, and Values.

Table 3. Fábrica de Cimento de Angola Mission, Vision, and Value

MISSION	VISION	VALUES
		
Produce and distribute The best quality cement At the competitive	**To be the leading company in the cement market in Angola. Preferred by consumers, customer, investors, government, workforce and communities.**	**Our values make us a company of excellence and guarantee the sustainability of our actions and our results**

2.1.1.2. Products offered by Fábrica de Cimento de Angola

- ✓ **Portland Cement CEM II B-L 32.5N**
  - Portland Cement CEM II B-L 32.5N (ideal cement for the construction of small works, such as: homes, schools, hospitals, and for finishing).
- ✓ **Portland Cement CEM II A-L 42.5N**
  - Portland Cement CEM II A-L 42.5N (ideal for large constructions: Dams, bridges, warehouses, etc).
- ✓ **Clinker**
  - In the clinquerization phase, the material(flour) is conducted through a cyclone tower with five stages and different temperature gradients (Inlet 400º).

2.1.2. Define the Process

The main problems faced by Fábrica de Cimento de Angola in its sales process are the control of payments made by customers, payment approval time, delivery time of products to customers, inventory control, lack of an online sales, bureaucratic and lengthy invoicing process.

Currently, customer payment control is not effective. When the customer makes the payment, the delay in responding and meeting the customer´s need is high. The are cases in which the customer, after making the payment, will only receive a confirmation of his payment after more than 48hours, when payment methods could be adopted to guarantee the confirmation in few minutes. In addition, there is the problem of excessive time in approving a customer´s order, which may exceed 48hours and, in turn, the delivery time of the product will follow the same timeline, which causes customer dissatisfaction. Alongside the issues already mentioned, there is also the issue of not having a system that effectively controls the stock of raw material, as well as the finished product, which results in significant losses. In terms of sales, the process is still old, which limits the response time to customer requests, when an e-commerce platform should be implemented, allowing online sales, the customer should automatically place his order himself online or from an application, be able to view the status of his order, consult balance and the entire sales history.

Based on this scenario, Fábrica de Cimento de Angola hired a consultancy specializing in business process management in the first phase to redesign a group of activities of its sales processes to reduce sales operations costs, improve customer service and operational efficiency and obviously increase sales. The first phase of the Project aims to improve the efficiency of the sales and credit departments for pre-payment sales. Pre-payment sales represent 40% of the orders created, with an average entry of 50 orders per day. The sales department has ten employees and finance department has 12 employees (total of 22 employees). The main objective of reducing the effort of the commercial and financial teams is to reallocate resources from administrative and bureaucratic activities to other activities with more added value, such as CRM, marketing, expansions, and improvement projects.

Fábrica de Cimento de Angola understands that their business models have become old and are no longer effective. They understand that if they remain working according to an outdated business model, they won't get very far. Fábrica de Cimento de Angola knows that it's time to make changes and implement a business process management solution to reduce costs. They need to focus on reducing costs to stay functional and steady, they will adopt business process outsourcing to reduce labour and operational costs. Another thing important is that the implementation of BPM in Fábrica de Cimento de Angola will help business recognize and respond to new customer demands. As we know, Successful businesses must be responsive. They must be able to recognize changing customer demands and preferences and react quickly, that's what's Fábrica de Cimento de Angola needs. Another problem that Fábrica de Cimento de Angola is facing is the lack of productivity. With rising competition and more demanding survival conditions, Fábrica de Cimento de Angola must work at their best, in this case BPM can lead to increase productivity and have a better chance at remaining competitive, retain customers as It's difficult enough to gain new customers. Retaining them can be even more of a challenge. However, retaining customers has a much bigger ROI than converting new ones. It costs less to do so, and existing customers offer more profit over time. Finally, Fábrica de Cimento de Angola knows that it is important for the company to have a clear, strategic plan of how things are done, standardize the processes within the company, leads to cross department collaboration and improves safety, security, and compliance.

2.1.3. Sales Process (AS-IS)

In interview sessions with key users from the commercial and financial departments, all the steps of the process were detailed, and the details are explained below. The sales department performs directly in three stages of the sales process: receiving the payment bordereaux and creating the sales order, invoicing authorization, and closing the sales orders. And the finance department in the payment conference and payment release for delivery and invoicing. First step: the bordereaux that proves the payment is sent by the customer and the availability of stock is immediately checked. If there is available stock, the sales order is created and later the order and bordereaux are sent to the credit department for payment verification. If there is no stock available, a new stock availability query is performed in the following day.

The financial department verifies the legitimacy of the bordereaux, analyses the customer's credit level, and checks the payment with the banking institution. If these steps are validated, the order is authorized for invoicing and returned to the finance department. The verification of the validity of the payment is also done daily, until the document is validated and consequently authorized for delivery and invoicing. In the next step, the sales department receives the authorization for sale from the financial department and checks the date for releasing the order, according to the delivery planning map (a document created and managed by logistics). The delivery date is defined, and the pick list is printed on the chosen day and sent to the security post that will authorize the customer to enter the company and to the logistics department to separate the items that the customer will collect. In the last stage of the sale, the sales department receives from the security post a notice of exit of the sales order and the activities of closing the order, updating the stock, and sending to accounts receivable are performed.

2.1.3.1. Group of Processes

Based on the AS IS scenario analysis, the following points have been identified:

- ✓ 1st Group of Processes – SO creation – Sales Department - "Stock availability check" activity performed without a sales order (SO) created. - Stock commitment without payment confirmation. - Inventory check routine performed once a day, making it impossible to release a sales order with less than 24 hours. - "send bordereaux and SO to FD" activity manually executed.
- ✓ 2nd Group of Processes – Payment Check – Finance Department - "check bordereaux validity" activity non value added - "payment receipt check" activity executed once a day, making it impossible to release a sales order with less than 24 hours - "notify DC sales authorized" activity non value added - "send credit information to the customer". The company's contact with the customer is supposed to be made by the sales department.
- ✓ 3rd Group of Processes – Sales Department - "check bordereaux, SO and SA" activity

non value added - "delivery date check" activity performed once a day 5 - "picklist creation" manually executed.

- ✓ 5th Group of Processes – Logistics - "invoice issue" activity performed by the wrong department.
- ✓ 7th Group of Processes – Sales Department – Sales closing - "stock quantity update" activity manually executed - "customer data update" activity manually executed - "send the invoice to the customer" activity non-value added - "send SO to AR" activity manually executed.

2.2. BUSINESS PROCESS MANAGEMENT (BPM)

In this era of digitalization, we observe that almost everything is increasingly connected. We need to be resilient and keep up with this constant transformation. Companies need to reinvent themselves in many cases to overcome the numerous problems that have arisen. A new dynamic is needed to make it possible to adapt to this transformation. Time is not always in favour of companies, with the increasingly numerous and challenging tasks that arise daily, and issues related to optimization and automation are often forgotten. So, it's time to think of solutions that can help resolve all these bottlenecks more quickly. It's time to look at the market and analyse what existing solutions exist to organize, facilitate, optimize, and even organize the organization's processes. It is time to think about process-based Management.

It is in this path that process management based on BPM methodology emerges. To do so, we need to understand the benefits that can be extracted from it, such as improved productivity, more adequate control of performance, cost reduction, and improved customer satisfaction, among many other benefits. Dumas et al, (2018) define Business Process Management (BPM) as the art and science of overseeing how work is performed in an organization to ensure consistent outcomes and to take advantage of improvement opportunities (Dumas et al., 2018). Here is important to understand what Dumas et al., (2018) wants to describe by improvement depending on the objectives of organization, improvement objectives include reducing costs, reducing execution times, and reducing error rates, but also gaining competitive advantage through innovation (Dumas et al., 2018). But there is a core concept to better understand and analyse the Business Process Management methodology, that is PROCESS.

What is a process?

To answer and understand all these points, let's get back to Dumas et al., 2018, that gives a comprehensive and clarify this issue, referring that "BPM is not about improving the way individual activities are performed. Rather, it is about managing entire chains of events, activities, and decisions that ultimately add value to the organization, and its customers. These chains of events, activities, and decisions are called processes (Dumas et al., 2018, p.1). A process is a collection of related, structured tasks that produce a specific service or product to address a certain goal for a particular actor or set of actors (Glykas M, 2013).

Finally, Hall and Johnson in their article in the Harvard Business Review, refer that “The movement to standardize processes has gone overboard. Some require an artist´s judgement –

and should be managed accordingly" (Hall & Johnson, 2009). In this article they introduce the question "When Should a Process Be Art, Not Science?". They argue that "Art" is often described as "judgment-based work," "craft work," or "professional work". The common thread in such work is variability in the process, its inputs, and its outputs. Art is needed in changeable environments (for example, when row materials aren´t uniform and therefore require a craftsperson´s adjustments) and when customer value distinctive or unique output (in other words, all customers don't want the product or service to perform or be performed the same way). If both of those conditions aren´t present, a mass or mass-customization process, not an artistic process, is the answer (Hall & Johnson, 2009).

2.3. PREVIOUS RESEARCH ON BPM (LAST PARA FOCUS ON CONSTRUCTION /CEMENT INDUSTRY)

BPM has been discussed and researched for long time, and the results are visible. Sometimes when BPM initiatives are not well conducted, the results are not achieved as expected. But, to better understand the study on BPM, starting from the Michael Hammer manuscript "Reengineering Work: Don't Automate, obliterate" (1990), where we could see the focus on BPR saying that "The essence of the reengineering philosophy is to achieve drastic improvements by completely redesigning core business processes, that is, by rethinking the way business is conducted". Reengineering advocates radical design changes and fast revolutionary implementation to achieve drastic improvements (Laguna M, 2013**).** Later, other studies were carried out. For Elzinga, BPM encompass methodologies and provides a general method for the study and improvement of business process (Elzinga, et al, 1995).

Additionally, progress has been made with studies done by Dumas et al., 2018**,** clarifying the concept of improvement, so we can understand by Improvement depending on the objectives of organization, improvement objectives include reducing costs, reducing execution times, and reducing error rates, but also gaining competitive advantage through innovation (Dumas et al., 2018).

Another important consideration in BPM is the flexibility or the notion of agile business processes. The need for increased attention to flexibility stems from two mains drivers. First, the trends toward decreasing time-to-market and time-to-customer demands and an increasing frequency of product innovation combined with market changes such as globalization and new levels of compliance require adaptative business processes (Rosemann et al, 2008). Building more agile, integrated, and flexible organizations is a prime condition for operations to sustain and improve organization performance (Paim et al, 2020). Business processes flexibility can be seen as the capability of a process to yield to externally triggered change by modifying only those aspects of a process that need to be changed and keeping other parts stable (Rosemann et al, 2008). Process flexibility consists of an extrinsic trigger for change and intrinsic change mechanisms toward self-organization. However, not every change necessarily requires process change. Instead, necessary, and sufficient pre-requisites have to be fulfilled before it becomes relevant and feasible to change the process (Rosemann et al, 2008).

The article of Anastassiu et al, (2016), "The quest for organizational flexibility : Driven changes in business processes through the identification of relevant context", refers that the need for organizations flexibility has become more and more prevalent as, among other aspects, laws, rules, technology, environment, strategies, norms, culture, behaviours and decisions have become increasingly difficult to be monitored, and are continuously affecting business process and impacting operational and strategic goals (Anastassiu et al, 2016). In the paper, the authors presented a method to identify the contextual elements of a business process that might impact on business goal. The method ORGANON is fundamentally based on the analysis of a process model and consists of a set of systematic steps aimed at putting in evidence context information considered relevant to a business process. First, the essential activities are discovered, and then their main attributes are examined in face of the definition of variation provided by the method (Anastassiu et al, 2016). An evaluation of the ORGANON method through a case study conducted in an organization that works in the social security domain was reported. The results provide some indication of the feasibility of the method application in this scenario (Anastassiu et al, 2016).

The method was applied and discussed its application and results through interviews with managers and technicians that perform the process. The results showed five elements, which were presented to respondents in order to assess whether they have any relationship with the situations they identified as impacting the process goal. Some evidence that it was possible to identify the contextual elements of a given business process through ORGANON was identified. The Key contribution is that ORGANON can allow extending current business processes modelling techniques in order to identify contextual factors that impact on business processes (Anastassiu et all, 2016).

Vom Brocke referrer the BPM as Holistic discipline, BPM must include a holistic approach that includes, for example, strategic, methodological, technical, and social aspects (vom Brocke et al, 2014). To better measure the results in BPM, lets return to Elzinga to understand the concept of critical success factor, that can be defined as factors or areas that if developed or improved successfully will lead to an improvement in business performance or it will assure organizations goals achievement (Elzinga et al, 1995). These critical success factors have to do with Strategic or the organization in terms of BPM development, Investment on IT, Specialization of the employees, continue improvement and so on.

Referring to critical success factors, Aysolmaz et al (2023), provided a comparative study between BPM and BPA critical success factors. Comparatively assesses how CSFs change for BPA with respect to BPM. Using a survey sample of 139 BPM and BPA experts, the study shows that top management support as a CSF warrants attention for BPM than BPA, while the importance of choosing project methodology significantly differs for BPM and BPA. The comparison between lightweight and heavyweight BPA types indicates that the top management support is relatively less critical for lightweight BPA. The explorative and fsQCA analyses provide insights about the patterns for industries with different IT strategies roles, experts perspectives, and among CSFs. Overall, the findings may help project managers assess the role of key CSF better based on project focus (Aysolmaz et al,.2023).

A group of BPM experts shared their viewpoint on principles of good BPM, based on their opinions, experience and literature. They identified ten principles of good BPM. The principles solidify the state-of-the-art knowledge in BPM and, thus, may serve as reference for further development of the field. Considering these principles, BPM can provide a solid set of capabilities, essential to master contemporary and future changes. For research, these principles are critical to further shape BPM as a research domain and at the same time prove its value for practice (vom Broke et al, 2014). According to these viewpoints, these principles are: Principle of Context Awareness, Principle of Continuity, Principle of Enablement, Principle of Holism, Principle of Institutionalization, Principle of Involvement, Principle of Join understanding, Principle of Purpose, Principle of Simplicity and Principle of Technology Appropriation (vom Broke et al, 2014).

The reported use of the BPM in the Cement industry is scarce. I will show some cases related or not with cement industry, to better understand the application of BPM.

Recker et al, (2010) provided empirical research in BPM. They described selected cases of research efforts in this field and how the papers accepted for these special issues contributed to extending their body of knowledge.

Case 1 (The first paper), "Six Sigma as Business Process Management Method in services – analysis of the key application", by Florian Johansen, Suzanne Leist and Gregor Zellner, takes a look at the application of Six Sigma as a BPM method. Apart from being applied in production, Six Sigma has lately gained considerable attention as a BPM method in service industries. The transfer of the method from production to service applications does, however, pose problems that affect successful implementations. Knowing and understanding these problems is helpful in order to be able to avoid them and to achieve the goals of Six Sigma improvement projects. The evaluation of the results shows, on the one hand, that, to date, the problems of the application of Six Sigma in services have not sufficiently bean dealt with. On the other hand, the evaluation provides a survey of the problems structured in accordance with the phases of the Six Sigma cycle (Recker et al, 2010).

Case 2 (The second paper), "The join Impact of Service-oriented Architectures and Business Process Management on Business Process Quality: An empirical Evaluation and Comparison" by Daniel Beimborn and Nils Joachin, deals with the question how high business process quality can be achieved through the interplay between BPM and SOA. Specifically, the authors empirically investigate the impact of both SOA and BPA on business process quality in terms of straight-through processing, business-to-business integration, quality control, as well as standardization and consolidation of business process. The empirical study is based on data from 157 German service firms. Results show that the SOA paradigm has still received rather low adoption rates in the industry. However, the study also shows that SOA, BPM, and related information technologies have a direct positive impact on business process quality and the analysis provides evidence for the complementary of BPM and SOA since interaction effects between them have an additional significant impact on business process quality (Recker et al, 2010).

Case 3 (The third paper), "Uncovered ITIL Claims: IT executives´ Perception on Benefits and Business-IT Alignment", Mauricio Marrone and Lutz Kolbe report on an international survey of

441 firms about the benefits that the IT Infrastructure Library (ITIL), the de-facto best practice framework for IT Service Management Process provided to the IT organizations. Their study examines operational as well as strategic characteristics of the firms participating in the survey and focuses on the relationship between business-IT alignment maturity and the adoption of the ITIL best practice process. The study shows that the adoption of ITIL processes positively contributes to operational benefits realization as well as to business-IT alignment maturity (Recker et al, 2010).

Case 4 (The fourth paper), “Advances in Business Process Management Implementation based on a Maturity Assessment and Best Practice Exchange” by Michael Rohloff, reports on a case study on the implementation of BPM in a large international company. In this case study, the authors focuses on the development of reference frameworks and maturity assessment models to guide the implementation process. The results are of interest to audiences interesting in the adoption of BPM in large organisational cohorts (Recker et al, 2010).

Chountalas & Lagodimos, (2018) presented a paper to explore BPM specification and compare the BPM implementation potential under four dominant management paradigms: Total Quality Management, Standardized Management Systems, Business Process Reengineering and Six Sigma. With this study, they provided a detailed overview on BPM-related similarities and differences among four dominant management paradigms, shows that, in each paradigm the BPM specifications are strongly dependent on the respective paradigm principles and determine specific paradigm-dependent and paradigm-independent attributes of BPM, and finally, they identified implementation weaknesses of the paradigm-dependent BPM variants and discuss the need for a generic paradigm-independent core model(Chountalas & Lagodimos, 2018).

In this context, Six Sigma was found to best exploit the BPM potential; it provides a satisfactory framework for practically implementing BPM (i.e., DMAIC or its variants), it covers most individual stages of the BPM lifecycle, and it integrates some important attributes to enhance implementability (Such as focus on human resources, use of advanced statistical methods, and use of data-driven decision making). Moreover, in conjunction with Lean, it also allows implementation at a (Partially), systemic level, thus supporting the claim that Lean Six Sigma comes closest in implementing a process-based organizational transformation throughout the organization (Chountalas & Lagodimos, 2018).

They argue that there is still room for improving BPM implementability within Six Sigma. On the basis of the analysis such improvements could take place at three levels: emphasizing the systemic approach to BPM, by strengthening the specifications of the Lean component; adopting rigorous documentation system specifications – which is a necessary condition for continues processes improvement – probably by integrating Six Sigma with SMS; embedding modern’s technological tools to better support the implementability of each lifecycle stage (Chountalas & Lagodimos, 2018).

Another case, related to use of BPM in the Cement Industry is related to Lean Six Sigma for cement process by Raine Isaksson, named CemLean6S, that I’ll show the results here.

CemLean6S

According to Isaksson the purpose of CemLean6S is to maximise cement building potential while making best use of resources, by reducing waste and variation (Isaksson et all, 2015). this relatively narrow definition enables us to identify the overall y-values of the define step in the DMAIC-process of Six Sigma as:

- Values creation: MPa*tonnes (shareholder and customer).
- Cost: Total cost of production(shareholder).
- Environment: Total tonnes of CO_2-emissions(environment).

Based on the above we can envisage two important relative indicators relating to what could be seen as the two main global stakeholder – Planet and People (Isaksson et all, 2015):

- Planet: MPa/CO_2-emissions;
- People: MPa/US$

Table 4. Principles, Methodologies and Tools for CemLean6S

Principles	Methodologies	Tools
Top management commitment to the philosophy purpose and principles	Demonstrating commitment to all principles in decision making	Management By Walking Around (MBWA)
Focus on stakeholder needs	Working with best use of raw material, equipment, plant process, personnel, and management	System benchmarks Training programs
Work with process	Value flow analysis (incorrect processing, waiting, defects) Process management and improvement Reducing process variation Benchmarking Process analysis Working with process capability Working with Statistical Process Control (SPC)	 Process maps Benchmarks KPI Capability indices SPC-graphs: SPC software SPC rules
Factual approach to decisions making	Collecting process data Analysing data using multiple regression analysis Interviewing personnel Risk management with FMEA	Predictive models for strength, costs and emissions Questions checklists FMEA rules
Continuous incremental and breakthrough improvement	Working with Kaizen Working with DASIAS	DASIAS checklist and breakdown
Work for making everybody	Employee training;	Training schedule

committed in the system	Employee participation in improvement work; Involving key players	List of key players
Systems approach to management	Working with process-based system modes	System models; System KPI
Base your management decisions on a long-term philosophy	Working with long range plans	

Has we can see in the Table 4 above, the principles, methodologies, and tools of the CemLean6S are illustrated, and are clearly defined. The model has been customized for cement manufacturing and cement manufacturing processes by identifying the main value created and by demonstrating how this could be practically implemented. This work results in two relative indicators that can be used for optimizing shared value. These are building values compared to price and building values compared to CO2 emissions. By identifying a clear purpose for the improvement philosophy, it becomes possible to identify the main Y-values. This then leads to the possibility of using cement technology knowledge to speed up the process of identifying predictive formulas for Y. When it has been confirmed that there is enough identified improvement potential to proceed, is to identify the main x´s affecting the y parameter, based on the Six Sigma approach of $Y = f(X1, X2,…Xn)$. Identification of the main x´s affecting y at the purely technical level can be done using different predictive models. With cement manufacturing this can help identify the main x´s that affect the strength value creation. Compared to only using number crunching on existing databases for y and x, prior understanding can be used to speed up the improvement process. Examples of this in cement milling are predictive models for cement strength, gypsum optimisation where cement strength is related to the percentage of gypsum added and functions for cement strength dependence on level and type grinding aid addiction (Isaksson et all, 2015).

A preliminary improvement management process is also identified as Diagnosing-Analysing-Solving-improving-Anchoring-Studying (DASIAS). Only a few important parts of the roll-out process are identified. These are creating management interest, management and employee training, and pilot improvement work using opportunity studies. This process consists of six steps and is based on a proposal on a generic improvement process, to form the DASIAS improvement management process (operational part) (Isaksson et all, 2015):

- Diagnosing – Finding the improvement potential (value creation, cost reduction, reduction of the carbon footprint);
- Analysing – Finding the causes for the existing potential $y = f(x1,x2,…xn)$;
- Solving – Proposing solutions and choosing improvement strategy;
- Improving – Project management;
- Anchoring – Changes into KPI, management system documents and culture;
- Studying – Double loop learning and improvements to approach.

Finally, we can see some success cases not related directly to the cement industry, but similar, related by Vom Brocke. The first successful case is the implementation of Sensor-Enabled wearable Process Support in the production Industry. It was an innovative BPM case carried out in the corrugation production industry. A sensor enable-enabled wearable process management device that collects sensor that, wearable interfaces, and execute BPM models, that way strengthening the organization's capability to delivery strategic objectives was implemented (vom Brocke et all., 2021). As a result, this solution significantly reduced reaction time decreased the number of deficient products and improved the overall quality of the corrugated paper produced (Vom Brocke et all., 2021). Another important case is the BPM Billboard illustrated by Vom Brocke, how to move from paper to impact in business process management: The journey of SAP. The results show that by 2017 when the case study was written, based "on a sample of 100 projects per year, SAP currently achieves a typical result of 20:1 payback and customer satisfaction that exceeds 75%. In addition, many processing time has been reduced significantly, including a process in the marketing service team that eliminated eleven process steps and reduced processing time by up to 74% (vom Brocke et all., 2021).

So, the research in BPM shows that it increases the performance of organizations, and the results are visible.

3. FRAMEWORK – THE BPM LIFECYCLE

In this section we'll show the framework to be used for the success of the Project. We will adopt the BPM Lifecycle as the main methodology for the Project, based on Dumas et al, (2018).

3.1. THE BPM LIFECYCLE

After we have analysed and understood the central concept of Business Process Management (BPM), and concepts of Business Process Modelling, we see how we can improve the processes with the Business Process Reengineering (BPR), with the notion of obliterate and the pros and cons of BPR, now we are going to focus our study on a core element of BPM, the **BPM Lifecycle.** The BPM lifecycle encompasses a range of methods and tools to identify processes and manage individual processes. The BPM lifecycle also helps us understand technology's role in BPM (Dumas et al., 2018). A BPM life cycle is an implementation of BPM concepts. It embraces the concept of continuous improvement by iteratively relating key BPM practices. The BPM life cycle is used as not only a roadmap for the implementation of BPM projects but also a benchmark for evaluating the maturity of BPMS (Van der Aalst, 2004).

There are different lifecycle models, according to each author. For this research, I will adopt the BPM Lifecycle model proposed by Dumas et al, (2018), which consists of the following phases:

- ✓ **Process Identification**
- ✓ **Process Discovery**
- ✓ **Process Analysis**
- ✓ **Process Redesign**
- ✓ **Process Implementation**
- ✓ **Process Monitoring**

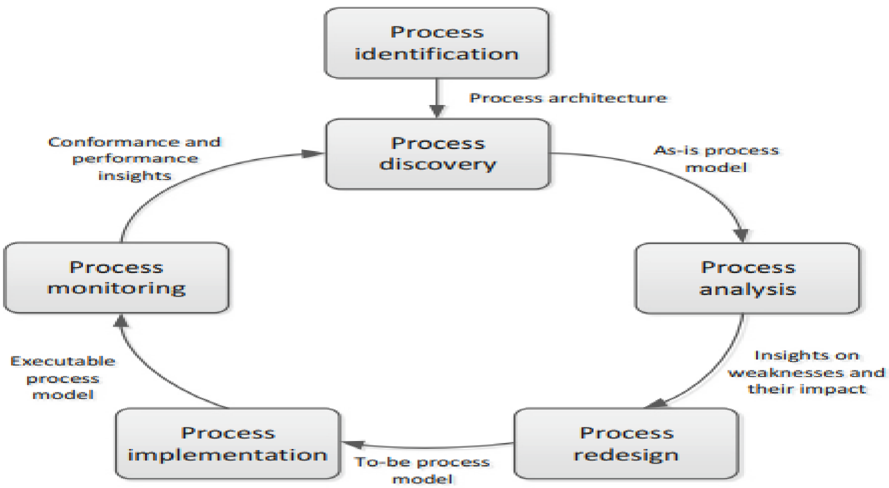

Figure 2. bpm Lifecycle

The Figure 2 above shows the BPM Lifecycle, and I will detail it below, according to (Dumas et al., 2018, p.23).

3.1.1. Process Identification

In this phase, a business problem is posed. Processes relevant to the problem being addressed are identified, delimited, and interrelated. The outcome of process identification is a new or updated process architecture, which provides an overall picture of the processes in an organization and their relationships. This architecture is then used to select which process or set thereof to manage through the remaining phases of the lifecycle. Typically, process identification is done in parallel with performance measure identification (Dumas et al., 2018). According to Dumas, one of the most influential categorization schemes is Porter's Value Chain model. It originally distinguished two categories of processes: core processes (called primary activities) and support processes (support activities). Management processes were added as a third category (Dumas et al., 2018).

For this project we have many things to do. Currently, the company doesn't have the processes well identified; there isn't a process architecture designed and documented, which means we'll have to do it from the beginning. The process architecture for the company will be defined according to Dumas, in a top-down fashion, starting with the process landscape showing the company's value chain on level 1. After that, on level two the business process will be decomposed, and finally more detailed decomposition down to subprocesses and tasks, will be provided on level three.

For the success of this Project, it will be necessary to involve everyone, from senior managers (Production, Logistics, Human Resource, IT, Commercial). Production has information regarding production processes, and production cost analysis, inputs for break-even. Logistics, inputs on raw material costs, Human resources the necessary people for the project success, Information Technology to give all the support and proper tool and methods for the success of the Project, and finally Commercial as the responsible for the sales process. Later, we go down to the key users. On the other hand, it will be necessary to follow-up with the board of the company, which must then carry out the necessary analyses of the performance of the processes at the highest level. Only after that, we'll be able to have a process duly identified, evaluated by all parties, and supported by the board of the company, and ready to serve as the focus of our work.

3.1.2. Process Discovery

Process discovery is defined as the act of gathering information about an existing process and organizing it in terms of an as-is process model. Here, the current state of each of the relevant processes is documented, typically in the form of one or several as-is process models (Dumas et al., 2018). As we could see in the previous step, we selected a process and as per Dumas et al (2018), now we need to gather information about this process and organize it. To accomplish this task, we'll follow the four tasks of process discovery. According to Dumas et al, (2018), first we need to assemble a team responsible for working on the process, which is called Defining the setting. For this task, we'll define two important roles, the process analyst (responsible for gathering information about a given business process, and driving the modelling task, under the leadership of the process owner, familiar with process modelling languages such as BPMN), and the domain expert (any individual who has an intimate knowledge of how a process or specific tasks within that process are performed).

In this Project the board and all team members need to clarify and understand Cleary these roles in the Project. The second task is Gathering information concerned with building an understanding of the process. Here, we can distinguish three classes of discovery methods, namely evidence-based discovery, interview-based discovery, and workshop-based discovery. For this Project, as the company has a lot of documents, we will take advantages of these documents and use evidence-based discovery method, we also want to take advantage of the knowledge of the domain experts to clarify the processes, so, we will interview them. It means that in this Project will be used a combination of these two methods (evidence-based discovery and interview-based discovery). The third task, the process model will be crated, all the processes will be mapped with BPMN, and finally in the fourth task we will guarantee the quality of the process model.

3.1.2.1. Business Process Modelling

In this chapter, our focus is to understand the concept of modelling, what modelling languages we can use, and what language we are proposing for this research. Sometimes, users face a lot of difficulties in understanding end-to-end processes, that's why we need a comprehensive and clear perspective about process modelling. Process models help us to better understand the process and to identify and prevent issues. This step towards a thorough understanding of business processes is the prerequisite to conduct process analysis, redesign, or automation (Dumas et al., 2018).

Goals of Process Modelling

The understanding of this topic is of great importance since the elaboration of an adequate diagram of the business process will facilitate the detailed understanding of the characteristics of the process, which activities are important and part of the process, how to manage the flow of information in this context. In this way, it is much easier to understand what will be done and who should do it, what is the sequence of activities, as well as generating the necessary documentation.

There are three common characteristics of models, namely Representation, Simplification, and pragmatic orientation (Glykas M, 2013).

- ✓ Representation: Models are models of something else;
- ✓ Simplification: Models possess a reductive trait in that they map a subset of attributes of the phenomenon being modelled rather than the complete set of attributes;
- ✓ Pragmatic orientation: Models have a substitutive function in that they substitute a certain phenomenon as being conceptualized by a certain subject in a given temporal space with a certain incentive or operation in mind.

Process Modelling According to Different Modelling Perspectives

In this section, I want to show the different perspectives of Process Modelling. In the market, we can find different approaches to issues, and many authors focus on diagrammatical modelling languages with an interesting perspective.

- **Behavioural Perspective**

There are two language-types commonly used to model Finite state machines (FSM):

a) State transition diagrams (STD)
b) State transition matrices (STM)

- **Functional Perspective**

After we understand the essence of the Behavioural Perspective, now let's see a little bit, how functional perspective works.

Processes are divided into activities, which may be divided further into sub activities. Each activity takes inputs, which it transforms to outputs. Input and output relations thus define the sequence of work (Glykas M, 2013).

Examples of this perspective are the following standards (Glykas M, 2013):

- ✓ Workflow Management Coalition (WfMC 2000);
- ✓ Internet Engineering Task Force (IETF);
- ✓ Object Management Group (OMG 2000);
- ✓ IDEF-0;
- ✓ Data Flow Diagram (DFD);

- **Combined Behavioural and Functional Approaches**

After we understand the two main perspectives (behavioural perspective and functional perspective), now I'm going to introduce the combine perspective. In this section, we'll combine both perspective and will arise new models such as:

- ✓ ARIS EPC
- ✓ UML ACTIVITY DIAGRAM
- ✓ YAWL
- ✓ BPMN

From all these modelling languages, the one that most interests us and will be object of our Project, as a standard model for our implementation is the BPMN.

3.1.2.2. Business Process Modelling and Notation (BPMN)

The business Process Model and Notation is a standard created by the Business Process Management Initiative, now merged with the Object Management Group (OMG), an information systems standards-settings group (ABPMP, 2013). In 2004, BPMN was presented as the standard business process modelling notation. Since then, BPMN has been evaluated in different ways by the academic community and has become widely supported in industry (Glykas M, 2013). The primary goal of BPMN was to provide a notation that is readily understandable by all stakeholders, from business people who will support the performance of the process, and finally to the business people who will manage and monitor those processes (Glykas M, 2013). The Business Process Modelling Notation (BPMN version 1.0) was proposed in May 2004 and adopted by OMG for ratification in February 2006. The BPMN 2.0 specification was formally released in January 2011. BPMN is based on the revision of other notations and methodologies, especially UML activity Diagram, UML EDOC Business Process (see under object-perspective), IDEF, ebXML BPSS, Activity-Decision Flow (ADF) Diagram, RosettaNet, LOVeM and EPC (Glykas M, 2013).

A business process involves events and activities. Events represent things that happen instantaneously (e.g., an invoice has been received), whereas activities represent units of work that have a duration (e.g., an activity to pay an invoice). Also, in a process, events and activities are logically related. The most elementary form of relation is that of sequence, which implies that one event or activity A is followed by another event or activity B. Accordingly, the three most basic concepts of BPMN are events, activities, and arcs. Events are represented by circles, activities by rounded rectangles, and arcs (called sequence flows in BPMN) are represented by arrows with a full arrowhead (Dumas et al., 2018).

3.1.3. Process Analysis

In this phase, issues associated with the as-is process are identified, documented, and whenever possible quantified using performance measures. The output of this phase is a structured collection of issues. These issues are prioritized based on their potential impact and the estimated effort required to resolve them.

After we have defined the as-is process or this Project in the previous discovery step, now we'll analyse the issues related to this as-is process. According to Dumas et all, (2018), two analyses can be done: Qualitative process analysis, here we have two objectives, first identified, and eliminate waste (Value-Added Analysis and Waste analysis), second identify, and prioritize problems (Issue register and rout-cause analysis). Quantitative process analysis, here we can use techniques for analysing business processes quantitatively in terms of process performance measures such as cycle time, waiting time, cost, and other measures. Our focus will be on three techniques: **flow analysis, queueing analysis and simulation**.

For this Project in Fábrica de Cimento de Angola, we will use both qualitative and quantitative analysis as the results obtained from qualitative analysis are sometimes not detailed enough to provide a solid basis for decision making, it will be completed with a quantitative analysis. So, we start with a proper Value-Added Analysis and a Waste analysis, a why-why diagram will be present. After that, quantitative that will be present to support the previous analysis, with a flow analysis and a simulation on bizagi modeller will be performed.

3.1.4. Process Redesign (also called process improvement)

The goal of this phase as per Dumas et al, (2018) is to identify changes to the process that would help to address the issues identified in the previous phase and allow the organization to meet its performance objectives. To this end, multiple change options are analysed and compared in terms of the chosen performance measures. Hence, process redesign and process analysis go hand-in-hand: As new change options are proposed, they are analysed using process analysis techniques. Eventually, the most promising change options are retained and combined into a redesigned process. The output of this phase is typically a to-be process model.

For this Project, this is an important step after we've finished the previous step, because here we define the TO-BE process to be implemented and monitored.

4. RESULTS – PROCESS CHOSEN

For this stage, qualitative process analysis and quantitative process analysis will be provided, and the results will be analysed carefully. The Cement Industry understand that their business models became old, lately they were facing many problems with customers, and they were also losing money because their business model are no longer effective. They've understood that if they remain working according to an outdated business model, they won't get very far. The Cement Industry understood that it's time to make changes and implement a Business Process Management solution to reduce costs, they need focus on reducing costs in order to stay functional and steady, they will adopt business process outsourcing to reduce labour and operational costs. Another thing important is that the implementation of BPM in the Cement Industry will help business recognize and respond to new customer demands.

As we know, Successful businesses must be responsive. They must be able to recognize changing customer demands and preferences and react quickly, that's what's the industry needs. Another problem that The Cement Industry is facing is the lack of productivity. With rising competition and more demanding survival conditions, they must work at their best, in this case BPM can lead to increase productivity and have a better chance at remaining competitive, retain customers as It's difficult enough to gain new customers. Retaining them can be even more of a challenge. However, retaining customers has a much bigger ROI than converting new ones. It costs less to do so, and existing customers offer more profit over time. Finally, Cement Industry knows that It is important for the company to have a clear, strategic plan of how things are done, standardize the processes within the company, leads to cross department collaboration and improves safety, security, and compliance.

4.1. PROCESS ANALYSIS

To provide a better understanding of the process of the Cement Industry, interview sessions with key users from the commercial and financial departments were provided, all the steps of the process were detailed, and the details are explained below.

Sales department perform directly in three stages of the sales process: receiving the payment bordereaux and creating the sales order, invoicing authorization, and closing the sales orders. And the **Finance department** in the payment conference and payment release for delivery and invoicing.

First step: The bordereaux that proves the payment is sent by the customer and the availability of stock is immediately checked. If there is available stock, the sales order is created and later the order and bordereaux are sent to the credit department for payment verification. If there is no stock available, a new stock availability query is performed in the following day.

The financial department verifies the legitimacy of the bordereaux, analyses the customer's credit level, and checks the payment with the banking institution. If these steps are validated, the order is authorized for invoicing and returned to the finance department. The verification of the validity of the payment is also done daily, until the document is validated and consequently authorized for delivery and invoicing. In the next step, the **sales department** receives the authorization for sale from the **financial department** and checks the date for releasing the order, according to the delivery planning map (document created and managed by logistics). The delivery date is defined, and the picklist is printed on the chosen day and sent to the security post that will authorize the customer to enter the company and to the logistics department to separate the items that will be collected by the customer. In the last stage of the sale, the sales department receives from the security post a notice of exit of the sales order and the activities of closing the order, updating the stock, sending to accounts receivable are performed.

The Figure 3 below show the Main **"AS-IS" process model**, and the sub-processes **SO creation** in the Figure 4, Payment check in the Figure 5 and SO authorization in the Figure 6 according to the steps above. The remain sub-precesses can be find in the Appendix section.

Main Process: "AS-IS" Sales Process model

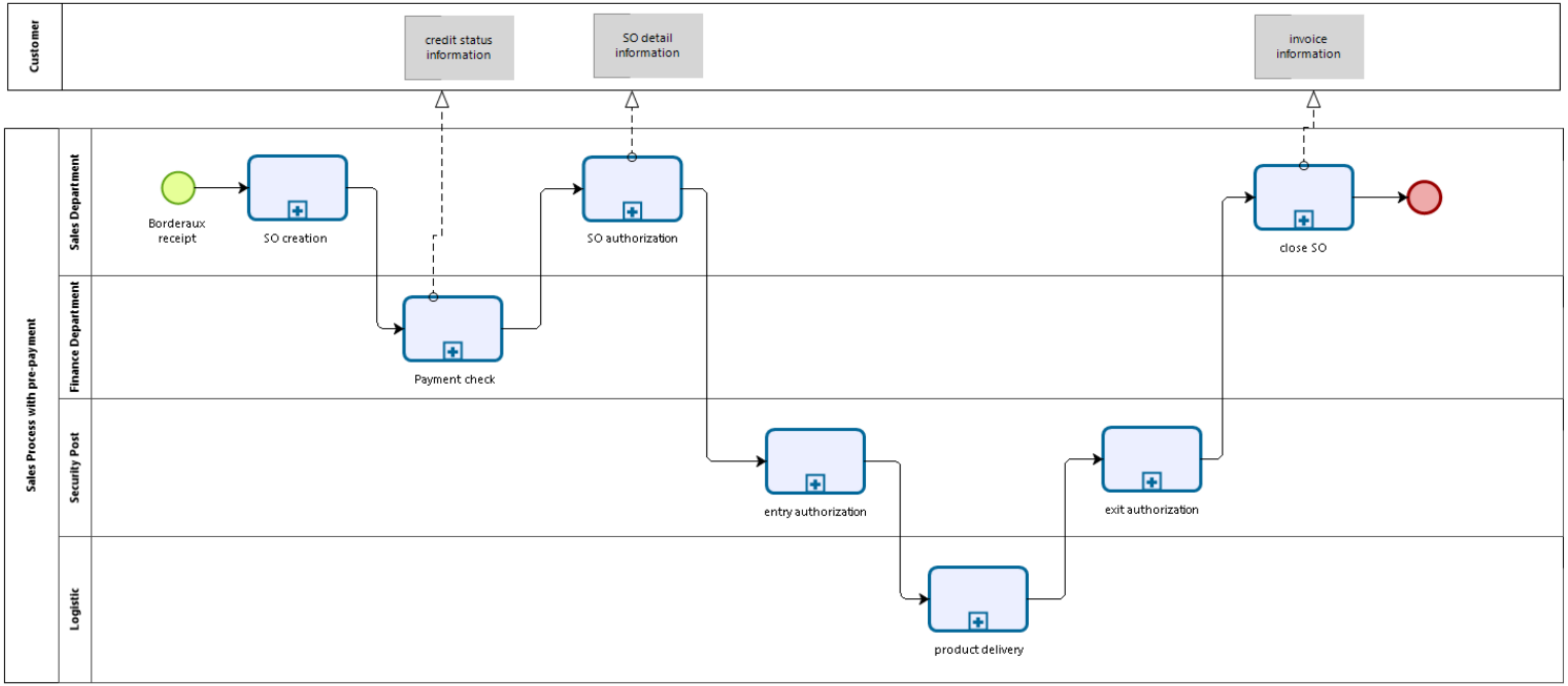

Figure 3. "AS-IS" Sales Process model

Sub-process: "AS-IS" SO Creation

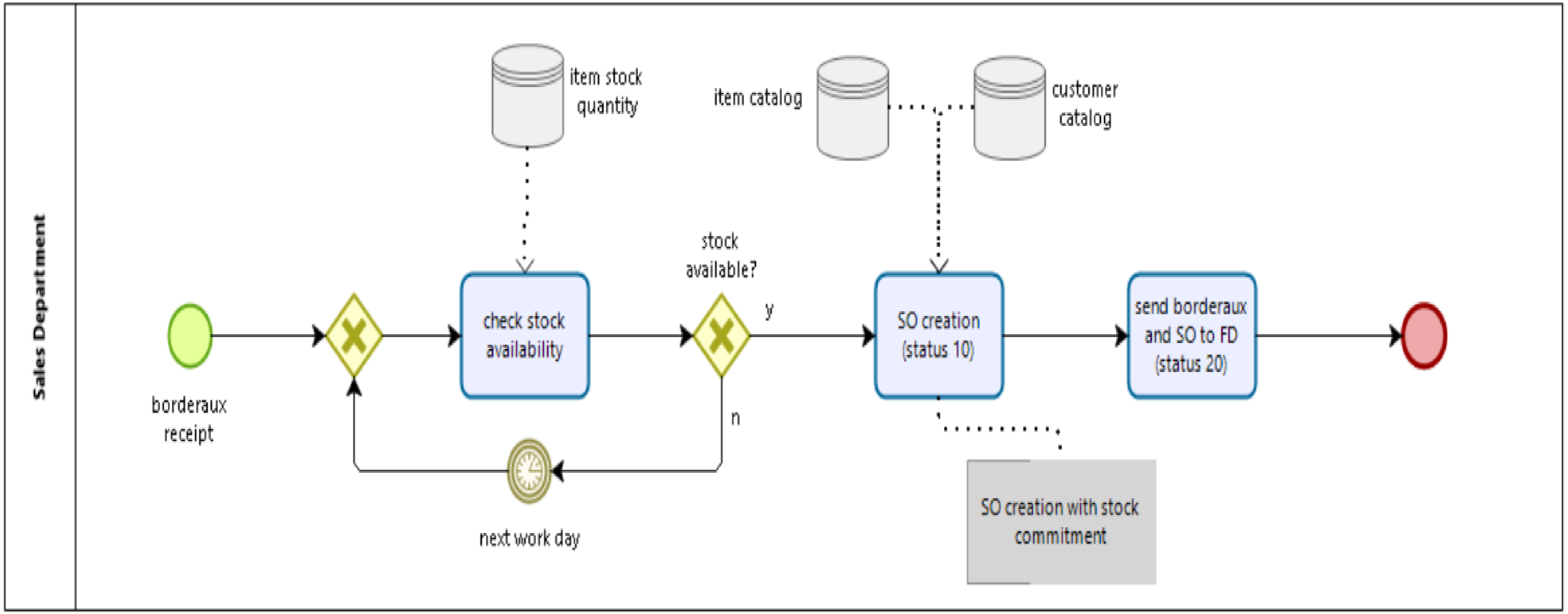

Figure 4. "AS-IS" SO Creation

Sub-process: "AS-IS" Payment Check

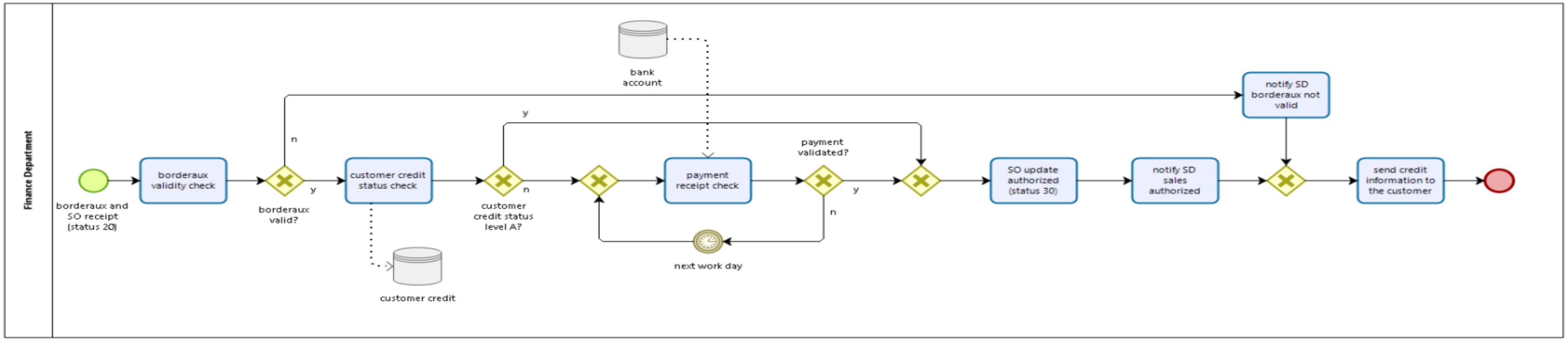

Figure 5. "AS-IS" Payment Check

Sub-process: "AS-IS" SO Authorization

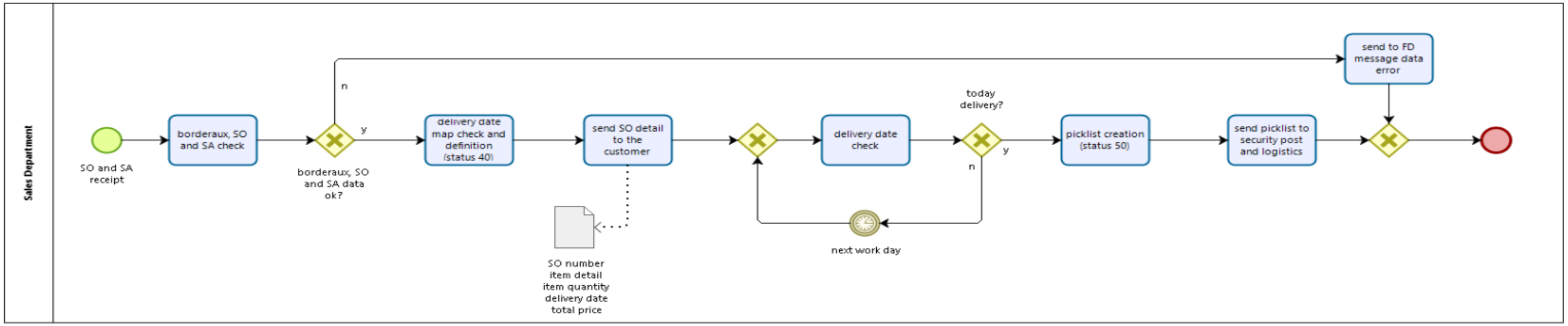

Figure 6. "AS-IS" SO Authorization

Based on AS IS scenario analysis, the Table 5 below shows the groups of processes that have been identified:

Table 5. "AS-IS" Groups of processes

Group of Processes	Activity	Description
1st Group of Processes		
SO Creation (Sales Department)	Stock availability check	Activity performed without a sales order (SO) created
	Stock commitment	without payment confirmation
	Inventory check	Routine performed once a day, making it impossible to release a sales order with less than 24 hours
	Send bordereaux and SO to FD	Activity manually executed
2nd Group of Processes		
Payment Check (Finance Department)	Check bordereaux validity	Activity non value added
	Payment receipt check	Activity executed once a day, making it impossible to release a sales order with less than 24 hours
	Notify DC sales authorized	Activity non value added
	Send credit information to the customer	The company's contact with the customer is supposed to be made by the sales department
3rd Group of Processes		
SO Authorization (Sales Department)	Check bordereaux, SO and SA	Activity non value added
	Delivery date check	Activity performed once a day
	Picklist creation	Manually executed
4th Group of Processes		
Entry Authorization	Customer data check and Picklist check	Activity performed manually
	Vehicle weight measure	Activity performed manually

(Security Post)	Picklist Authorization collection stamp	Activity non value added
5th Group of Processes		
Product Delivery **(Logistic Department)**	Invoice Issue	Activity performed by the wrong department
6th Group of Processes		
Exit Authorization **(Security Post)**	Vehicle weight measure	Activity performed manually
	Vehicle weight and transp doc check	Activity performed manually
	Transport document stamp	Activity non value added
	Notify SO conclusion to sales Department	Activity non value added
7th Group of Processes		
Sales closing **(Sales Department)**	Stock quantity update	Activity manually executed
	Customer data update	Activity manually executed
	Send invoice to the customer	Activity non value added
	Send SO to AR	Activity manually executed

4.1.1. Qualitative Analysis

In this chapter, qualitative analysis will be performed to identify and eliminate waste and identify and prioritize problems. For qualitative analysis, two techniques were used to classify and categorize activities of the current process, although it is often subjective: Table 6 shows the Value-Adding Analysis, while Table 7 represents the Waste Analysis, as follows.

4.1.1.1. Value-Added Analysis

Table 6. Value-Added Analysis

Activity	Performer	Classification
Check stock availability	Sales Department	BVA
SO creation	Sales Department	VA
Send bordereaux/SO to FD	Sales Department	BVA
Bordereaux validity check	Finance Department	NVA
Customer credit status check	Finance Department	BVA
Payment receipt check	Finance Department	BVA
SO update authorized	Finance Department	BVA
Notify SD sales authorized	Finance Department	NVA
Notify SD bordereaux not valid	Finance Department	NVA
Send credit info to the customer	Finance Department	VA
bordereaux, SO and SA check	Sales Department	NVA
Delivery date map check and definition	Sales Department	BVA
Send SO detail to the customer	Sales Department	VA
Delivery date check	Sales Department	NVA
Picklist creation	Sales Department	BVA
Send picklist to security and logistic	Sales Department	BVA
Send to FD message data error	Sales Department	BVA
Customer data check and picklist check	Security Post	BVA

Vehicle weight measure	Security Post	BVA
Picklist authorization collection stamp	Security Post	BVA
Driver receipt and picklist check	Logistic	BVA
Truck loading	Logistic	VA
Transport document issue	Logistic	VA
Invoice issue	Logistic	VA
Vehicle weight measure	Security Post	BVA
Vehicle weight and transp doc check	Security Post	BVA
Transport document stamp	Security Post	BVA
Notify SO conclusion to sales	Security Post	BVA
Update SO to status closed	Sales Department	BVA
Stock quantity update	Sales Department	BVA
Customer data update	Sales Department	BVA
Send invoice to the customer	Sales Department	VA
Send SO to AR	Sales Department	BVA

4.1.1.2. Waste Analysis

Table 7. Waste Analysis

Situation	Classification
Send bordereaux and SO to FD	Transportation
Inventory check routine performed once a day	Waiting
Check bordereaux validity	Overprocessing
Payment receipt check	Waiting
Notify SD sales authorized	Transportation
Send credit information to the customer	Transportation
Check bordereaux, SO and SA	Overprocessing

Delivery date check	Waiting
Picklist creation	Overprocessing
Stock quantity update	Overprocessing
Customer data update	Overprocessing
Send SO to AR	Transportation

4.1.2. Quantitative Analysis

To better understand the performance of the processes, quantitative analysis will be provided, and details of the execution time of the activities and percentages of resource utilization will be analysed, for the current situation "AS-IS Process model". Here, we need to understand how the processes works and the evidence in terms of times, use of resources, quality of customer service and consequently costs.

For this quantitative analysis, simulations were performed, and the results were explained according to the previous information. To start the simulation, an 8h work simulation was assumed in the scenario, and time analysis and resource analysis were provided. For the simulation, we assume that the availability of employees was, 4 security officers, ten logistics technicians, seven sales technicians and six financial technicians. For the execution of the activity, we assumed that only one person was necessary at the time, except for logistics that we assumed two people were necessary. With this information, we need to understand the average time and total time for each process, the entire process, and the percentage resource utilization.

According to the information above, the results of the simulation are shown below:

Average Time (AS-IS)

Table 8. Average Time (AS-IS)

Process	**Avg Time**
SO Creation	8m29s
Payment Check	12m41s
SO Authorization	6m29s
Entry Authorization	11m1s
Product Delivery	50m
Exit Authorization	10m29s
Close SO	4m59s
Total	1h44m10s

Total Time (AS-IS)

Table 9. Total Time (AS-IS)

Process	Total Time
SO Creation	6h39m10s
Payment Check	9h31m15s
SO Authorization	4h52m10s
Entry Authorization	7h53m52s
Product Delivery	1d6h50m3s
Exit Authorization	6h17m34s
Close SO	2h59m39s
Total	2d21h3m45s

Resource Utilization (AS-IS)

Table 10. Resource Utilization (AS-IS)

Resource	Utilization
Sales Department	25,92%
Finance Department	20,35%
Security Post	45,43%
Logistics	82,74%

The tables above show the current situation of the sales process with pre-payment of the Cement Industry. With these results, we can understand why the company has had many difficulties in this process, the reason why the numerous complaints from customers. These results show that the average time of these processes as per Table 8, from the SO Creation to the SO Close seems quite high, making up an average time to process a sale with high values. Suppose we need an average time of 8m29s to create a SO, an average time of 1h44m10s to conclude a "Sale Process with pre-payment," and a Total Time of 2d21h3m45s according to **Table** 9. In that case, there is no doubt about the inefficiency of the entire process, and the results cannot be satisfactory. Improvements in the process are necessary to better respond to the necessities of the Cement Industry and market demands, in spite of the resource utilization in Table 10.

4.2. Process Redesign - Heuristics

At this stage, we will understand what shall be done to improve the previous process. Here, the interpretation of the previous process (AS-IS) does not mean that it was poorly designed or a bed process. During the interviews, it was possible to understand that since the process was designed until the present date, there have been many changes in the Cement Industry. New working methods have been introduced; the industry has grown as a whole, and the demands have increased with the arrival of new customers. There were changes internally and also in terms of the external environment. However, the processes did not follow these changes.

In terms of Heuristics, redundant or unnecessary tasks were eliminated. Tried to increase flexibility in making tasks composition, it was possible also to specialization and resource optimization to improve time and costs, and finally, it was possible to automate some activities that were performed manually.

4.2.1. Heuristics 1 – Task Elimination

For Heuristics 1, non-value-added steps will be eliminated, and some manual control steps as well.

For the sale process with pre-payment, the number of sub-processes was not changed, but some of the sub-process changed their concept. For the first sub-process, SO Creation, changes were provided, and the SO Creation is done without a stock commitment. The item catalog and customer catalog are updated in this activity, as can be seen in the Figure 7 It eliminates the problem if the stock is not available only on the next working day the activity is performed again.

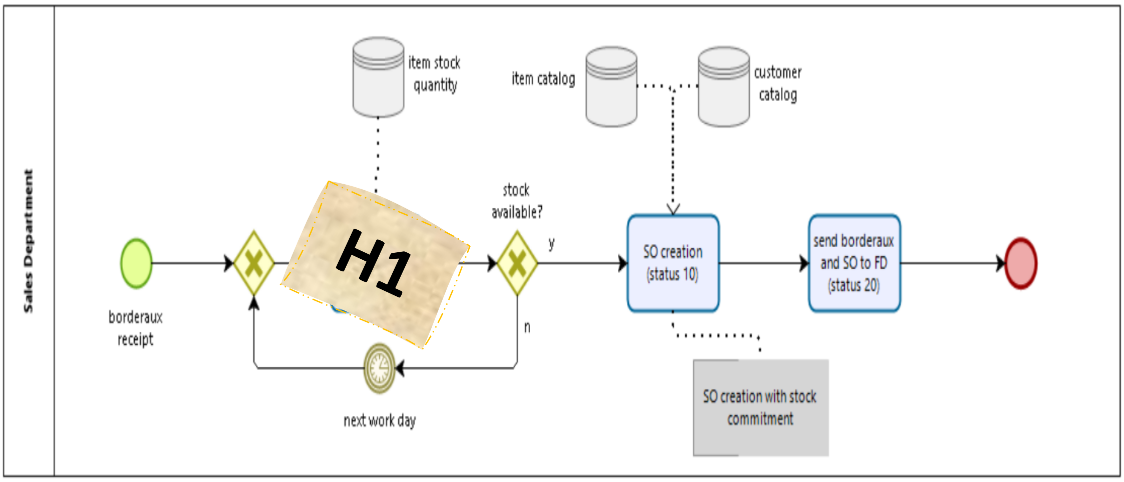

Figure 7. Task Elimination - SO Creation without a stock commitment

In the sub-process Payment check, in the activities "notify SD sales authorized" and "send credit Information to the customer" also eliminated helping reduce time, according to the Figure 8.

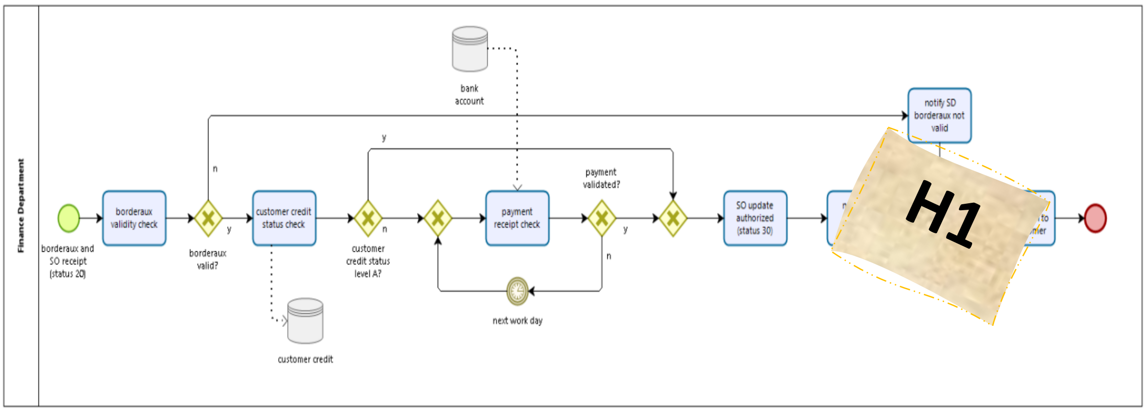

Figure 8. Elimination of “notify SD sales autho” and “send cred Inf to the custom”

Likewise, changes were made to the SO authorization sub-process, as Figure 9, the concept was changed to a new one, and bordereaux SO and SA check was eliminated because this task is performed in the payment check sub-process and time can be reduced in the sub-process.

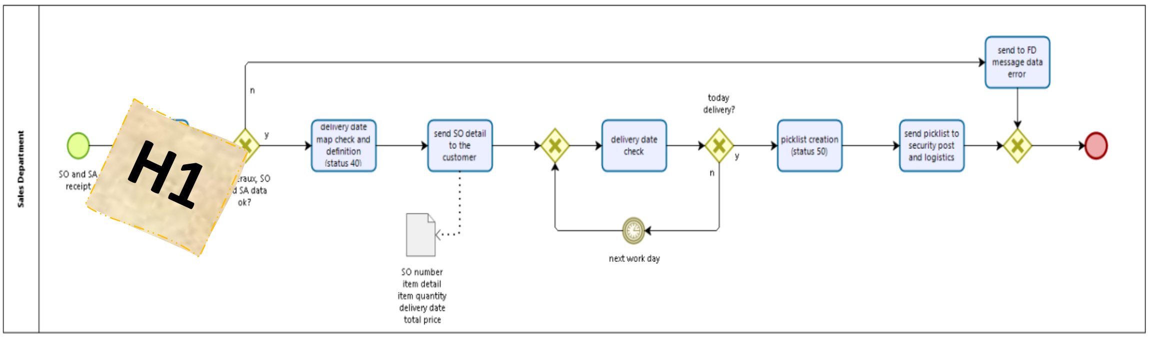

Figure 9. Elimination of the "bordereaux SO" and "SA check"

The sub-process product delivery was also updated to a new one. Here, the activity "Invoice issue" is eliminated, as can be seen in the Figure 10, as it is done in another subprocess, increasing the resource optimization, and eliminating conflict and redundancy.

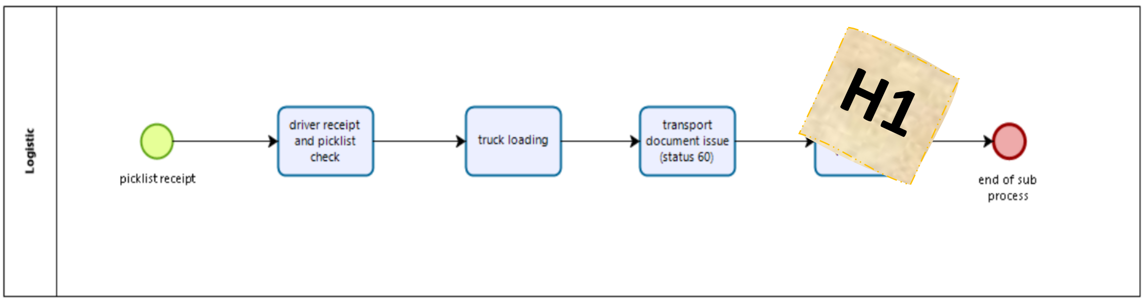

Figure 10. Elimination of the activity "Invoice issue"

Finally, the sub-process "SO closing" was also updated and the activity "send the invoice to the Customer" was eliminated, according to Figure 11 as it is done in another sub-process, and it was automated.

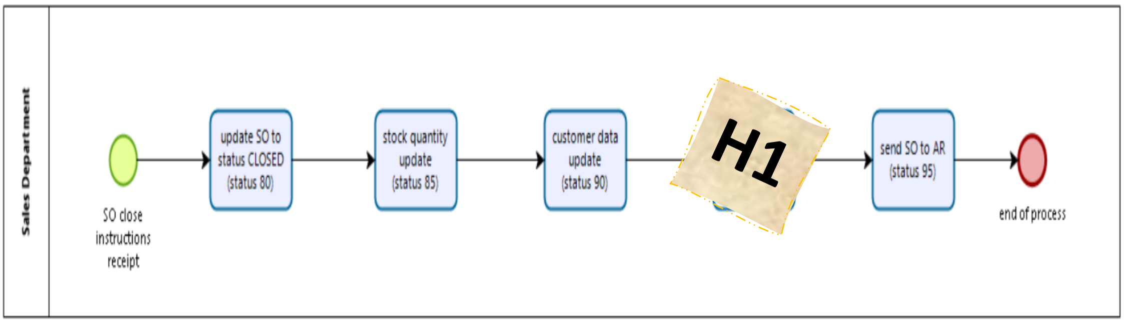

Figure 11. Elimination of the activity "send the invoice to the Customer"

4.2.2. Heuristic 2 – Task Composition

In the sub-process Payment check, the activity bordereaux check was composed in a single activity because it is redundant with the payment receipt check, and time can be reduced in the sub-process, according to Figure 12.

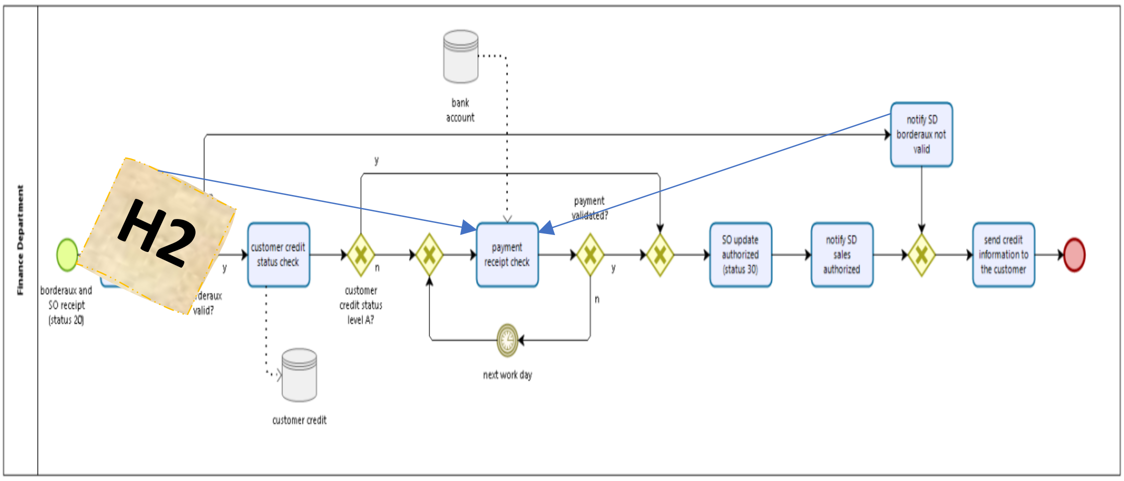

Figure 12. Activity "bordereaux check" composed in a single activity

4.2.3. Heuristic 6 – Process standardization / Unification

Here, processes will be unified. The activities bordereaux "validity check", "customer credit check", and "payment receipt check" are performed in different sub-processes and departments, and now they will be pooled in a single process in the Finance department, as can be seen in the Figure 13.

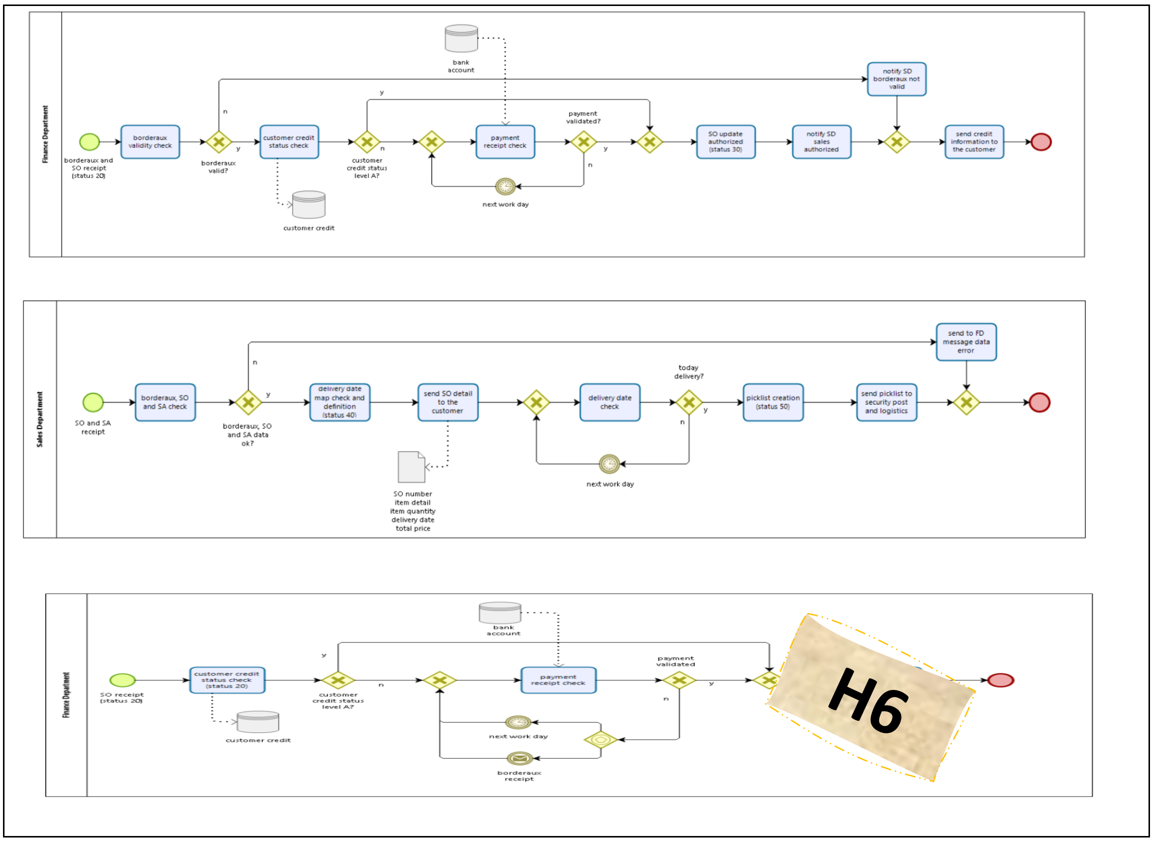

Figure 13. Heuristic 6 - Process unification

4.2.4. Heuristic 8 – Communication Optimization

In Heuristics 8 as per Figure 14, the idea is to automate the handling, recording, and organization of messages in the process. In the SO Authorization process, inform Sale Technician that the stock is not available, and only on the next working day is the activity performed again after the stock item is updated.

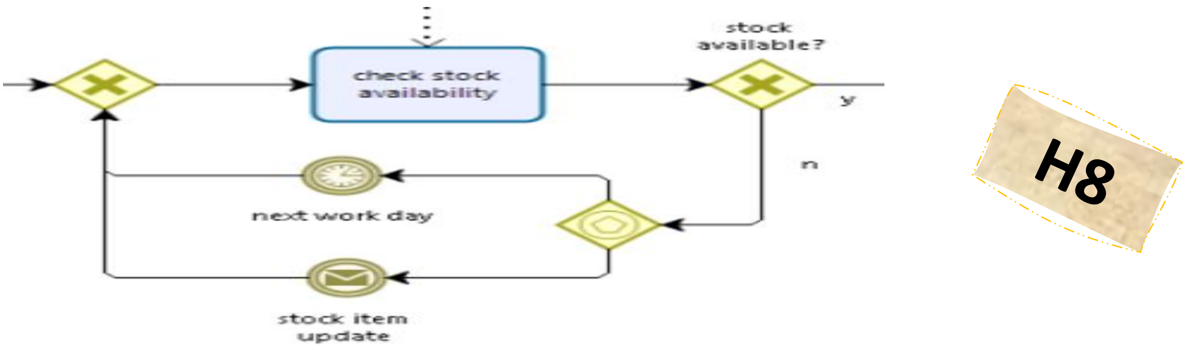

Figure 14. Heuristic 8 – Communication Optimization

4.2.5. Heuristic 9 – Automation

The activities that are performed manually can be automated, to improve operational efficiency. The sub-process "SO closing" updated and the activity "send invoice to the Customer" was eliminated as it is done in another sub-process, and it is automated. The application used for the invoices, automatically sends the invoice to the customer when the sales are authorized. The "customer credit status check" activity in the payment check process was automated, as the system automatically checks the customer credit status, improving operational efficiency.

4.2.6. Impact of the Changes – Devil's Quadrangle

In this topic, the impact of the changes proposed in the redesign, in terms of the performance dimensions of the Devil's Quadrangle, is explained in the Table 11 below.

Table 11. Impact of the Changes – Devil's Quadrangle

Level	**Heuristic**	**Description**	**Impact**			
			Time	Cost	Quality	Flexibility
Task	1	Task elimination	Improves	N/A	N/A	-
	2	Task composition	Improves	Improves	N/A	Improves
Process	6	Process standardization	-	Improves	N/A	Improves
	8	Commun. optimization	Improves	N/A	N/A	-
	9	Automation	Improves	N/A	Improves	-

The Figure 15 below show the Main **"TO-BE" process model**, the sub-processes "TO-BE" SO Creation in the Figure 16, and "TO-BE" Payment check can be seen in the Figure 17 according to the Heuristics above. The remain sub-processes can be found in the Appendix section.

Main Process: "TO-BE" Sales Process model

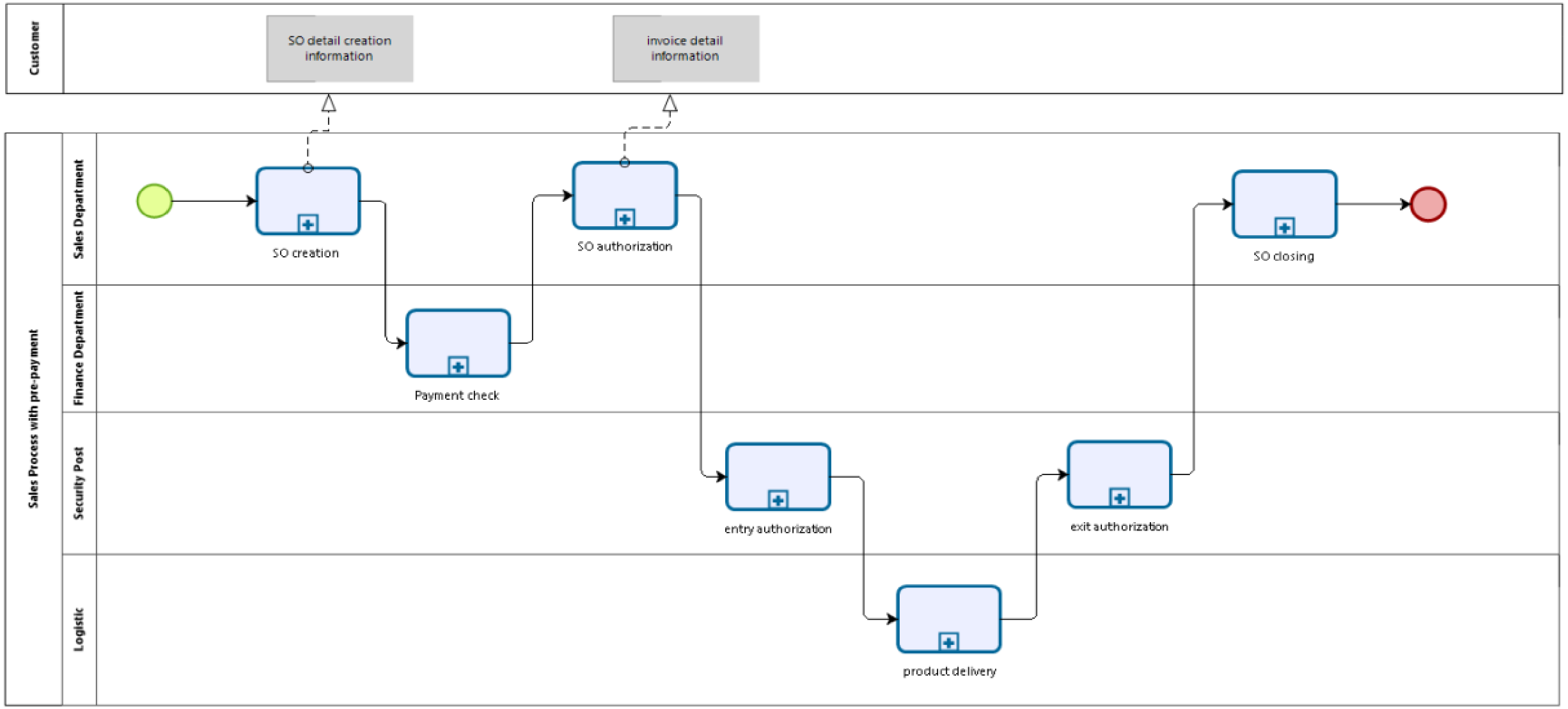

Figure 15. "TO-BE" Sales Process model

Sub-process: "TO-BE" SO Creation

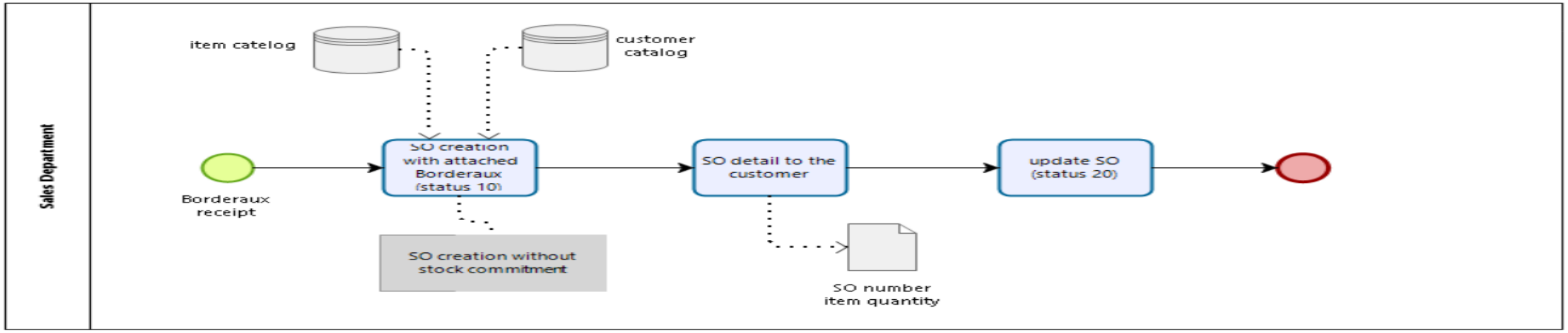

Figure 16. "TO-BE" SO Creation

Sub-process: "TO-BE" Payment check

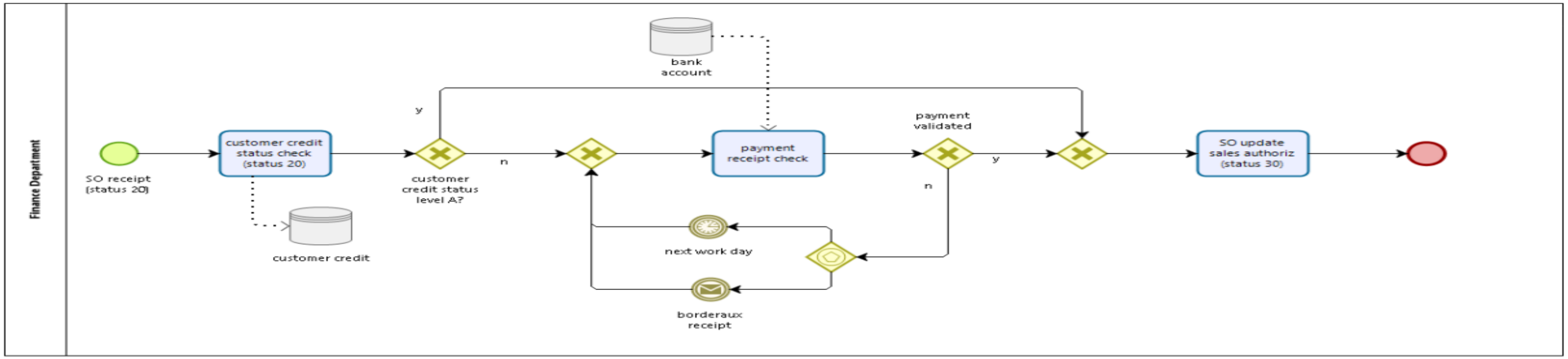

Figure 17. "TO-BE" Payment check

According to the figures above, quantitative analysis will be provided for the "TO-BE" process model. Details of the execution time of the activities and percentages of resource utilization were analysed for the future situation "TO-BE Process model", to better understand the performance of the processes. Here, we need to understand how the processes work and the evidence in terms of improvement in times, as can be seen in the Table 12, the average time and, in the Table 13 the total time, and the use of resources, according to Table 14, quality of customer service and consequently, costs.

For this quantitative analysis, simulations were performed, and the results were explained according to the previous information. To start the simulation, an eight-hour work simulation were assumed in the scenario, and time analysis and resource analysis were provided. For the simulation, we assume that the availability of employees was four security officers, ten logistics technicians, six sales technicians and five financial technicians. For the execution of the activity, assumed that only one person is necessary at time, except logistics that we assume that two people are necessary. With this information, we need to understand the average time and total time for each process, and for the entire process, and the percentage resource utilization as well.

According to the information above, the results of the simulation are shown below:

Table 12. Average Time (TO-BE)

Process	Avg Time
SO Creation	4m59s
Payment Check	7m59s
SO Authorization	5m29s
Entry Authorization	11m1s
Product Delivery	48m
Exit Authorization	10m29s
Close SO	1m59s
Total	1h29m58s

Table 13. Total Time (TO-BE)

Process	Total Time
SO Creation	3h54m40s
Payment Check	6h7m45s
SO Authorization	4h12m39s
Entry Authorization	8h15m57s
Product Delivery	1d6h24m14s
Exit Authorization	6h28m8s
Close SO	1h13m36s
Total	2d12h37m2s

Table 14. Resource Utilization (TO-BE)

Resource	Utilization
Sales Department	19,48%
Finance Department	15,61%
Security Post	46,41%
Logistics	81,74%

5. BUSINESS IMPLICATIONS

The results of the TO-BE has a great implication in the Cement Industry Business. First, as can be seen in the Table 15 below, for the beginning, comparing the Avg Time(AS-IS) of 8m29s and Avg Time(TO-BE) of 4m59s, the time was reduced in 41% for SO creation, it's a very important indicator when this task is executed with less 3m30s than the previous one, it means that there is time gain and the task become faster. When observed the Payment check, the reduction is in terms of 37% from 12m41s to 7m59s, it is a considerable reduction of the execution time and the gain is considerable, in terms of 4m42s for accomplishing this task. When talking about total Avg time gain, as per Table 16, the results are encouraging for the Cement Industry business. Here we can see that 22,4% of the total Avg Time were reduced, in a total of 14m12s time gain. Of course, for the business, these are important indicators, when the industry reduces Cycle time, the productivity shall increase, can reduce costs, and increase sells. The same considerations can be seen in the Table 17, the resource utilization, even reducing the number of resources, there is still gain in terms of utilization.

Table 15. Average Time AS-IS&TO-BE

Process	Avg Time (AS-IS)	Avg Time (TO-BE)	Reduction (%)	Time Gain
SO Creation	8m29s	4m59s	41%	3m30s
Payment Check	12m41s	7m59s	37%	4m42s
SO Authorization	6m29s	5m29s	15%	1m0s
Entry Authorization	11m1s	11m1s	0%	0m0s
Product Delivery	50m0s	48m0s	4%	2m0s
Exit Authorization	10m29s	10m29s	0%	0m0s
SO Close	4m59s	1m59s	60%	3m0s
Total	1h44m10s	1h29m58s	22,4%	14m12s

Table 16. Total Time AS-IS&TO-BE

Process	Total Time (AS-IS)	Total Time (TO-BE)	Reduction (%)	Time Gain
SO Creation	6h39m10s	3h54m40s	41%	2h44m30s
Payment Check	9h31m15s	6h7m45s	37%	3h23m30s
SO Authorization	4h52m10s	4h12m39s	15%	39m31s
Close SO	2h59m39s	1h13m36s	60%	1h46m3s
Total	2d21h3m45s	2d12h37m2s	37%	~9h

Table 17. Resource Utilization AS-IS&TO-BE

Resource	Utilization (AS-IS)	Utilization (TO-BE)	Utilization Gain
Sales Department	25,92%	19,48%	6,44%
Finance Department	20,35%	15,61%	4,74%
Security Post	45,43%	46,41%	-0,98
Logistics	82,74%	81,74%	1%

6. LIMITATIONS AND FUTURE WORK

The limitation of this study as to do primarily, with lack of information and documentation regarding the use of BPM in the Cement Sector, considering the size of the sector and all the potential that the implementation of BPM can bring to the companies. The small sample size implies limited validity or a more adequate comparison with other literatures and success cases in the sector. For instance, it was not possible to find any BPM article regarding the Angolan market, in a specific industry whether, Cement, Diamonds, Oil or similar.

Regarding, directly, the implementation of the project, it was possible throughout its development to identify numerous limitations, right away, the fact that there is a local team with many technical limitations, which results in a very cautions and slow application of improvements, being of a project already in operation. In this sense, the tools and techniques applied to the project had to be adjusted to the current reality. For example, for the implementation of the Heuristics, those that best fit the current context had to be adapted, not all that were intended to be included in this phase. However, these others will remain for future work, considering the improvements that will have to be carried out later.

In future work, the preliminary findings give rise to some important aspects to improve de project, such as, continuous improvement of the processes already implemented, improve the process redesign in terms of Heuristics. On the other hand, is important to explore the synergies between BPM and Digital Innovation to improve the customer experience, as mentioned by van Looy & Poels., 2019, all experts agreed that a strategic link exists between BPM and DI, and that IT enables the realization of process and business strategies. Research carried out during the data collection process, after several visits in factories in the same industry in Angola and Portugal, found that some of these factories already have much more consolidated processes and are far ahead in terms of digital innovation and automation.

Using SLV CEMENT software, it will be possible, in the future, to implement an intelligent, integrated software platform that addresses the automation of processes and operational procedures. In the future, it will also be possible to implement solutions such as:

- ✓ Self-service solution for drivers, sequencing trucks, managing queues, and automating the entry of waiting trucks;
- ✓ Self-service weighing operations at the entrance gate, with automatic printing and delivery of final documentation to drivers;
- ✓ Validation of location and product when loading bags, with counting control on manual lines and automation interface with auto packers on automatic lines;
- ✓ Control of the loading of the bags on pallets with devices embedded in forklifts;
- ✓ Validation of loading place, product, and control of bulk loading operations with dosing in cement silos scales integrated with automation.

7. CONCLUSION

In conclusion, it was possible to explore the impact of BPM in this Cement Industry and, is believed that the Project have achieve d its objectives, as the results showed that the adoption of BPM in the company, improved the performance of the organization, based on the correct adequacy of the BPM lifecycle in the implementation. To achieve this goal, it was necessary to collect and review relevant BPM articles published in the top BPM Journals and books, despite did not find BPM articles regarding the Angolan market, which implies limited validity or a more adequate comparison with other literatures and success cases in the sector. Despite all this, it was possible to find very good previous research on BPM, related or not to Cement Industry, cases in similar industries and well described.

After that, process analysis was provided, issues associated with the as-is process were identified, documented, and quantified using performance measures. These issues were prioritized based on their potential impact and the estimated effort required to resolve them. Then, in the redesign phase, changes to the process that would help to address the issues identified in the previous phase and allow the organization to meet its performance objectives were identified and applied. Hence, it was possible to process redesign and process analysis go hand-in-hand: As new change options were proposed, they were analysed using process analysis techniques. The output of this was typically a to-be process model.

The results of the TO-BE has a great implication in the Cement Industry Business. First, as can be seen in the Table 15 above, comparing the Avg Time(AS-IS) and Avg Time(TO-BE), the time was reduced in 41% for SO creation, it means that there is time gain and the task become faster. When observed the Payment check, the reduction is in terms of 37%, it is a considerable reduction of the execution time, and the gain is considerable. The same considerations about total Avg time gain, as per Table 16, reducing Cycle time, the productivity shall increase, can reduce costs and increase sells ; the Table 17, the resource utilization.. The resource utilization, there is gain in terms of utilization.

Finally, recommendations were left for the future work and, its necessary to look at the next stages, is necessary to monitor and control, as Ho et al, (2009) argues, from the perspective of the BPM lifecycle, process design and process evaluation are the most researched BPM practices overall. More research attention is required on process monitoring and process enactment.

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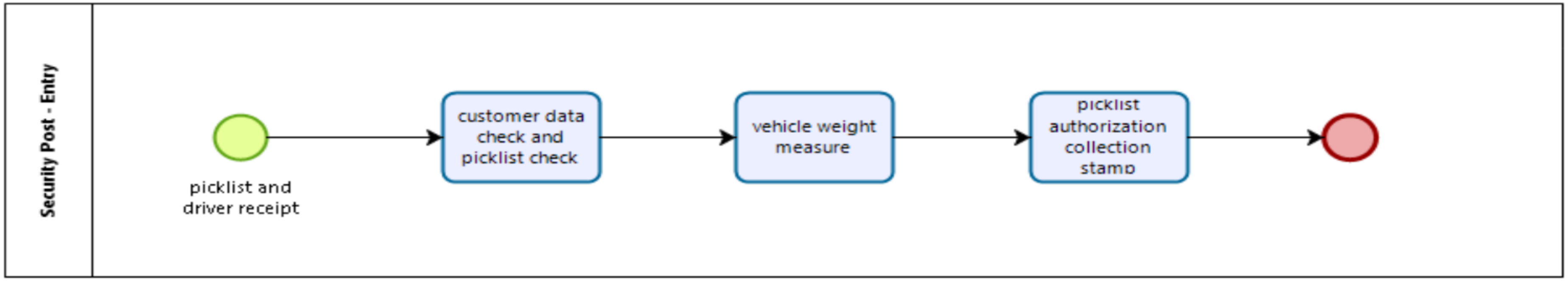
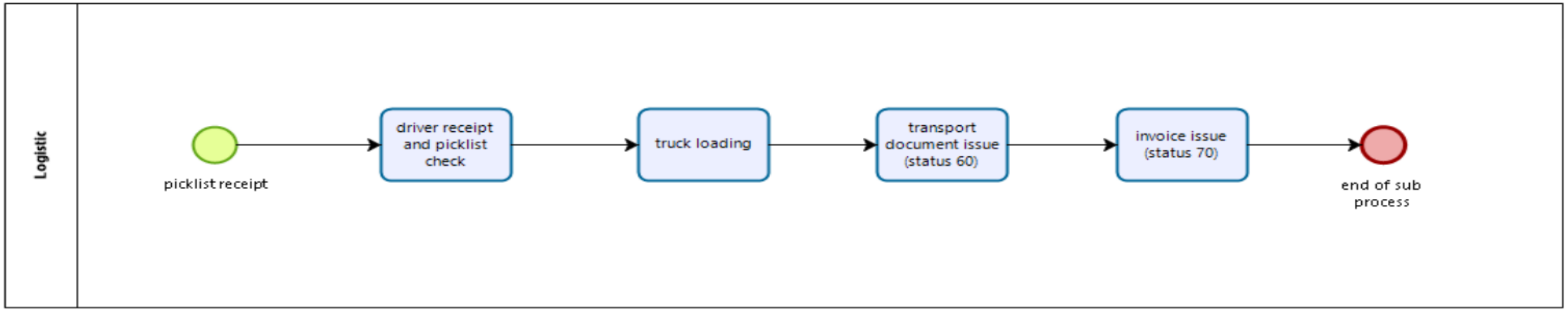
APPENDIX A

"AS-IS" Process Model

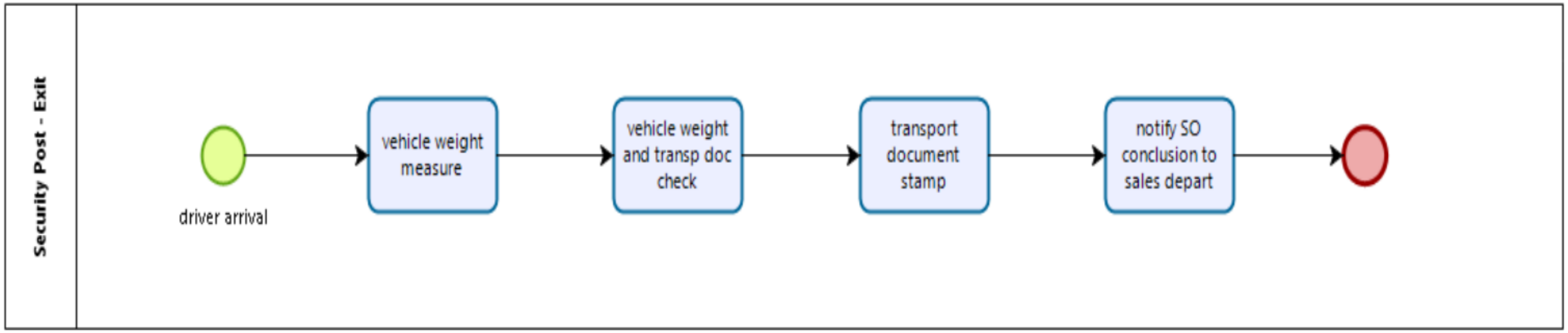
Sub-process: "AS-IS" Entry Authorization



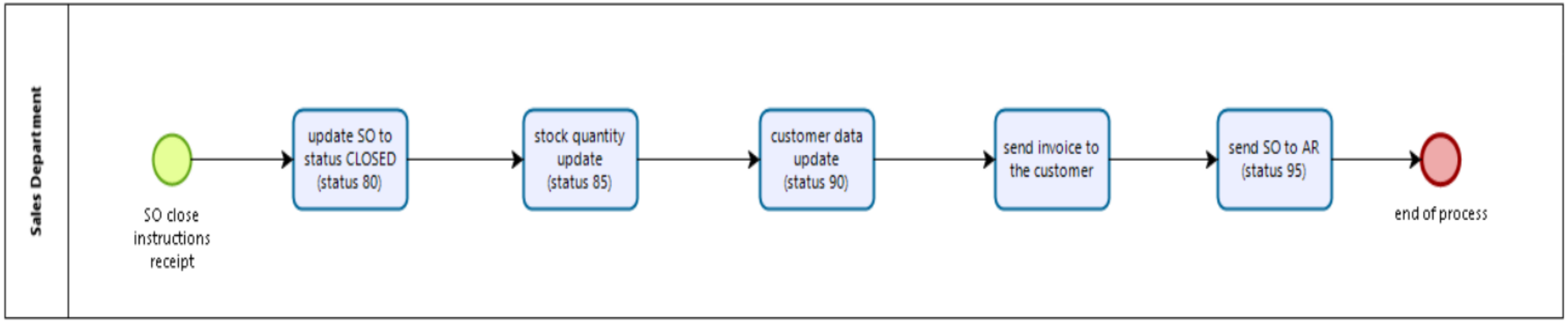
Sub-process: "AS-IS" Product Delivery



Sub-process: "AS-IS" Exit Authorization



Sub-process: "AS-IS" SO Closing



APPENDIX B

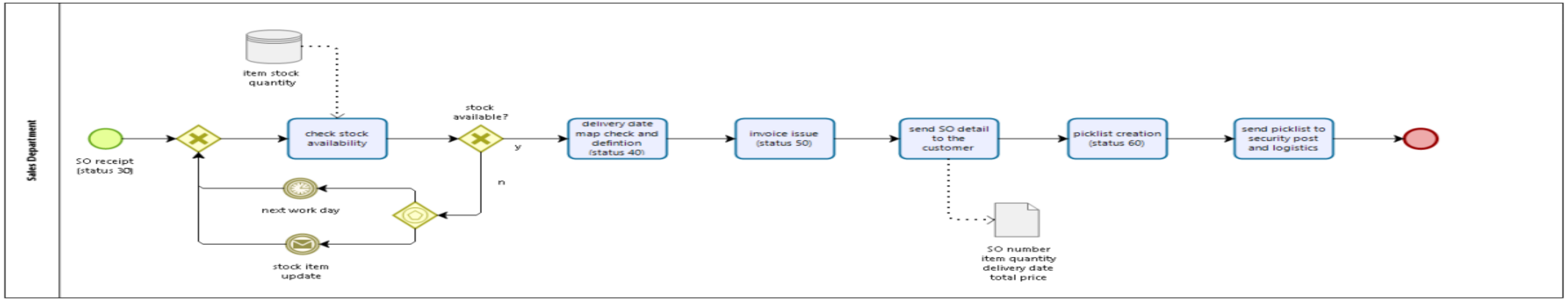
"AS-IS" Simulation Results

Time Analysis							
Name	**Type**	**Instances completed**	**Instances started**	**Min. Time**	**Max. Time**	**Avg. Time**	**Total Time**
Sales Process with pre-payment	Process	36	47	1h43m49s	1h44m28s	1h44m10s	2d21h3m45s
Borderaux receipt	Start event	47					
NoneEnd	End event	36					
Exit authorization	Task	36	37	10m23s	10m37s	10m29s	6h17m34s
Product delivery	Task	37	43	49m46s	50m9s	50m	1d6h50m3s
Entry authorization	Task	43	45	10m56s	11m9s	11m1s	7h53m52s
SO authorization	Task	45	45	6m22s	6m37s	6m29s	4h52m10s
Close SO	Task	36	36	4m54s	5m5s	4m59s	2h59m10s
Payment check	Task	45	47	12m34s	12m48s	12m41s	9h31m15s
SO creation	Task	47	47	8m20s	8m36s	8m29s	6h39m10s

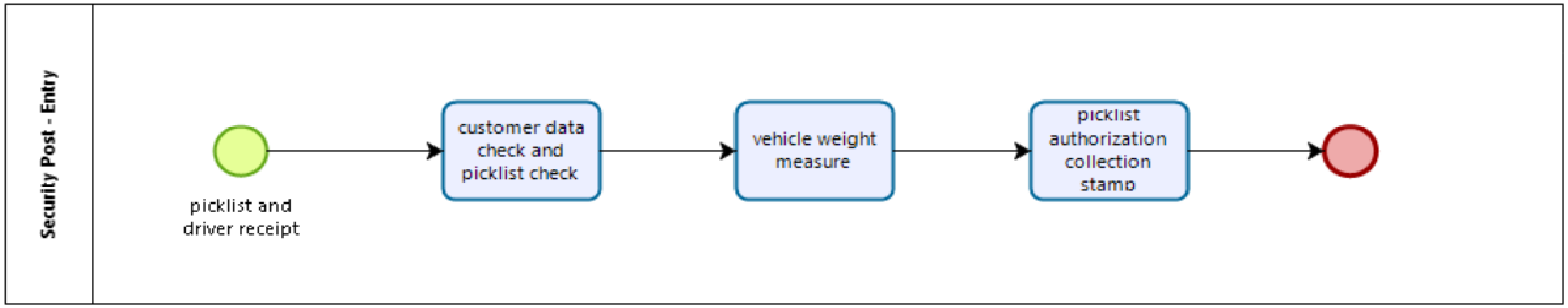
APPENDIX C

"To-Be" Process Model

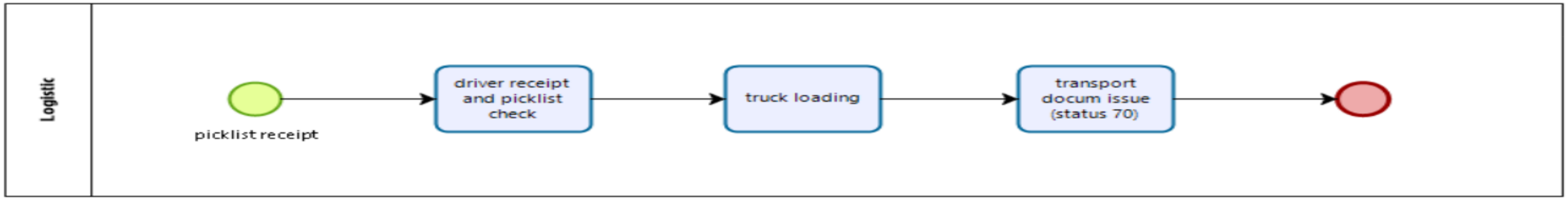
Sub-process: "TO-BE" SO Authorization



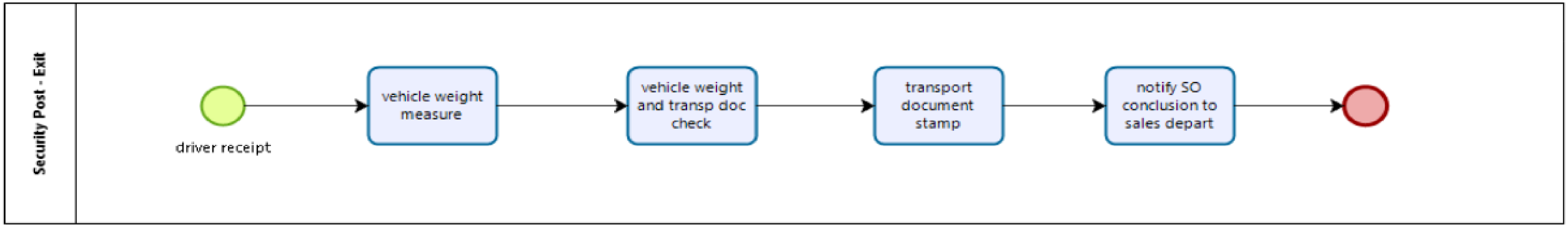
Sub-process: "TO-BE" Entry Authorization.... Appendix



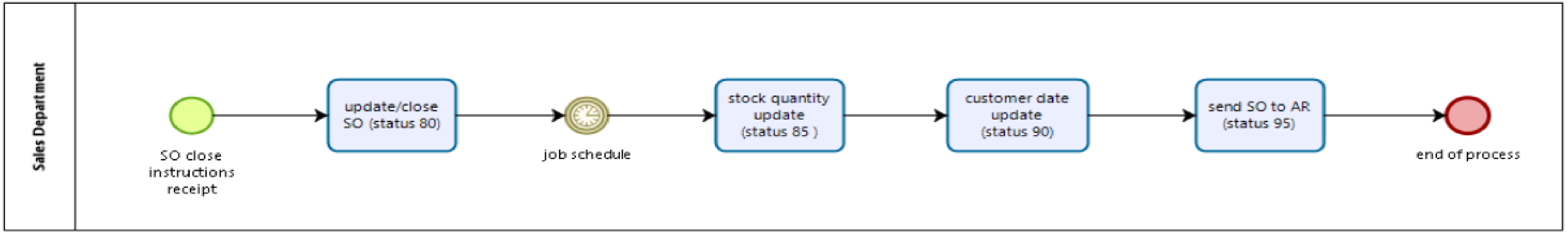
Sub-process: “TO-BE” Product delivery…. Appendix



Sub-process: “TO-BE” Exit Authorization…. Appendix



Sub-process: “TO-BE” SO Closing …. Appendix



APPENDIX D

"TO-BE" Simulation Results

Time Analysis							
Name	**Type**	**Instances completed**	**Instances started**	**Min. Time**	**Max. Time**	**Avg. Time**	**Total Time**
Sales Process with pre-payment	Process	37	47	1h29m37s	1h30m16s	1h29m58s	2d12h37m2s
NoneStart	Start event	47					
NoneEnd	End event	37					
Exit authorization	Task	37	38	10m23s	10m37s	10m29s	6h28m8s
Product delivery	Task	38	45	47m46s	48m11s	48m	1d6h24m14s
Entry authorization	Task	45	46	10m56s	11m9s	11m1s	8h15m57s
SO authorization	Task	46	46	5m22s	5m37s	5m29s	4h12m39s
SO Closing	Task	37	37	1m54s	2m5s	1m59s	1h13m36s
Payment check	Task	46	47	7m52s	8m6s	7m59s	6h7m45s
SO creation	Task	47	47	4m50s	5m36s	4m59s	3h54m40s