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Faculty of Business Economics

Master of Management

Masterthesis

An analysis of the effective application of process improvement patterns

Chefebi Francis Ngwa Nebane

Thesis presented in fulfillment of the requirements for the degree of Master of Management, specialization Business Process Management

SUPERVISOR :

Prof. dr. Koenraad VANHOOF

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Abstract

Business Process Improvement has been reported to be among the main topics in the minds of managers and executives in the last few years, due to its potentials to help improve customer satisfaction, reduce costs and throughput times. The existing approaches on process improvement mostly give instructions on what improvements should target, such as cost reduction, shorten cycle time, reduce waiting time etc. However, very limited research has been directed towards the actual "act of improvement". To close this gap, a pattern-based approach has been designed and already tested by several researchers, which has so far delivered positive outcomes. The objective of this research is to further evaluate the functionality and the usefulness of the pattern-based approach by analyzing the effective application of the proposed pattern-based approach. The result of the study proved that for process improvement patterns to be effectively applied, there should exist a strong relationship between the organizational objectives and process models.

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Keywords: Business Process Management, Business Process Improvement, BPI-Pattern, Evaluation, Organizational Objectives.

List of abbreviations and terms

AP	Accounts Payable
ATAMO	And Then a Miracle Occurs
BPI	Business Process Improvement
BPM	Business Process Management
BPMN	Business Process Modelling Notation
DSRM	Design Science Research Methodology
ERP	Enterprise Resource Planning
KAOS	Keep all Objectives Satisfied
IS	Information Systems
IT	Information Technology
TQM	Total Quality Management

1 Introduction

1.1 Introduction

The concept of Business process improvement alongside its methods and techniques has been widely regarded as one of the most important aspects for companies to survive in increasingly intense competitive environment. Several factors have driven companies to re-examine their processes such as cost savings, increased productivity, customer satisfaction and the need to improve on their products and services.

Several process improvement methodologies and approaches have been suggested both by researchers and practitioners to help companies deal with this intense competition. Examples of such methodologies include, (*BPI)* which focuses on continuous improvement of an organization's business processes (H.J. Harrington, 1991); *Business Process Reengineering (BPR)* which aims at completely dissolving and rebuilding the process from scratch (Hammer & Champy, 1993), and *Six Sigma* (Pande, Neuman, & Cavanagh, 2000) just to name a few.

BPI approaches both in literature and practice have provided practitioners with extensive methodological support on crucial aspects such as mapping processes, identifying problems and their root causes (Falk, 2017). These approaches also give instructions on what improvements should target, such as cost reduction, shorten cycle-time, reduce waiting time, improved quality etc. However, these approaches often lack concrete guidelines to the 'act of improvement', which is the transformation of a process from its "as-is" to a desired "to-be" state (Nwabueze, 2012). Most of the academic research on BPI, mainly focus on successful BPI projects, and in most cases, only the situations before and after implementation are outlined, but not the actual 'act of improvement' (Forster, 2006). There is therefore the need for a systematic methodological support as there exist a gap between the "as-is" and the "to-be" state (Nwabueze, 2012). An example of such lack of concrete improvement measures can be observed with Six Sigma which appears to be an overall *"business improvement strategy"* but proposes within its improve phase *"develop potential solutions to fix the problems and prevent them from recurring"* (Antony, 2006). No further information is provided as to how the potential solutions needs to be developed.

To tackle this problem, a pattern-based approach was proposed that will methodically back the 'act of improvement' when implementing BPI initiatives (Falk, Griesberger, Johannsen, & Leist, 2013a). The applicability of this approach has been demonstrated by a case study (Falk, Griesberger, & Leist, 2013b), and through a simulation (M. Lang, Wehner, Falk, Griesberger, & Leist, 2015). However, there is still the need to further evaluate the suggested pattern-based approach, in order to have an exhaustive understanding of its effectiveness and usefulness.

The purpose of this research is to carry out a qualitative analysis on BPI-Patterns, with close attention on the effective application of the pattern-based approach. To fully understand the situation at hand, an analytical evaluation was conducted that enabled us to better assess the potential benefits of implementing BPI-Patterns for process improvement in practical scenarios.

1.2 Problem statement

Research questions (What do we want to know?)

In analysing the effective application of process improvement patterns, this thesis aims at answering two main research questions;

RQ1) To what extend are process models related to organizational objectives?

This research question is refined to analysing the relationship between the organizational objectives and process models of our sample case studies. The top-down approach for eliciting requirements in goal-oriented requirements engineering such as KAOS (Van Lamsweerde, 2001) has proven to be capable of delivering clearly defined goals to be met by a system. The GoalBPM method (Koliadis & Ghose, 2006) proposes a method of establishing a relationship between the organizational goals and the process models (Koliadis & Ghose, 2006). Lohrmann and Reichart (2016) adapted the top-down approach similar for eliciting requirements in goal-oriented requirements engineering by deriving suitable process improvement patterns from organizational objectives. The top-down approach applied by (Lohrmann & Reichert, 2016), w yielded positive results. The purpose of this research question assumes that, establishing a strong relationship between organizational objectives and process models is an important and determining factor in effectively applying BPI-Patterns. This will be further examined in Chapter three.

RQ2) To what extend do BPI-Patterns influence the expected improvement outcome*?*

This research question will be refined to our sample case by investigating the existence of BPI-Patterns within an improved Accounts payable process. We will first attempt to identify the existence of BPI-Patterns in the improved processes, and then investigate to what extend these patterns influenced the obtained result from the improvement. This research questions aims at validating the assumption that BPI-Patterns are effective in achieving the expected improvement outcome.

Unit of study (About what?)

The case study reports of fictional car rental companies, and a sample case covering an Accounts payable business process constitute the unit of study for this research. The case study reports are case studies that were carried out by University students in Cuba. The strategic documentation and the process models of the case study reports are our main unit of study in attempting to answer our first research question.

The main of unit of study for our second research question covers an Accounts payable process of a logistics company. The information used for our research mainly comprise an interview with a stakeholder involved in the process and the documentations that was provided to us in the form of her Master thesis. The sample case covers the "as-is" and the "to-be" processes of an Accounts Payable process.

Relevant concepts (What do we know in advance?)

We mostly relied on related work in literature consisting of existing literature on BPI-Patterns, and case studies on similar processes. Information was also obtained through a discussion with one of the stakeholders of the Account payable process.

Research goal (Why do we want to know?)

There has been very little research on process improvement over the years that cover the "act of improvement". The BPI-Pattern approach proposed by (Falk et al., 2013a) which has been tested already through an experiment (Falk, 2017), simulation (M. W. Lang, Benjamin; Falk, Thomas; Griesberger, Philipp; and Leist, Susanne,, 2015), case study(Falk et al., 2013b; Lohrmann & Reichert, 2016) has proven to be capable of closing this gap. Our intention is to analyse how BPI-Patterns can be effectively applied to a business process. Through our research

questions, we aim at discovering some of the key factors that need to be considered before or during the implementation of BPI-Patterns.

1.3 Structure of thesis

This Chapter already covered what this thesis is all about in the preceding paragraphs including our developed research questions.

In Chapter Two we will examine the key concepts related to this research in detail. This chapter starts by outlining what BPM is, including the BPM-Lifecycle and suggesting a definition for a business process. The concept of business process improvement is also examined including the evolution on this topic that has taken place over the years. Business process improvement patterns are then examined. Next, the performance measure dimensions and some selected BPI-Patterns will be examined.

In Chapter Three mainly covers the research methodology that was used to carry out this research. The research methodology will be explained and the reasons why this research methodology was deemed most appropriate for this research. It also includes the research design, the method of data collection and the results from the data analysis.

Chapter Four is the general conclusion to this research. It includes a discussion about our findings during the research, answers to the research questions, the limitations encountered during this research, conclusion and possible recommendations.

2 Literature Review

2.1 Business Process Management

The potentials of BPM have led some managers and executives into believing that process management is the key to achieving organizational goals. This ideology has been addressed by Jeston and Nelis (2014) by pointing out *that "process management must become one of the abiding approaches to managing organizations, and it has to augment and align with strategy, human resource management, financial management, information management and other traditional management disciplines"*(Jeston & Nelis, 2014).

The growing interest on this topic by different groups such as consultants, analysts, managers and top executives has given rise to diverse meanings and definitions of what BPM really is.

According to Van der Aalst (2013), BPM is *"the discipline that combines knowledge from information technology and knowledge from management sciences and applies this to operational business processes"*(Van der Aalst, 2013). This definition and many other definitions include information technology as an essential component of BPM. However, it is worthy to mention that business process improvement can be achieved without the use of technology (Jeston & Nelis, 2014).

Another important definition of BPM is that of Jeston and Nelis (2014) who defined BPM as *"a management discipline focused on using business processes as a significant contributor to achieving an organizations objective through the improvement, ongoing performance management and governance of essential business processes"*(Jeston & Nelis, 2014). Equipped with both definitions of Business Process Management, it will therefore be important to examine the BPM lifecycle to have a complete understanding.

2.1.1 The BPM Lifecycle

According to Dumas et al. (2013) it is advisable that before embarking on a BPM initiative, clarity on *"what business process is intended to be improved"* should be determined (Dumas, La Rosa, Mendling, & Reijers, 2013). If the organization has implemented BPM initiatives in the past, reference could be made to the inventory of possible business. It may also be the

situation that the organization has never been engaged in any BPM initiative, which will then be necessary to refer to the BPM lifecycle (Dumas et al., 2013).

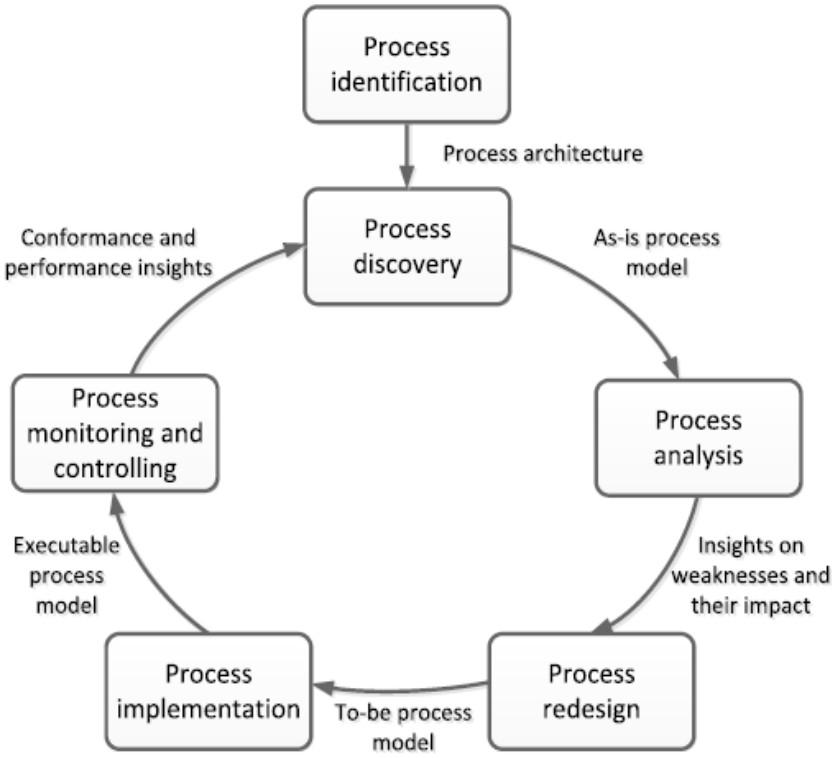

Figure 2.1 BPM Lifecycle[1]

As seen in Figure 2.1 BPM is a continuous cycle comprising of several phases that needs to be accomplished. For this research our interest will be limited to the process redesign phase. This phase mainly involves identifying changes that need to be implemented to meet the necessary organizational objectives. Multiple change options are analysed and compared in terms of the chosen performance measures (Dumas et al., 2013).

BPM also proposes numerous techniques that can be adopted by organizations to better manage their processes which will result in possible cost reduction and enhanced productivity.

[1] BPM Lifecycle adapted from (Dumas et al., 2013)

However, in order for these techniques to be applied, a thorough understanding of the nature of business processes is required (Lindsay, Downs, & Lunn, 2003). It is therefore necessary to examine some of the definitions of a business process that exist in literature.

2.2 What is a business process?

There exist very limited attempts to define business processes, but those definitions and corresponding models are mostly focused to a mechanistic viewpoint of processes. The evolution of business processes has pushed companies to not only focus on offering their goods for sale, but to stay viable they strive to keep their competitive advantage by focusing more on service. The introduction of automation in the office saw the shift in the spotlight in search for efficiency and cost reduction not only at the level of the shop floor but the office with the same principles applied to office work (Lindsay et al., 2003).

Ivar et al. (1995) describes a business process as; *"The set of internal activities performed to serve a customer"*(Ivar, Maria, & Agneta, 1995). They mention activities that are performed and the purpose of performing these activities, but it is worth mentioning that the overall aim of a business process may not always focus on the customers. They further describe a business process as cutting across traditional hierarchies and it is important for collaboration between individuals and groups to be maintained in order to achieve a goal (Ivar et al., 1995).

The shift from business processes commonly associated to the production environment to service environments is often based on the assumption that "*production workflow is traditionally analysed by attention to the activities being performed whereas office systems are more goal based and people do whatever is necessary to attain a goal"*(Lindsay et al., 2003). Yu in (Lindsay et al., 2003) distinguishes office processes from processes executed by machines, by stating that *"processes executed by machines are simply a progression of tasks whereas office workflows are about actors in social systems collaborating to achieve goal"*. Joosten in (Lindsay et al., 2003), further extends this point of view for workflow to a *"a system whose elements are activities, related to one another by a trigger relation, and triggered by external events, which represents a business process starting with a commitment and ending with the termination of that commitment"*.

According to Hammer and Champy (1993), a business process is regarded as *"Collection of activities that takes one or more kinds of input and creates an output that is of value to the customer. A business process has a goal and is affected by events occurring in the external world or in other processes"*(Hammer & Champy, 1993). This definition is more or less contradictory to that of Erikson and Penker (200), who see a business process to emphasize on how work is performed rather than describing products or services that are the result of the process (Eriksson & Penker, 2000). According to Dumas et al. (2013) *"a business process is a collection of inter-related events, activities and decision points that involve a number of actors and objects, and that collectively lead to an outcome that is of value to at least one customer"*(Dumas et al., 2013). This definition clearly points out the key aspects that act as the basis when modelling business processes.

Figure 2.2 Business Process[2]

Davenport 1993), defines a business process as *"a structured, measured set of activities designed to produce a specified output for a particular customer or market"* (Davenport, 1993). This definition supports the view of Erikson and Penker (200), as it underlines a strong emphasis on how work is done within the borders of an organization rather than just the result of the process. Davenport (1998) in his later research added that *"a business process is a*

[2] Business Process diagram adapted from (Chesbrough & Rosenbloom, 2002)

specific ordering of work activities across time and place, with a beginning, and an end, and with clearly identified inputs and outputs"(Davenport, 1998).

2.2.1 Business Process Modelling with BPMN

A business process in BPMN are consist of *flow objects* (events, activities, and decisions); *connecting objects* (control flow links and message flow links); and *swim lanes* (pools and lanes within pools) (Dumas et al., 2013).

A process also involves several participants, physical objects and immaterial. Among the participants involved in a process, the one who consumes the output is commonly known as the customer. Upon execution of the process, one or several outcomes are achieved. Under normal circumstances, an outcome should deliver value to the actors involved in the process, but in some cases, this value is not achieved or is only partially achieved (Dumas et al., 2013).

Figure 2.3 illustrates an example of a business process of handling incoming applications in BPMN. This process is made up of numerous activities, events and decision points which combined delivers a desired outcome.

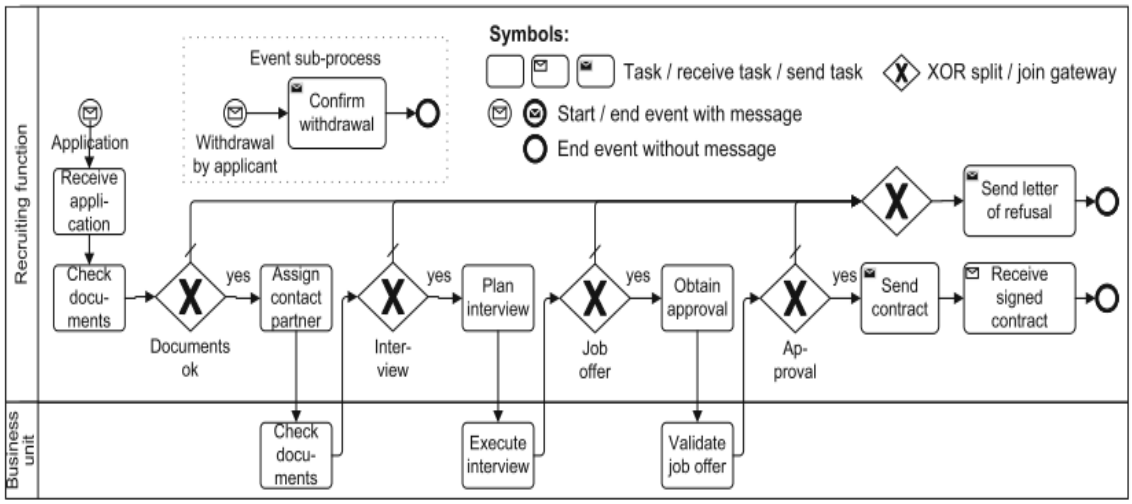

Figure 2.3 Business Process example with BPMN[3]

[3] Business Process example adapted from (Lohrmann & Reichert, 2016)

2.3 Business Process Improvement

This focus on improving processes has been mainly driven by the desire for companies to be effective, efficient and flexible (H.J. Harrington, 1991), which will for example reduce costs or cycle times and thus yield competitive advantage. Process improvement is positively regarded for its ability to create sustainable value for customers or innovative products and services (Ganesh & Marvin, 2005), and it is also common phenomenon for organizations to link the improvement of their processes to their business strategies (Smart, Maddem, & Maull, 2009).

The concept of BPI was first defined by Harrington (1991) as *"a systematic methodology approach developed to help an organization make significant advances in the way its business processes operate"*(H.J. Harrington, 1991). In his later research he describes BPI as basically *"the product of BPR, Redesign, and Benchmarking, depending on the degree of change necessary"*(H. James Harrington, 1998). Davenport on the other hand describes *BPI "as an incremental bottom-up enhancement of existing processes within functional border"* (Davenport, 1993).

Different approaches have been developed for this tasks such as business process reengineering (BPR), in which the "as-is" processes have to redeveloped from scratch (Hammer & Champy, 1993). This is contrary to the concept BPI to maintain the current "as-is" process and directs more effort on incremental improvements by altering the existing process design to make it more effective, efficient, flexible (H.J. Harrington, 1991) thereby transforming the process into a desired "to-be" process.

There exist several BPI approaches that have proved their usefulness over the years, however there still exist a prominent problem as none of these approaches adequately supports the user through all the stages in the improvement project, particularly the "act of improvement" (Gregor, 2011). Gerrits (1994), went further to state that the "*literature on process improvement is restricted to the descriptions of the situation before and the situation after the improvement implementation with very little or no information on the improvement phase itself"*(Gerrits, 1994). This view was also supported by Sharp & McDermott (2001) who concluded that *"during the break (for improvement), the famous ATAMO procedure is invoked"*(Sharp & McDermott, 2001). Figure 2.4 below is clearly to illustrate that there is not much knowledge in

literature about what is taking place between the situation before and after the process is changed.

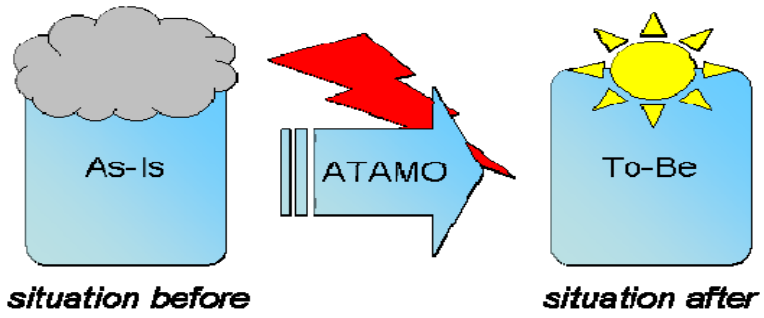

Figure 2.4 The and Then a Miracle Occurs (ATAMO) effect[4]

Detail instructions on how to improve a process taking into consideration given objectives such as cost reduction, shorten cycle time are very scarce and generic, thus most of the available approaches rely on human creativity and personal experience (Nwabueze, 2012). There is therefore the need for sufficient methodological guidance, structured methods and techniques, as well as guidelines describing the necessary changes in BPI projects. Taking into consideration the above challenges, this research focuses on analysing how BPI-Patterns can be effectively applied to overcome some of the challenges already mentioned above.

2.4 Business Process Improvement Patterns

The concept of pattern was first introduced in IS by Alexander (1979) as *"a three part rule, which expresses a relation between a certain context, a problem, and a solution"*(Alexander, 1979). This concept has been widely successful in other fields in IS, and it has recently been accepted within the framework of process improvements. Forster (2006) define BPI-Patterns as *"an abstract form of a recurring instance of a process modification step used in a Business Process Improvement activity"*(Forster, 2006).

[4] The and Then a Miracle Occurs (ATAMO) effect adapted from (Sharp & McDermott, 2001) in (Forster, 2006)

Reijers and Limam (2005) provided a collection of best practices in business process redesign that are derived from literature and practical experience (H. A. Reijers & Liman Mansar, 2005). They describe 29 best practices that have been adapted from literature and can be used within a BPR project, but these best practices do not follow a consistent form of description. Kim et al. (2007) examined how BPM can be supported by business process change patterns that enhance flexibility of BPM approaches (Kim, Kim, & Kim, 2007). They clearly explain the functionality of each of their proposed patterns, but a consistent description of the individual patterns is lacking. For this research we will mainly examine in two approaches that give detail description on the application of BPI-Patterns.

2.4.1 Approach 1 for applying BPI-Patterns

Falk et al. (2013a) define a BPI-Pattern as *"a reusable solution for a certain problem in a business process within a certain context"*. They go further to state that the main objective is to transform a business process from an "as-is" to a desired "to-be" state (Falk et al., 2013a). They suggest BPI-Pattern approach that supports the "act of improvement", and consist of two main components that are both integrated into a software tool: a pattern catalogue as a repository of improvement propositions and a step-by-step selection process for identifying and selecting suitable patterns (Falk et al., 2013a; Falk et al., 2013b). The applicability and effects of their proposed BPI-Patterns have been tested by means of a simulation (M. W. Lang, Benjamin; Falk, Thomas; Griesberger, Philipp; and Leist, Susanne,, 2015). They developed a template, to formalize the specification and reuse of BPI-Patterns. This description template consist of a problem description, the measures that should be taken to apply the BPI-Pattern and an assessment of the anticipated effects on cost, time, quality and flexibility (M. Lang et al., 2015).

As seen in Table 2.1 below, the specification of BPI- Patterns requires several attributes for its effective and efficient application during the improvement of a business process. The attribute *name* acts as an identifier and represents the underlying concept. An *example* ensures reliability of a pattern as it entails proven knowledge that has been acquired from real-life examples. An example also illustrates the application of a BPI pattern and offer the performer with guidelines for its use. Further, a *problem* statement is important since improvements within BPI aim at the

resolution or reduction of problems. Careful evaluation needs to be done to determine which pattern suits best the problem at hand.

Table 2.1 Attributes of a BPI-Pattern[5]

Attributes	Description
Name	The name as a unique identifier of a BPI pattern.
Example	Illustration of the application of a BPI pattern for the problem at hand.
Problem	Formulation of the issue that needs to be solved by means of the BPI pattern.
Context	Characteristics that imply conditions that have to be present to apply the BPI pattern.
Solution	Concept for solving the problem complete with the necessary steps which have to be executed.
Mechanism	Operations that are executed as part of the solution.
Building Block	Pre-built models for implementing within the problem-solving approach.
Effect	Resulting effects of a BPI pattern regarding cost, time, quality, and flexibility.
Performance Indicator	Indicators for measuring if the application of a BPI pattern has resulted in the desired change.

[5]Attributes of a BPI-Pattern adapted from (Falk et al., 2013a)

The attribute *effect* expresses the impact that is realised on a business process upon the implementation of a BPI Pattern. The impact should be evaluated based on cost, time, quality and flexibility. *Performance indicators* are necessary to determine if an improvement effort meets the objectives set aside from the start of the BPI project. *The context* is specified by the situational aspects which is represented by characteristics that involve conditions for the applicability of a BPI pattern.

It is worthy to mention here that the underlying intention of BPI-Patterns is to provide detailed guidelines that enable performers, experts and novices to adapt a pattern within a current situation. Understanding how to produce a solution based on a pattern is very important when determining the attributes for a BPI-Pattern. Base on the definition of BPI suggested by Falk et al. (2013a), improvement always results from changing one or more elements of a business process. These changes that take place, reveal the way of proceeding and can be used within a BPI-Pattern mirrored in the *mechanism* attribute. To complement the derived attributes, they developed a metamodel which defines the structure of a BPI-Pattern more precisely as seen Figure 2.5 below. The attributes are contained together, and their mutual relationships are also shown.

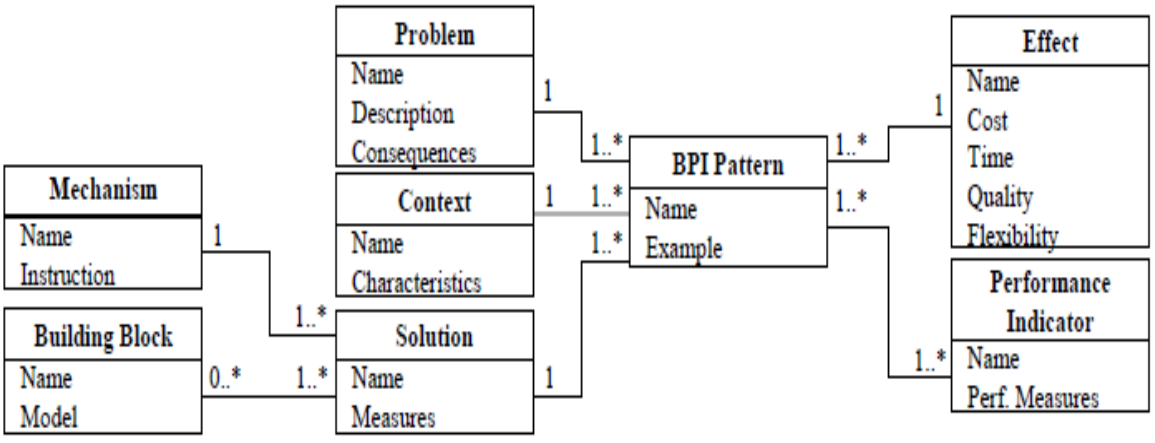

Figure 2.5 Metamodel of a BPI Pattern[6]

[6] Metamodel of a BPI-Pattern adapted from (Falk et al., 2013a)

Taking a closer look at Figure 2.5, it can be noticed that, the object type BPI Pattern is located at the centre and has a name as its unique identifier. Every pattern is specified by a single problem, a single context and a single solution which is described by the interrelationships between the BPI type and the related problem type, the contact type, and the solution type.

There exists a link between the solution type and the mechanism type as well as the building block type. This means that every solution is made up of a single mechanism and optionally one or several building blocks. Application of the BPI-Pattern aims at the reduction of a variable which could be cost or time and is described with the object type effect and its corresponding attributes (cost, time, quality and flexibility). Finally, the performance indicator type is necessary to measure the actual outcome of the intended business process to be improved (Falk et al., 2013a). Several instances of BPI have been developed and the functionality of this approach has already been demonstrated in (Falk et al., 2013a; Falk et al., 2013b).

2.4.2 Approach 2 for applying BPI-Patterns

Another approach was suggested by (Lohrmann & Reichert, 2016) who further from the concepts of BPI-Patterns and business processes, also introduced organizational objectives, process improvement objectives, and process improvement measures as determinants of starting a BPI project as illustrated in Figure 2.6.

Organizational Objectives

It is a common phenomenon that every company has objectives which acts like a guide for the long-term goals the organization intends to achieve. In the context of business processes, organizational objectives reflect the goals an organization aims to achieve based on a specific application scenario (Lohrmann & Reichert, 2016). Common examples of organizational objectives include the effectiveness of process output, cost savings, or compliance with regulations. These examples can also be used as a starting point when identifying organizational objectives relevant to a scenario at hand. Organizational objectives are generic in most cases, but it is the responsibility of the organization to prioritize which ones are specific to their strategy (Lohrmann & Reichert, 2016).

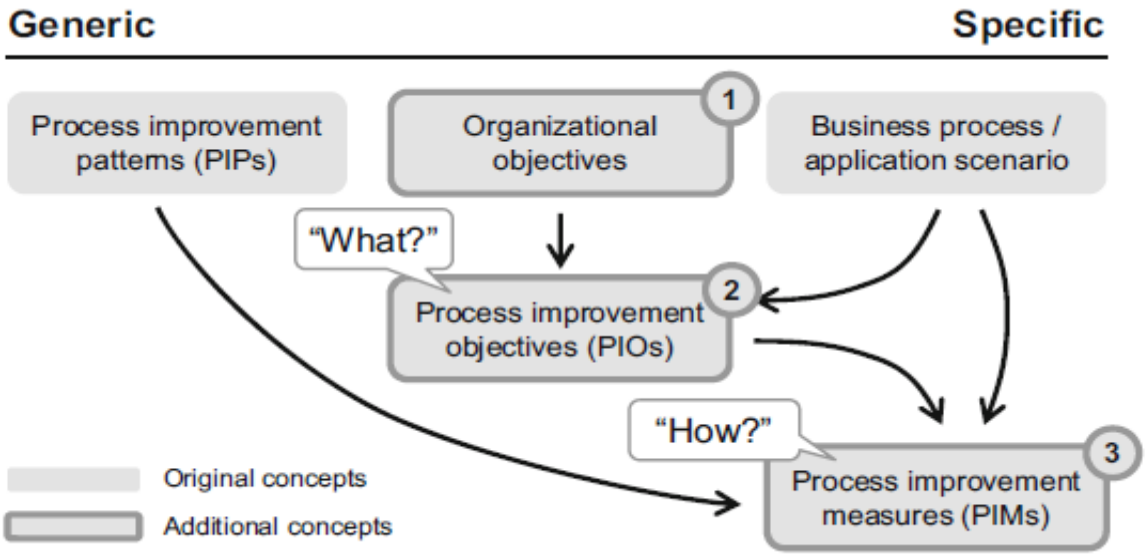

Figure 2.6 Implementing BPI-Patterns[7]

Process Improvement Objectives

With the organizational objectives fully determined, further refinement will result in process improvement taking into consideration the challenges linked with the concrete application scenario. Process improvement objectives therefore acts as a "bridge" between abstract organizational objectives and concrete process improvement patterns. Through a step-by-step approach, the PIOs are further refined to match the application scenario resulting to PIMs which consist of a bundle of BPI-Patterns.

Process Improvement Measures

Process improvement measures are regarded as a package of process improvement patterns that have to be applied to a specific process to realize PIOs. The suitable BPI-Patterns that have to applied to the specific application scenario should aim at realizing the process PIO. BPI-Patterns are more generic and depending on the application scenario have to be adapted to suit

[7] Implementing BPI-Patterns adapted from (Lohrmann & Reichert, 2016)

the PIO. This approach was implemented to a hiring process and yielded positive results (Lohrmann & Reichert, 2016).

2.4.3 Reasons for applying BPI-Patterns

The use of patterns has proven to be efficient and effective in other disciplines of IS and has been suggested by many others to be the solution that will overcome the gap between the situation before and after when improving business processes. In (Falk et al., 2013a), they argue that *"a systematic, structured and reusable approach for improving business processes is promising and ultimately leads to improvement"* (Falk et al., 2013a). Forster (2006), further supported this view by pointing out that, these structured guidelines will support that creative skills of employees and therefore help to formalize improvement methods (Forster, 2006).

Barros (2007) pointed out that *"a common theme in the more recent Business Process literature is the search for the approaches that allow formalizing domain knowledge into structures, patterns or frameworks which can be reused to facilitate process redesign and support systems development"* (Barros, 2007). It will be important therefore to examine some of the reasons that have been suggested by several researchers over the years in support of using patterns to improve business processes.

First, taking into consideration the definition of a pattern which is a reusable component that has proven itself in the past, it will be reasonable to assume that this solution can be helpful again under similar circumstances such a similar problem in a business process with the same context within BPI projects (Stephenson & Bandara, 2007). Since the pattern already exist, it may save a lot of time and cost, and the users can just be concerned about improving the process with the use of the patterns.

Second, alternative solution possibilities will be available for any given problem. This gives the user the choice to select among a huge number of possible BPI-Patterns that can be applied to solve the problem at hand (Falk et al., 2013a).

Thirdly, according to Jung and Sprenger (2006) in (Falk et al., 2013a), each name of a documented pattern represents a detailed structure, and therefore the names of the patterns will serve as a vocabulary which will enhance the communication among participants. This documentation is also beneficial for the documentation of derived process models.

Fourth, BPI-Patterns will be advantageous as the user already has some guidelines to start with and may always go back for reference should need be. Applying a pattern in BPI supports the user with promising guidance provided that the patterns are described properly (Jung and Sprenger, 2006) in (Falk et al., 2013a). Even though there exist numerous approaches and methodologies for improving business processes, the argument still remained that these methods rely on human creativity rather than on rationality (Pourshahid, Mussbacher, Amyot, & Weiss, 2009). The guidance within BPI-Patterns will be beneficial especially to novices as they can build on expert knowledge through the use of documented patterns for initial training.

Finally, the patterns that have been created could also be integrated into BPM software for instant visualization of a pattern's impact on existing process models (Falk et al., 2013a). This will not only make the whole experience of process improvement more effective as the impacts of the pattern can instantly be visualized and may aid when selecting which patterns to be applied in future BPI projects.

2.5 Performance Measure dimensions.

In the last couple years, a variety of performance measurement systems have been developed to evaluate the impact of process improvements (Jansen-Vullers, Loosschilder, Kleingeld, & Reijers, 2007). These authors assessed literature related to this topic to find out what dimensions of performance are suitable for measuring business process performance. After assessing the different systems, they concluded that the dimensions of the devil's quadrangle are suitable for measuring the performance of a workflow (Jansen-Vullers et al., 2007).

Brand and Van der Kolk (1995) distinguished four main dimensions for the evaluation of impacts of redesign measures which are: time, cost, quality and flexibility. To justify and support their point of view, they suggested the consideration of an ideal situation, whereby the redesign of a business process will reduce the time required to handle an order. It also decreases the required cost of executing the business process, it improves the quality of the service delivered and it improves the ability of the business process. The appealing point about this model is that, improving one dimension may have a weakening effect on another. To clearly indicate the difficult trade-offs that sometimes have to be incurred, they referred to their model

as the ‘devil’s quadrangle’ (Brand & Van der Kolk, 1995) (H. A. Reijers & Liman Mansar, 2005).

Knowledge of the trade-off that govern an improvement measure is very important in the improvement of a business process. In certain situations, the impact of the improvement measure may be that the result may appear worse than the existing process. Each of the four dimensions (i.e. time, cost, quality and flexibility), may be operational in different ways. It is therefore important that the key performance indicators of an organization should be ideally formulated as much more precise for application of the four named dimensions (H. A. Reijers & Liman Mansar, 2005). In the coming sections, we will examine each of the dimensions separately.

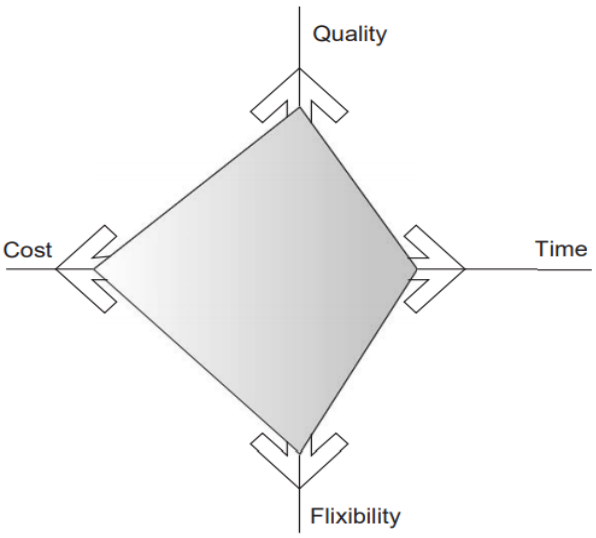

Figure 2.7 The devil's quadrangle[8]

[8] The devil’s quadrangle adapted from (Brand & Van der Kolk, 1995)

2.5.1 The Time Dimension

Time has been regarded as both a source of competitive advantage and the fundamental measure of performance (Donald, 1987). According to Forster (2006), *"time is seen as the total time an activity requires to be executed, from the beginning to the very end"* (Forster, 2006). There exist a lot of information on time measurement in literature, which has made possible the development of a set of performance measures for time dimension specifically for workflows (Jansen-Vullers et al., 2007). Lead time is the time it takes to handle an entire case, while throughput time is the time between the moment a task is completed and the moment the next task is completed.

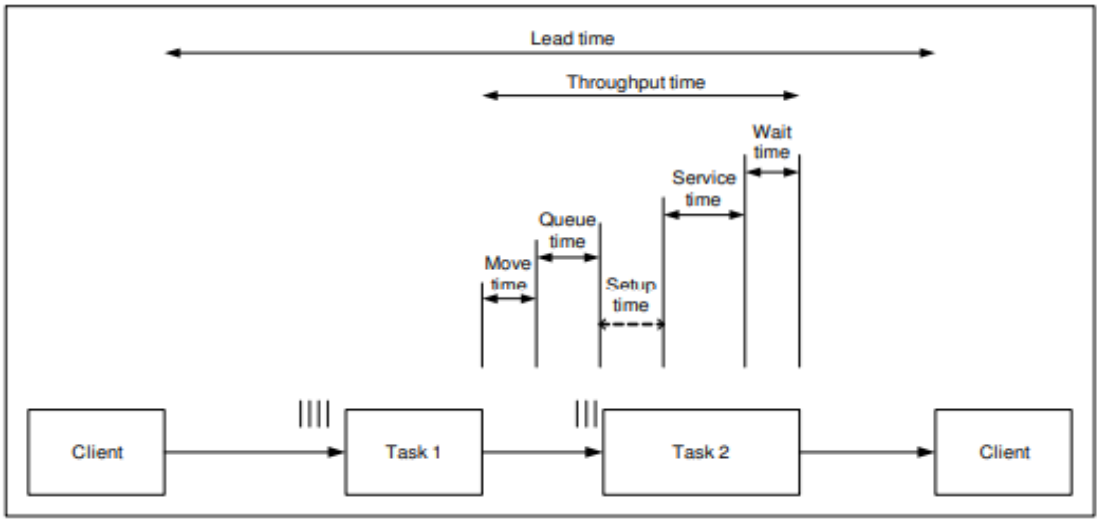

Figure 2.8 Performance measure - time dimension diagram[9]

2.5.2 The Cost Dimension

It is no news that, one of the primary ways of measuring business improvements is to look at the financial figures of the business. The cost dimension is closely linked to the other dimensions. The resulting impact on the other dimensions may influence cost directly or indirectly. Consider the case of long lead times, which in turn demands more workforce and

[9] Performance measure - time dimension diagram adapted from (Jansen-Vullers et al., 2007)

such increase cost in the form of salaries. Costs, can be direct or indirect, fixed or variable, and short or long – term (Forster, 2006).

2.5.3 The Quality Dimension.

According to Forster (2006) *"inherent characteristics define the quality of a product, process, or system related to requirements"* (Forster, 2006). The advancement of total quality management (TQM) resulted in a shift from "conformance to specification" towards "customer satisfaction" (Neely, Gregory, & Platts, 1995). There exist several ways to look at quality, be it from an external perspective which is regarded as external quality or internal quality which refers to the condition of working within the business process. The former can be measured as client satisfaction with either the product or process.

2.5.4 The Flexibility Dimension.

Knoll and Jarvenpaa (1994) describe flexibility as *"an essential property for the maintenance of fit between Business Processes and the supporting systems in changing environments"*(Knoll & Jarvenpaa, 1994). Reijers (2003) on the other hand define flexibility as *"the ability to react to changes"*(Hajo A. Reijers, 2003). According to Forster (2006), flexibility can be differentiated between the runtime and the build-time flexibility. The former is focused on handling changes, and the latter is the ability to respond to a shift in demand (Forster, 2006).

2.6 An overview of Selected BPI-Patterns

Reijers and Liman (2005) identified best practices for improving business processes that are oriented towards ; Customers, Business process operation, Business process behaviour, Organization, Information, Technology and External environment (H. A. Reijers & Liman Mansar, 2005). In carrying out this analytical evaluation, we mainly selected BPI-Patterns that are oriented towards business process operation, business process behaviour, organization, information and technology, based on the intended outcome we want to achieve.

The effects of the selected patterns are mainly measured on the performance dimensions; cost and time. Performance measure dimension of quality and flexibility which are also generally measured when implementing BPI-Patterns are not subject of this evaluation. We will therefore examine the selected BPI-Patterns for our evaluation.

2.6.1 Task elimination

This pattern suggests the elimination of non-value-adding steps within a business process. This pattern aims to increase the speed of processing and to reduce the cost of handling an order. This pattern is expected to result in positive effects on time and cost (H. A. Reijers & Liman Mansar, 2005).

2.6.2 Task composition

This pattern suggests the combination of small tasks into composite tasks and divide large tasks into workable small tasks. Consider composing two tasks to eliminate transportation or splitting a task into two and assign to separate, specialized resources. This pattern is expected to result in positive effects on time and cost (H. A. Reijers & Liman Mansar, 2005)

2.6.3 Triage

Suggest the division of a general task into two or more alternative tasks or consider the integration of two or more alternative tasks into one general task. It is advisable when applying this pattern. This pattern is expected to result in positive effects on time and cost (Dumas, 2015).

2.6.4 Resequencing

Suggests the movement of tasks to more appropriate places according to their cost/effect ratio to minimize over processing. Postpone expensive tasks that may end up not being necessary until the end. Put “Knock-out checks” first in order to identify problems early. This pattern is expected to result in positive effects on time and cost(H. A. Reijers & Liman Mansar, 2005).

2.6.5 Parallelism

This pattern suggest that two or more task may be performed in parallel. A drawback of introducing more parallelism in a business process that incorporates possibilities of knock-outs is that the cost of business process execution may increase. The management of business processes with parallel behaviour may become more complex, which may introduce errors or restrict run-time adaptations(H. A. Reijers & Liman Mansar, 2005).

2.6.6 Knock-out

Suggests the execution of tasks with high probability of providing sufficient information for a decision and with comparably low execution effort earlier in the process. If there exists freedom in choosing, the condition that has the most favourable ratio of expected knock-out probability versus the expected effort to the condition should be pursued, and next the second-best condition (Lohrmann & Reichert, 2016).

2.6.7 Process specialization and standardization

With process specialization, one process is split into multiple processes such as; customer class, by geographic location, by time period (e.g. winter, summer). With process standardization all cases are treated equally. Two or more processes can be integrated (Dumas, 2015).

2.6.8 Resource optimization

Consider using resources as if they are in one room, therefore avoid one group of people overloaded and another group waiting for work. Assign resources in such a way that maximal flexibility is preserved for the near future. If a task can be executed by either of two available resources, assign it to the most specialized resource (Dumas, 2015).

2.6.9 Communication optimization

Suggests reducing the number of contacts with customers and business partners. Automate handling, recording and organization of messages with customers and business partners. (Dumas, 2015)

2.6.10 Task automation

Suggests using data sharing systems such as Intranets, ERP systems to increase availability of information to improve decisions or visibility (subject to security/privacy regulations). Use network technology to replace materials flow (e.g. paper documents) with information. Enable self-service for example online forms and web data services. Use tracking technology to identify and locate materials and resources (Dumas, 2015).

3 Research Methodology

In researching this topic *"An analysis of the effective application of process improvement patterns"* a mixture of qualitative and design science research was deemed most appropriate. This thesis is designed as a mixture of secondary data from homepages, reports and literature studies, online journals, articles and books from the university library. To have a better and clearer understanding into our subject matter, the qualitative research is complemented with the design science research methodology (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007). According to Hevner et al. (2004) *"design science creates and evaluates IT artefacts intended to solve identified organizational problems"*(Hevner, March, Park, & Ram, 2004). They go further to state that such artefacts are symbolized in a structured form that may vary from software, formal logic, and rigorous mathematics to informal natural language descriptions (Hevner et al., 2004). In relation to IS, such artefacts may include constructs, models, methods, and instantiations (Hevner et al., 2004).

Hevner at al. (2204) also outlined practice rules for conducting research in the IS discipline through seven guidelines that illustrate characteristics of well carried out research (Hevner et al., 2004). The most important guideline stipulates that *"design science research should produce an artefact created to solve a problem"(*Hevner et al., 2004). BPI-Patterns, just like other IS artefacts constitute goal-bound artificial constructs in the sense of the design science paradigm (Simon, 1996), which can be evaluated in terms of "utility, quality or efficacy"(March & Smith, 1995).

Figure 3.1 below illustrates a conceptual framework for understanding, executing and evaluating IS research that combines behavioural-science and design-science paradigms (Hevner et al., 2004). The environment in IS research is mainly composed of people, organizations, and their current planned technologies. The environment further consists of goals, tasks, problems, and opportunities that determine business needs identified by the people within the organization. The identified needs are constructed by the roles, capabilities, and characteristics of the people within the organization. These business needs are further determined and evaluated within the context of organizational strategies, structure, culture, and existing business processes. The business needs are further arranged relative to technology

infrastructure, applications, communication architectures, and development capabilities. All these aspects determine the business need that has to be solved and thereby assures research relevance (Hevner et al., 2004).

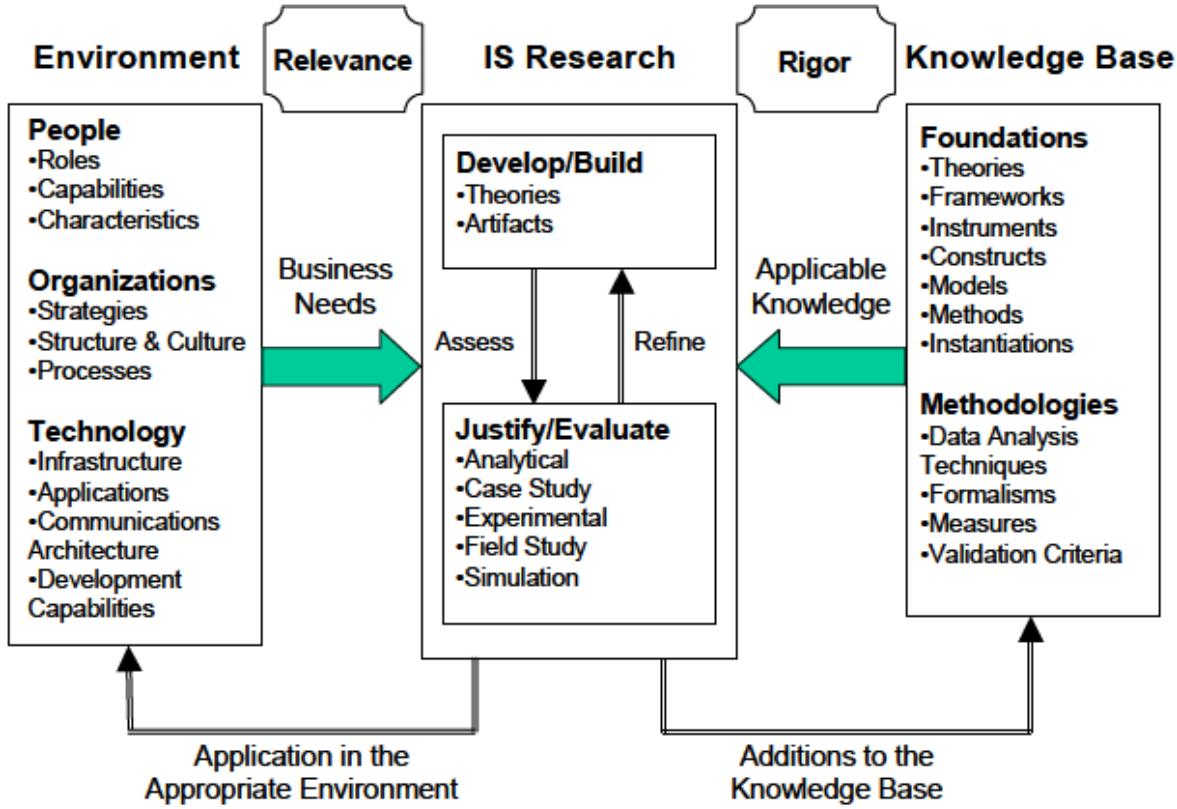

Figure 3.1 Information Systems Research Framework[10]

Based on the identified business need, IS research is carried out with the intention of solving this business need, which is conducted in two complementary phases. This consist of development and building of artefacts to address the business needs, and justification and evaluation of the artefact. The knowledge base is made up of foundations and methodologies which are mainly retrieved from already existent IS research which provide foundation theories, frameworks, instruments, constructs, models, and methods which are relevant in the develop/build phase during a research (Hevner et al., 2004).

[10]Information Systems Research Framework adapted from (Hevner et al., 2004)

The DSRM is made up of six activities, that act as guidelines for carrying out research based on design research principles (Peffers et al., 2007). These activities include; Problem identification and motivation, define the objective for the solution, design and development, demonstration, evaluation and communication (Peffers et al., 2007).

3.1 Evaluation in design science research

Previous research on BPI-Pattern already focused on Activity 1 – 4 (Falk et al., 2013b), (M. W. Lang, Benjamin; Falk, Thomas; Griesberger, Philipp; and Leist, Susanne,, 2015). This research is focused on DSRM Activity 5 (Evaluation) by analysing the effective application of BPI-Patterns. Activity 5 aims at observing and measuring how will the developed artefact support the solution to the problem (Peffers, Rothenberger, Tuunanen, & Vaezi, 2012).

Apart from simply stating that an artefact worked or didn't work, the evaluation method also has the responsibility to determine how and why it worked or not (Pries-Heje, Baskerville, & Venable, 2008). Hevner et al. (2004) summarised different methods that can be used to evaluate designed artefacts which include observational, analytical, experimental, testing and descriptive. According to Hevner et al. (2004), the analytical method may be used to study an artefact in use for dynamic qualities such as performance. As a basis for this thesis, we chose the analytical method for the evaluation of BPI-Patterns.

3.2 Research design

The three of the five components proposed by (Wieringa, Heerkens, & Regnell, 2009) constitute our research design which are; unit of data collection, environment of data collection, and data analysis. We will therefore examine each of these components in relation to our research.

3.2.1 Unit of data collection

The unit of data collection for this research is twofold considering the approach in answering two research questions. Regarding our first research question, the data is comprised of the final reports that were submitted by the students consisting of details on organizational objectives and process models of the car rental process. In total we will examine 7 case studies in answering our first research question. Concerning our second research question, we could refer to the Account payable business process which consist of the "as-is" and the "to-be" processes.

We also refer to the statistic of the obtained results and detail description of the 10 BPI-Patterns obtained from literature.

3.2.2 Environment of data collection

The data for our first research question was obtained from Prof. Koen Vanhoof (University of Hasselt) which consist of case studies that were carried out by students for the course Business Process Modelling. However, it was not possible to meet with the authors of the case studies, therefore we relied solely on the information within the documents.

The environment of the data regarding our second research question, comprised of a discussion with an Account Payable specialist as process stakeholder. In terms of documentation, we used the information within her Master Thesis which is focus on process improvement of the accounts payable process. As limitation to our sample environment of data collection, some information was considered confidential and could not be used for this research.

3.2.3 Data analysis

A qualitative analysis was carried out for this research and consisted of analysing the documentation that was provided and a discussion with the stakeholder involved with the accounts payable process. The structure for the data analysis was adapted towards obtaining answers to our research questions. The data analysis was carried out in two phases. The first phase aimed at answering our first research question and the second phase was directed towards answering our second research question. In the first phase, we examined the relationship between the organizational goals and the "car rental" process models of our sample case studies. In the second phase, we investigated the existence of BPI-Patterns in the improved processes of our sample case "Accounts payable process".

Phase 1: Relating organizational goals to business process models

The GoalBPM method (Koliadis & Ghose, 2006) was used for the identification of a satisfaction relationship between the organizational goals and the process models of our sample case studies. Figure 3.2 below is an illustration of the approach we used to apply the GoalBPM method to our sample case studies.

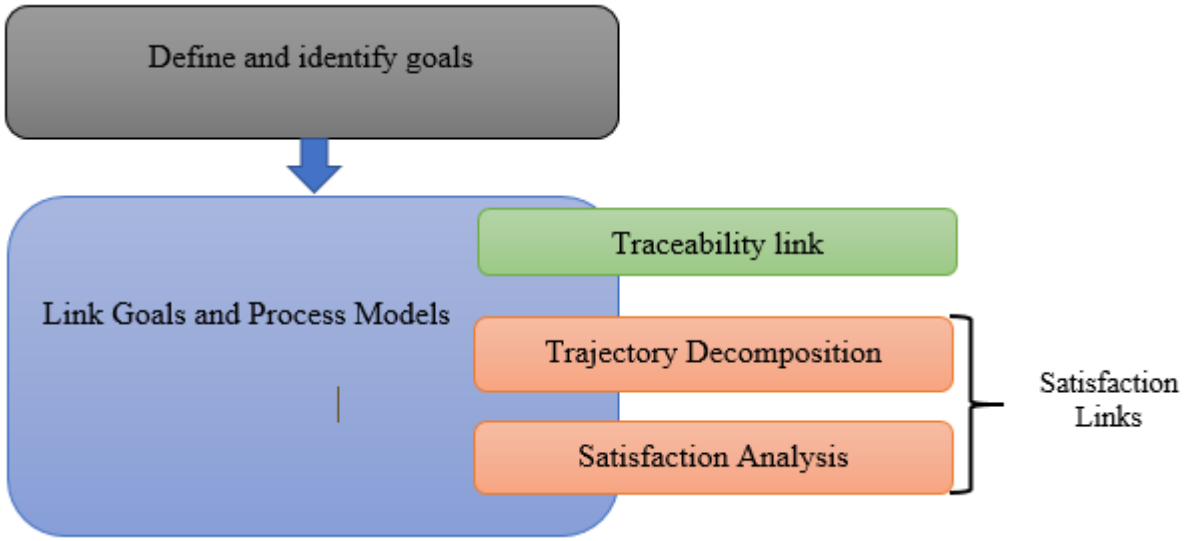

Figure 3.2 Applying GoalBPM

Goals may be formulated at different levels of abstraction, ranging from high-level, strategic concerns to low-level, operational concerns, which can also be differentiated between functional goals which underly services that the system is expected to deliver and non-functional goals which refer to expected system qualities such as security, safety, performance, usability, flexibility, customizability, etc (Koliadis & Ghose, 2006). Based on these approaches, the organizational goals in our sample cases were identified by searching for intentional keywords in the preliminary documents such as ‘goal’, ‘objective, ‘purpose’, ‘intent’, ‘aim’, etc. Once the preliminary set of goals were obtained, further goals were identified by refinement and abstraction, by asking HOW and WHY questions about the goals already available.

The relationship between the organizational goals and process models were established in two stages. The traceability link was identified through cross examination of the links between the pre/post conditions for the processes and pre/post conditions for the specific goals of our sample case studies. Secondly, we established satisfaction links between goals and the process models of our sample case studies.

The GoalBPM method establishes satisfaction links between goals and process models in three steps but this has been limited to two steps for this research;

We identified a set of critical trajectories from the process model. A trajectory can be labelled as having either a *normal* or *exceptiona*l type, based on its final achieved state. Trajectories that cannot resolve exceptions and requires termination prior to meeting all the goals it must satisfy, are commonly called exceptional (Koliadis & Ghose, 2006). In our sample cases, trajectories whereby the rental process had to be aborted abruptly were regarded as exceptional.

Next, we identified the satisfaction links by analysing critical trajectories relative to process effect annotations. During this stage, we analysed the outcome of the satisfaction process by identifying whether the process supports the achievement normative satisfaction goals and the determined the satisfaction relationship between the process and the associated refined goal as either *strong*, *weak*, or *unsatisfied* (Koliadis & Ghose, 2006)

- A strong satisfaction relationship is determined if all possible trajectories are *'normal'*.
- A weak satisfaction relationship is when there is at least an *'exceptional'* trajectory and one *'normal'* trajectory.
- An unsatisfied satisfaction relationship is the result of there not being a single *'normal'* trajectory decomposed from the process (Koliadis & Ghose, 2006).

Table 3.1 Result of GoalBPM application to sample case studies

Company	Organizational Goal (s)	Process Model	Satisfaction Status
CubarCar	-Increase Customer Satisfaction -Reduce customer complaints	Car reservation	*Unsatisfied*
Classic Cars	-Increase Customer Satisfaction -Reduce waiting time	Rent a car	*Weak*
American Classic	-Increase Customer satisfaction -Increase Profitability	Rent a car	*Strong*
Guardalavaca	-Increase Customer Satisfaction -Ensure Customer Safety -Increase Profitability	Rent a car	*Strong*
One Family	-Ensure Customer Safety -Offer Flexible Service	Rent a car	*Weak*

A structured application of the GoalBPM method to our sample cases show that, while some of the organizational goals and the process models demonstrate a strong satisfaction relationship, other companies demonstrated weak or unsatisfied relationships. Table 3.1 above depicts the

result obtained after applying the GoalBPM method to our sample case studies. Among the 5 cases status that we analysed, 2 portrayed a strong relationship between the organizational goals and the process models, 2 portrayed a weak relationship and one had an unsatisfied relationship between the organization goal and the process model. The process models of our sample case studies can be found in the appendix.

Phase 2: Identifying BPI-Patterns

This section is mainly related to answering our second research question that was mentioned at the start of this thesis. The business process we use to identify the BPI-Patterns selected for this research stems from the Finance department of a logistics company called Flash Group located in the Netherlands. It addresses the Account payable process of handling invoices that are received from the carriers. The Objective of the process is to achieve one of two states for each invoice processed: either the invoice is paid, or the invoice is blocked, and more information requested from the carrier.

Overview of the business processes

The Account payable process is made up four main activities being sorting invoices, processing payments, payment proposal and payments of invoices. Our interest is limited to the sorting invoices, processing invoices and the payment proposal as these activities cover the scope of responsibility of the stakeholder we interviewed.

The first step in the process is sorting the received invoices. The invoices are delivered everyday by post to the Account payable department. The invoices have to be sorted manually by the Account payable specialists which takes about 1h30 minutes. On average 4 to 5 employees must sort the invoices daily taking into consideration the payment dates, the received dates and the type of carrier. The invoices are sorted based on the received date and the type of carrier. This sub-process ends with the sorted invoices ready to be processed.

The next step covers the processing of the sorted invoices and is exclusively performed by the Account payable specialist. Each invoice must be checked and validated in the system alongside several accompanying documents particularly the Purchase Order reference number. The invoice/ PO reference number check could result in: either the invoice is blocked and cannot be validated, or it can be validated and ready for processing. In case the invoice is blocked, the AP

specialist puts the invoice aside and is checked every Friday if it has been unblocked by the department responsible. This sub-process ends with the invoice being validated or waiting to be unblocked.

The next step in the process is generating the payment proposal for the overdue invoices. All the overdue invoices for each carrier is checked and the associated cost deducted. In case of inconsistences during the deduction of the cost, the approval of the supervisor is requested before generating the payment proposal. After the deductions have been made, the Account payable specialist generates a payment proposal which is be approved by the supervisor before any payments can be made. This sub-process ends with the generated payment proposal approved and ready for payments.

What were the problems?

- Received invoices were mixed up during sorting, resulting to late or unpaid invoices.
- Received invoices were unorganized and as such pages were unnoticed when processing the invoices resulting to unpaid invoices.
- AP specialist had to process invoices from different countries which was at times confusing and time-consuming resulting to long processing time.
- Blocked invoices were often forgotten to be unblocked by the other departments responsible resulting to late payments.
- Long waiting time for approval in case of cost deduction inconsistencies when generating the payment proposal.

All of the above-mentioned problems resulted in “unpaid invoices” and “long cycle times” in processing invoices.

How did they solve it?

In our sample case, improvements were implemented to the different activities of the accounts payable process.

Regarding the sorting process, each AP specialist was assigned to handle invoices from a specific country or geographical location. When the invoices were received, only one AP specialist instead of four or five, sorted the invoices by the different countries and then handed over to the AP specialist responsible for processing the invoices from the country in question.

This reduced the time for processing the invoices, as it was possible to recognize the invoices and possible characteristics related to the carriers over time. This improvement is identified as the BPI-Pattern *"Specialisation".*

Also, within the sorting sub-process, the carriers were involved early in the process by requesting that the invoices are organized in an orderly manner. Unlike the situation before when the invoices were unorganized and took too much time to process, this task was assigned to the carriers to organize the invoices orderly. This resulted to faster processing time of the invoices. This improvement is identified as the BPI-Pattern *"assign activities to external parties".*

Concerning the invoice processing sub-process, the problem of long waiting time to process blocked invoices was solved by enhancing communication with other departments involved. Unlike the situation before whereby the AP specialist had to check every Friday if the blocked invoices had been unblocked, an excel google file was created containing all the necessary information on the blocked invoices. This document was shared by all the departments involved, and the reaction time was faster. This reduced the waiting time for the invoices to be unblocked, and the status of the invoices was known by all the departments in real time. This improvement is identified as the BPI-Pattern "*communication optimization".*

Within the payment proposal sub-process, the AP specialist could now make reasonable decision when generating the payment proposal without seeking the approval of the supervisor. Unlike before when the AP specialist needed the approval of the supervisor in case of inconsistencies when generating the payment proposal, the AP specialist could take actions when needed. The involvement of the supervisor was eliminated and as such the waiting time for approval by the supervisor was reduced, hence increasing the number of generated payment proposals. This improvement is identified as the BPI-Pattern *"task elimination"*

It is important to mention here that these improvements that were implemented in our sample case were purely based on human creativity and no guidelines were followed during the implementation.

Result after implementing improvements

Table 3.2 shows the results before and after implementing the process improvement. The results mainly focused on the outcome related to the number of invoices that were validated and the number of blocked shipments that were processed for the analysed period. It is important to mention here that these results were limited to the Romanian carriers which was handled by the stakeholder we interviewed.

Table 3.2 Results after process improvement

Nr. of invoices validated	Before (2nd Qtr. 2017)	After (3rd Qtr. 2017)	% change
Mean	**3,739**	**3,961**	6%
Nr. of blocked shipments	Before (4th Qtr. 2017)	After (1st Qtr. 2018)	% change
Mean	**311**	**186**	-40%

For the performance indicators; number of invoices validated and the number of blocked shipments, the mean values were calculated and compared between two quarters and are included in the cells of the table. As seen in the table, after the implementation of the process improvement, the number of invoices validated increased between the 2nd Qtr.2017 and the 3rd Qtr.2017 by 6%. It can also be noticed that, the number of blocked shipments also reduced between the 4th Qtr.2017 and 1st Qtr.2018 by 40%. Relating both results to the performance measure dimensions, it can be noticed that there is was a decrease in the cycle and processing times of the invoices.

Table 3.3 Identified BPI-Patterns

Selected BPI-Patterns	Processes		
	Sorting invoice	Processing Payment	Payment Proposal
Task Elimination			X
Task Composition			
Triage			
Resequencing			
Parallelism			
Knock-out			
Specialisation/Standardization	X		
Resource Optimization			
Communication Optimization		X	
Task Automation			
Not selected BPI-Pattern			
Assign activity to external party	X		

Table 3.3 above illustrates the BPI-Patterns that could be identified in our sample case after the improvements were implemented to overcome the problems faced. The identification of these patterns was conducted by comparing the context of the BPI-Patterns and the actual act of improvements that was implemented. As seen in the table, we were able to identify three of our selected BPI-Patterns within the sample accounts payable case after the improvements had been implemented. We could also identify the BPI-Pattern "Assign activity to external party" which was not included in our selected patterns which is labelled in the table under "Not selected BPI-Pattern". In Chapter Four, we will discuss the implications of our findings and what this means for our research.

4 Discussion and Conclusion

4.1 Discussion

The purpose of this thesis is to analyse the effective application of BPI-Patterns with the intention of identifying or suggesting key factors that should be taken into consideration when applying BPI-Patterns. In this thesis, a systematic literature review was conducted on the concept of process improvement patterns in order to have a detail understanding, including the reasons for applying such patterns. Based on the information acquired from the existing literature, we could identify two BPI-Pattern approaches that have proven their functionality but differ in their methods of applicability.

(Falk et al., 2013a) proposed a BPI-Pattern approach that supports the "act of improvement" and consist of two main components that are both integrated into software tool: a pattern catalogue as a repository of improvement propositions and a step-by-step selection process for identifying and selecting suitable patterns. This approach also included a Metamodel which defines the structure of a BPI-Pattern. The functionality of this approach has been demonstrated in (Falk et al., 2013a; Falk et al., 2013b).

We also examined a second approach by (Lohrmann & Reichert, 2016), as they also introduced organizational objectives, process improvement objectives, and process improvement measures as determinants of applying a BPI-Pattern to a specific application scenario. They made use of the top-down approach of deriving process improvement objectives and process improvement measures from organizational objectives, similar to techniques for eliciting requirements in goal-oriented requirements engineering (seen in Figure 2.6). The functionality of this approach has been demonstrated in (Lohrmann & Reichert, 2016). This approach was chosen for this thesis, in order to analyse the effective application of BPI-Patterns. Based on the positive results obtained when this approach was applied to specific application scenario, we wanted to investigate the extend of the relationship between organizational objectives and process models. We therefore applied the GoalBPM method to investigate the relationship between the organizational objectives and the process models of our sample case studies.

From the analysis of our sample case studies, it was noticed that even though the strategic objectives / organizational goals were clearly defined in all the five case studies, not all the

organizational goals had a strong relationship with the process models. Out of the five case studies that we analysed, only two had a strong relationship between the organizational objectives and the respective process models. Two portrayed a weak relationship and one portrayed an unsatisfied relationship. A possible explanation for the unsatisfied relationship could be that, the main organizational goals are not clearly refined to sub-goals that will be reflected in the process model. Based on the results of our analysis, we could argue that some of the relationships between the organizational goals and process models fell short of our expectation (answer RQ1).

From the systematic literature review, one could argue that BPI-Patterns are very influential in obtaining positive improvement outcomes. We therefore investigated the validity of this claim by attempting to identifying BPI-Patterns in a sample business process that was improved by merely applying human creativity skills. We therefore selected 10 BPI-Patterns from literature based on the intended result to be achieved in our sample case, which was mainly "reduce processing time" and "cost reduction". We were able to identify 3 of the 10 selected BPI-Patterns in our sample case, and it was not surprising that all the identified BPI-Patterns proved to be very influential to the obtained result. However, despite the results obtained from the improvements implemented to our sample case, it will be interesting to evaluate the efficiency of these results.

It is also worthy to mention here that, unlike the assumption that BPI projects implemented by external advisors who are experts and contribute the methodological knowledge will lead to positive results, our findings prove that positive results may also be achieved by the concerned employees who have little or no knowledge on methodological techniques. This is also advantageous, as it offers the possibility for the concerned employees to exploit their domain-specific knowledge as well as minimize the resistance to change, which is commonly experienced with such projects. Another interesting finding was the fact that, even with little or no knowledge about BPI-Patterns by the employees in our sample case, considerable improvement results can be achieved if the participants are knowledgeable about BPI-Patterns. Based on findings, we can conclude that BPI-Patterns influence the expected improvement outcome (answer RQ2).

4.2 Limitations of study

Our approach was limited only to the time and cost dimension measures as they relate to the expected outcome of our sample case. The other dimension measures of quality and flexibility were not subject of our research. This omission to an extent limits the result of our finding only to the considered performance dimension measures.

There is also the possibility that the BPI-Patterns selected for this research are to an extent dependent on the researcher, however this threat was mitigated to an extent by clearly explaining the reason for choosing the selected patterns.

Another limitation we encountered was not able to involve the authors of the case studies during our analysis. It was difficult to relate a scientific research methodology to our unique research process. The research method chosen may not entirely inteprete the aim of our research, but our desired outcome was realised (i.e. attempting to answer our research questions)

Finally, the interval for the collection of the results of the Accounts payable process was relatively short, thereby posing a threat about the validity of the results which may not also be an accurate timeframe to make conclusions. However, the purpose of this research was to have a first-hand experience by evaluating BPI-Patterns with a real-life case.

4.3 Recommendations

This research could be of importance to the intended reader because it provides new insights of looking at BPI-Patterns. Unlike the case with other IS disciplines, the application of patterns in process improvement has not been fully exploited, thus results presented in this thesis could be used as a starting point for both practitioners and researchers to further evaluate the effectiveness of BPI-Patterns.

The contribution of this research is twofold and provides valuable insights for theory and practice. The result from the analytical evaluation adds to the already existing evidence that the newly developed BPI-Pattern approach, produces positive outcomes as intended. We also examined some of the guidelines that could be considered in deriving BPI-Patterns, and as such their effective application. Although the evaluation was based analysing fictional case studies and a real-world case, the use of other evaluation methods such as case studies, experiments on

different scenarios is recommended to validate the findings in context of real world applications.

4.4 Conclusion

In this thesis, a systematic literature review and an evaluation according to the principles of design science research was conducted to find answers to two main research questions. Our findings show that the assumption about BPI-Patterns is valid as patterns will in most cases bring about the intended positive effects. It is however important for companies to continuously ensure that a strong relationship exist between their organizational objectives and their process models. The likelihood of companies effectively applying BPI-Patterns to achieve the intended outcome proves to be higher if there exist a strong relationship between their organizational goals and the process models. Based on our findings in, we can argue that, the use of the "top-down approach" will greatly contribute the effective application of process improvement patterns, however involvement of knowledgeable and influential stakeholders should be one of the priorities when implementing a BPI-Patterns.

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Appendix

Appendix 1 Interview Questions and Answers

Interview

Name of Interviewee: Daniela Barbu

Date: 25/05/2018

Time: 17h15

Questions and answers

Who are the main participants in the Accounts Payable Department?

- Manager
- Supervisor
- Account Payable Specialist

What are the main duties of the Accounts Payable Department?

Checking if the PO matches the invoice from Carriers, and the process involves;

- Sorting Invoices
- Processing invoices
- Generating Payment Proposals

Who is responsible for carrying out these processes?

- We are a team of 12 Account Payable Specialist and we are responsible for carrying out these processes.

What are the main tasks to be performed for each of these processes?

<u>Sorting Invoices</u>

- Every day, 4 or 5 AP specialist have to sort the received invoices by differentiating them according to the received date, and the type of carriers. Invoices are now ready to be processed.

What are some of the problems that you encounter when performing this task?

- Invoices are mixed up during sorting which gives us extra work to re arrange them, and as such time consuming

- Invoices were stapled together which leads to some pages not noticed (invoices not correctly processed)
- Invoices were unorganized which leads to some pages forgotten to be processed (invoices not correctly processed)

What did you do to overcome these problems?

- Each AP Specialist handles a country (specialisation)
- Carrier were involved early to organize invoices (this facilitated the processing time of the invoices)

<u>Processing Invoices</u>

- Check PO reference number
- Validate PO reference number
- If not ok (blue), put invoice aside to be checked every Friday.
- If Red, invoice is rejected (damaged goods)
- Check and validate invoice amount → if amount does not match, correct amount manually.

What are some of the problems that you encounter when performing this task?

- Blocked invoices were forgotten by the AR or Operations department to be unblocked. Could be delayed because of;

Some documents were missing from the carriers

Differences in the price such as extra cost (waiting time, tunnel fee or handling fee)

What did you do to overcome these problems?

- Introduction of an excel google document to be accessed by the other departments with a list of blocked invoices
- Inform carriers about status of invoice and advice on who to contact
- The number of blocked invoices reduced

<u>Generating Payment proposals</u>

- Check overdue invoices for each carrier
- Deduct other cost (fuel, telephone, etc)

What are some of the problems that you encounter when performing this task?

All decision was made by the supervisor taking too much time to decide whether to propose payment or not.

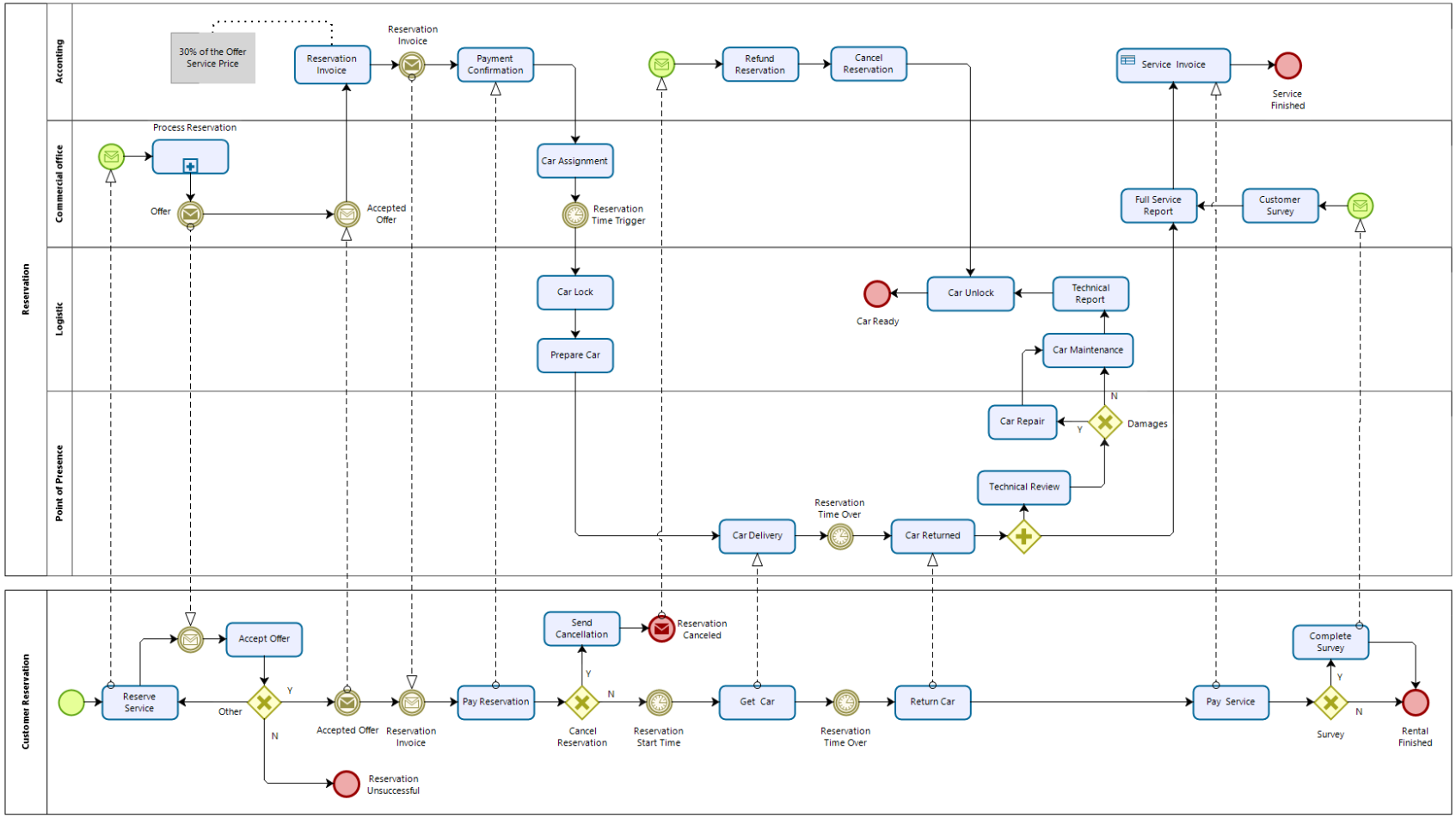
What did you do to overcome these problems?

- Now I don't have to seek the approval of my supervisor before deducting certain cost which has reduced the time for generating the payment proposal.

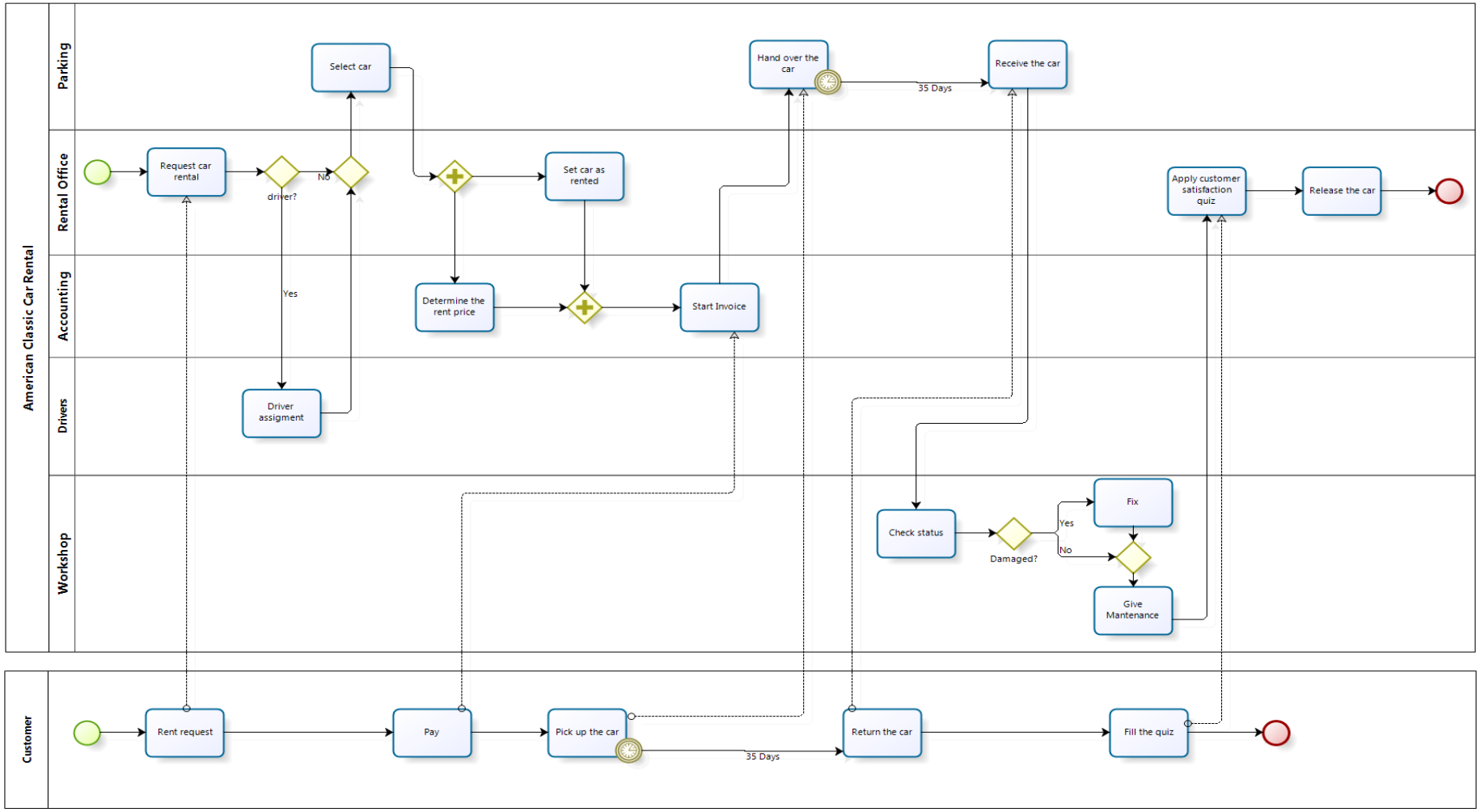
Did you inform your superiors before implementing all these changes?

- Yes, they were informed about the changes, but it has not been documented.

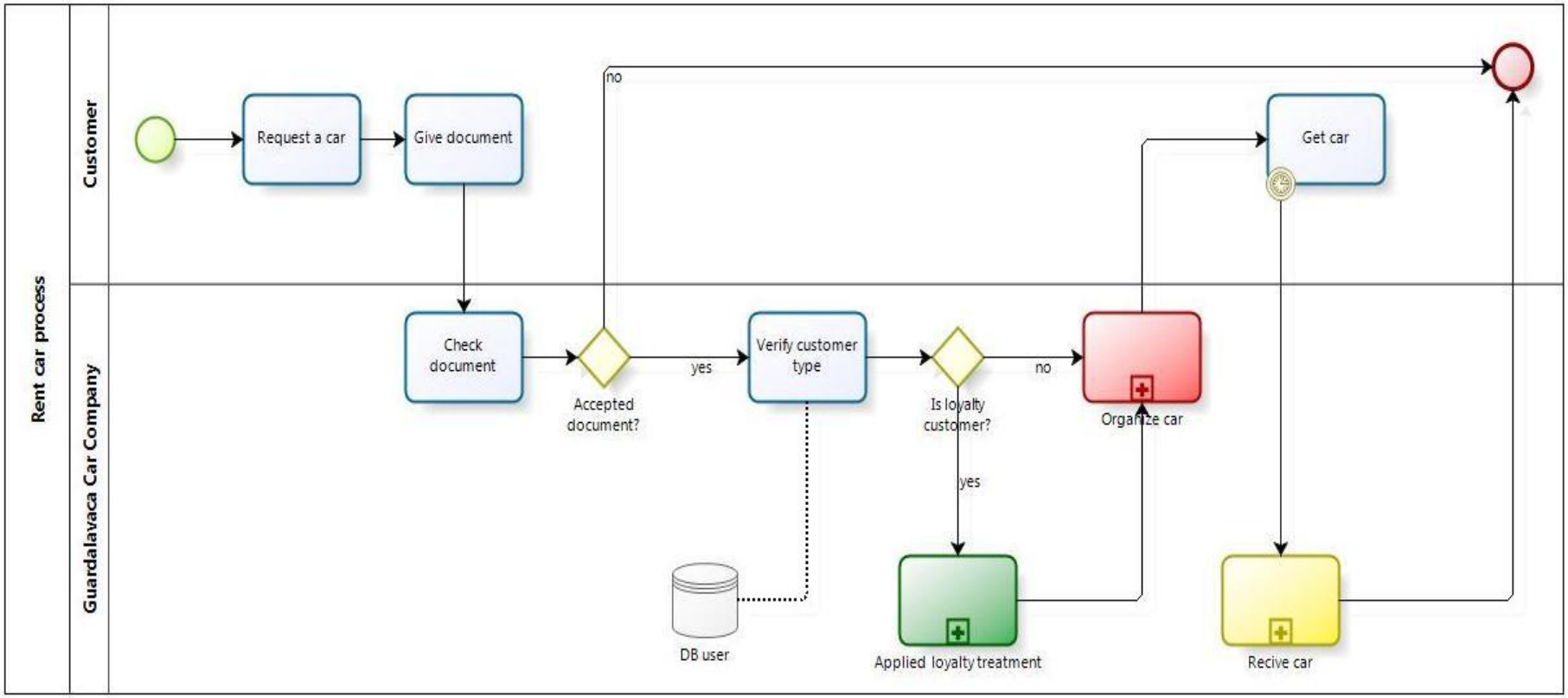
Appendix 2 CubarCar – Car reservation process



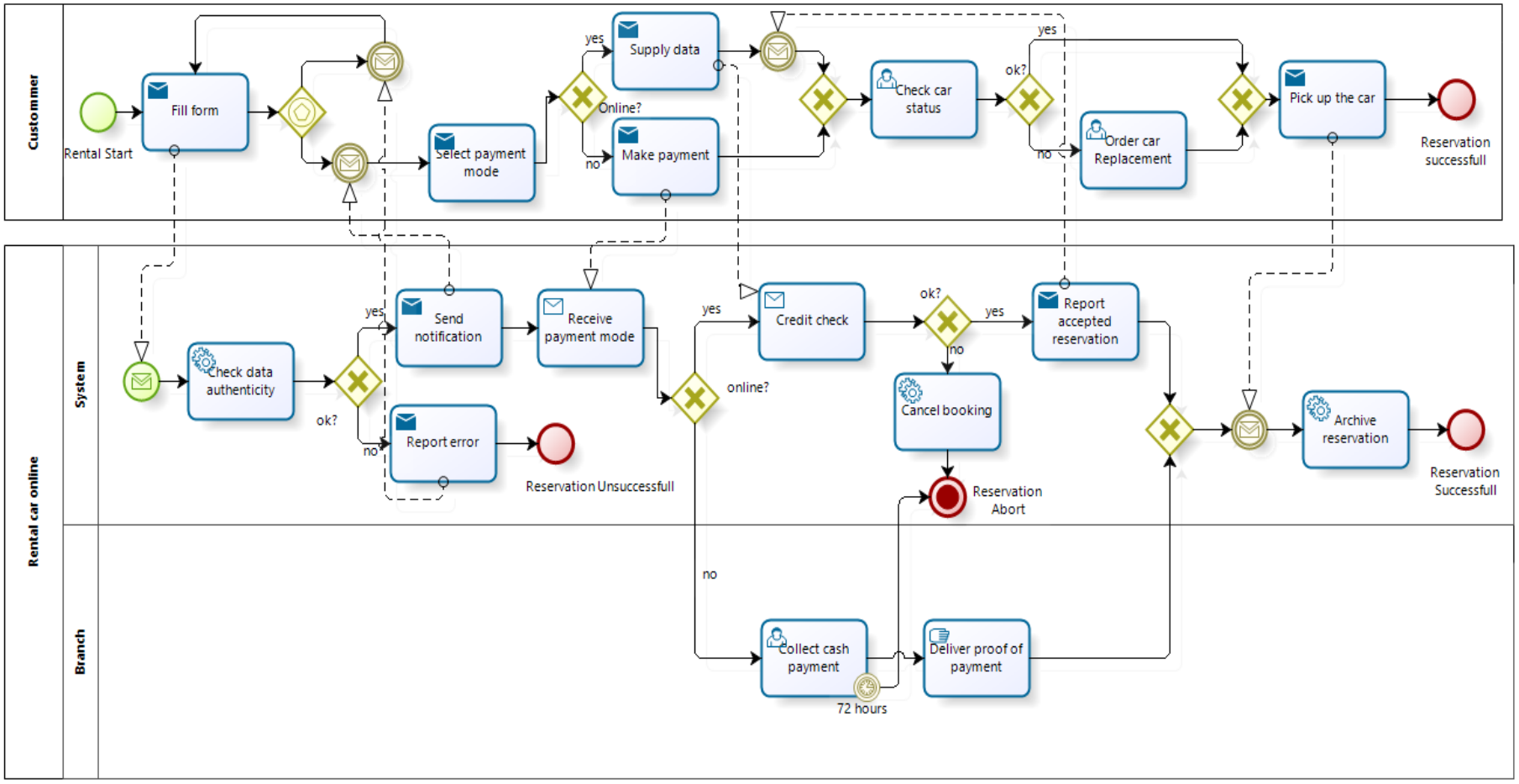
Appendix 3 American Classic – Car rental process



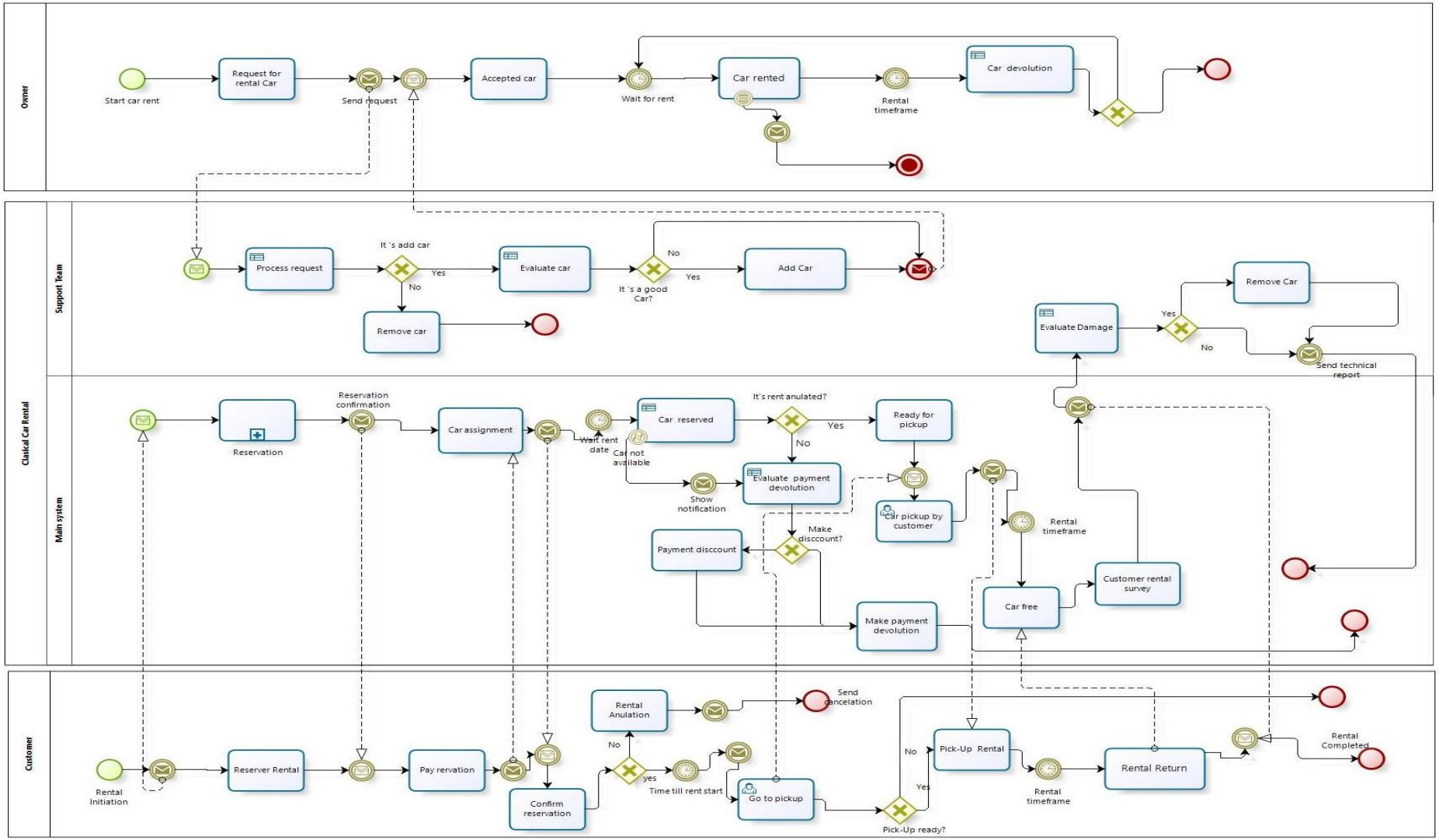
Appendix 4 Guardalavaca – Rent a car process



Appendix 5 One Family – Rent a car process



Appendix 6 Classic Cars – Rent a car process



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Richting: **Master of Management-Business Process Management**
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