Reengineering a trans-national paper process through IT automation

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Abstract:

Nissan Europe SAS (NESAS) is engaged in the after-sales business selling parts and accessories on the market. The accessories are produced by external suppliers under requirements and specifications given by NESAS Conversion & Accessories Engineering. In order to be sold on market, accessories need to be homologated and a process is set-up for this purpose. Several divisions of the company, which are located worldwide, are involved in the process and contribute by providing input to the process in form of data. The process is currently paper-based with a working document which is updated by all departments involved. In order to improve overall performance of the process in terms of visibility, data-sharing, communication and user-friendliness, a BPR project is launched. This Thesis presents a solution to reengineer the paper-based process and automate it through the use of an IT application built on existent IT resources available company-wise. The reengineering activity is conducted by a reengineering team based on a 4-phases framework developed for this case, which starts from Analysis of the process, its Redesign, Implementation of the reengineered process and Evaluation. The steps to follow and the main factors to consider when automating a cross-divisional paper data-flow are described in this Thesis.

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Executive Summary

Global companies are counting more and more on global processes, which are crossing departments' and involve divisions located worldwide. Although IT development gave a great contribution to improve internal processes within departments or divisions borders, cross-divisional processes, especially when they manage information, are often let to responsible people who perform them based on their experience. Information and data flow through the organisation, being the trigger for important business processes. Many paper processes are executed without a sufficient control and many knowledge workers in global companies base their work on that amount of information which is not controlled and most of the times unclear and poorly understood.

Nissan Europe bases its process for European homologation of accessories on a paper flow. That paper is issued in France printed, filled-in, scanned and sent to UK, Japan and Switzerland, where the same operations are done. Once many copies of that paper has been printed and sent, that is eventually lost, abandoned or trashed.

Homologation is the enabler for accessories enable their sales of accessories on a European scale: what if something goes wrong in the paper-process?

Most of the times a paper process is hidden and, as a result, its consequences are also hidden, until the moment they occur. In this case:

No European homologation = No sales all over Europe.

Automating a process is a matter of change. Many companies struggle trying to implement process changes which stay within departments' borders making the challenge even bigger when it is about reengineering a transnational process.

A Business Process Reengineering project was launched to turn the paper-based homologation process for accessories into an electronic process. Replacing a paper process with an electronic process is not just a technological problem, but mainly a managerial problem, as it is about changing people's actions. This Master's Thesis proposes the steps and techniques to follow in order to reengineer a transnational business process. An electronic application was developed to manage a redesigned process meeting the objectives, which are often management's concerns about technology: reliability of the solution and compatibility.

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Abstract

Nissan Europe SAS (NESAS), divisione Europea di Nissan Motor Ltd, è presente, per mezzo della Divisione After Sales, nel business Automotive After Market attraverso la vendita di parti ed accessori. La vendita di accessori a livello europeo avviene previa omologazione WVTA (Whole Vehicle Type Approval), basata sulla normativa Europea di riferimento. NESAS C&A Engineering esegue uno specifico processo per ottenere l'omologazione WVTA degli accessori attraverso il coinvolgimento di vari dipartimenti e divisioni localizzati in Francia, Gran Bretagna, Giappone e Svizzera. Il processo è interamente basato su un documento cartaceo sul quale il personale dei vari dipartimenti coinvolti nel processo indica quali accessori possono essere omologati, sulla base di giudizi di natura tecnica e commerciale. Con l'obiettivo di migliorare l'efficienza del processo, la sua visibilità e la condivisione dei necessari documenti tecnici che vengono scambiati tra i vari dipartimenti, il processo deve essere riorganizzato, in particolar modo attraverso l'utilizzo di opportune soluzioni informatiche. Questa Tesi di Laurea è basata sul lavoro condotto per la riorganizzazione del processo di omologazione degli accessori e presenta l'applicazione di teorie, concetti e metodi utilizzati nel campo del Business Process Reengineering. Il progetto di riorganizzazione del processo prevede l'utilizzo di una soluzione compatibile con l'esistente piattaforma informatica, adottata dalle varie divisioni di Nissan Motor Ltd a livello globale. L'intero progetto, condotto da un team composto di quattro persone del dipartimento NESAS C&A Engineering, si articola in quattro fasi, che sono: analisi del processo esistente, sviluppo della nuova soluzione, implementazione e successiva valutazione. La Tesi di Laurea ha l'obiettivo di individuare le tecniche da utilizzare e le azioni da eseguire in modo da implementare una nuova soluzione per lo specifico problema, rappresentato dall'automazione dell'esistente processo interdipartimentale di omologazione degli accessori per il mercato Europeo.

Preface

This Master Thesis is written based on a project conducted during an internship at Nissan Europe SAS in France. The work has been conducted in the Engineering department during the period from July 2010 to May 2011 and is submitted as final long project for 3^{rd} and 4^{th} semesters of the Master's Programme in International Technology Management at Aalborg University. References are done according to the Harvard methodology (Author, Year).

I would like to express my gratitude and thank the following people for having contributed and supported this project:

- Section Manager Michel Cedolin, for his guidance during my entire internship and for having provided me lot of learning opportunities;
- Section Manager Michael Thewissen, for all explanations on the process and the overall WVTA homologation activity;
- Section Manager Louis du Garreau, for having attended many meetings and having provided precious inputs to this project;
- Manager Pascal Constant, for his explanations, support and sponsorship during the entire project;

A special thanks to Dr Harry Boer, supervisor of this project, for having offered his guidance through the entire work conducted for this Thesis, his insight and suggestions on all theoretical aspects and a series of precious feedbacks.

Summary

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Definitions of terms

WVTA: Whole Vehicle Type Approval
RBU: Regional Business Units
PMZ: Homologation department (United Kingdom)
XB3: Homologation department (Japan)
CVE: Chief Vehicle Engineer (Japan)
A-CVE: Assistant Chief Vehicle Engineer
NTC: Nissan Technical Center (Japan)
NTCE: Nissan Technical Center Europe
NESAS: Nissan Europe SAS
NISA: Nissan International SA
NML: Nissan Motor Limited
CMM: Chief Marketing Manager
RPM: Regional Product Manager
GAE: Global After-Sales Engineering
NESAS AS C&A: Nissan Europe SAS After Sales Conversion And Accessories
C&A GM; Conversion and Accessories General Manager
OEM: Original Equipment Manufacturing
VBA: Visual Basic for Applications
PI: Performance Indicators
KPI: Key Performance Indicators

Acknowledgements

When preparing this Master's Thesis, I was working in the NESAS C&A After Sales Division, where also the Engineering department is located. I have been in contact with many people, who have contribute to this project, providing me support and explanations to get a good insight on the topic, but also by offering me great opportunities of leaning in a unique multicultural work environment: thanks to the entire After Sales Division.

A special thanks to my supervisor Michel Cedolin for having supported me during my project and challenged by providing me many other learning opportunities during my 1-year internship, which was a great experience.

I owe my deepest gratitude to my parents who have supported me all the way since the beginning of my studies.

A special thanks to all my family and my uncle Onorato, who would have loved to see this Master's Thesis concluded.

Giovanni Porcu

1 Chapter: Introduction

This Chapter gives an introduction to the Master's Thesis introducing the background of the study and the related problem area.

Globalization and delocalization are phenomenons which are changing the business world in the last two decades. Companies are forced into change if they want to be successful in their businesses. Change a company to make it global also means to change its processes. The automotive industry is particularly affected by these phenomenons that see carmakers becoming global players, running their business on a global scale (Mentuccia, 2010).

Besides, authorities and governments are making pressure on automotive companies to comply with even more strict and articulated regulations. Thus, carmakers are striving to adjust their processes accordingly, in order to improve their efficiency and their ability to meet the new requirements (McGarrahan and Harris, 2008).

As a result, they are investing a lot of resources in research and product development processes, often neglecting all the remaining ones. In addition, the more "visible" is a process and its output, the more evident may be its need of improvement. Information and data processes are most of the times "hidden" processes, especially when they are based on paper and run through different departments and divisions. Often, information and data flows are left to an appointed responsible person, meaning that lot of space is left to one's "ability" and inventive. Rather than regulating these information and data processes, companies prefer count on someone's hands, determining, in most of the cases, the unclearness of these processes.

Carmakers, on global scale, count on a high number of hidden processes to exchange data and information among divisions and departments. Many "knowledge workers" in the automotive industry base their work just on the huge amount of data and information, which flows through the organisation. Most of the times, the data and information flows are not sufficiently regulated and controlled: we cannot even say how many documents, papers and forms transit on the desks of a certain organisation every day! But it does happen. When processes are less "visible", as information and data processes on paper, their possible failure and consequences are most of the times hidden, until the moment they occur.

Then, the question is: why don't we get rid of paper and automate these processes?

More than on the technological side, the challenge lies on the change management area, as automating a paper process means changing the actions people do to execute it. The challenge for managers is even bigger when this change has to cross the department's borders. In the following Chapters is introduced the solution developed for a global company in order to automate a cross-divisional data flow based on paper.

1.1 Background of the study

This Master's Thesis is based on the work done during a 1-year internship at Nissan Europe SAS, based Montigny le Bretonneux. Nissan Europe SAS is the holding company for European subsidiaries and pan-European operational support of Nissan Motor Company Ltd (Nissan, 2010). The work was conducted at the Engineering department, which is part of the After Sales Conversion and Accessories (AS C&A) division.

The After Sales (AS) division is engaged in the parts and accessories (e.g alloy wheels, parking systems, alarms, etc...) development and sales for after-market business in Europe, Russia and Turkey.

The Aftermarket business is seen with different perspectives by carmakers. Some pay high attention to it, while some others don't think it is a critical business function (Mentuccia, 2010). However, consideration of after-sales business among companies is lately increasing as the customers' trend is to postpone new vehicle purchase and hold on their cars for a longer time. That increases the importance of the After-sales business as a source of profit and as a mean to feed customer loyalty (Mentuccia, 2010).

With the aftermarket business, carmakers are engaged in providing parts, accessories and service to their customers. Accessories are most of the times manufactured by suppliers based on carmaker specifications. In order to be able to sell the accessories, car manufacturers must ensure if the accessories need to be homologated or not and, if so, proceed with the homologation. Accessories can be sold if homologated against national standards/requirements or against European standards. EU set a regulation WVTA (Whole Vehicle Type Approval) aiming at harmonizing the different national homologation systems present in the EU countries (WVTA, 2010), allowing thus a carmaker to sell all over Europe a vehicle WVTA homologated, with no need of additional national homologation.

The entire division coordinates its activities according to the NESAS After-Sales development process which indicates process flow, roles and responsibilities of the different departments.

Nissan Europe is in charge of different activities for the accessories business, which are carried out by purchasing, engineering, marketing, quality and pricing departments.

All internal activities and task related to the accessories business are described by the NESAS After-Sales development process, which includes the process for WVTA Homologation of accessories. The latter is described by the "Procedures manual for EC-WVTA homologation of option parts". If accessories are WVTA homologated they can be sold in all European countries with no limitation and substituting national homologation.

This project carried out as a BPR activity consists in the creation and implementation of an electronic process for WVTA homologation of accessories which aims at replacing the existing paper-based process.

1.2 The problem area

In the last 20 years the Business Process Reengineering subject emerged and made roots in the fiels of management, giving an important consistency to the related literature and making it widely available. The IT evolution offered new solutions (Simultaneous engineering, CAD, CASE, ERP, MRP, etc) to enterprises, being a trigger to initiate BPR projects and leading the researchers to focus on specific areas. As a result, the BPR literature is today more oriented towards the implementation of specific IT solutions (es. CAD, CASE, ERP). In addition, although data management and data workflows are well explained by high-level IT literature, which is mostly referred to software creation, there is a high fragmentation of studies and theories on how to cope with BPR of information/data flows, which can either be represent either the main flow for a process or a "support" flow. The following Chapter will present theories and concepts from BPR, workflows and information quality to build the theoretical foundations for this project.

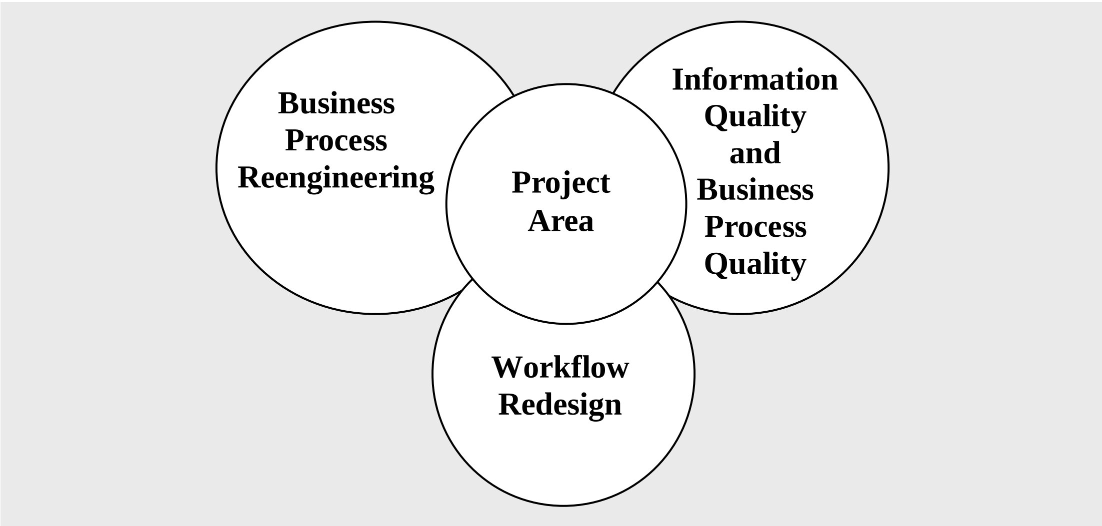

Figure 1. The project's theoretical domain.

In order to organize the different theories and concepts reported in this Thesis, will be defined the sequence of actions of a business process. This solution clarifies the part of a business process where the theories and concepts insist and will be described later in this paper.

2 Chapter: Methodology

This Chapter describes the methodology followed to conduct this project and introduces the research design adopted to solve a specific company problem.

This Master's Thesis is based on a project conducted to elaborate a solution for a problem of a case company. The problem was represented by a business process to be automated, requiring a Business Process Reengineering initiative, which consists of mainly two parts: analysis of an existent situation and design of a new solution. For the purpose of this thesis, the analysis part is approached as case study analysis. A case study can be done on a organisational process and a specific research design has to be developed, being a plan to link the empirical data collected to the initial research question and, eventually, to its conclusions (Yin, 2009). According to Yin (2009), there are five components which are particularly important for a research design, namely:

1. Study's questions, with questions as "what", "why" and "how" that result the most appropriated for the case study method;
2. Theirs propositions, if any, which set the direction of the study catalysing the attention on the what should be examined within the scope of the study;
3. The unit(s) of analysis, which defines what the case "is";
4. The logic linking the data to the propositions;
5. The criteria for interpreting the finding.

The research design elaborated for this project follows the path indicated by Yin (2009) with its five components and it is described in the next Section.

2.1 The research design

The *study questions* for this Master's Thesis are presented in form of problem statement and related objectives of the study, respectively in sub-subsection 2.1.1 and 2.1.2. The *propositions* set the direction of the study and consist of analysing the existing process for WVTA homologation of accessories, understanding its basic and automate it in order to increase the overall process performance. The *unit of analysis* is the process for WVTA homologation of accessories, which is a cross-divisional paper data flow.
The components of the research design and explained more in details in sub-subsections 2.1.3 and 2.1.4.

2.1.1 Statement of the problem

The problem statement for this project was formulated as follows:

"What are the main steps to follow and the techniques to use when reengineering and automating a cross-divisional business process which manages a paper data flow?"

2.1.2 Objectives of the study

Based on the case of the process for WVTA homologation for accessories, the project tries to achieve several objectives:

1. To analyze the current process, including performance, and identify areas of improvement;
2. To study what are the improvements that can be made by using an electronic process as replacement of the existing paper-based process;
3. To design and develop several alternatives for improving the process;
4. To propose the Business Process Reengineering (BPR) design in order to improve performance through the elimination of unnecessary steps or actions and, by consequence, reduce the number of follow-ups requested by process users;
5. To implement the re-engineered process through a simulation to test its efficiency and identify improvements so that the real process will not be affected.

2.1.3 The logic linking the data to the propositions

The research design used for the purpose of the project aims at linking the data to the propositions conducting two different activities, which were the *process analysis* and its *redesign*. The analysis had the objective to define the "as-is" situation on the basis of the analysis of the existent process. Once the "**as-is**" situation was determined, a redesign study followed aiming at defining the "**to-be**" situation, represented by a new design for the process.

Case analysis

The *case study* approach is used to conduct the analysis part of this project. It includes data collection, validation and analysis to understand the existing process for WVTA homologation of accessories. The components of the case study analysis are described in further details below here.

<u>Data collection</u>

To conduct the case analysis different types of sources and materials were consulted, such as field notes, manuals, written and electronic working documents, forms and interviews. The paper documents consulted were:

- Procedures manual for EC-WVTA option parts homologation
- Working documents used for the process, which were FOPL (Full Option Part List) and VE (Vehicle Enhancement) List;

Then, the two types of interviews mostly used for this project are, as defined by Barlow (2009):

- Unstructured interviews, stimulating stakeholders to present what they knew about some topics using open-ended question and verbal or non-verbal encouragers (e.g slides);
- Focus groups, which were carefully moderated to get some knowledge and relevant information about some topics; field notes were extensively used.

Key persons were selected in order to gather information and data, from different departments, divisions and managerial levels were consulted in order to obtain a high level of validity and reliability of the information. Key persons interviewed were:

- Michel Cedolin, NESAS C&A Engineering Section Manager;
- Michael Thewissen, NESAS C&A Engineering Section Manager;
- Louis du Garreau, NESAS C&A Business and Product Planning;
- Pascal Constant, NESAS S&A Engineering Manager;
- Kevin Brown, PMZ Engineer;
- Seji Takahashi, XB3 Manager;
- Nobuo Kanazawa, GAE;
- Nobuhisa Sekimoto, GAE;
- Gareth Dunsmore, NISA CMM.

During interviews and focus group, field notes were taken. According to Gambold (2009), the field notes represent a technique for collecting data and making field work into a case study: the translation of field work into a case study cannot be successful without proper field notes.

<u>Data validation</u>

The data collected during this phase of the project have to be questioned in matter of validity and reliability, as these two aspects represent the key elements to deem in order to conduct a rigorous research design (Yue, 2009). Validity and reliability determine the quality of any empirical social research (Yin, 2009), including case studies. As previously mentioned, the analysis conducted for this project follows a case study approach and it will then questioned in terms of validity and reliability.

According to Yue (2009), "*validity refers to the extent to which a concept is actually represented by the indicators of such concepts*" (no page available for quote citation).

After validity, reliability is the other key element in order to conduct rigorous research design and, according to Kerry and Street (2009), it "*assesses the extent to which the*

results and conclusions drawn from a case study would be reproduced if the research were conducted again" (no page available for quote citation).
Yin (2009) introduces some tactics to be used for dealing with the quality (validity and reliability) tests, which are reported in Table 1 (external validity is not considered as relevant for this project and will not be reported).

Tests	Case study tactics	Phase of research in which tactics occur
Construct validity	Use multiple sources of evidence	Data collection
	Establish chain of evidence	Data collection
	Have key informants review draft case study report	Composition
Internal validity	Do pattern matching	Data analysis
	Do explanation building	Data analysis
	Address rival explanations	Data analysis
	Use logic models	Data analysis
Reliability	Use case study protocol	Data collection
	Develop case study database	Data collection

Table 1. Quality test and related tactics adapted from Yin (2009).

An additional point brought by Yin (2009) is that the tactics should not be used only in the beginning of the case study, but their adoption should continue after the initial design plans.

Validity

In order to construct validity for this project, the tactic of triangulation was extensively used. Indeed, given the variety and types of sources consulted to collect the data and information (forms, field's notes, interviews, etc...) it was possible the use of different types of triangulation. To reduce any problems of deficiencies and bias, different types of triangulation derived from Evers (2009) were used, as:

- *Data source triangulation*, which consists in gathering data at different moments in time and with different persons.
- *Theory triangulation*, which is the use of different theory positions to collect and interpret data.
- *Methodological triangulation*, which is the use of multiple methods for gathering data (e.g., interviewing, document analysis).

- *Data type triangulation*, that indicates the use of different types of data as manuals, forms, written documents, field notes and they are a result of the triangulation of methods.
- *Analysis triangulation,* which consists of using several separate analytic techniques to validate the meaning in the data set. Analysis triangulation can also involve multiple units and levels of analysis (e.g., individuals, families, settings). The combination of analytic techniques enhances the breadth and depth of what researchers see in their data.

As just mentioned, it is plain how the type of information and data gathered for this project and then analysed (manuals, procedures, regulations, field notes, forms and working documents) was mostly qualitative data.
Relevant importance for this project had the qualitative analysis of the process, which was carried out at first stage. The sole analysis of the Procedures Manual and the working documents were not necessary as more information was needed to get a good insight of the process. Indeed, the manual was written by a former worker of the department, thus some knowledge was not actually included in the manual as it was probably taken for granted. Besides, it has to be highlighted the fact that the information reported in the manual may be not complete as a sole person may neglect some parts or information.
In order to catch the missing information necessary to have a good understanding of the process, its stakeholders were constantly interviewed during meetings or at any time it was needed. The interviews, most of the times, were not organised in form of a set of questions, but open questions were asked in order to get as much information as possible and also because the level of knowledge of the interviewer (myself) was not sufficient to ask precise questions targeted to specific topics (though some case like this did occur).

Reliability

The concept of reliability deals with the reproducibility of the results obtained by a case study (Kerry and Street, 2009). In other words, it assesses if the same results and conclusions are obtained if a case study is conducted again. The objective of the reliability test is to minimize the bias and error during the collection and the analysis of the data (Kerry and Street, 2009). The analysis part conducted for this project will be tested in terms of reliability, similarly to how it is done with a case study.
As Yin (2009) suggests, tactics to obtain reliability of a case study are the use of a case study protocol and the creation of a case study database.
When conducting the case analysis for this project, all steps followed, starting from the data collection and ending with the results, have been written down in this paper as well as the procedures and the actions taken. Hence, the process has been translated as a sequence of actions that should be reproducible, if the context and the initial conditions are the same. The data collection was conducted using extensively the method of

triangulation to reduce the bias and errors and status meetings were continuously done during the entire project, making several reviews. In addition, meeting minutes were constantly released to inform about the steps and actions taken for the purposes of this project. However, the results obtained are also related to the electronic application developed to best serve the redesigned process, and specific IT skills are required to reproduce it.

Analysis of the current situation ("as-is")

An analysis of the data collected was done and in order to avoid bias and error, the method of triangulation was used also in this phase as well as the other tactics proposed by Yin (2009). The data was collected and validated by *data source, data typ*e and *methodological triangulations*. Based on that, concepts and explanations were elaborated to explain unclear parts of the "as-is" situation, which were mainly related to the understanding of the current process (e.g. responsible person to perform a certain action in the process). Explanations were then presented and discussed, mostly during meetings, in order to get a high degree of validation. During the analysis phase, whenever any rival explanation emerged, this was properly addressed and conclusions were elaborated only after discussion.
In order to support and integrate the analysis of the current "as-is" situation, it was conducted a thorough review of the theories, tools and techniques in:

- Workflow and Business Process Modelling;
- Business Process Management;
- Business Process Reengineering;
- Key performance indicators and balanced scorecards;
- Business Process Management/redesign handbooks;
- Change management theory.

Then, the theories, tools and techniques were used to conduct *theory and analysis triangulations* aiming at supporting analysis of the "as-is" situation and build the foundations for the following redesign study. As it will be further explained in the Chapter 4, these theories will be integrated in the operational framework used to conduct this project.

Redesign study

It was conducted an investigation on the IT solutions currently used by the company to identify a suitable solution for the BPR project described in this paper. The IT solution for this case study was identified by the reengineering team as a combination of:

- eRoom, which is a platform for data-sharing available company-wise;

- Visual Basic for Application, which was used to develop an electronic application to be shared on the eRoom.

Several alternatives for the new design were proposed during this phase and their validity was tested by triangulation. The data type triangulation was used to test whether the solutions proposed by the electronic application were matching the actions the redesigned process was meant to perform. Then, in order to get high grade validation, the solutions were also proposed to the reengineering team, which chose the best solutions among the different alternatives.

2.1.4 Criteria for assessing the finding

The criteria for assessing the finding are case specific. For the purpose of this project they were established in form of project objectives by the reengineering team, as it will be explained in the next Chapters. Considering that the solution to propose for the new designed process was an electronic application, the criteria of interpretation were related primarily to:

- Reliability, to ensure that the electronic application could support the process with no failures;
- Compatibility, to ensure that the electronic application was compatible with the existing technologies.

Later in this paper, it is presented a comparison between result of analysis and results of the redesign. No precise information were gathered and stored about the performance of the old process and, therefore, its analysis was done with a qualitative approach. However, the performance of the new electronic process is measured, creating a database that will make possible to monitor the process over time.

The next Chapter will present the Literature Review conducted for this case study, which will be used jointly with an operational framework developed for this case study according to the research design.

2.1.5 Scope and limitations

The Business Process Reengineering (BPR) project presented in this paper is targeted to best serve a process designed to get, manage, elaborate and share data used for homologation process of accessories on Nissan vehicles in Europe.

Scientific literature available on specifically technical and managerial aspects of IT solutions for reengineering this type of data processes is limited and, as implementation of IT solutions is continuously and rapidly evolving, the literature is not up-to-date.

The study was conducted on the data-flow part of the process, meaning that extending the research to product-flow of the processes might need more powerful tools for planning, in & out goods and such (e.g. ERP).
Process analysis was done on working documents and through feedbacks from people involved, but no opportunity of analyzing a real case has occurred. Thus, some additional information may be lost.
The solution studied is only targeted to manage communication and result data (outputs) and it is not managing the physical items and technical and business aspects which are left to internal studies of the departments (divisions). Inclusion of these other aspects as material flow and cost may require conventional software packages (e.g. MRP, ERP, SAP). Besides, the BPR solution hereby presented is also developed specifically the type of data and the scale of the process for WVTA homologation of accessories performed by Nissan Europe and, even though is can be used as a base, is not applicable to any other similar process.
For the purposes of this project it was chosen to use available software packages for all Nissan divisions involved in the process (MS office 2003 and VB for Application version 5) and eRoom software version 7). The implementation results are monitored over a short span of time.

3 Chapter: Literature review

This Chapter gives an overview of the literature concepts used for this thesis. BPR is introduced, then literature is presented on how to understand, analyse and reengineer business processes with the contribution of theories and concepts picked up from related study fields.

The Oxford English (OED, 2011) dictionary defines **business process re-engineering** (BPR) as **“***a system or programme for a thorough review and restructuring of a company's organization and methods, especially so as to exploit the capabilities of information technology; abbreviated* BPR”.

Business process re-engineering is also indicated with the term **business process redesign**, defined as its synonym (BD, 2010).

In the 1990, Hammer (2010) introduced his own work in Business Process Reengineering (BPR) that later showed a main weakness in not being a continuous activity, but only episodic. However, Hammer himself highlighted the strength of BPR in redefine a process attacking delays, non-value adding activity, errors, complexity (Hammer, 2010). Besides the BPR brought also a different point of view on the matter, focusing more on the process design than the process execution.

Other than business process re-engineering and business process redesign, other terms that refer to the same subject can be found in the literature:

- *Business process improvement*;
- *Business process management*.

The first explanation of the use of different terms lies in the evolution of the discipline, which begun in 1990 with the definition of BPR given by Hammer and was later referred as Business Process Management. Figure 2 shows, on a time basis, the different terminology used by authors to refer to the BPR discipline (Reijers, 2003)

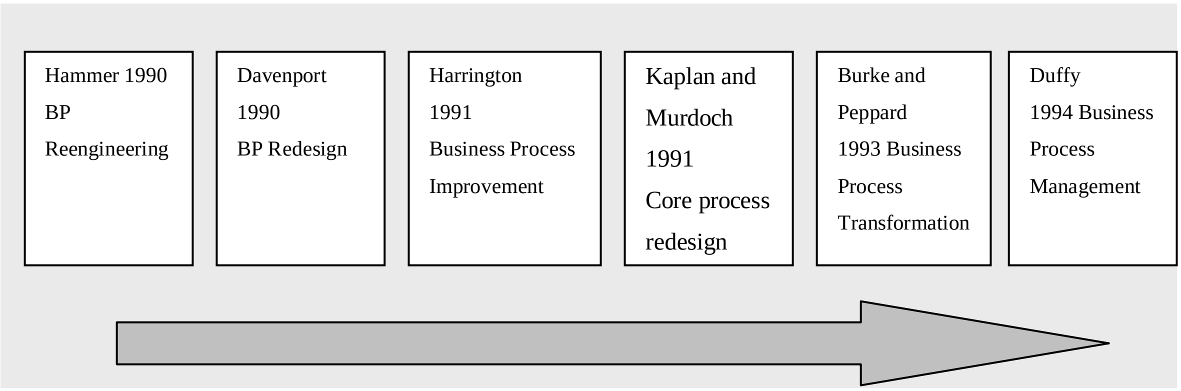

Figure 2. Terminology evolution for BPR (Reijers, 2003).

In the literature can be also found references to business process improvement (introduced by Harrington), which mainly refers to the improvement that can be made on a existent business process as also suggested by its definition: "*Improving quality, productivity, and response time of a business process, by removing non-value adding activities and costs through incremental enhancements*" (the business dictionary).

Business Process Management is instead a much wider subject as it indicates a comprehensive system for managing and transforming organisational operations. It was introduced first by Deming and Shewhart dealing with statistical process control which led to the quality movement and then up to the Six Sigma philosophy (Hammer,2010).

The Business Process Management is the latest concept as Hammer (2010) considers it the sinthesys of the two approaches of process improvement just mentioned, which are Shewhart and Deming approaches.

Another point of view on the discipline of process management consists of deeming the Process Management area originated by the confluence of Reengineering and Business Process Modelling, as illustrated by the Figure 3 (Reijers, 2003)

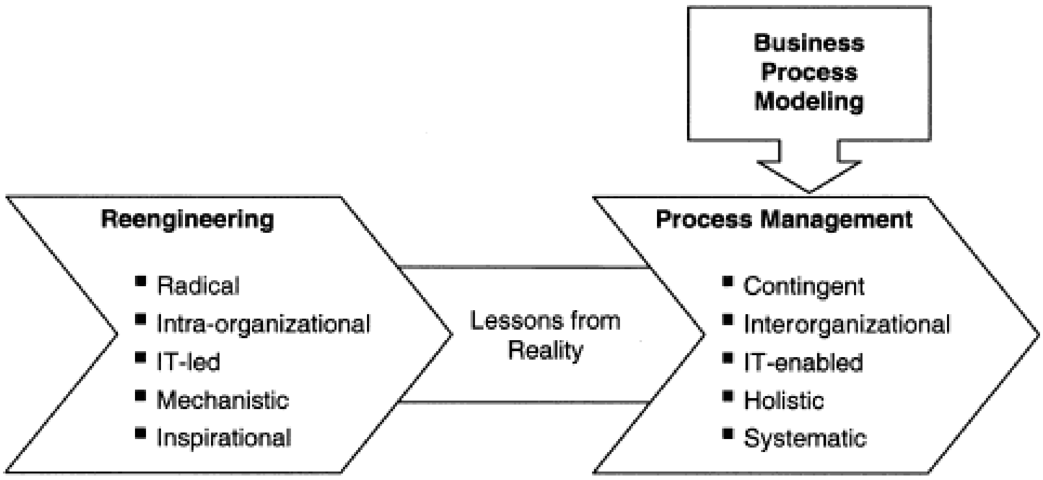

Figure 3. View on Process Management discipline (Reijers, 2003)

According to Hammer (2010), the advantages for enterprises to increase process performance through process management activities consist in operating at lower costs, faster speed, greater accuracy, reduced assets and enhanced flexibility. Besides, process management enables to focus on value-adding activitites, assure timing of output and its delivery and asses whether a process meets or not its needs and those of the customers. In the last situation, it is plain the importance of process management as enabler of a business process reengineering activity. Doing BPR, the organisation can get benefits which Hammer (2010) indicates in terms of consistency, cost, speed, quality and service. They result in lower operating costs and improved customer satisfaction, which in turn drive improved enterprise performance (Hammer, 2010).

3.1 Business process categorisation

In order to be able to understand a process and assess if there is a need of redesigning, it has to be classified and further analysed to get deeper knowledge.
Reijers (2003) suggests a first distinction between administrative and manufacturing processes: the “business outcome” or “output” that is, more explicitly, the process product, can be either a good, which has a physical manifestation, or a service, which has not. Hence, a business process that produces goods is more known as a manufacturing process, while one that delivers a service is commonly classified as a workflow, service or administrative process.
A business process can be further categorised in terms of execution frequency and level of standardisation (van der Aalst and van Hee, 2002):

1. Customized process, ad hoc process or project;
2. Mass-customization or production process;
3. Mass-production or transaction process.

In addition, van der Aalst and van Hee (2002) classify the business process depending on the place where it happens in the organisation, making a distinction among:

1. Primary or production process;
2. Secondary or support processes;
3. Tertiary or managerial processes.

3.2 Key factors for BPR

Having introduced the classification of a business process, its analysis can proceed further. Hammer (2010) suggests the key factors for BPM, which are also considered as the enablers of a process and the organizational capabilitites for a process.
The process enablers, which are critical for high performance processes are:

1. Process design, which indicates the specifications of the process (Who, what, when, where, with what info, etc);
2. Process metrics, which are the base to set targets and measure process performance;
3. Process performers, who are people with a specific set of skills suitable to realize the process and achieve its goals;
4. Process infrastructure, which are the IT and HR systems that support the performers when carrying out their process functions (e.g. ERP, training, compensation systems, etc..);
5. Process owner, who should be a person with authority and responsibility for the process across the entire organisation (e.g. senior manager).

Sharp (2008) also indicates a similar view on process enablers, which can be classified in six types, as shown in Figure 3: workflow design, Information Systems, Motivation & Measurement, Human resources, Policies & Rules and Facilities.

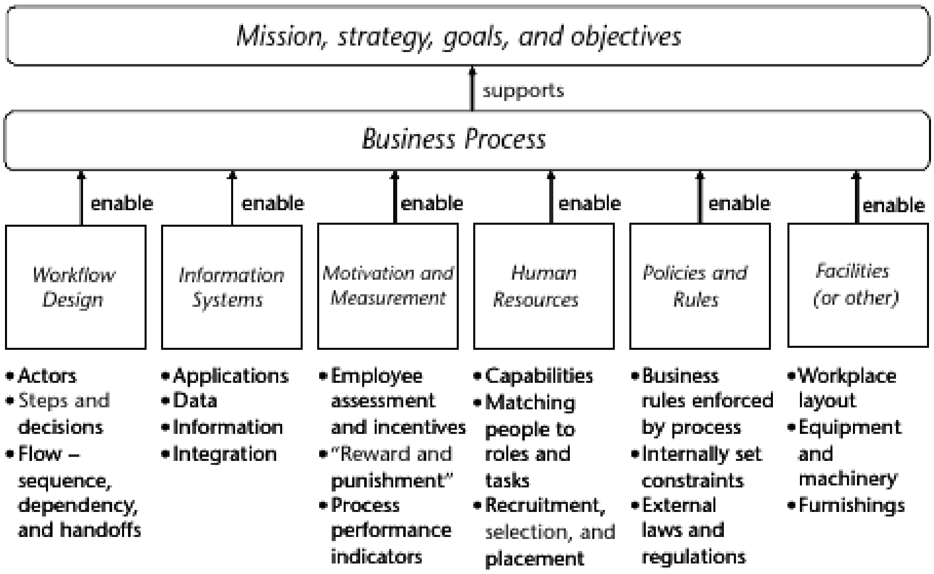

Figure 3. Six type of process enables indicated by Sharp (2008).

In order to install successfully in an organisation the enablers for a process, certain organisational capabilities are needed, which Hammer (2010) considers critical and indicates as, in order of importance:

1. *Leadership*, which is the "conditio sine qua non" to make the change happen, as resistance has to be won, resources assured and only a senior executive can take and hold the reins of the change, making it his/her personal mission;
2. *Culture*, with people of the organisation willing to accept the change, assuming personal responsibilities for the results and aware of the importance of the customer of the process;
3. *Governance*, necessary to assign responsibilities and ensure the integration of the processes (e.g. setting direction and priorities, addressing cross-process issues);
4. *Expertise*, as process management is a complex activity, companies need skilled people (e.g. good at process design and implementation, metrics, change management, program management)

Figure 3 shown earlier in this Section of the process management cycle can also be a hint to think of the process from a different perspective when a redesign activity is needed. In literature is widely adopted a view of process reengineering which look at it in terms of "As-Is" and "To-Be" situations (Reijers et al., 2010; Sharp, 2008),

Having categorised the business process, the analysis has to go further to lead to the next step, which consists in thinking about how to strengthen the process. Indeed, to reengineer a business process, the sole categorisation does not represent a sufficient analysis. BPR is a complex activity and it implies a further analysis of the process which is explained in the next Section. To avoid confusion, it is relevant to point out that, the analysis of an existing process requires an assessment activity, which is also part of the designing of the new process. Thus, as shown in the Figure 4, the boundaries between the "as-is" and "to-be" phases are not strictly defined but there will be cases of overlapping.

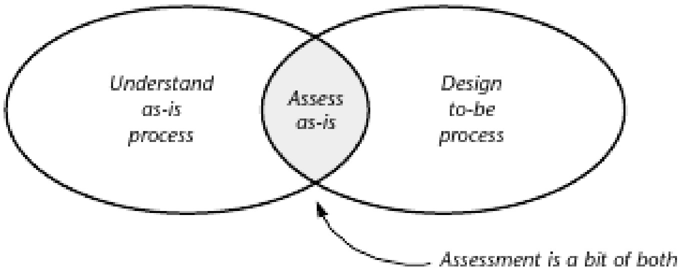

Figure 4. The assessment activity in BPR (Sharp, 2008).

3.3 Understanding the existent process

Peppard and Rowland (1995) suggest how to start looking at an organization, which is, as shown by Figure 5, built on three main pillars: processes, people and technology. When designing processes, the three pillars must consider the needs of the market, represented by its customer.

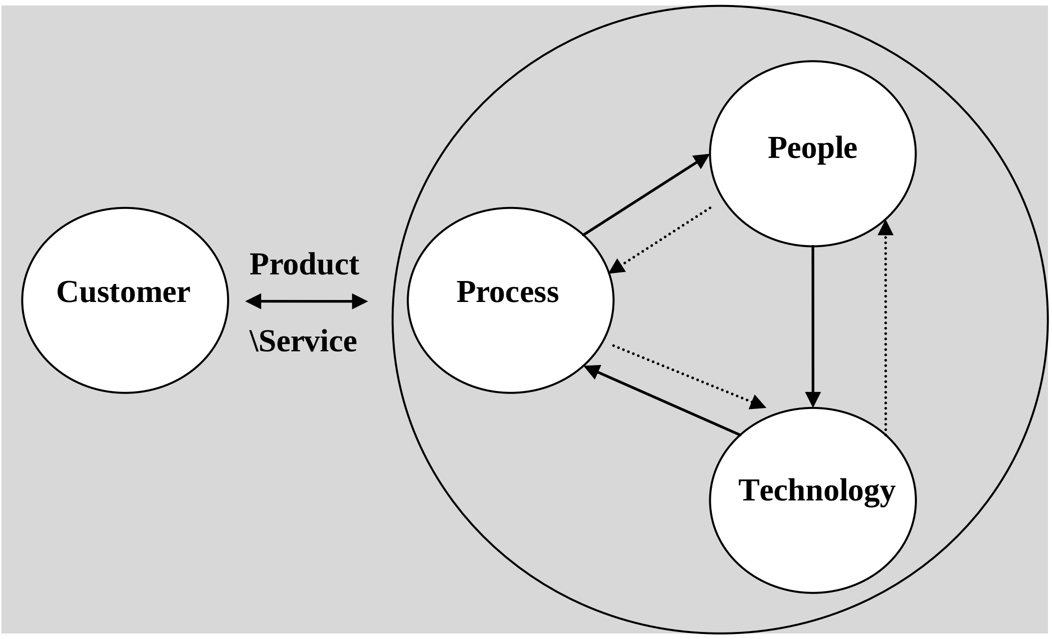

Figure 5. The organisational pillars (Peppard and Rowland, 1995).

For the purpose of this thesis, the focus will be on processes and technology. The people are considered only in relation to the function they have within the process. Deepening the research on the people's side would imply looking at aspects as transnational management, organizational design and the like, which would widen too much the scope of this research.

With regard to the process, BPR literature suggests different approaches to the analysis of a process. The process considered for this research can be easily categorized on the basis of the theoretical concepts illustrated in the previous Section as:

- Service, since the process consists of an information and data workflow;
- Primary process as it enables, based on its outcome, the product sales all over Europe based on its outcome;
- Customized - Ad hoc, as it is a dedicated activity.

Considered the characteristics of the process it is chosen to target the analysis of the process on:

- Data and information management, as the service process manages an information flow and has to ensure sharing of high quality information;

- IT systems, which, given the importance of the process, have to be reliable and error-proof, as already introduced by the Criteria for assessing the finding in Sub-subsection 2.1.4;
- Specific solutions as workflows, measurement, given that the process is dedicated to a specific activity.

Therefore, specific topics are picked up from the existing literature on BPR in order to proceed with the analysis of the existing process, aiming at getting a sufficient understanding of it. Indeed, according to Shin and Jemella (2002), a detailed knowledge would be counterproductive for the redesign activity, as also explained in the later Sections.

The topics for the process analysis, illustrated in Table 2, are chosen taking inspiration from the process enablers mentioned by Hammer and Sharp, which are described in the previous Section.

Process enabler	Topic
Process design	Workflow diagrams
Process metrics (motivation and measurement)	Stakeholder analysis, KPI
Process infrastructure	Applications, data, information, integration

Table 2. Process Enabler for this project.

In matter of process performers no further details will be presented, since, as explained before, the people side will not be explored thoroughly and the process owner had been already identified in the project leader.

3.3.1 Process design

The process flow

The theory on workflows will not be presented in details as, also the next Sections will point out, it is not the purpose of this project to build a solid theoretical ground, but the research on workflows will be source of inspiration for developing an IT tool for this project.

Workflows for Business Process Reengineering are manly adaptation of IT workflows (Reijers, 2003; Peppard and Rowland, 1995). As IT led BPR within organisations, workflow mapping became a practice well adopted around organisation as a mean to understand and monitor the processes, creating specific electronic tools.

Different interpretations of workflow can be found in literature.

The workflow management has the objective of modelling and controlling the execution of complex application processes in different domains as business, electronic learning, natural sciences and so forth (Reijers, 2003). The workflow models are instead a representation of application processes which are used by workflow management systems for controlling the automated execution of workflows. The workflow models are developed on a project basis making them kind of unique. However, it can be outlined a general process for the development of the workflows.

Workflow types

Sharp (2008) indicates different types of workflows which show work flows that involve combination of people, systems, machines, or other mechanisms.

The first point which has to be made is on the distinction between the two types of workflows which constitute a business process. One is the data/information workflow and the other one is the product workflow also known as manufacturing process (Reijers, 2003). As the latter is managed mostly by using targeted IT solutions as e.g. ERP or CSP and it has not be considered for this project, focus is kept on the data and information workflows.

Once determined that the product of the workflow is actually information, there are some main differences between a workflow and a manufacturing process as indicated below (Van der Aalst, 1999):

- Making a copy is easy and cheap;
- There are no real limitation with respect to the in-process inventory;
- There are less requirements with respect to the order in which tasks are executed;
- *Quality is difficult to measure*, as criteria to assess the quality of an informational product are usually less explicit than those in manufacturing environment;
- Quality of end products may vary;
- Transportation of electronic data is timeless.

A general workflow diagram shows what is done, by whom, in what sequence—“who, does what, when”. Sharp (2008) mentions how, in the field, is common to say that workflow models depict the three R’s— roles, rules, and routes. “Roles” refers to the actors who complete steps in the process. Responsibilities are the individual steps that each actor performs. Routes are the flows and decisions that connect the steps and therefore define the path (or route) that an individual work item will take through the process. It is then a key characteristic for workflows to adhere to the 3R formula to meet the purposes they are built for (Sharp, 2008). With regard to this project we can differentiate two types of workflows. One is the workflow that has to be reengineered, which has a current version and a second version after the redesign of the process. A second type of diagram is the one that will guide the map of the IT tools. Generally

many authors refer to Petri nets about the creation of workflow diagrams as base of electronic processes to be performed by software based on the Petri nets themselves.
Indeed, as Reijers (2003) states Petri nets are used as the basis for modelling workflows. Since Zisman in 1977, who used Petri nets to model workflows for the first time, several authors have modelled workflows in terms of Petri nets, amongst which Ellis in 1979, Lee in 1992, Ellis and Nutt in 1993, Merz et al. in 1995 and Van der Aalst and Van Hee, in 1996.
The choice for Petri nets is consistent with a task-oriented view on workflows.
However, taking into account the objectives of this project and considering that the electronic application will be develop on an empirical base, the Petri Net's theories will not be used for software development purposes.

Workflow diagram use

The use of workflow diagrams can serve different purposes as mentioned by Reijers (2003). Some of them are particularly relevant for the objectives of this project:

- **Communication and training**, as workflow models that can be used for introducing to newcomers the overall structure of the business process, the products that are delivered by it, and the dependencies with other parts of the company;
- **Simulation and Analysis**, with executable specification of a workflow to be used for simulating the behaviour of the workflow under different circumstances;
- **Documentation, Knowledge Management, and Quality,** with the workflow model that indicates work instructions on each of its tasks (instructions can be consulted by the resources responsible for their execution) and can be a support for Total Quality Management (TQM) implementation, providing a clear business process codification to reduce role conflict and ambiguity, thereby increasing work satisfaction and reducing feelings of alienation and stress.
- **Enactment,** with the workflow that can be managed and controlled, through its model, in real-time by an enterprise system such as a Workflow Management System or Enterprise Resource Planning System;
- **System Development,** with the workflow model that acts as input for system development activities, specifying functional requirements for the supporting systems that have to be modified or build;
- **Management Information,** with the workflow model that identifies and specifies the key mile stones within a workflow from a manager's perspective**.**

3.3.2 Process metrics

As previously introduced in this Section, process metrics are defined by Hammer (2010) as the base to set targets and measurement for the process.
Since every organization has its own strategy and objectives to achieve, measurement acts as a compass that allows the user to constantly monitor his direction towards the destination.
Kaplan and Norton (1996), in their publication on balanced scorecards, suggest the importance of metrics:

“If you can’t measure it, you can’t manage it” (p.21).

The theme of performance measurement is widely covered in business process re-engineering and management literature: *Key Performance Indicators (KPIs)* and *balanced scorecards* are two of the most common used approaches. *KPIs* are defined by Parmentier (2009) as “a set of measures focusing on those aspects of organizational performance that are the most critical for the current and future success of the organization” (p.4).
Instead, the *balanced scorecards* have been developed with the aim of combining financial measures of past performance with measures that are linked to the future performance of the organization, considered based on the following aspects: financial, customer, internal business process, and learning and growth.
Therefore, the balance scorecard is a framework that translates vision and strategy into a set of measurable parameters, as stated by Kaplan and Norton (1996). As for the scope of this project is limited to the process itself, no financial aspects are considered, balanced scorecards will not be applied to this case, but references to related theory will be made to set the necessary performance measures for the process.
When an organization engages itself into a process redesign project, objectives and targets are set for the new activity in line with the overall vision and strategy of the organization. As mentioned by some authors (Parmentier, 2009; Kaplan and Norton, 1996), managers and key people are addressed by a great amount of data and information day by day. Not all the times the information is the right one or it is handled in the best way to make decision. At the same way, a process reengineering activity needs good indicators which can be considered in form of KPIs and/or balanced scorecards.

How to find out KPI for the process

When BPR projects start, they are surrounded by uncertainty, due to the fact that the “to-be” situation is not clearly defined as well as objectives: a blurred vision of the new situation dominates the scene. Often, in the case of paper processes, also the “as-is” situation does not appear very clear, due to the intrinsic limits of a paper process (e.g. difficulties to track the actual process and understand the value-adding activity, poor understanding of the process and its objectives by the people, etc). This implies that, though a rough vision/idea of how the new process is shared among stakeholders, details are still far from being defined. So, project objectives appear fuzzy during the early phases of the project. In order to establish a proper system of measurement for the process, having said the importance of strategy and objectives, it is plain how the first step to do is to set, refine or make explicit the objectives, which will indicate the way to build the performance measurement system.

KPI and process objectives

Every process in an organization is set to perform a certain work and achieve certain objectives, which are related to both the process itself and overall organizational objectives and strategy.

A manufacturing process is set to give products as output in a determined time, meet certain criteria as cost, quality and so forth.

An information workflow, created for managing data, implies an understanding of what are the objectives and the targets for an electronic process in order to be able to set the good parameters and build on the proper performance measurement system.

The way to explicit the objectives of the project is pretty straightforward. Under the pressure made on organization by the IT wave during the 90s, it is common belief that there are benefits in turning the paper workflows into electronic processes. Most of the times, the electronic processes is a top-down decision. As a result, not many people around organizations understand where the benefits in having electronic processes are and thus objectives are often not defined for this kind of projects.

This problem area is widely touched in the literature, though it is hard to find where and when it comes into the sphere of BPR. Davenport (1993) wrote on the BPR activities done for process automation, but this is still not sufficient to clarify the issue. A lens to look at the matter and see it more defined is represented by the convergence of the subjects of Information Quality, BPR and Business Process Quality, as shown by Figure 6.

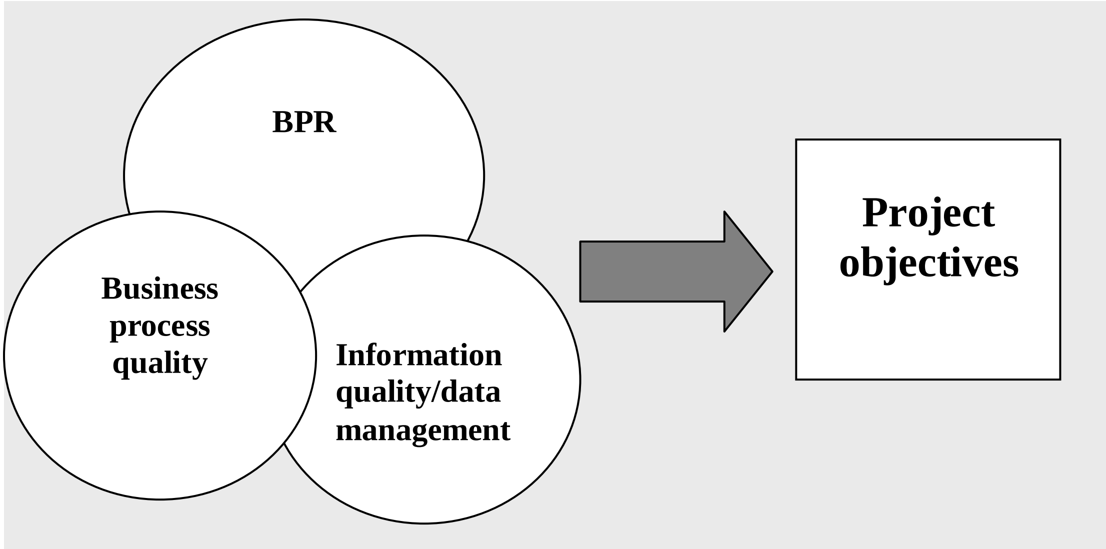

Figure 6. The theories that determine project objectives.

Lee et al. (2002) state how, following the growing amount of information and data warehouses dimensions of companies around the world, information quality is becoming more and more critical and no tools and/or framework to assess information quality are widely recognized. Lee et al. (2002) present a classification of IQ in 4 dimensions: *intrinsic*, *contextual*, *representational* and *accessibility*.

Intrinsic IQ implies information has quality on its own right; contextual IQ states how IQ must be referred to the context at hand, which means having information timely, complete and appropriate so that it is value-adding; representational and accessibility IQ highlight the importance of computer systems to store and provide information, making it easy to access, to handle, to share but through an accessible and secure environment.

Then, Lee et al. (2002) propose also what IQ measures are important for some organizations involved in the study. Most rated were *accuracy*, *completeness*, *consistency*, *validity*, *timeliness and uniqueness*. For the purpose of this project, the IQ dimensions and their measures highlighted by Lee et al.'s study can not be used rigorously from a research point of view, but they become a relevant source in order to define objectives and their measurement. As a result, the reference to the IQ studies will be done only considering as focus its convergence to the BPR and Business process quality areas.

Another source to refer when looking at the quality features of a business process is offered by Heravizadeh et al. (2008). Here quality dimensions are identified as Function, Input/Output, Non-Human Resource and Human Resource. Figure 7 gives an overview of the quality requirements for each of the dimensions.

Function	Input/Output	Non-Human Resource	Human Resource
Suitability Accuracy Security Reliability Understandability Learnability Time Efficiency Resource Utilization Effectiveness Productivity Safety User Satisfaction Robustness	Accuracy Objectivity Believability Reputation Accessibility Security Relevancy Value-added Timeliness Completeness Amount of Data	Suitability Accuracy Security Reliability Time Efficiency Resource Utilization Effectiveness Safety User Satisfaction Robustness Availability	Domain Knowledge Qualification Certification Experience Time Management Communication Skills

Figure 7. Dimensions of Business Processes Quality (Heravizadeh et al., 2008).

Having identified the project objectives and the parameters (quality dimensions) to evaluate a business process which manages a data workflow, the appropriate KPIs have to be set in order to shape the process redesign activity and monitor its progress towards the realization of the new process desired.

Establishing a performance measurement of the process

Having identified in the data workflow the value-adding activity(-ies) of the process has to be identified. Kaplan and Norton (1996) propose an approach on how to set up key performance indicators: the starting point is represented by the strategy, which is summarized as a set of hypothesis about cause and effect relationship, which is in turn a set of if-then statements.

Kaplan and Norton (1996) state that what a balanced scorecard, intended as a set of Performance Indicators, should do is "*tell the story of the business unit's strategy through such a sequence of cause-and-effect relationships*" (p.149).

Therefore, the measurement system has to make the whole manageable, making explicit the sequence of hypothesis about the cause-effect relationships existing between outcome measures and the performance that determines those outcomes.

More in details, the generic outcome indicators can be profitability, market share customer satisfaction and many more, while the performance drivers are lead indicators. They are specific for each business (e.g. the financial drivers of profitability), the market segments in which the unit chooses to compete, the particular internal processes and the objectives that will deliver the value propositions to targeted customers and market segments. Kaplan and Norton (1996) conclude that:

"A good Balanced Scorecard should have an appropriate mix of outcomes (lagging indicators) and performance drivers (leading indicators) that have been customized to the business unit's strategy to tell how the outcomes have been achieved" (p. 150).

Setting Key Performance Indicators

If a Key Performance Indicator has to be set for a process, this should indicate how the process is actually doing better over time. It can be useful to concentrate on the aspect of the process which is creating value for the organization. A value adding activity can be conducted so that the Value Adding (VA) activity(-ies) of the process can be found out and, at the same time, the Non Value Adding (NVA) actions will be identified and considered for elimination.

Conger (2010) proposes some steps to follow in order to conduct a Value Adding Analysis, for a process with an output to be delivered to a customer. Adapting the procedure for the purposes of this project, the steps can be summed-up as follows:

1. Map the process.
2. List all process steps and place them in a table with four other columns for duration, value adding activities (VA), non value-adding activities that are required (NVA), and non value-adding activities that are unnecessary (NVAU).
3. Review each process step considering if, after eliminating one activity:
   a) Somebody will be affected by that;
   b) Somebody will ask for that activity to be restored;
   c) Overall process will be affected by the activity elimination;
4. Evaluate all NVAU activities for elimination;
5. Evaluate remaining activities for automation, outsourcing, or co-production.

NVA and NVAU activities that do not appear able to be automated or eliminated are marked for further analysis for streamlining, outsourcing, or some other replacement with VA activities.

As mentioned by Kapland and Norton (1996), it is proposed to link the measurement system to the financial measures but it is not the purpose of this project to examine the financial side of the process, as there is no relation between the information flow and the financial aspects.

Stakeholder analysis

A process in an organization is performed by people, who are given tasks and responsibilities. Understanding a process is also a matter of understanding the actual tasks and responsibilities of the people: they are the process stakeholders and will be the key for the process redesign. Indeed, people are and remain the final users of the process: they have expectations from the process and thus they have more or less influence on that. A process redesign activity which will be not supported by the process performers is likely to fail.

Process stakeholders do not have all the same expectations and are not all at the same level: Johnson et al. (1998) state that "stakeholder mapping identifies stakeholder expectations and power and helps in understanding political priorities" (p. 181), suggesting the importance of stakeholder mapping to get a "political picture" of the situation and set up a proper action plan.

Through the use of the power/interest matrix (Johnson et al., 1998), shown in Figure 8 as an adapted model from matrix proposed A. Mendelow, the following issues can be better understood:

- If the actual power and interest of the stakeholders is reflecting the corporate governance framework in place;
- Who are the blockers or the facilitators and how any unfavorable situation can be overcome;
- If some stakeholders would be better repositioned, taking into account the feasibility of this action;
- Maintain favorable situation avoiding they turn into unfavorable (e.g. keeping stakeholders is C quadrant satisfied, avoiding that they reposition themselves.

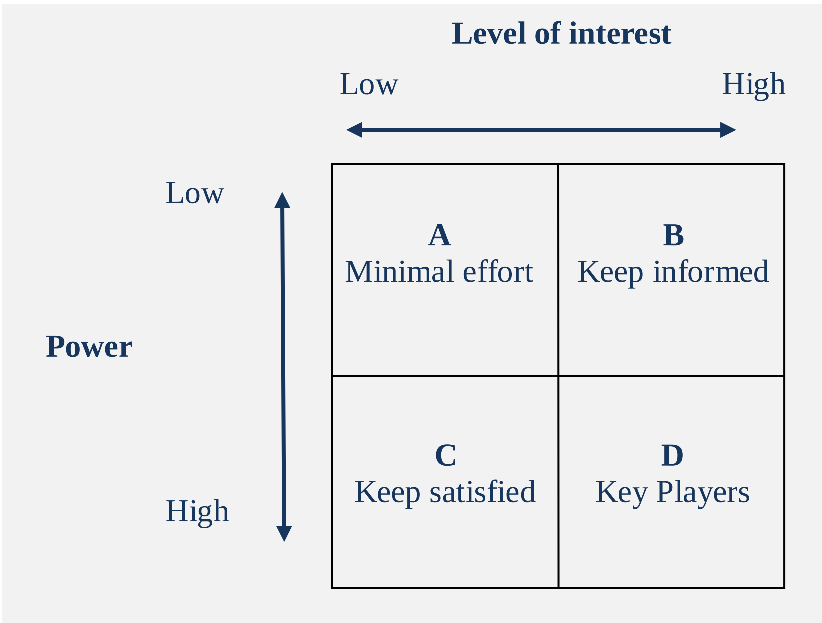

Figure 8. Power/interest matrix for stakeholder mapping (adapted from Johnson et al., 1998).

Moreover, mapping stakeholders and understanding which are their expectations is also related to a power issue. Johnson et al. (1998) define power as the "mechanism by which expectations are able to influence purposes and strategies". In this context, power can be

better explained as “the ability of individuals or groups to persuade, induce or coerce others into following certain courses of action” (p. 185). It is plain how any action taken must consider the power issue in order to set an appropriate strategy, especially when reengineering a process.
Another approach widely used for stakeholder analysis is also the one offered by Gardner (2004), where stakeholders are rated on the basis of their support and influence, which determine the impact score. Then, the impact score is an input to decide what kind of strategy/action has to be chosen in order to decrease potential threats or increase potential benefits brought by stakeholders that could affect the project.
More detailed approaches to stakeholder analysis can be found in the literature as can be seen from the studies conducted by Fletcher (2002): in order to find out stakeholders' expectations it indicates a process of defining KPAs (Key Performance Area), chosen by the stakeholders themselves. In the later Sections, it will be presented a practical application to this project of the theories here introduced.

3.3.3 Process infrastructure

Nowadays, thanks to Internet and the IT development, the quantity of available information around companies is more and more increasing. Hence, the quality of information becomes a critic point for organizations and individuals. That is also, and perhaps primarily, a management challenge (Eppler, 2003). In fact, knowledge work is more and more collaborative and distributed and information is both an input and an output of the processes.
A first distinction is made by Eppler (2003) between data and information. Data is “raw”, unconnected, qualitative or quantitative items and becomes information when it is put into a context and related to other data.
Then information is input, output and production factors of a certain business process (Eppler, 2003). When aiming at managing information and its quality, it must be ensured that there is high value information provided to knowledge workers, who need in knowledge-intensive processes: the goal is to improve usefulness and validity of the information (Eppler, 2003).
The problems which can be encountered in matter of information quality are reported by Eppler (2003) (e.g. Limited usefulness, Ambiguity, Incompleteness, Inconsistency, Inadequate presentation format, Reliability, Accessibility, distortion), thus the need of establishing criteria to evaluate the quality of the information emerges. Based on a study of criteria proposed by different authors, Eppler (2003) proposes his 16 criteria, which are then integrated in a 4-step framework, called the information usage cycle.
Table 3 shows criteria derived from Eppler (2003) with some of them that will be selected and applied for this project.

Criterion name	Description	Sample indicators
Comprehensiveness	Is the scope of the information adequate (not too much not too little)?	Scale of a geographic map
Clarity	Is the information understandable or comprehensible to the target group?	User feedback/number of follow-up
Correctness	Is the information free of distortion, bias, or error?	Numbers of errors in a document
Currency	Is the information up-to-date and not obsolete?	Number of outdated items in a database
Convenience	Does the information provision correspond to the user's need and habits?	Numbers of necessary process steps to access information on line
Timeliness	Is the information processes and delivered rapidly without any delays?	Time from creation to publication
Traceability	Is the background of the information visible?	Percentage of items without authors and date indications on a intranet
Accessibility	Is there a continuous and obstructed way o get the information?	Downtime of an information system per year
Security	Is the information protected against loss or unauthorized access?	Number of required passwords
Maintainability	Can all the information be organized and updated on an on-going basis?	Number of administrator hours required per period
Speed	Cam the infrastructure match the user's working pace?	Response time of the server

Table 3. Criteria for Information quality derived from Eppler (2003).

BPR and IT

BPR has had an increased importance for companies in the last decades getting on the wave of IT technology. Companies invest more and more money in IT improvements, though sometimes they do not have high returns in terms of profits. That's because it is applied to existing processes, which do not change. Inefficiencies were kept, resulting in unsuccessful investments in IT. Processes have to be reengineered and changed to allow IT to bring benefits.

When doing reengineering activity to automate existing process, it is key to assess the type of IT change an organization will go through as well as internal capabilities to perform the change. As Peppard and Rowland report (1995), the choice of internal IT departments to develop new software is risky as systems may be delivered late, over-budget and with user not satisfied.

3.4 Reengineering the process

An essential process management cycle is proposed in Figure 9 (Hammer, 2010), with the illustration of the different actions performed during the cycle life.

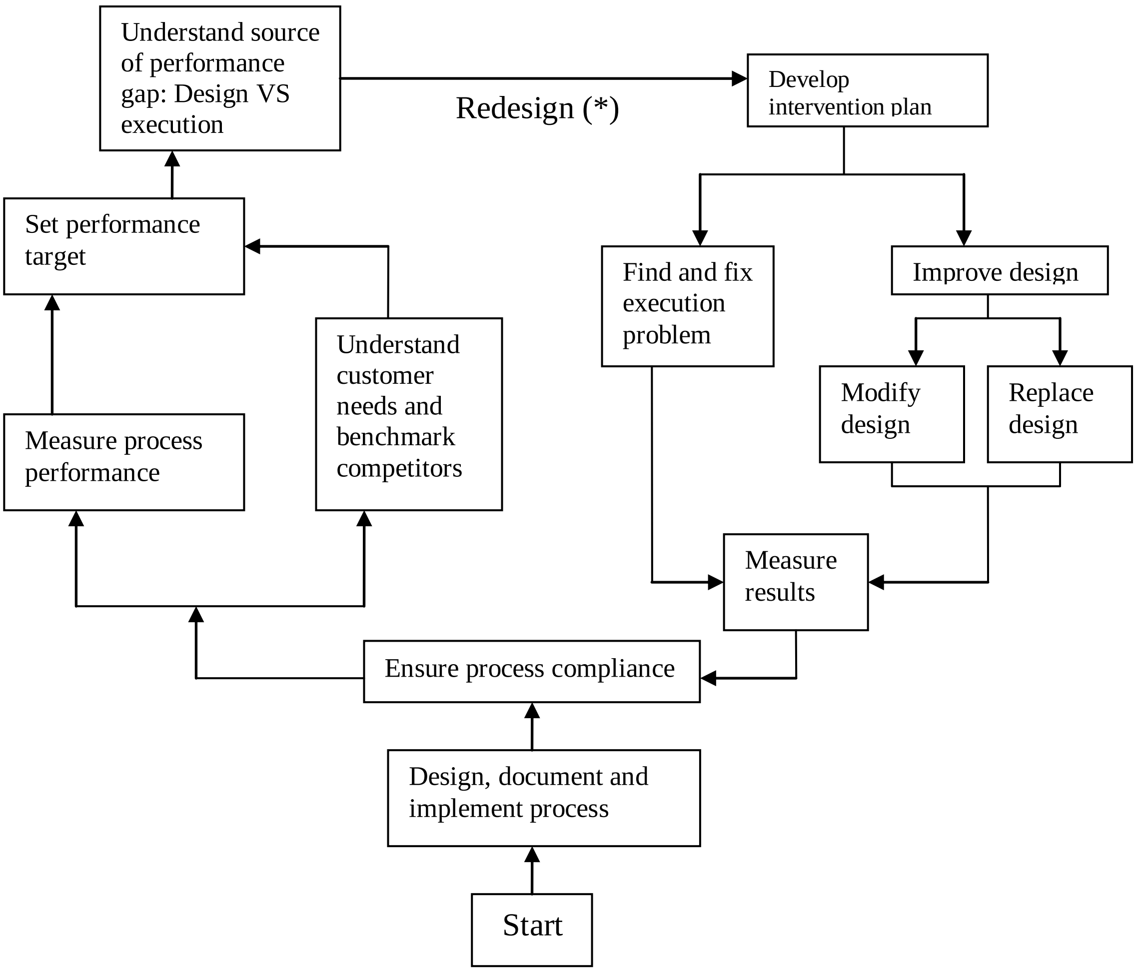

Figure 9. An essential Process Management cycle (Hammer, 2010).

The process starts from the bottom, being designed and implemented. Then targets are set depending on process objectives. If targets are not met the cause is, according to Hammer (2010), most of the times a *faulty execution* or a *faulty design*. When the fault lies in the design of the process, intervention is hard to make as the process needs rethinking and redesign (*), illustrated on the right side of the Figure 9.

This Section present the findings from the BPR literature review conducted for this process with the aim of building a background on reengineering of business processes to transform paper-based data flows into electronic processes.

The first part presents how to categorise the process, the second introduces the issue of analise and understand an existing process and the last part is on how to reengineer the process creating a new design.

Some major issues have to be investigated in order to be prepared for reengineering a business process and start to define the “to-be” process. The most important are:

- Evaluation of the existing business process as a base for the new redesigned process;
- Level of investigation and understanding of the existing process.
-

According to Peppard and Rowland (1995), the approaches taken when carrying out BPR activities are classified as either *systematic redesign* or *clean sheet.*
Systematic redesign approach consist on identifying and understanding existing processes and then it proceeds in a systematic way working for the creation of the new process which delivers the desired output.
The *clean sheet* approach re-thinks the process and the way of delivering the outcome to make a new design out of scratch.
Depending on the kind of change companies want to put in place with BPR, one approach is preferred to the other. Incremental change is preferred when aiming at performance improvement of the process in the short term, whilst looking at the medium-long term, the clean sheet is more likely to be adopted to introduce new ways to compete.
Peppard and Rowland (1995) state how **systematic redesign** can be made more quickly, in small chunks and at a reduced risk for the companies. As example, Japanese car manufacturers with their *kaizen* philosophy have made huge improvements as sum of many small changes that were implemented. Indeed, the best for companies would be to make systematic redesign part of their Business Process Management activity, in alternative to Business Process Re-engineering or Business Process Redesign.
Clean sheet approach is also defined by Peppard and Rowland (1995) as capable to give companies good chances of performance leaps. It is about starting from the target and the desired result and work back creating a design to make it happen. The main reason that drives the choice of a clean sheet approach lies in either a failure of re-engineering of existing processes with no satisfying results or in the belief of being arrived to a “breakpoint”. Risks when starting with a clean sheet approach are higher.
However, there are many factors that influence the choice of the approach for BPR, as organisational readiness for change, scale of the change and so on. As a result, many times companies end up in choosing a mix of the two philosophies
The choice of one approach instead of the other will also have implications for shaping the BPR project, according resources, choosing the change agent/team, technologies and so on.

Besides, there are some required characteristics for conducting BPR projects that are, according to Peppard and Rowland (1995), a combination of:

- Motivation, with a clear outline on where the change will lead the organisation as well as targets to set organisational challenges to make employees start work towards them;
- Attitude, with teams which should adopt a questioning attitude, especially towards assumptions which do not have to be taken as granted;
- Knowledge, with teams that should gain knowledge on the existing process and on the potential improvement, where knowledge will have a key role in supporting decision under uncertainty;
- Creativity and Innovation, that must be supported by “out of box” thinking, helping the organisation in discovering new areas of improvement which will be the starting point for redesigning the processes.

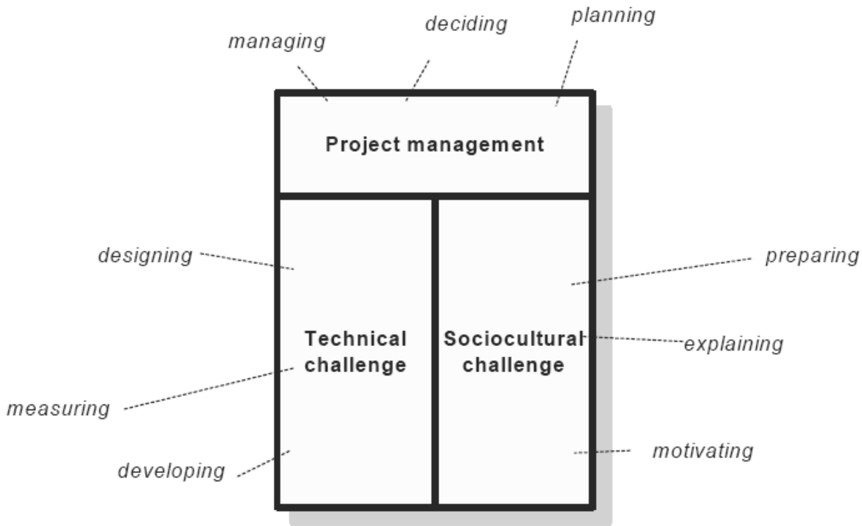

Figure 10. The components of a BPR project (Reijers, 2003).

Figure 10 indicates how to look at a BPR initiative and individuate its components. The components of BPR are contained in three main areas, which are:
- Project Management;
- Sociocultural challenge;
- Technical challenge.

According to the Problem statement presented in Subsection 2.1.1, the next Sections will focus on the areas of project management and technical challenge.
A reengineering process activity will pass through a series of steps which will eventually determine its success or failure. This Section outlines the relevant steps to take when going through the design phase of a BPR project.

3.4.1 Build the new process design

This phase aims at building a high-level process concept on the base of the vision developed at the first stages of the process (Davenport, 1993). Davenport (1993) mentions there is more to say on the activities which lead to the design phase than on the latter itself. Creativity and a capable group of people are important ingredients to analyse the elements and information previously collected and synthesize it to generate a new designed process. In addition, the people directly responsible for the process redesign activities should involve the different stakeholders in this process as their view is fundamental. Even if the design phase may take longer time involving all the stakeholders, it can result in shorter implementation time of the new process (Davenport, 1993). Davenport (1993) states how the solution chosen to develop the new process, should be able to perform some actions as:

- Graphically represent the process steps as well as material and information flow between steps;
- Rolling up the process steps in a sequence;
- Have a high interactive and graphical user interface;
- Produce real-time graphical output;
- Identify key bottlenecks in the process.

A particular attention should be paid when designing the features of the new process and assessing which IT-tool will be chosen to execute the new process and meet its requirements. Ideally, the two actions should be conducted hand in hand in order to find the convergence and achieve the objectives (Davenport, 1993).

To develop a new design, it is quite important the idea generation to perform through brainstorming, looking at best practices and involving stakeholders and so on (Sharp, 2008). Indeed, as stated by Sharp (2008), the way from the “as-is” state of a process to the “to-be” is most of the times not clearly defined, making relevat the importance of the creativity and the idea generation to design the new process.

3.5 Implementation

Implementation is also a complex part when doing BPR. Peppard and Rowland (1995) claim how redesigning activity of a process is rather simple when compared to the implementation, as many BPR projects fail when time comes for the implementation. In fact, organisations and people within them are resistant to change. Then the implementation phase of a BPR initiative should be highly considered and some important steps have to be followed.

Different approaches are presented in the literature regarding implementation of the new process. Peppard and Rowland (1995) present a brief framework to approach implementation of BPT, which consists of five phases:

1. Create the environment;
2. Analyse, diagnose and redesign processes;
3. Restructure the organisation;
4. Pilot and Roll-out;
5. Realise vision.

The five phases are described in more details, with the exception of *create the environment* and *restructure of the organisation* phases, which were not conducted for this project. The phases mentioned below, will be used as source of inspiration for conducting this project, being included in the operational framework, illustrated in the next Section.

3.5.1 Analyse, Diagnose and Redesign Processes

A reengineering activity starts with an analysis of the "as-is" situation of a process. The reengineering agent (or team) should be careful to not spend too much time on that as reengineering a process needs the creation and adoption of new solutions for the process, which can be affected by sticking too much on the way things are currently done (Peppard and Rowland, 1995; Shin and Jemella, 2002). Peppard and Rowland (1995) propose a step-based model to adopt for this phase of the BPR initiative, which is as follows:

- Recruit and train teams;
- Identify process outcomes and linkages;
- Diagnose condition;
- Benchmark best practices;
- Redesign processes (systematic or clean sheet, or a mix of them);
- Review people requirements of new process design;
- Review technological requirements of new process design;
- Validate new process design.

The practical application of these steps will be described in Chapter 5.

3.5.2 Pilot and roll-out

After having determined the new design of the process, the critic point is how to put it in place. A simulation is recommended to test the new solution prior to its actual implementation. Depending on the product output of the process, the simulation might have high costs, thus limiting the possibilities of testing for the redesigned process.

Obviously, when the process consists of a data-flow, the simulation can be done nearly without any constraint in terms of budgeting.

Pilot

The new processes should be laid down in cooperation with selected actors and in two steps, which are the pilot and the roll-out (Peppard and Rowland, 1995). The pilot is a smaller scale, but fully operational, implementation of a new process in a relatively small unit of the organisation (Davenport, 1993) and its advantage is also to make the migration to the new process less radical. The roll-out follows the pilot and refers to the actual implementation of the new process. The selection of the pilot is considered crucial for the success of the overall BPR activity and some characteristics are required as *make visible the improvements brought by BPR on the process* and *have high chances of success without being too complex.* Once the pilot is launched, it has to be closely monitored and make it work, if necessary with the senior management support. Failures are a good chance for learning and have to be quickly fixed. The purpose of launching a pilot is to make a process simulation with the objective of “mimic the reality in some way” (Laguna and Marklund, 2004). According to Laguna and Marklund (2004), the steps to perform are as follows:

1. Building a simulation model of the process;
2. Running the simulation model;
3. Analysing the performance measures;
4. Evaluating alternative scenarios.

A very important point is also to give priority to the BPR programme during this phase, as pilot is the base for a successful implementation. Furthermore, as Laguna and Marklund (2004) state, conducting a process simulation brings some main advantage to the overall BPR project, as:

- *Reduce the risk related to any type of change*, because current operations for real processes are not affected allowing strategies to be tested;
- Examine the process over a long time, since simulation compresses process time;
- *Capture system dynamics*, which are the random events that can occur and affect the process during its execution;
- *Visualise process operation*, making ideas alive and improving their communication and win resistance to change.

Roll-out

Peppard and Roland (1995) state that no matter “however successful the previous stage are thought to have been it is this stage which will actually transform the organisation”(p.224).

The main points highlighted by Peppard and Rowland (1995), which can also be considered with regard to this BPR project are:

- Staff training, which takes a long time and should go hand-in-hand with the implementation of the redesigned process to not be forgotten;
- Roll-out plan, which has to be clearly communicated;
- Management support, to sustain the activity and pull it forward if needed.

If the pilot or the following roll-out will take too long time, there will be high risk of losing the change momentum with the new process that will be forgotten as time goes on (Peppard and Rowland, 1995). Again, senior management support becomes crucial for a successful pilot and roll-out.

3.6 Realise vision

It consists of a "next phase" which follows the implementation of the redesign process. Indeed, many authors refer to it as a new phase to be conducted to evaluate the redesigned process (Motwani et al., 1998; Reijers, 2003; Kettinger, 1997). Peppard and Rowland (1995) define the important steps to realize vision as:

- Assessment of the new process performance;
- Improvements capitalization;
- Identification of new uses for the capabilities developed for the redesigned process;
- Continuous improvement.

The steps above may appear obvious at first sight, but that is where most of the companies are struggling after having implemented successful BPR projects (Peppard and Rowland, 1995).

4 Chapter: Operational Framework

In this Chapter the Operational Framework used to conduct the BPR project is illustrated and integrated with the theories and concepts illustrated in the literature review in Chapter 3.

The project timeline specifically created for the reengineering programme of the process for WVTA accessories is represented in Figure 11. The four phases of the project are represented, being *analysis*, *design*, *implementation* and *evaluation* with an equal time attributed to each of them.

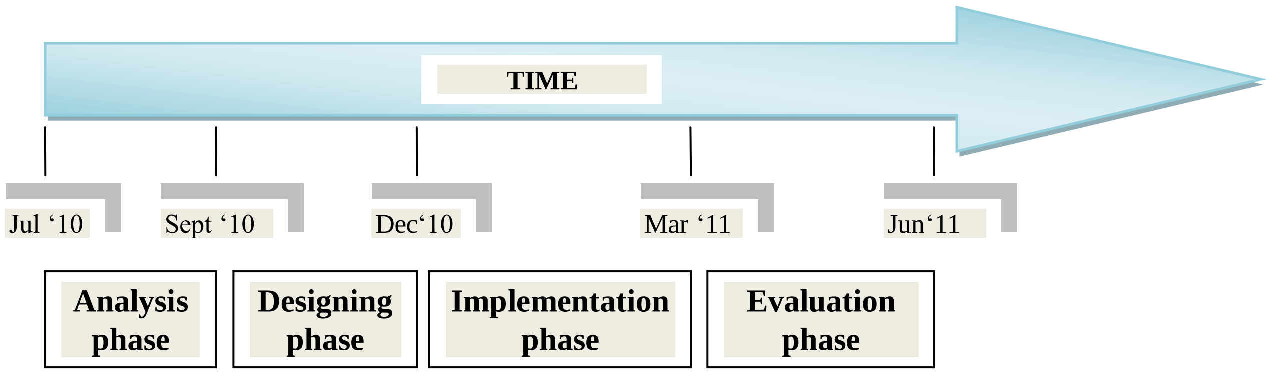

Figure 11. The BPR project timeline.

On the basis of the literature review conducted on framework used for BPR project and presented ion Appendix A, it can be concluded that the project timeline in Figure 11 is suitable to be adopted as a base to build an operational framework for this project. Indeed, all important phases of a BPR project are covered by the project timeline, with the exception of the scoping phase. Since the project was already defined, no scoping was conducted. The purpose of the operational framework is to be a sort of “guide” for the BPR project, making explicit the relation between the research design, introduced in by methodology in Chapter 2, and the empirical work, illustrated in Chapter 5. The *case analysis* introduced in Chapter 2 corresponds to the **analysis** phase of the Operational Framework, while the *redesign activity* refers to the **design** phase. Then the solution, represented by the redesigned process, is **implemented** and **evaluated**, based on the *criteria for assessing the findings*, introduced in Chapter 2 and specifically developed for this project.
An additional purpose of the operational framework is also to give a clear picture of the relevant theories, tools and techniques, described in the Literature review in Chapter 3, and their relevancy for the empirical work and the research design. As shown by Figure 12, the theoretical aspects are integrated in the operational framework deeming their matching with the framework phases. In other words, theories are classified in the

operational framework depending on their relevance against the different phases of the BPR project.

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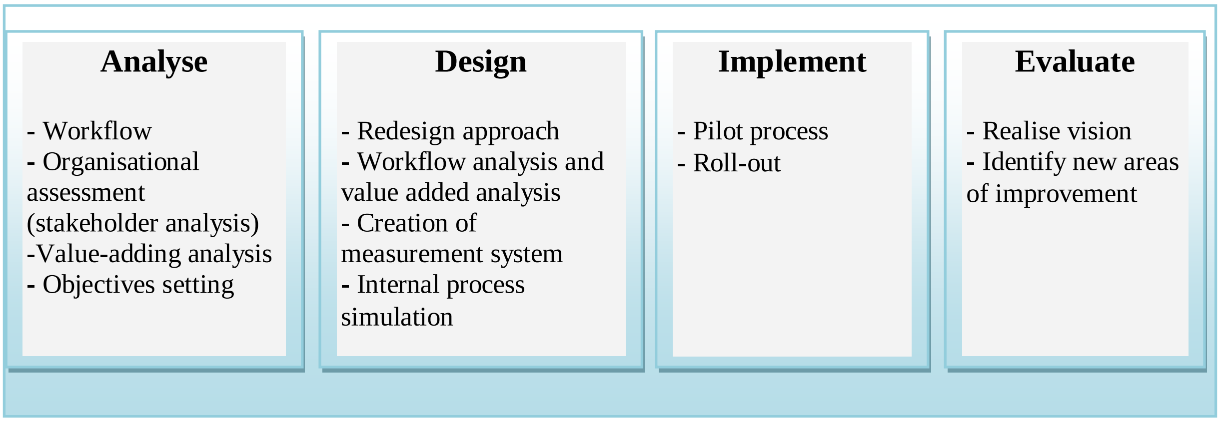


Figure 12. The operational framework with the integrated theories.

The operational framework and its phases are further analysed below here in order to explain the relevance of the theories which have been integrated and how they are used for the purpose of this project.

4.1 Analyse

In this Section are described the theories used for the analysis of the “as-is” situation, which are: the workflow diagram creation, the stakeholder analysis, the value-adding analysis and the objective setting. Besides, it is also described the reason why they were applied to the process to analyse and how they were applied for the purpose of this project

4.1.1 Workflow analysis

As introduced in the literature review in Chapter 3, the workflow analysis is conducted to create a workflow diagram, which would clarify the different steps of the process as well as the actions executed by the process performers. To reengineer a process, it must be clear the sequence of steps to follows for the process’ execution. In addition, once the workflow analysis is done, the related diagram is created. Having a workflow diagram, bring the benefits describe by the literature review, in Chapter 3.

The importance of the workflow diagrams for the analysis of the “as-is” situation was also particularly important given the type of process to reengineer. The process for WVTA homologation of accessories is cross-divisional and based on paper. Taking into account the communication problem related to the fact of having division and departments in many different locations, a workflow diagram brings relevant benefits in terms of communication. When conducting interviews (unstructured by phone or focus groups by Video conference) with people not on-site, the workflow diagrams are a powerful tool to make a person understand the basics, the inter-dependencies between people and the actions, the latter are required to take.

Once the process analysis gets into details, the workflow diagram becomes more precise and its range of use becomes wider. The workflow diagram, according to Peppard and Roland (1995), became helpful as a training tool as well as a mean of communication with specific stakeholder of the process. Generally, the higher interest the stakeholders had in the process the more there was the need to provide a detailed diagram or more information to explain the contents of the diagram.

In addition, the workflow diagrams are a fundamental tool to use in software development. As this project consisted of creating an electronic application for the redesigned process a workflow diagram is needed, even though if not in its articulated version as the ones used for software development purposes.

4.1.2 Stakeholder analysis

The process for WVTA homologation of accessories is a cross-divisional process which is entirely managed by the NESAS C&A Engineering department, given that it is a process that mostly involve engineering problems. The process' stakeholders present a high variety in terms of functions as technical, business and marketing departments are involved in the process. As a result, stakeholders have different interest in the process and different expectations from it. As reengineering a process is also a matter of change management, the issue of power is fundamental. The question was then: who is holding the reins of the change?

The answer was given by the stakeholder analysis, which mapped all the stakeholders in relation to their power and interest in the process. An additional reason to use the stakeholders' mapping was also overcoming the problem of visibility of the stakeholders: if a stakeholder is not "visible", due to physical absence, it may be considered as not important and thus forgotten when taking decision that will affect him/her. Having all stakeholders mapped helps in not forgetting their importance and asking their involvement, when needed.

To map the stakeholders' interest, the process manual was consulted to understand the role and the task that each stakeholder had to perform. It was looked also the level in the organisational chart. Then, it was considered the type of information they supplied as input to the process and whether this could have been considered as critic information or not.

4.1.3 Value added analysis

As the new process aims at improving the overall performance and meet the objectives set in the previous phase, it will be counterproductive to keep non value-adding steps in the new process. Hence, an analysis was conducted to identify the value-adding and non value-adding activities of the process. The value-adding activities will be the focus when setting a system of performance measurement. The application of the value-adding analysis to the WVTA process will be described later in this paper.

4.1.4 Project objectives

Given that the goal of the reengineering process is to improve overall efficiency of the process and information is the product of the process, the dimensions of business process quality are examined in order to determine the objectives.

Dimensions of business process quality allowed to identify what were the problems related to the type of data and information handled by the WVTA process. Based on that, the project objectives were also better defined.

Quality dimensions of Business process are looked up because even though the aim of the reengineering a process is to improve its performance and visibility, a set of measures is needed in order to rate the redesigned process against the targets. Based on that, it is possible to start the design activity.

The project analysis will clarify the "as-is" situation, especially through the mapping of the process. Given that the ultimate goal is to improve the overall process it can be assessed on which of the dimensions the process need improvement. In particular, the classification of the process can also help in determining the dimensions where the process needs improvement. The project objectives setting can be summarised by the equation:

Process analysis + BPQ = Project objectives

As explained in Chapter 3 by the literature review there are some problems in managing information and data flows, which must be considered. In addition, the need of reengineering with IT is generally driven by the need of bringing some kind of improvement for the process. For instance, if the product delivered by a production process is food, there may be quality parameters related to food as taste, freshness and so on. Similarly, if the product of a process is information, information quality has to be considered.

4.2 *Design*

In this Section it is described which theories were used during the design phase of the BPR project, the reasons behind their selection and the way they were applied. The theories and concepts are related to the choice of a redesign approach, the workflow redesign and the value-adding analysis.

4.2.1 Redesign approach

The type of reengineering activity to conduct required a mixed approach between systematic redesign and clean sheet, as shown in Figure 13. The existent process ended up in being systematically redesigned, with the extracted workflow being the basis for the creation of the electronic application to be designed with a clean sheet approach.
A systematic approach for redesigning requires a well conducted analysis for identification of improvement areas.

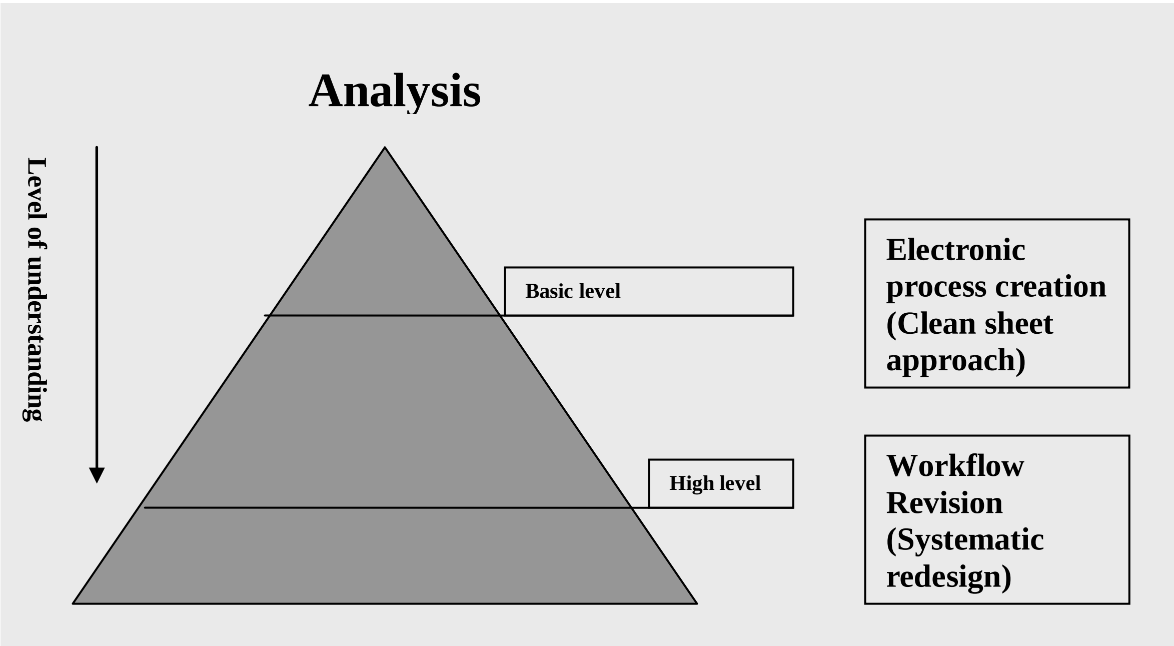


Figure 13. Illustration of level of understanding of the process for starting redesign.

In matter of contents, the analysis activity of the process had two main areas of interest: the *information analysis* and the *workflow analysis*. Information is required as it is the product of the process, which is obtained through a determined sequence of steps, defined by the workflow.

4.2.2 Performance measurement system

The performance measurement system of the new process was set in relation to the project objectives, according to Kaplan and Norton (1996).

The *Dimensions of Business Process Quality* and the criteria for *Information Quality* were used to develop *Performance Indicators*. They were selected by the reengineering team and approved to be used for a first set of measurement. It is plain how some of them resulted in being “intrinsic reasons” which motivate and trigger the introduction of IT in organisations (e.g. documents lost, documents with no owner’s info, etc). However, these reasons are not always understood by companies, or simply they are not explicitly stated.

The reason why a system of process performance measurement has to be set is to evaluate if a process is capable to achieve its objectives and, if so, at what degree. The measurement indicators set for a process should be considered, not only when the new process is already in place, but also during its redesign in order to do a first qualitative assessment. To create a performance measurement system for the process, some pre-requisites are necessary:

1. The purpose of the process and the product that it delivers must be clear;
2. The objectives that the redesigned process should achieve have to be defined;
3. The value added activities have to be defined by the value-adding analysis, since they will be the focus of the performance measurement system.

For this project, the prerequisites were necessary based on the following logical sequence:

1. To improve the process (and its output) the focus is put on the product;
2. The process product is information (data are also supplied in order to generate the output information);
3. The information is generated by the process performers and the actions they take (not all the actions generate information: e.g. taking a pen do not generate information, whereas using that pen to fill-out a form it will);
4. If actions are better performed, its output will improve;
5. To perform actions, the process performers use information and data, which come from previous process steps and/or from the external environment.

In conclusion, information and data are the focus for improving the process: increasing their quality will increase the overall process quality. Information and data quality parameters have to be set and to do this, Information Quality theories are used. For the purpose of this project, information and data will be handled differently, as it will be further explained in this Section.

4.2.3 Internal process simulation

Internal process simulation, executed within the reengineering team, can be considered as a milestone to mark the conclusion of the design phase. If its outcome is satisfactory, the project can step into the implementation phase. Hence, the internal process simulation is a sort of validation of the redesigned process, as also stated by Peppard and Rowland (1995).

The choice of conducting an “internal pilot” within the reengineering team was made to avoid the pitfalls related to the selection of “external” process performers. Though more complicated to execute, an “external pilot” would better raise awareness of the project within the organisation and perhaps improve the implementation time shortening it. Indeed, in order to raise change awareness and balance the choice of the pilot conducted internally, the electronic application was at this stage tested with the departments on a one-by-one basis. In this way, external feedbacks were received and considered to develop the final application. The objective of conducting an internal pilot is the assessment of whether improvements are made and the performance measurement system set for the process is used for this purpose.

4.3 Implementation

For the implementation, the literature review indicates some practical actions to perform and steps to follow in order to proceed. Those are the *pilot process* and *roll-out*, which are hereby described.

4.3.1 Pilot

The pilot process is considered by Peppard and Rowland (1995) as key for the success of the BPR programme. The Design phase of the BPR project aims at creating an electronic application, which will then be run for a pilot process.

A key point was to provide stakeholders a vision of the new process once automated, so that ideas could have been generated and implemented in the *final version* of the application, to make it capable of better achieve the project objectives. The purpose is to do a quick fixing in case some unconformities are found and get feedback for rapid corrections in order to prepare the roll-out phase.

As indicated by Peppard and Rowland (1995), the pilot process needs a careful selection. Sponsorship was used for internal simulation and one-by-one testing and different strategies were used with the stakeholders, based on the stakeholders' analysis. According to the stakeholder mapping, most involved stakeholders in the process were involved frequently to get their feedback while less important departments were consulted less frequently. The issue of stakeholders' involvement will be further explained by the empirical work in Chapter 5. It was paid a particular attention on recording the events in order to proceed with the fixing activities in case of need and prepare in a sufficient manner the following pilot process

4.3.2 Roll out

The roll-out represents the actual implementation of the redesigned process and it is a critic point as many authors report how BPR projects fails right at this time. The roll-out it is also the activity that builds the ground for the final evaluation of the redesigned process, which should start right after kicking-off the roll-out.

No specific planning with details on how to proceed with implementation was made.

Implementing the workflow changes did not require any big change for the process performers except in terms of how to execute the process. Indeed, a process step was eliminated without further changes in terms of roles and responsibilities for the other process performers.

During the implementation, as the users are more confident with the tool, the "weaknesses" of the electronic application tend to be highlighted and the main suggestions for improvement are likely to appear at this time. Thus, the reengineering team and the project leader should allow enough space to emerging suggestions for improvements.

4.4 Evaluation

To evaluate the new process, Peppard and Rowland (1995) suggest two main actions to perform, which are realise vision, followed by the identification of new areas of improvement

4.4.1 Realise vision

Once the redesigned process is put in place with the pilot process, the evaluation activity starts to assess the new process. Its performance has to be evaluated in order to identify weaknesses and areas of improvement (Rowland and Peppard, 1995). For the purpose of this project, a preliminary assessment is done on the basis of the performance system put in place at the end of the Design phase. The preliminary character of the assessment is due to the limited span of time available, whereas a thorough assessment requires a longer span of time, demanding a systematic measurement on the process.

4.4.2 Identify new areas of improvement

As users become more trained, the redesigned process will be more and more used: then, the implementation phase will tend to highlight more and more the “weaknesses” of the redesigned process.
The reengineering team and the project leader have to let emerge and encourage users’ feedbacks in order to identify the areas of improvement.
A good point in having a business process which is automated, mapped and monitored through all its passages and steps, consists of having a base of data which are organized and easily understandable. An easier monitoring of the process, combined to user’s feedbacks, will set the way for further improvement of the redesigned process. All activity carried out for the process can now be monitored using the electronic tool. Numbers and costs can be implemented in the base of data.
People will use the tool more and more and will highlight any bad point as well as improvements to make. However, even the *evaluation* and *continuous improvement* activity needs project leader to catalyse all the activity related inputs and take ownership of any action.

5 Chapter: The empirical work

In this Chapter is described the empirical work conduct for this project on the basis of the four phases of the operational framework presented in Chapter 4. The analysis of the existing process is conducted, the process is then redesign and implemented. The last Section presents the evaluation of the redesigned process.

The empirical work was conducted in cooperation with the reengineering team, composed by:

- The project leader;
- Two C&A Engineering Section Managers;
- The C&A Engineering Manager;
- The C&A Business & Product Planning Section Manager.

After the analysis and the redesign phases of the process were conducted, the reengineering team composition did not include anymore the C&A Business and Product Planning Section Manager, since implementation was purely a matter of the department leader of the process, NESAS C&A Engineering. However, it has to be pointed out that since C&A Engineering and C&A Business and Product Planning teams work in close cooperation during the daily activities, a neat distinction can not be done: even if not involved directly in the implementation activity, the NESAS C&A Business and Product Planning Section Manager was consulted and kept informed.

The operational framework used for conducting the empirical work defines four phases and, as already introduced in Chapter 4, it does not cover a scoping activity which was done before the beginning of this project. Indeed, the scoping done for this project was very limited; it consisted mostly in a kick-off of the project by the project leader.

However, some actions were performed in order to begin with the empirical work and the analysis of the process: a BPR programme planning was established, which included a project schedule and a communication planning with identification of all responsible persons and their contact.

5.1 Analyse

In this Section will be presented a concentrated and simplified form of the analysis conducted on the process for WVTA homologation of accessories, aiming at giving the reader a basic understanding of the main principles, concepts and actions performed.

NESAS C&A Engineering is leader of the process for WVTA homologation of accessories to be installed on Nissan vehicles sold in Europe, Turkey and Russia. If applicable, the homologation is mandatory if accessories want to be sold in Europe and the WVTA, being a European regulation, allows car manufactures to sell all over Europe the successfully homologated accessories, as it substitutes national homologation. The process is performed according to the "Procedures manual for option part EC-WVTA homologation": it involves 5 different departments, as shown by Figure 14, being a cross-functional process as Sales & Marketing departments cooperate with technical departments. The departments involved in the process are:

- NESAS C&A Business and Product Planning (France), which is responsible for marketing and business aspects;
- NISA Product Strategy and Planning (RPM) or NISA Strategy and Planning (CMM), which support and confirm marketing and business aspects proposed by NESAS C&A Business and Product Planning;
- PMZ (UK) or XB3 (Japan), which are responsible for homologation: departments;
- CVE (Japan) or A-CVE (UK), which are responsible for technical issues.

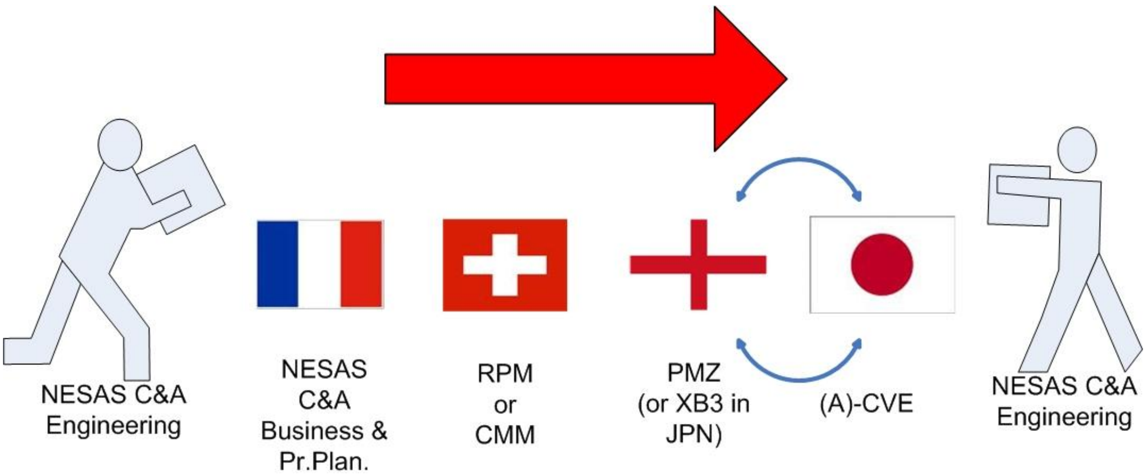


Figure 14. The WVTA process actors.

The choice of the technical (CVE or A-CVE) and homologation (PMZ or XB3) departments to involve in the process depends on the production site of the vehicle (Japan or Europe). Vehicles produced in Japan require the involvement of the Japanese counterpart, while in the case of a vehicle produced in Europe, European departments are involved. The choice of involving either NISA Product Strategy and Planning (RPM) or NISA Strategy and Planning (CMM) depends on the vehicle project phase: if the vehicle development is undergoing RPM is involved, whereas if the vehicle is already on sale CMM is appointed. Some exceptions are represented by vehicles designed in North America and imported to Europe as well as vehicles Infiniti branded. These exceptions are not considered for this Thesis.

Discordances were found in naming of departments and workflow described by the manual and actual workflow. For the reader's sake and to avoid confusion, it is here reported the process flow that was actually performed, with the indication of the current departments' names. Table 4 indicates the different departments involved in the process (current names), their location and their basic function.

Department name	Responsibilities	Location
NESAS C&A Business and Product Planning (B&PP)	Based on market investigation and RBUs' inputs it creates a list of accessories to homologate with the vehicle.	France
NISA Product Strategy and Planning (RPM) or NISA Strategy and Planning (CMM)	Confirms or not for homologation the accessories proposed by NESAS C&A Business and Product Planning taking into account business and marketing aspects	Switzerland
PMZ	It is responsible to test and verify accessories compliance against the WVTA regulation for vehicles produced in Europe	UK
XB3	It is responsible to test and verify accessories compliance against the WVTA regulation for vehicles produced in Japan	Japan
Chief Vehicle Engineer (CVE)	Responsible for all engineering activities regarding the development of a specific vehicle produced in Japan	Japan
Assistant Chief Vehicle Engineer (A-CVE)	Responsible for all engineering activities regarding the development of a specific vehicle produced in Europe	UK
Global After-Sales Engineering (GAE)	During the process execution that require involvement of Japanese counterparts (CVE and XB3), acts as interface between them and C&A Engineering	Japan

Table 4. The department involved in the WVTA process.

5.1.1 Process description

The process is organised on a vehicle basis, meaning that a set of accessories that are intended to be installed on a vehicle, are part of the same process flow (event) and constitute a unique input for the process, in form of a list: the FOPL (Full Option Part List).

The process schedule is set referring to the Start Of Sales (SOS) of the vehicle and it is linked to the main process which organises the activity of the C&A After Sales Division, the NESAS C&A After Sales Development Process.

At – 21 months to the Start of Sales of a vehicle NESAS C&A B&PP discusses with NISA RPM/CMM about the accessories to be WVTA homologated and at month -18, it creates the FOPL. However, as the process timing depends on the NESAS C&A After Sales Development Process, it cannot be anyhow modified by this process or for its purpose. Therefore, process schedule is not considered as a relevant aspect when reengineering the process. The process is now analysed taking into account the process inputs, steps and output.

5.1.1.1 Process inputs

FOPL

It is the main input of the process and its enables it. The FOPL (Full Option Part List), shown in Figure 15, is a list, created by NESAS C&A Business and Product Planning, which contains the accessories to homologate for a specific vehicle. The accessories are defined on the basis of marketing investigations, performed with different techniques (market analysis, customer profiles, competitor analysis, etc). Hence, the market and customer wishes are the triggers to define the list of accessories which will be homologated with the vehicle (e.g. alloy wheel, parking systems, alarms, styling accessories, etc..). Without homologation, the accessories cannot be sold in the market.

NESAS C&A Business and Product Planning and NISA RPM (or CMM) both sign the document.

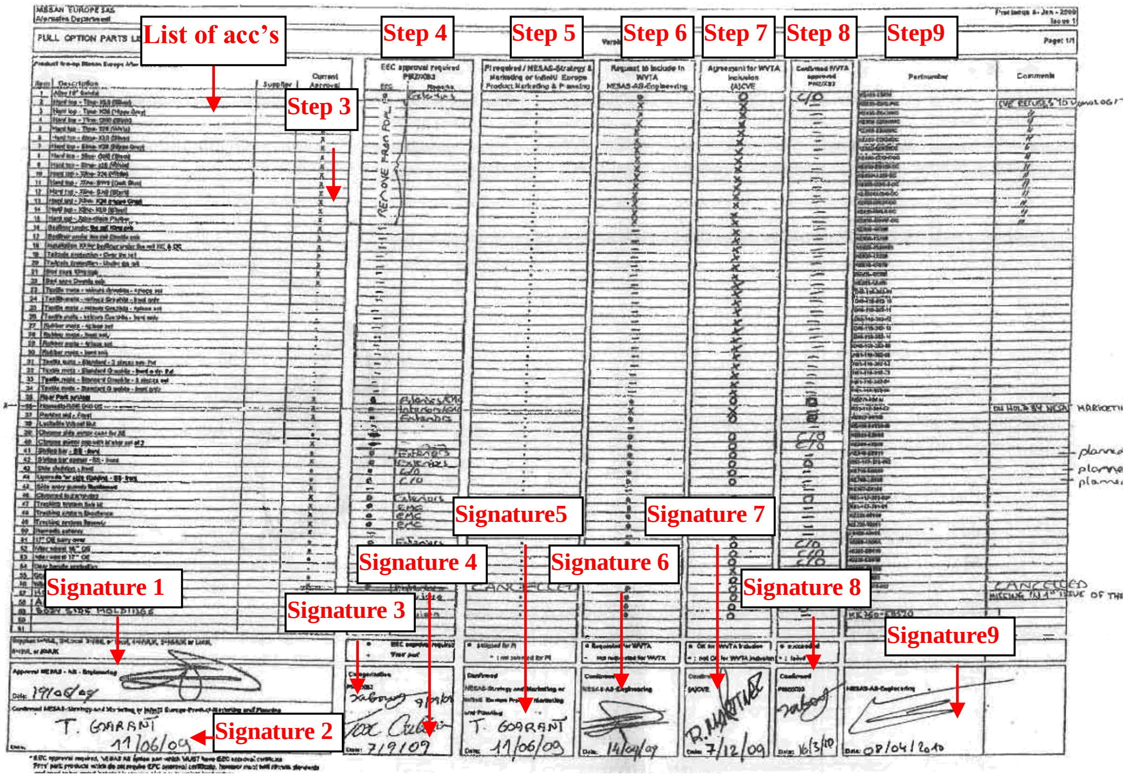


Figure 15. The FOPL.

FOPL Entries

The FOPL entries are the information which is added at each step of the process by its performers and it is the outcome of the task they conduct for the process.

The type of information and data which were input for the process was analysed.

The main input given to the process is represented by the information supplied by the process performers to confirm or not confirm accessories' inclusion in the WVTA campaign, when they will be WVTA homologated. The FOPL analysis showed that symbols as "X","O" or "-" were used to confirm or not for homologation a certain part proposed in the accessories' line-up. In several cases, old documents did not appear readable or understandable due to the misuse of the symbols and the not widely recognised meaning for them. A third case is that of a part declared "FREE" of homologation, which falls out of the process but will be anyway included in the VE list (output document). The Dimensions of Business Process Quality identified are aligned with the following criteria of Information Quality, taken from Eppler (2003):

- Clarity;
- Correctness;
- Convenience (linked to Value-added);
- Accessibility;
- Security.

The Information Quality criteria identified for the data handled by the WVTA process were taken into account when designing the new process, as described in the next phase.

According to the Dimensions of Business Process Quality, the type of information provided as input to the process can be compared against the dimensions of:

- Accuracy;
- Understandability.

Moreover, technical data (drawings, specifications, etc) were also provided as input to the process, in form of electronic files. For those relevant Dimensions of Business Process Quality were identified in:

- Accessibility;
- Value-added.

Technical Data

Data are represented by the technical documents which are added to the process. Data includes technical sheets, weight information of accessories and vehicle, CAD data and so on. Since the technical data are not included in the FOPL, their content is not taken into consideration for the purpose of the project, which only considers the way they are handled during the process.

5.1.1.2 The process steps

The accessories included in the FOPL have to meet certain requirements, which are mostly related to technical matters (EU regulations, vehicle characteristics, etc). With the process for WVTA homologation of accessories, each accessory is examined by:

- The Certification Department (PMZ or XB3), to ensure it meets specific regulation issued in matter by European Authorities (e.g. Malso test for a Parking system) and can be successfully homologated;
- NISA Product Strategy and Planning (RPM) or NISA Strategy and Planning (CMM), to ensure the accessories proposed for homologation meet marketing and business requirements;
- NESAS C&A Engineering, to ensure if they can be correctly fitted, and how, on a specific vehicle and all its models (e.g. Diesel, Petrol, Right Hand Drive, Left Hand Drive, Automatic Transmission, Manual Transmission, etc…);
- A- CVE (or CVE), to ensure that an accessory can be fitted on a vehicle without affecting the overall vehicle performance and safety (e.g. Alloy wheels can be fitted on a vehicle up to certain dimensions).

The technical issues will not be further described in this Thesis as it is not the purpose and the reengineering process will not affect any technical issues. The purpose of the process for WVTA homologation of accessories is to collect the information outcome of the solution of any technical problem. In other word, the relevant information from a process point of view is whether an accessory CAN be homologated or CAN NOT be homologated. Figure 16, extracted and adapted from the "Procedures manual for EC-

WVTA Option Parts homologation", represents the basic process flow with an indication of the process performer and the actions the latter takes.

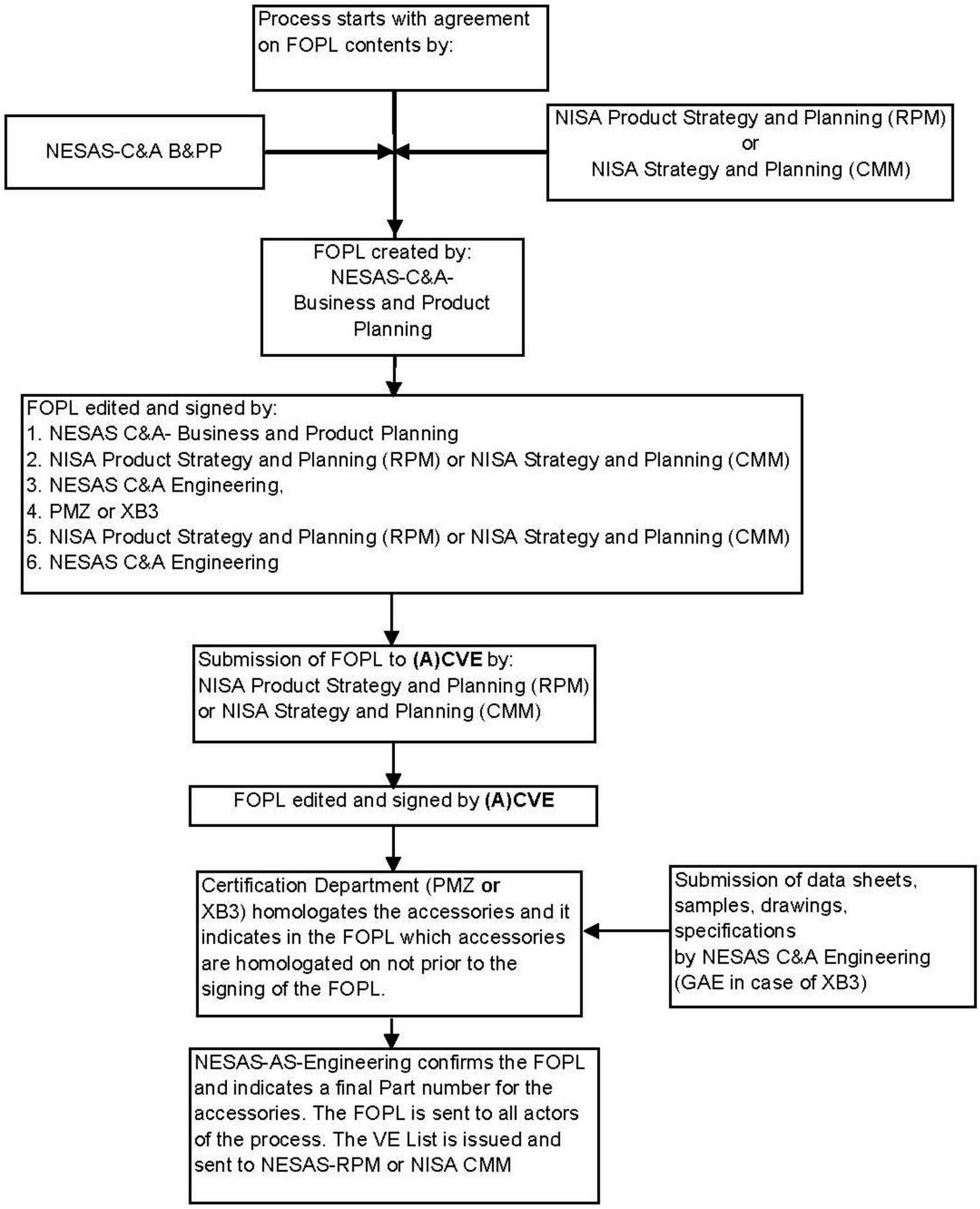


Figure 16. The basic WVTA process flow and actions.

From Figure 16, nine steps can be identified as key steps of the process, namely:

1. NESAS C&A Business and Product Planning creates the list of accessories (FOPL) and signs it for confirmation. The FOPL is scanned and sent to NISA RPM or NISA CMM).
2. NISA RPM (or CMM) approves or not each of the accessories for WVTA homologation from a business/marketing point of view and signs the list as confirmation. The FOPL is scanned and sent to NESAS C&A Engineering.

3. NESAS C&A Engineering does a preliminary judgement of the list of accessories from a technical point of view, indicating which ones will be considered or not considered for WVTA homologation. Then, the FOPL is signed as confirmation, scanned and sent to PMZ (or XB3).
4. PMZ (or XB3) judges each accessory of the FOPL in terms of compliance with the WVTA regulation. Each accessory is then approved to go on through the process or rejected. A third case is represented by an accessory which does not need to be homologated. Then PMZ (or XB3) signs the FOPL for confirmation, scans and sends it to NISA RPM (or CMM).
5. NISA RPM (or CMM) confirms or not if each of the accessories is still in line to meet business and marketing requirement. The FOPL is signed for confirmation, scanned and sent to CVE (or A-CVE).
6. NESAS C&A Engineering takes the final decision in matter of presenting the accessories to the WVTA homologation campaign. Each accessory is approved or not and the FOPL is signed for confirmation, scanned and sent to CVE (or A-CVE).
7. A- CVE (or CVE) approves or not each of the accessories from a technical point of view. In order to confirm its judgement, CVE (or A-CVE) signs the FOPL prior to sending it to PMZ (or XB3).
8. PMZ (or XB3) presents the accessories to homologation. The FOPL is then updated based on the outcome of the homologation, indicating the accessories which were successfully homologated and which not. The FOPL is signed for confirmation, scanned and then sent to NESAS C&A Engineering.
9. NESAS C&A Engineering adds to the FOPL the part number information and confirms it by signing-off. The FOPL is then sent to all departments involved for information. The VE (Vehicle Enhancement) list is then created as output of the process and sent to NESAS C&A Business and Product Planning and NISA RPM (or CMM).

5.1.1.3 Process output

The VE (Vehicle Enhancement) list, shown in Figure 17, represents the output of the process. It lists all the accessories which have been successfully homologated as well as the accessories which have been declared FREE of homologation by the Certification Department.

Parts and Accessories Authorized for PI

Version 1.0

Item	Description	Part number	Application	Remarks
1	Alloy 18" Sendai		01/10 ->	
2	Bedliner under the rail King cab		01/10 ->	
3	Bedliner under the rail Double cab		01/10 ->	
4	Installation Kit for bedliner under the rail KC & DC		01/10 ->	
5	Tailgate protection - Over the rail		01/10 ->	
6	Tailgate protection - Under the rail		01/10 ->	
7	Bed caps King cab		01/10 ->	
8	Bed caps Double cab		01/10 ->	
9	Textile mats - velours Graphite - 4piece set		01/10 ->	
10	Textile mats - velours Graphite - front only		01/10 ->	
11	Textile mats - velours Graphite - 4piece set		01/10 ->	
12	Textile mats - velours Graphite - front only		01/10 ->	
13	Rubber mats - 4piece set		01/10 ->	
14	Rubber mats - front only		01/10 ->	
15	Rubber mats - 4piece set		01/10 ->	
16	Rubber mats - front only		01/10 ->	
17	Textile mats - Standard - 3 pieces set- lhd		01/10 ->	
18	Textile mats - Standard Graphite - front only- lhd		01/10 ->	
19	Textile mats - Standard Graphite - 3 pieces set		01/10 ->	
20	Textile mats - Standard Graphite - front only		01/10 ->	
21	Rear Park system		01/10 ->	
22	Parking aid - Front		01/10 ->	
23	Lockable Wheel Nut	)	01/10 ->	
24	Chrome side mirror caps for XE		01/10 ->	
25	Chrome mirror cap with blinker set of 2		01/10 ->	
26	Styling bar corner - SS - front		01/10 ->	
27	Side entry guards illuminated		01/10 ->	
28	Chromed foglamp ring		01/10 ->	
29	Nomadic ashtray		01/10 ->	
30	17" OE carry over		01/10 ->	
31	Alloy wheel 16`` OE		01/10 ->	
32	Alloy wheel 17`` OE		01/10 ->	
33	Door handle protection		01/10 ->	
34	Gear shift knob, black leather		01/10 ->	
35	Hood Deflector		01/10 ->	
36	Alarm System		01/10 ->	

Prepared by , NESAS-AS-Product Enginee Approved by , NESAS-AS-Engineering Manager

Date 08/04/2010 Date 08/04/2010

Signature Signature

Figure 17. The VE List.

The VE List contains also the information related to the part number and the vehicle model application. It is used by NESAS C&A Business and Product Planning to inform mainly Regional Business Units, Dealers, Regional Homologation Managers about the Genuine Nissan Accessories which are homologated and can thus be fitted on a Nissan vehicle. It is distributed to NISA RPM (or CMM) and NESAS C&A Business and Product Planning.

5.1.2 Workflow analysis

The workflow of the process for WVTA homologation of accessories was analysed mainly referring to the following sources:

1. *FOPL analysis*, where the process steps were extracted from (the working document gave the actual sequence of the steps, while the manual does not);
2. *Procedures Manual*, where roles and responsible of the different departments and persons were extracted from;
3. *NESAS AS Development process*, which provided the information related to project milestones (the milestones that define the schedule of the WVTA process for accessories homologation depend on the vehicle schedule).

The result of the workflow analysis was the creation of a draft of the workflow diagram. Once created, it was proposed to the reengineering team for review. Then, in the Design phase of this project, the workflow analysis will be combined with the Value-added analysis to determine the workflow redesign.

5.1.3 Value adding analysis

Once the process was mapped and it was clarified which actions each process performer was executing and the type of input to the process, it was possible to evaluate each step of the process to assess whether the actions were adding value to the process or not.
The value-adding analysis is presented in Table 5, where it is indicated, for each step of the process, its value-adding and the non value-adding. As previously mentioned, the process timing is not considered when reengineering the process and it is not included in the Value-adding analysis. In the *step* column are reported the step number and its performer.

Step	Value-adding	Non value-adding
1. NESAS C&A B&PP	1. Creates the FOPL by adding the acc list 2. User signs the FOPL 3. User sends the FOPL	1. User prints the FOPL 2. User scans the FOPL
2. NISA RPM (or CMM)	1. User edits the FOPL: confirms or not each of the accessories included in the FOPL under a business/marketing point of view	1. User prints the FOPL 2. User scans the FOPL
3. NESAS C&A Engineering	1. User edits the FOPL: gives a preliminary confirmation of which accessories can be WVTA homologated from a technical point of view	1. User prints the FOPL 2. User scans the FOPL
4. PMZ (or XB3)	1. User edits the FOPL: confirms or not each of the accessories for WVTA homologation	1. User prints the FOPL 2. User scans the FOPL
5. NISA RPM (or CMM)		1. User prints the FOPL 2. User scans the FOPL 3. User edits the FOPL: confirms or not each of the accessories included in the FOPL under a business/marketing point of view
6. NESAS C&A Engineering		1. User prints the FOPL 2. User scans the FOPL 3. User edits the FOPL: confirms or not each of the accessories for WVTA homologation from a technical point of view
7. A-CVE (or CVE)	1. User edits the FOPL: confirms or not each of the accessories for WVTA homologation from a technical point of view	1. User prints the FOPL 2. User scans the FOPL
8. PMZ (or XB3)	1. User edits the FOPL: communicated the result of the WVTA homologation, indicating whether homologation was successful or not for each of the accessories	1. User prints the FOPL 2. User scans the FOPL
9. NESAS C&A Engineering	1. User edits the FOPL: adds additional information for each of the accessories 2. User creates the VE List	

Table 5. The VAA (Value-adding analysis).

The action of scanning and printing the paper FOPL is obviously non value-adding and it was already selected for elimination through process automation; in fact, this has been the trigger reason to kick of this BPR initiative. It is pointed out that with the electronic process in place, the FOPL will not be send, but the location of its electronic version on the data-sharing platform will be **communicated**.
The results of the value added analysis, illustrated by Table 5, will be considered when doing the redesign of the process, described in next Section.

5.1.4 Organisational assessment

The purpose of the organisational assessment was to understand the environment where the BPR project was taking place and elaborate a proper strategy for guiding the prosecution of the project. The stakeholder analysis was conducted to elaborate a strategy in matter of people management. The main stakeholders are classified in the stakeholder map, illustrated in Table 6. The strategy and actions that the reengineering team takes depend on their classification.

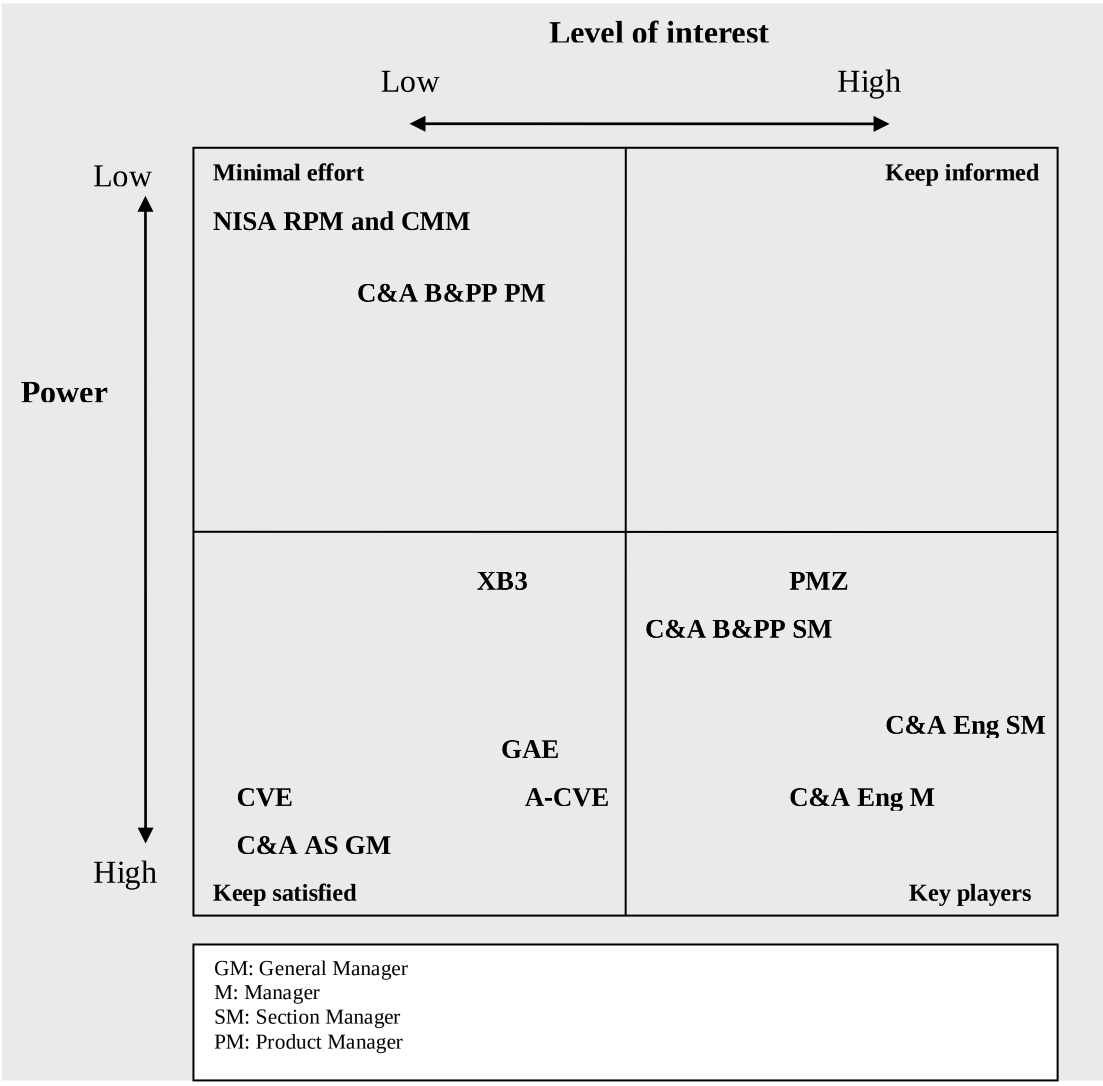


Table 6. The stakeholders' map.

The stakeholder map reports a division that does not perform any action directly linked to the process (no inputs are given), but has a very high influence on it, the Global AfterSales Engineering (GAE). This division can be considered the equivalent of NESAS AS C&A at a global level and since their location is at Japanese headquarters they act as a key player being the interface between NESAS AS C&A Engineering and the CVE

5.1.5 BPR Project Objectives

Often, at project birth the objectives are not precisely identified as the reengineering team and the organisation know only roughly what outcome has to be generated by the redesign of the project (e.g. financial benefits, process speed increase, etc). That is why they will be identified after some analysis of the project where it will be clearer which are the aspects that will need to be improved resulting in be more precise and detailed targets for the BPR project. Turning a data flow from paper to an electronic format brings several benefits, mainly related to data handling and management.

Taking inspiration from the theory on Information Quality, some Performance Indicators (PI) were developed as candidates to monitor the performance of the chosen solutions for BPR activity and evaluate the grade of achievement of the objectives. The first step was to examine the Dimensions of Business Process Quality to draw the items which can be suitable to rate a data and information flow.

The followings were selected:

- Security
- Reliability
- User satisfaction
- Accessibility
- Time efficiency

Based on the five dimensions of Business Process Quality selected, five main objectives of the BPR project, shown in Table 7, were identified by the reengineering team.

Objective
User-friendliness
Communication
Data sharing
Security
Process Speed

Table 7. The BPR project objectives.

User-friendliness was required due to the fact of having an electronic application: this had to be easy to use in order to facilitate users' tasks, similarly to any well known electronic application based on Windows system (e.g. consider a Windows Media Player, with a main window where buttons click perform several actions and menus to access the various options).

Communication among all departments and through all the process phases (including communication of process outcome) had to be improved; communication also emerged as a critic aspect of the process during its internal audit.

Data-sharing was also identified by the internal audit as a matter of improvement, as the WVTA process includes, other than the FOPL and the VE list, additional documentation which need to be shared among departments and people involved in the process: as all documentation is necessary for process actors in deciding their input to the process, it has to be widely available, accessible and traceable.

Since paper documents used for the process are continuously scanned, sent and then carelessly trashed and/or abandoned, *security* emerged as a key aspect to be considered when reengineering the process: data and information handled by the process had to be kept reserved to process users, stakeholders and, when necessary, other selected persons.

The *process speed* was obviously affected by the fact of having a paper-based process, as the working document (FOPL) needed to be printed out, filled in and scanned in order to be submitted to the next accountable person in the process.

The BPR project objectives will be taken into account to set a proper system of performance measurement in form of Performance Indicators, as described in the next Section.

5.1.6 IT assessment

An IT assessment was conducted to know what kinds of IT software packages were used within the company and by which departments. Other than common software (e.g. MS Office suite, Adobe), there are many software packages specifically targeted for some divisions, thus not available worldwide for all companies divisions due to different reasons (costs, internal IT resources, security, etc). However, the eRoom platform is worldwide available for all Nissan employees, which allows users to share information, files and databases in a secured environment that they can access prior to a required authentication.

5.2 Design

This Section describes the creation of an electronic application to manage the process for WVTA homologation of accessories as well as the modifications done on the existing paper process in terms of process design. Moreover, it is presented how the new process gets its shape and the objectives are clarified, making possible to build a performance measure system.

5.2.1 Stakeholder involvement

To actually start the design phase, it was made a plan of involvement for stakeholders, based on the outcome conducted with the stakeholders' analysis presented in the previous Section.

The strategy for the involvement was elaborated on the basis of the stakeholders' interest in the process. It was deducted that if a stakeholder had a higher interest in the process, would also be more willing to contribute more to its redesign. Thus, the strategy consisted on adopting different types of communication, based on frequency, which was classified as Low, Medium or High. Table 8 shows the type of involvement and the frequency of involvement for each of the stakeholders.

Stakeholder	Type of involvement	Frequency
C&A Engineering Section Manager	Meeting to decide strategy, next actions, solution to implement, electronic application improvements, stakeholder communication	High
C&A Engineering Manager	Meetings to decide strategy, next actions, solution to implement, electronic application improvements, stakeholder communication	High
C&A Business and Product Planning Product Managers	Meetings and one-by one actions to test application and get comments	Low
C&A Business and Product Planning Section Manager	Meetings on electronic application improvements, stakeholder communication., new design of the process	Medium
C&A GM	Meeting on project status update	Low
PMZ	Meetings on process update and redesign, test of the application and feedbacks	Medium
GAE	Meetings on process update and redesign, test of the application and feedbacks	Medium

Table 8. The stakeholders' involvement.

Once the test version of the electronic application was ready, the design phase went on with testing with single departments. Their feedback was considered and, based on their interest, a proper strategy for involvement for set up. The process stakeholders were involved in the following ways:

- email communication to inform about decisions involving them and ask feedback on that;
- Dedicated video conferences whenever there was the need of involve more people to address in the proper way any issue;
- Rarely by invitation to status meetings with the reengineering team, which were set-up and conducted on specific topics of discussion that were interesting for the stakeholder (least performed action).

It was deducted that the higher the stakeholders' interest, the higher contribution they could give to the redesign phase. The strategy consisted in involving stakeholders with more or less frequency in the redesign phase. For instance, key stakeholders with low interest and high power were involved at the beginning and the end and the points they raised properly addressed (e.g. CVE). Email communication has resulted to be suitable in serving the communicational strategy: persons with high interest in the process were informed with high frequency by "direct" (addressed to themselves) or "indirect" (addressed to somebody, with relevant person in the copy recipient of the email) communication.

5.2.2 Workflow redesign

Based on the outcomes of the workflow analysis (draft of workflow diagram) and Value-adding analysis, the workflow was revised and redesigned. Two main options were considered with regard to the workflow redesign:

1. Elimination of Step 5 performed by NISA RPM or CMM;
2. Elimination of Step 6 performed by NESAS C&A Engineering.

The two options are discussed separately.

<u>Option 2: Step 5 elimination</u>

The process required NISA RPM (or CMM) a double input. As shown by Figure 18, the first input was at Step 2 to confirm the accessories line-up proposed by NESAS C&A Business and Product Planning.

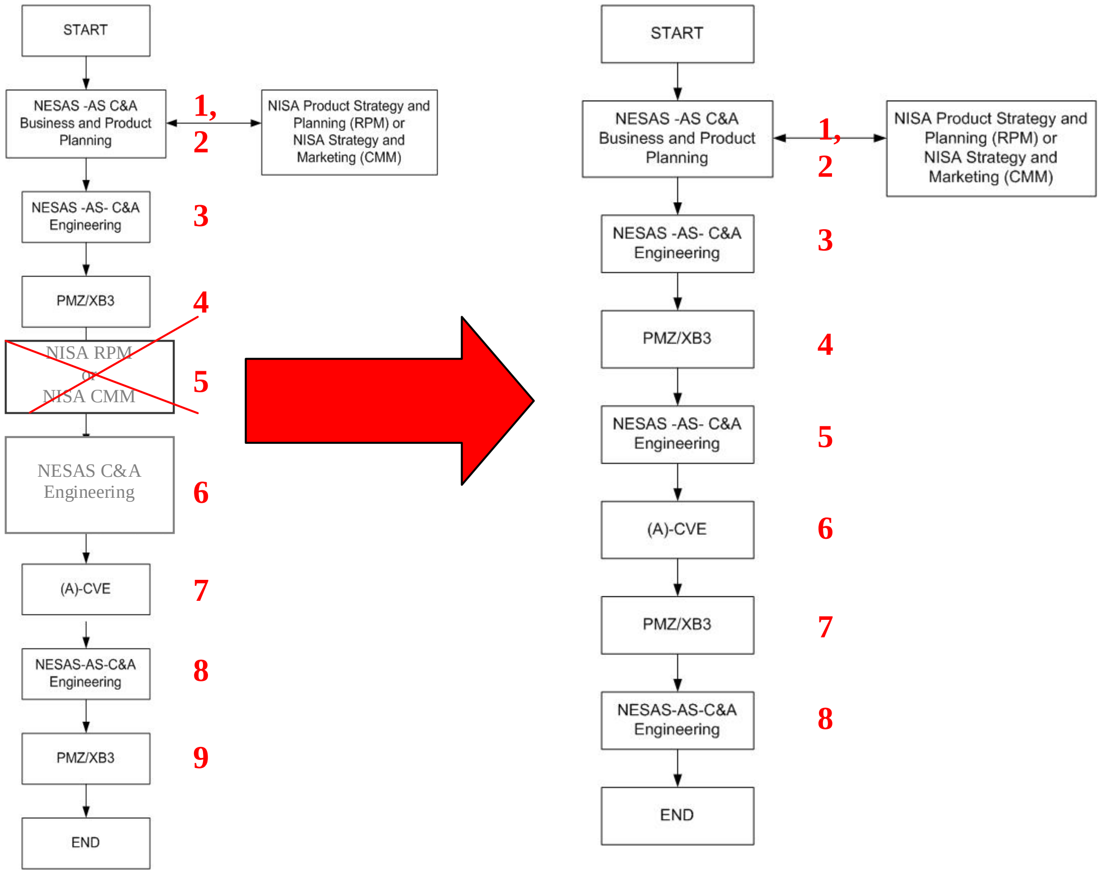


Figure 18. Elimination of non value-adding step from the process.

Then, NISA RPM (or CMM) was asked to take a second action at Step 5, after NESAS C&A Engineering second input to the process. The FOPL analysis highlighted how NISA RPM (or CMM) was taking both actions at the time of their first involvement (at Step 2, FOPL was signed for both Step 2 and Step 6). It was not possible to get any explication for this matter of fact; thus, the reengineering team concluded that the second action required to NISA RPM (or CMM) was actually not bringing any added-value to the process: the step was eliminated from the process flow.

Option 1: Step 6 elimination

As shown by the Value-adding analysis in Table 5, NESAS C&A Engineering performs at Step 6 the same action as Step 3. Thus, it was considered to eliminate Step 6. Eventually, the reengineering team decided to keep the Step 6 for reasons which are partially depending on its contribute to the process in term of information. Indeed, the functions of Step 6 are mainly monitoring the process and establish a proper communication with the Chief Vehicle engineering (or A-CVE), which is a key actor for the process. In addition, communication is even more critical when the Japanese counterpart is involved in the process (CVE), making the role of C&A Engineering even more critical in terms of communication.

5.2.3 Workflow diagrams

Having revised the process steps by using the Value-adding analysis, two workflow diagrams, for respectively Japanese and European production, were created to map the WVTA process. The workflows diagrams were then sent to key departments to get their feedbacks on. In their final version, the workflow diagrams indicate:

- the steps that constitute the process;
- the steps' performers;
- the action to perform;
- the process schedule;
- the process milestones;
- the main milestones for the vehicle schedule.

The workflow diagrams built for the WVTA process are shown in Appendix B, for European production, and Appendix C, for Japanese production (timing is not shown as it is confidential information).

The workflow mapping was good technique for definition of timing of the process that was linked to the vehicle schedule. The links between the different departments were also made explicit by the diagram as well as the sequence of steps.

The creation and use of a workflow diagram had several benefits on the BPR programme:

- *Communication and training*, especially with external divisions and departments;
- *Documentation, Knowledge Management and Quality*, as it indicates, linking to the "Procedures manual" when necessary, the work instructions and the tasks in order to give a clear overview of the process reducing role conflicts and ambiguity;
- *Management information*, as it identifies the key milestones from a manager's point of view.

No specific modelling method was chosen, but it was decided to keep on the current method used around the division for process mapping in order to reduce any risk of misunderstanding. Basic diagrams were used as working diagrams to provide brief and basic description of the process to stakeholders.

5.2.4 Performance measure system

The performance measurement system of the new process was set in relation to the project objectives.

The Dimensions of Business Process Quality and the criteria for Information Quality were used to develop Performance Indicators. They were selected by the reengineering team and approved to be used for a first set of measurement. It is plain how some of them resulted in being "intrinsic reasons" which motivate and trigger the introduction of

IT in organisations (e.g. documents lost, documents with no owner's info, etc). However, these reasons are not always understood by companies, or are not make explicit.
As explained in Chapter 3 of this Thesis, having determined the BPR objectives and chosen the IT solutions to achieve them, it is possible to investigate what type of PI can be set when reengineering the WVTA process. Table 9 shows the IT solutions chosen for conducting the process reengineering activity.

Objective	Solution adopted
User-friendliness	Visual Basic for Applications (VBA) in order to develop a Windows-based application
Communication	eRoom messaging
Data sharing	eRoom
Security	eRoom authentication + passwords of the electronic application
Process Speed	Visual Basic for Applications (VBA) in order to develop an electronic application

Table 9. The objectives and the chosen solution for the BPR project.

Choosing the eRoom platform and Visual Basic allowed to prevent any problem of compatibility, introduced as Criteria for assessing the finding in Subsection 2.1.4, as they are available to all Nissan users.
As mentioned in Chapter 3, the focus to improve the overall process performance is on the information which process performers supply. Hence, the target is improving the quality of information. The criteria for information quality introduced in the Analysis phase were:

1. Clarity, which tells how clear is an information;
2. Correctness, which tells how correct is an information;
3. Convenience, which tells what is the value that an information delivers;
4. Accessibility, which tells how accessible is an information;
5. Security, which indicates if there are any risks connected to the used and/or accessed information.

Besides, an additional source of inspiration to develop PIs consists in considering what problems are encountered when executing the business process.
Open discussions during meetings organized with the BPR team for the analysis of the existent process (paper-based) and the following creation of the electronic application activity showed how some events and problems occurred with a certain frequency:

- Follow-up requests (information requests due to poor understanding of the task);
- Lost documents;
- Documents with no owner's info;
- Documents tracking;
- People notification;

- Electronic application crashes;
- Help-desk requests (requests due to problems with the electronic application/process) ;

Table 10 shows how IQ criteria are matched by the process events.

IQ criteria	Process events
Clarity	Follow-up requests; Documents with no owner’s info; Documents tracking; Help-desk requests
Correctness	Documents tracking; Follow-up requests
Convenience (value-added)	Follow-up requests
Accessibility	Follow-up requests; Documents tracking; People notification; Help-desk requests; Electronic application crashes
Security	Documents tracking; Lost documents

Table 10. The matching between IQ criteria and process events.

Once it is confirmed (by triangulation) that there is a relation between the process events and the IQ criteria, it is sought a way to measure the process events. Translating the problems and events above into measurable items, the following indicators are obtained:

- Number of follow-up requests;
- Number of crashes of the electronic application;
- Number of help-desk requests;
- Number of lost documents;
- Number of documents with no owner’s info;
- Number of follow-up requests (documents tracking);
- Number of persons notified (notification of process outcome).

Once determined the indicators to rate the performance of the process, it is assessed whether they match the project objectives, and the result is shown by Table 11.

PI	Objective
Number of follow-up requests	User-friendliness, Communication, Process speed
Number of crashes of the electronic application	User-friendliness
Number of help-desk requests	User-friendliness
Number of lost documents	Communication, Data sharing, Security
Numbers of documents with no owner’s info	Communication, Data sharing

Number of documents with no editing info	Communication, Data sharing, Security
Number of persons notified (notification of process outcome)	Communication, Data sharing

Table 11. PIs and their contribution to project objectives.

The solution chosen to redesign process (eRoom) was company-wise recognized as a reliable platform in terms of security and, in addition, the electronic application created included a security features with passwords given to single departments. As a result, the *security* objective became less relevant due to the type of IT solution chosen.

5.2.5 Process automation

The process of creation of the electronic application started right after a basic analysis of the WVTA process. This because the process automation was expected to be the most time consuming part of the process. The fact of having available some basic versions of the electronic application, early in the project, gave also a good contribute in creating the vision for the new process and gain change momentum. In addition, as the electronic application would be successfully implemented if the process users will be satisfied by its performance, it is plain how a long time has to be allocated to testing and getting comments and feedbacks on the new solution. Additionally, the more testing will be done on the application the easier will be the bug-removal operation.
The objective of the first phase of this activity is the creation of a test version of the application, which was used for an internal simulation of the new process among the reengineering team. The goals of the internal process simulation were:

- Enhance the vision of the reengineered process created during the beginning of the BPR programme;
- Test the usability of the solution;
- Debug the application;
- Get feedbacks and suggestions on the electronic application;
- Estimate whether the electronic application seems capable to meet the BPR objectives.

The electronic application was developed to create and manage the editing of the FOPL, which is thought as a sort of “information collector”, since the process performer is required to insert some information in it. Hence, from the user point of view, the aim of the electronic application is to “behave” similarly to the paper document in matter of actions required to process performers. With the FOPL paper, the user takes the documents, searches his/her column, inserts the information and signs. With the electronic FOPL, the user is prompt the main page of the application which indicates him where to click on with visual aids, as shown in Figure 19 by the yellow color indication.

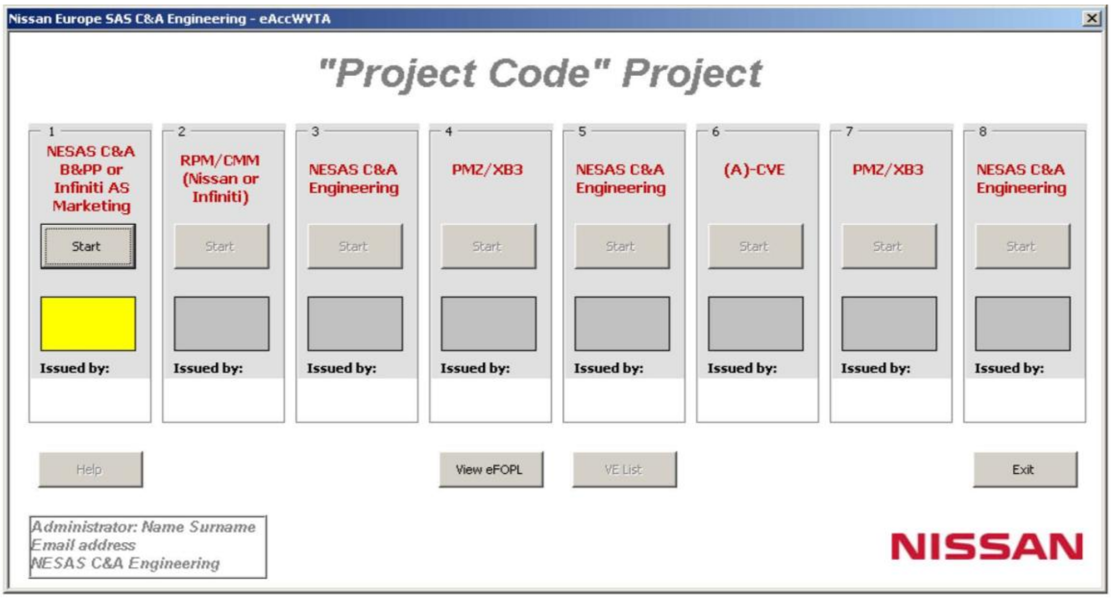


Figure 19. The main page of the electronic application for the redesigned process.

Once the user gets access to his dedicated section for editing the electronic FOPL, as shown in Figure 20, the information can be entered in the system.

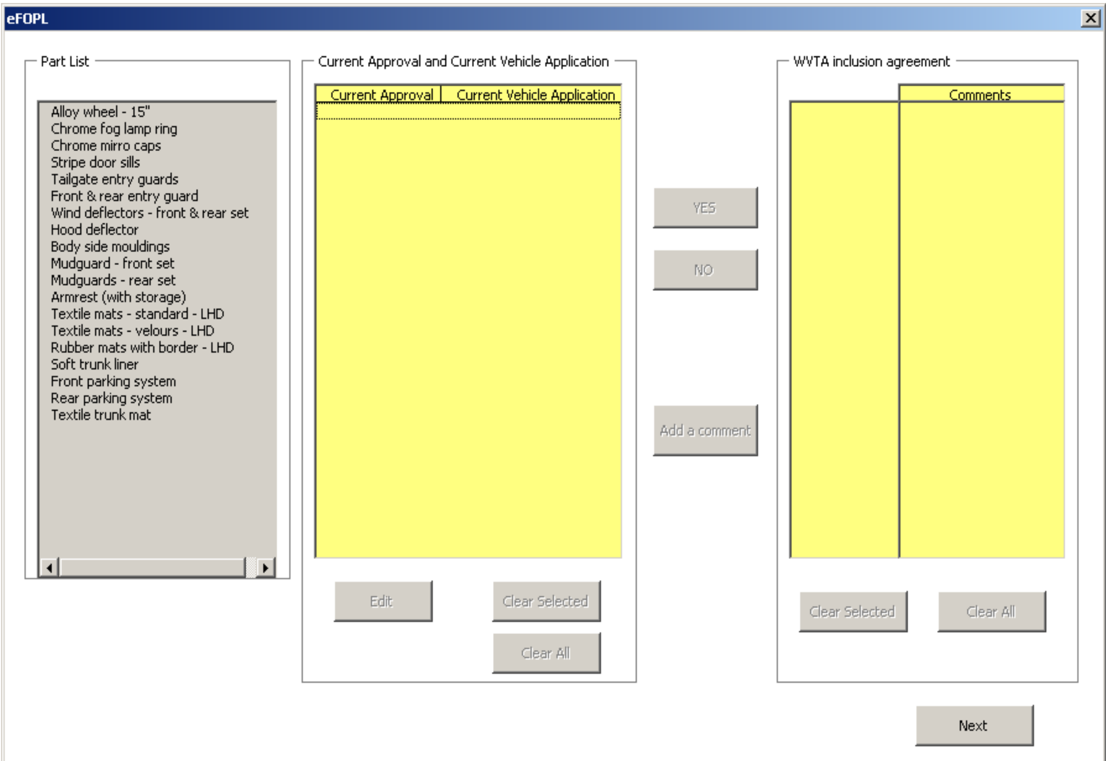


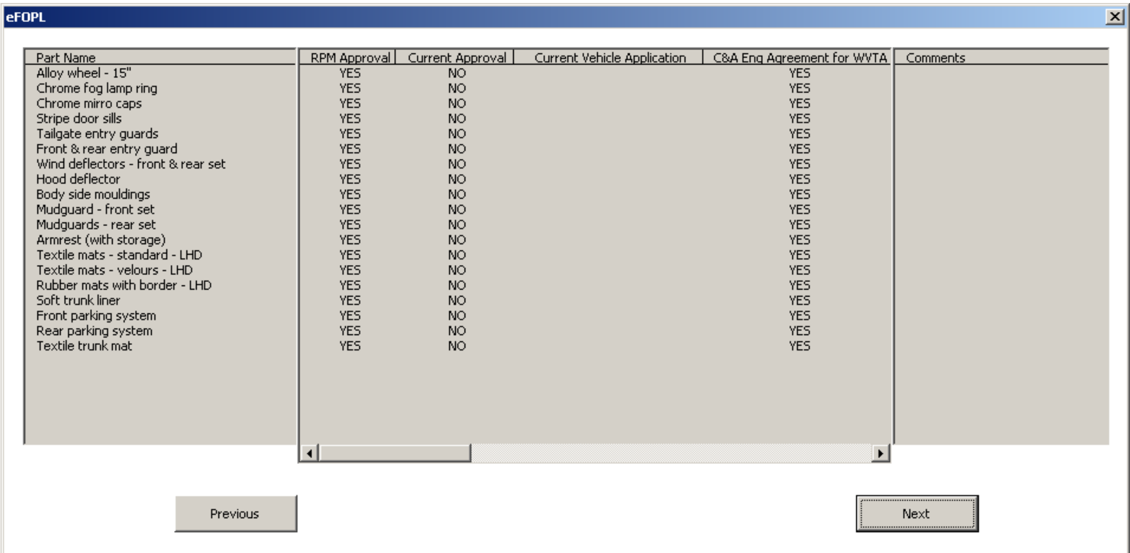
Figure 20. The user-interface for editing the electronic FOPL.

Since the creation of the electronic process dealt with data handling and management, the findings of the process entries analysis, illustrated in the process analysis in Section

4.1, were considered. According to the Dimensions of Information Quality identified, the process' entries for confirmation or rejection of parts proposed by the accessories' line-up were revised. In order to meet the Dimensions of *Accuracy* and *Understandability*, the symbol system, introduced in Subsection 2.2.1, was turned into a wording system, which was:

- YES, to confirm an accessory for WVTA homologation;
- NO, to not confirm an accessory for WVTA homologation;
- FREE, to declare an accessory free of homologation.

Regarding the IQ dimensions of the technical information, accessibility was achieved by the use of an electronic process. The content of the technical data were not considered by this project as their analysis is totally up to the process performer.
After, the process performer enters his contact information and concludes the editing of the electronic FOPL, which can eventually be visualized, as shown in Figure 21.



Part Name	RPM Approval	Current Approval	Current Vehicle Application	C&A Eng Agreement for WVTA	Comments
Alloy wheel - 15"	YES	NO		YES	
Chrome fog lamp ring	YES	NO		YES	
Chrome mirro caps	YES	NO		YES	
Stripe door sills	YES	NO		YES	
Tailgate entry guards	YES	NO		YES	
Front & rear entry guard	YES	NO		YES	
Wind deflectors - front & rear set	YES	NO		YES	
Hood deflector	YES	NO		YES	
Body side mouldings	YES	NO		YES	
Mudguard - front set	YES	NO		YES	
Mudguards - rear set	YES	NO		YES	
Armrest (with storage)	YES	NO		YES	
Textile mats - standard - LHD	YES	NO		YES	
Textile mats - velours - LHD	YES	NO		YES	
Rubber mats with border - LHD	YES	NO		YES	
Soft trunk liner	YES	NO		YES	
Front parking system	YES	NO		YES	
Rear parking system	YES	NO		YES	
Textile trunk mat	YES	NO		YES	

Figure 21. The user-interface to consult the electronic FOPL.

It is important to highlight the fact that each step shows a referent person, represented by the process performer who edited the electronic FOPL with regard to a certain step. Then, the process performers' sequence is made explicit, allowing the user to contact relevant persons whether they have specific questions in matter.

5.3 *Implement*

This Section highlights the main actions executed during the implementation of the new process, when the redesigned process was rolled-out with the involvement of all the stakeholders.

Once the internal process simulation is concluded, the implementation phase starts by launching the pilot process with the involvement of all the departments.

The implementation was officially kicked-off with a series of meetings (VC or face-to-face) to communicate with the most interested stakeholders (PMZ and GAE to begin communication with CVE) and by email communication with the less interested stakeholders. The on-going work of development of the electronic application had inputs coming from tests with departments and resulted in a series of improvements. A continuous assessment was done in order to rate the performance of the electronic application, generally after a single improvement or function was implemented. A low number of follow-up may indicate an effective communication. However, it has to be considered that not all stakeholders were involved in the pilot (more stakeholders involved in the process are expected to generate more follow-up requests).

Moreover, *people's training* was delivered for the implementation of the redesigned process and it consisted of providing to the process users the necessary knowledge needed to perform their tasks. Process users were notified about the purpose of their actions as well as how to use the electronic application through the creation of user-specific guides to execute their tasks. The success of the people training activity can be measured by the low number of follow-up requests.

5.3.1 Pilot process simulation

No specific planning with details on how to proceed with implementation was made.

Implementing the workflow changes did not require any big change for the stakeholders, since a process step was eliminated without further changes in terms of roles and responsibilities of the other stakeholders.

Thus, the implementation phase was represented by the execution of the pilot process, to test the final version of the electronic application and the entire redesigned process in order to assess if the latter was capable of meeting the project objectives. The reengineering team chose to get the involvement of the European counterparts as they were considered more responsive than the Japanese counterpart, where GAE usually acts as mediator between C&A Engineering and CVE. Stakeholders were not previously informed for agreement on the process simulation. The simulation started by asking involvement time by time and this resulted in long time and high conflicts with daily activities.

Main actions to support the pilot and the overall implementation phase were:

- People training (final versions of user-guides);
- Communication with all stakeholders;
- Identification of improvements for the redesigned process to be quick-fixed (before roll-out).

Figure 22 presents the estimated results of the pilot process. Indeed, at the time of writing this paper, the pilot process was not concluded as it was missing the last step, Step 8, to be performed by NESAS C&A Engineering.

	
# of follow-up	**3**
# of crashes	**1**
# of people notified	**20**
# of help-desk requests	**1-2**
Time required per task (step)	**5 min**
# of docs with no owner info	**0**
# of lost docs	**0**
# of docs with no editing info	**0**

Figure 22. The results of the pilot process.

As the last step was not concluded, the Figure 22 contains the estimated value for the number of people notified at the end of the process. All other values, even if estimated, are likely to not change (or not significantly) given that the last step is performed by NESAS C&A Engineering. Indeed, the last step of the process, Step 8, is the third involvement of NESAS C&A Engineering in the process, meaning that a good understanding is already gained by the process performer.

Results of the pilot process were properly handled in n order to better prepare the following roll-out phase and proceed with quick-fixing of the redesigned process when possible.

5.3.2 Roll-out

The roll-out was launched when the pilot process was not concluded and no specific planning was dedicated to it, other than the regular process schedule issued for each vehicle project (it sets the timeline for the WVTA homologation process). The decision of launching the roll-out was taken based on the good results of the pilot process, in spite of long time taken for its execution. By coincidence, the process performers required to take actions for the roll-out, had been already involved earlier in the project, to test the application under development. Thus, it can be assumed they had already “assimilated” the change to the redesigned process. For this reason, they may be considered for inclusion in the stakeholder network with the role of facilitators, to sustain the implementation of the redesigned process. An additional factor to consider is that the rolled-out processes are related to other processes and have a specific schedule, which allows the process to run at the right time.

5.4 Evaluate

This Section indicates the actions planned within the BPR programme in order to start an evaluation activity of the redesigned process, monitor its performance, sustain its adoption and identify areas for further improvement.

Although a thorough and comprehensive evaluation was not conducted for this project, given its timeline presented in Chapter 4, a preliminary elevation was done when concluding the implementation. As previously stated in this paper, as users will use more the new application and become more trained, the “weaknesses” of the new process will start to become more evident as time goes on.

The preliminary evaluation done for the new electronic process consisted of measuring the process performance through the set of Performance Indicators elaborated and evaluate with the reengineering team if the objectives of the BPR programme could have been considered as achieved. The assessment proposed by Figure 23 presents an estimation of the overall process performance based on:

- Three processes which were performed until Step 3;
- The result of the pilot process (estimated).

	
# of follow-up	0
# of crashes	0
# of people notified	10/15
# of help-desk requests	1-2
Time required per task (step)	5 min
# of docs with no owner info	0
# of lost docs	0
# of docs with no editing info	0

Figure 23. Evaluation of the reengineered process (last step is estimated)

The evaluation may show good results in terms of performance indicators, but it must be considered that, in these cases the process performers, are the same for all the processes (e.g for NESAS C&A B&PP the same person performed the process three times).

This highlights the importance of monitoring and evaluating the redesigned process over a long time.

5.4.1 Areas of improvement

The reengineering team encouraged users' feedbacks in order to identify the areas of improvement. A good point in having a business process which is automated, mapped and monitored through all its passages and steps, consists of having a base of data which are organized and easily understandable. Thus, an easier monitoring of the process, combined to user's feedbacks, will set the way for further improvement of the redesigned process. All activity carried out for the process can now be monitored using the electronic tool. Numbers and costs can be implemented in the base of data. People will use the tool more and more and will highlight any bad point as well as improvements to make. However, even the *evaluation* and *continuous improvement* activity needs project leader to catalyse all the activity related inputs and take ownership of any action. Some areas for improvements were identified, as:

1. Kick-off of the FOPL
2. Follow-up indicator to be taken down to zero;
3. Process is automated but not autonomous yet. Users have to be involved case by case. A process plan can be launched at starting of each project so that the performers can be identified beforehand: positive effects are expected on a communicational point of view.
4. New performance indicators should be identified as many of the current ones are close to zero.

5.4.2 Alternative actions

The different frameworks presented in Appendix A, suggest some actions to perform when implementing a reengineered process. However, given the not high level of details suggested for a certain action, when it gets executed, there might be several ways to perform it. Based on empirical work conducted for the electronic application of the WVTA process, it is plain how many factors may affect the duration of the implementation phase. A detailed planning of the implementation can definitely improve its timing and it should contain:

- Actions to perform and their explanation;
- Responsible persons for those actions;
- Deadlines.

Formal commitment has to be gained by the designated persons for the actions to perform as well as an explicit management support and sponsorship.

6 Chapter: Results

In this Chapter the results of the BPR projects are presented by comparing the old and the redesigned process, building the necessary background for answering the problem statement.

A BPR project can be considered successful when it brings significant improvement to the process and presents a satisfactory level of objectives' achievement. Projects are also evaluated on the basis of business aspects, but those were not considered for this project. In this Section are presented the differences between old and new process, based on paper, and redesigned process, which is electronically based. The differences are expressed in terms of actions performed by the user, as the redesigned process changes the way a process performers execute their tasks, but the change does not involve its content itself: the process performer still has to confirm or not confirm an accessory for homologation. Table 12 presents the differences between old a new process from an action/task point of view. The steps of the process are classified as first step, intermediate steps and final step. Indeed, as also reported by Table 12, the intermediate steps of the process do not differ in matter of actions required to process performs, although the content of their action does change (type of information their supply to the process).

Step	Actions performed to edit the FOPL	
	Old process	Redesigned Process
1. NESAS C&A Business & Product Planning	1. User receives the input for creating the FOPL (oral or email) 2. User creates the FOPL and enters the list of accessories 3. User prints the FOPL 4. User signs the FOPL 5. User scans the FOPL 6. User sends the FOPL by email to the next person	1. User receives the input for creating the FOPL (email) 2. User creates the FOPL and enters the list of accessories 3. User sends the email with FOPL's link to the next person
2 -> 7: Intermediate steps	1. User prints the FOPL 2. User edits the FOPL 3. User signs the FOPL 4. User scans the FOPL 5. User sends the FOPL by email to the next person	1. User edits the FOPL 2. User sends the email with FOPL's link to the next person
9. NESAS C&A Engineering	1. User prints the FOPL 2. User edits the FOPL 3. User signs the FOPL 3. User scans the FOPL 4. User sends the FOPL by email 5. User creates the VE List 6. User sends the VE List by email	1. User edits the FOPL 2. User sends the email with VE list and FOPL's link (VE list is automatically generated)

Table 12. Main differences between old process and redesigned process.

Once the second milestone has been reached with the conclusion of the second process simulation and the following implementation of the feedbacks gathered, the implementation phase can also be considered as concluded. The performance of the electronic process has to be evaluated and compared to the former paper-process, as shown by the Figure 24.

	Paper process	Electronic process
# of follow-up	0	0
# of crashes	0	0
# of people notified	5 max	10/15 (expected)
# of help-desk requests	0	1
Time	5/10 min	5 min
# of docs with no owner info	Several	0
# of lost docs	Some	0
# of docs with no editing info	0	0

Figure 24. Comparison table of old and new process (paper VS electronic).

Some considerations have to be done on the results of the evaluation of the redesigned process. As stated earlier in this paper, a reliable evaluation can be done over a longer span of time in order to have a sufficient base of data for evaluation. It has also to be taken into account the fact that usually process papers are not monitored in matter of performance (usually they are not key processes: important processes are most of times automated). In addition, whenever a user performs a process for the first time, follow-up requests are likely to come for both paper and electronic processes. They can be minimized, but it is again relevant to have a long span of time, so that a more comprehensive base of data can be gathered for analysis of the reasons.
In conclusion, the grade of objectives' achievement, the process performance measurement and a sustaining activity, including feedbacks which will come from the application use, aim at identifying any critic point and are the triggers to start a "next phase". The entire project and its results will be presented in form of a blueprint to management, who will decide if proceed with a continuous improvement phase.

7 Chapter: Discussion of methods, data and theory

In this Chapter the overall approach used for this research is questioned, through the discussion of the methods, theories and concepts used as well as the collection of the data conducted.

7.1 Theories

In order to build the theoretical background for this Thesis, the literature on BPR was reviewed. Many authors have been presenting their approaches to BPR and in literature can be found a good variety of frameworks and tools to use for BPR activities. As the BPR discipline was born on the IT wave which started to invest companies in the 90s, frameworks and tools to apply for BPR are derived and linked to application of IT reengineering to processes. Literature is also wide available on specific solution which has been designed to meet specific business needs of companies as ERP, CASE, Simultaneous Engineering and so forth. However, as many authors suggest, available literature does not go into specific cases and details on how to conduct a Business Process Redesign activity for specific types of processes. Then, among all the theories there was not obvious choice of frameworks and tools for the purpose of this study. It was then decided to review the theoretical frameworks, as illustrated in Appendix A, to derive a framework which was considered suitable to be used for this project, taking also into account the time factor, since the project had an already imposed schedule. In addition, as the frameworks where not case specific, the derived framework was integrated by theories mainly related to the following study fields:

- Workflow design;
- Information and data quality;
- Business process quality.

Thus theories and authors were chosen on the basis of the type of problem that had to be solved. The main idea proposed in terms of theories' utilisation is the decision of picking up specific theories different but related fields of studies (Information quality, Business process quality, BPR and workflows) which allowed building a solid foundation for the solution, covering the different subjects linked to the main problem.

7.2 Data

The data collection was done by using the methods described by the methodology in Chapter 2.

The type of data and information was mostly qualitative. The process managed a paper data flow and no need was perceived to monitor and elaborate any quantitative data.

However, this fact constituted a problem when setting up a measurement system to evaluate the process performance towards the achievement of the objectives set for the BPR programme. Indeed, as the Performance indicators where set, the comparison between old paper process and new electronic process was hard to be defined since the old process was not monitored and measured and no data were collected on it, letting performance measurement to “rough ideas” (e.g. number of papers lost with the paper process: sometime lists got lost but nobody could quantify the event referring to the past). A performance measurement becomes effective when the measures are taken for those indicators and the same type of information can be compared over time (quantitative measurement VS quantitative measurement).

7.3 Methods

Methods for gathering information and data were described by methodology in Chapter 2. To overtake any problem of bias or poor knowledge, it was extensively used the triangulation method in order to verify and validate the information acquired. However, triangulation was not always possible due to key people’s absence (not employed anymore). At Nissan there is a high staff rotation, with personnel who leave the company and new personnel who is recruited on a regular basis. It is reasonable to assume that the same phenomenon occurs in many global companies. Thus, when a person leaves the company some knowledge and experience is inevitably lost. It is plain the impact of this phenomenon on the processes, especially when those are not currently updated and reviewed. A process manual may not describe in details all the actions required to take and process performers will tend to take some actions by own initiative in order to perform the assigned task. Thus his/her actions are not translated into words introducing the issue of tacit knowledge, which can not be transferred anymore once somebody leaves the company.
In conclusion, triangulation was not always possible and the resulting process, even though revised, may still miss some information.

8 Chapter: Reflections

In this Chapter are illustrated the reflections on the overall project to assess which alternative actions could have been taken.

Reflecting on the steps taken for carrying out this project and looking backwards some different actions could have been taken, especially in matter of scoping of the project and during the implementation phase. The choice of automating the process was taken based on indications given by internal audit of the process with the objective of an overall improvement of the process in terms of visibility and document sharing. After a brief investigation on available software packages around the company, as the process documents were printed out from Excel files and an existent platform was available for sharing documents worldwide within the company, it was chosen to push automation through that direction. However, a different approach could have been taken doing a wider scoping to assess if within the department (or division) there was the need of improve other processes with similar architecture as the WVTA. A preliminary study on this subject would have better defined the problem as well as its importance for the business of the department (or division). Doing this a better approach could have been chosen and, in addition, different solutions could have been considered at a higher level. Eventually, a better solution could have been identified for generating a better improvement on more processes and to the entire business. Obviously, that would have led to a business case for improving department processes, which would have needed the allocation of certain resources.

When implementing the new electronic process, various events affected the activity largely delaying the pilot process and its conclusion. The causes were mainly related with conflicts against daily business and no specific priority accorded to the pilot process to overcome those conflicts. A pilot process loses effectiveness if its execution gets delayed too much and reduces the change momentum of BPR activity. In order to avoid possible failures in the implementation, as the pilot process was running late, after the first feedbacks received on it, the implementation proceeded with real processes to not interrupt or delay the overall the BPR project. However, when a pilot process is not concluded, its benefits are also reduced in terms of:

- Fine-tuning of the process;
- Improvements of the final version of the process;
- Change awareness, whose level can be increased or kept;
- Staff training, as long implementation time makes people forget.

Better implementation of the process could have been done through:

- Project planning specifically targeted for the pilot process;
- Explicit sponsorship of the management to raise awareness and establish a kind of “priority”;

- Explicit commitment by selected actors for the pilot process.

In conclusion, different execution of the pilot process, through the measures above stated, could have increased the benefits of the reengineered process' implementation.

8.1 Main factors for process automation

Based on the work conducted for the process automation, some main factors were identified as influential for the success of this BPR project. The premise to kick-off and implement a BPR programme in an organisation is the *change readiness* of the organisation, which is fundamental for the programme's success. If organisational mindset is not responsive towards change, a BPR activity will certainly take longer time and its success may even be at risk.

Besides, some other factors which occurred during this project and may be encountered during the daily business around many organisations can also influence the success of BPR programme.

People's training

As the process for WVTA homologation of accessories is executed on a vehicle basis and over a long span of time (21 months approximately), the people involved in the process are different from time to time. Indeed, NISA RPM and CMM roles are vehicle specific, meaning that there is a CMM or RPM per vehicle (or more vehicles), CVE and A-CVE are appointed for a vehicle platform being responsible for generally 2-3 vehicles. NESAS C&A Business and Product Planning staff is composed by three Product Manager, who split responsibilities of the entire range of Nissan's vehicles. Upon that, people turnover happens at an important frequency: a trained person might not perform the process a second time, creating in the need of training new personnel. Thus, in order to training of people simple to deliver and easy to understand, there are some important issues to consider:

- Network's creation, that has to counterbalance the leave of trained person/s through an effective contact with the other stakeholders;
- Access to information, which has to be easily available to new users;
- Quality of information, which has to be easily understandable for a new user.

Power

A key factor is definitely sponsorship/management support especially when it comes the time of putting in place the new process. Power is a fundamental point in order to win resistance, if any, and get priority over the daily businesses which run within the organisation.

With regards to this reengineering project, the not understanding of the process change can be considered as a form of resistance and it was addressed with appropriate communication to clarify issues.

Indeed, best practice to address against the resistance and to decrease it resulted to be communication and explanation. Agreement in the guiding coalition is definitely a **must** have to success in the change, especially in this case where the rest of the guiding coalition was also the management sponsor of the change. Without sponsorship reengineering may become quite difficult

Project Planning

The BPR programme was kicked-off involving the reengineering team to start creating the necessary change momentum and get the different points of view for the prosecution of the project.

The planning adopted for the BPR of the WVTA process confirmed how the time issue is a key point for the process reengineering. An early starting of the process automation helps in gaining time with this high time consuming activity. Another benefit is also in having available a first version of the electronic application earlier, thus contributing in creating a vision, gaining momentum and support, which are described also by R&PP as a fundamental aspect when conducting a reengineering activity. This can be also referred again to the reengineering approaches used for the process. The creation of the electronic application basically consisted of a clean sheet approach, thus more time consuming, while the process revision itself followed a systematic redesign.

Time is also another key aspect: in a transnational company the message of BPR needs time to be communicated, received and kept by the different stakeholders which are all over the world. Time is critic also when the BPR message has to win against:

- Communicational barriers (e.g. language), which implies detailed information and often repetition of explanation;
- Poor knowledge of the real process, raising the need of informing about the current process before actually starting the introduction of the new process;
- Conflicts with daily activities, where people are engaged in the daily work delaying the BPR activity.

Whatever project runs and involves an organisation over a long span of time, there will be events that inevitably slow down the activity. It is wise to organise the planning of any project accordingly. If possible, setting of important milestones, steps or activities of a BPR project should not be at the same time of other important events for the organisation (or even e.g. just before long holidays, when there is a huge workload in connection to some deadlines, etc). The objective is to find the best time to get people involvement.

Communication

Getting the involvement of the reengineering team and the other stakeholders was also a fundamental aspect of the overall BPR activity. Continuous information was provided as well as targeted questions as suggested by R&PP (look at davenport for communication) In order to manage the involvement of external stakeholder, its mapping was used to determine the type of strategy to use. Stakeholder mapping and related strategy for stakeholder handling resulted a useful tool for a communication plan and strategy avoiding over-informing of people, poor informing and clarifying the type of involvement necessary when making activity plans (e.g. whether it was necessary to set up meetings or VC, or email communication etc….). It is plain how, to make a BPR initiative successful in a transnational company, communication has a relevant role and it raises the importance of *communication's effectiveness*. Global companies that can count on communicational effective persons are more likely to see BPR initiatives successfully implemented. Indeed, some communicational difficulties are encountered when reengineering in a global company implies the involvement of departments located worldwide. Then, **effectiveness of communication** joint to **ease of the solution proposed for redesign the process** are definitely a key aspect as the more complex are the issues and the more difficult will be to explain and train people by virtual communication (VC or email). As some time and efforts were necessary to solve quite simple problems, it may be reasonable to think that a bigger problem may be even more difficult to solve with only email and VC.

9 Chapter: Conclusions

This Chapter concludes this Thesis answering the problem statement and identifying the area of further research and improvements.

The Master's Thesis presented was based on the problem of reengineering a business process in a transnational company by turning a paper process into an electronic process. The research conducted was based on the following problem statement:

"What are the main steps to follow and the techniques to use when reengineering and automating a cross-divisional business process which manages a paper data flow?"

Summing-up the project it can be concluded that the reengineering process passes the critic point of the implementation and it is moving on. However, the risk of falling back is not eliminated.
The steps taken for this project, derived from the Operational Framework in Chapter 4, can be proposed again in form of sequence as a general approach to use for this type of project, as shown by the Figure 25.

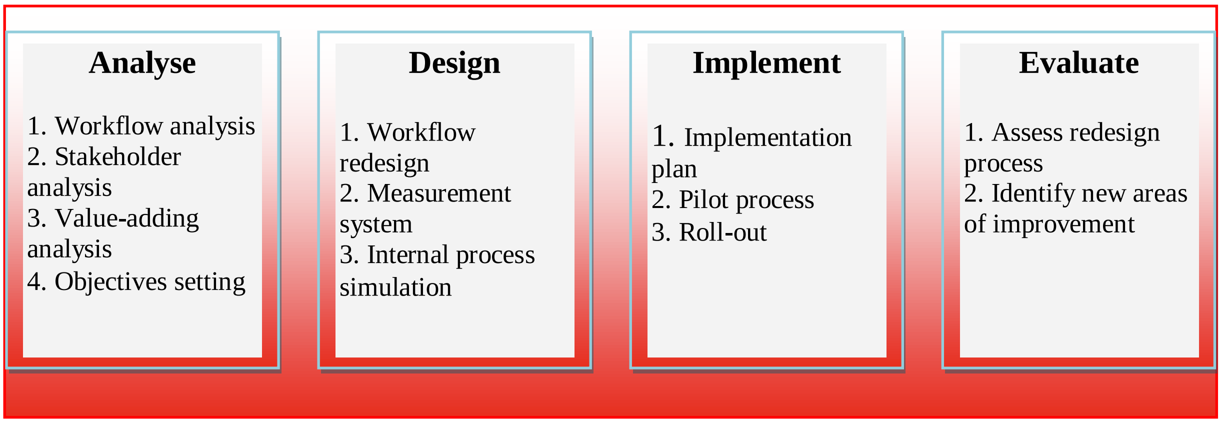


Figure 25. The sequence of steps for this project.

However, as implementation had a difficult way, the alternative actions proposed in Sub-subsection 4.4.2 are strongly recommended. A solid project plan to ask people's commitment and management support on, is certainly a must have for a successful implementation. The latter has also to be accompanied by an effective communicational plan.
Based on the degree of objectives' achievement, it can be concluded that the designing phase was successfully executed. In turn, the analysis phase can be also considered as successful as it built the ground for the following Design phase. Thus, the techniques

used for conducting analysis and design phases of this BPR process can be proposed as valid techniques to use. As indicated in Chapter 4 and 5, they are:

- Stakeholder analysis;
- Value-adding analysis;
- Workflow mapping;
- Process input analysis (Information quality assessment);
- Performance measurement system creation.

The techniques listed above were used to design a new process capable of achieving the objectives set. It can be concluded that making any error in setting objectives, may lead to design a wrong solution for reengineering the process, even though the other techniques are correctly used.

This project had the purpose of achieving five objectives and, as described below here, they can be considered achieved.

1. To analyze the current process, including performance, and identify areas of improvement.

The current process was analyzed in two steps: basic understanding to start the process automation and higher level of understanding to revise the process and its workflow. The performance of the current process was evaluated only in a qualitative way as no quantitative measures were collected with regards to the Performance Indicators set for the process.

2. To study what are the improvements that can be made by using an electronic process as replacement of the existing paper-based process.

The improvements that can be made on a paper-based process, which manages a data flow, by replacing it with an electronic process, can be summarized by its preliminary evaluation, as illustrated in Chapter 5. The preliminary evaluation was considered by the reengineering team to rate the degree of achievement of the objectives and thus which improvements can be brought on the process by the use of an electronic format.

3. To design and develop several alternatives for improving the process.

Several alternatives of an electronic application were developed for managing the redesigned process. Then, the alternatives were proposed to the reengineering team explaining their logic and the type of improvement that they could make on the process.

4. To propose the Business Process Re-engineering design in order to improve performance through the elimination of unnecessary steps or actions and, by consequence, reduce the number of follow-ups requested by process users.

The Business Process Reengineering allowed a design which improved the process (based on the preliminary evaluation) and eliminated the unnecessary steps and actions. However, the electronic application caused a certain number of follow-ups in form of help-desk requests and they were mostly reduced by the improvement of the electronic application more than the process itself.

5. To implement the re-engineered process through a simulation to test its efficiency and identify improvements so that the real process will not be affected.

Through the process simulation it was possible to test the electronic application without affecting the process. Once implemented on a real process, any weakness of the re-engineered process will be highlighted making clear any trouble not previously detected. However, the long span of execution time of the process and all the fine-tuning of the reengineered process done before the implementation significantly reduced the magnitude of encountered problems, making possible quick fixing and adjustment.

The objectives are considered as achieved and the solution presented, being specifically tailored, was capable of meeting the project objectives as well as leave room for further improvement of the process.

However, the introduction of an electronic process as replacement of a paper-process raises a problem of employees' capabilities and skills. When an electronic process is created internally and specifically targeted for a process, the process performers can be more or less easily trained to do their tasks as well as a process manager, which has to perform basic actions. But in order to further improve the process itself, IT capabilities will be required, meaning that, if an organisation wants to keep on improving over the IT wave, skilled employees will be more and more needed.

Indeed, the condition for continuous improvement is to have skilled personnel to manipulate the electronic process and execute the improvements highlighted.

Moreover, in order to give a final judgement of the reengineered process implemented, a constant monitoring is needed to evaluate if all actors will become familiar with the new solution and have understood their role, task and responsibilities.

In addition, among the set of Performance Indicators used to develop and implement the process, Key Performance Indicator(-)s will have to be chosen and in the mid/long term, there might be the need of review the performance measurement system of the process.

9.1 Further activities

The project conducted in connection to this Master's Thesis highlighted some areas of further activities, which are identified in:

1. **Extension of redesigned process to entire WVTA homologation activity**, including costs and financial measurement;
2. **Adaptation of the redesigned process,** with the electronic application developed for the redesigned process that can be adapted to manage other departmental processes which are related to the WVTA and based on paper (e.g. accessory development);

Besides, the findings of this project can be tested in other similar contexts, to see how easily of this solution can be adapted to same or similar problems in other global companies.

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Appendix A: Comparison of BPR theoretical frameworks

As all the reengineering projects conducted around organisations, a framework derived from the literature review was used for the reengineering of the process for WVTA homologation of accessories at Nissan Europe.
Frameworks are widely available in the literature and the ones presented in this Appendix were consulted to create a framework for this project and to get inspiration on how to execute the different phases of the project. This Appendix offers only a general overview to offer an idea of the frameworks presented.
Rowland & Peppard (1995), Shin & Jemella (2002), Reijers (2003), Kettinger (1997), Motwani et al.(1998), Sharp (2008) frameworks for BPR are consulted in order to have different points of view on how authors consider the BPR discipline.

A. Shin and Jemalla
B. Motwany et Al – BPR a theoretical framework and an integrated model
C. Peppard and Rowland: ESIA Framework
D. Kettinger (6 stages – SA Model)
E. PDBW methodology (Reijers, 2003)
F. Sharp, workflow modelling: tool for process improvement

While Shin and Jemella, Motwani et al., Peppard and Rowland and Kettinger propose general frameworks to apply for BPR projects, Sharp's proposal is more related to workflow modelling and the PDWB, rooted in the field of computer science, presents an approach more suitable for software engineering execution. However, as this project deals also with workflows, a general review of the Sharp's and PDBW frameworks is done, in order to highlight the limitations of this project in matter of workflow analysis and designing.
A different approach to BPR is offered by the "Quick hits" approach by Kevin F in form of small and rapid improvements to make on the process.
The illustration below plots the different frameworks together giving a rough idea on the way they overlap each other.

Sharp	Establish project context, scope and goals	Understand As-Is process workflow and other enablers	Define to-be process characteristics and requirements			
PBWD	Scoping	Analysis	Design	Evaluation		
Shin & Jemella	Energize	Focus	Invent	Launch		
Kettinger	Envision	Initiate	Diagnose	Redesign	Reconstruct	Evaluate
Rowland and Peppard	Eliminate	Simplify	Integrate	Automate		
Motwani et al.	Understanding	Initiating	Programming	Transforming	Implementing	Evaluating

<u>Shin and Jemella</u>

In their study on the case of Chase Manhattan back, Shin and Jemella propose a framework for business process reengineering composed of 4 phases, which are: energise, focus, invent and launch.

Energise is about getting started with the reengineering of the process, which consists of obtaining the necessary sponsorship, laying down a project and communication plan, setting up the reengineering team and getting the people's commitment to the project. Management commitment is indicated as a crucial aspect for starting the BPR project, given the fact that it has emerged as one of the main causes for failure of reengineering activities. It is indicated how this phase represents around 10% of the total project time.

Focus accounts for around 20% of total project time and it is the phase of analysis of the current process, in order to understand the "as-is" situation. More in details, the Chase case reports that the process does not have to be analysed, but only understood, as the purpose of reengineering should be to propose a radical change of the process. The chase approach suggests three main areas where to focus attention, which are:
- Current process diagnosis, to understand the current "as-is" situation including the business performance, the context and the players within it;

- Entry points, which are represented by the aspects where to work on in order to reengineer the process during the next phases and then realise the benefits for the process;
- Quick hits, which are small improvements on the process that can be quickly implemented.

The focus phase is also hypothesis-driven: the reengineering team develops a set of hypothesis that will be then verified or not as the focus phases proceeds.
More in details, there are four kinds of assessments conducted during this phase:

- Process;
- Organisational;
- Financial;
- Information Technology.

The *Invent* phase is mainly based on two actions to perform:

- Identification of a path towards the objectives' achievements;
- A re-elaboration of how the work is performed.

A vision of the new process should be established starting from all the different ideas which can be generated by people involved in the reengineering of the process, mostly through brainstorming sessions orientated towards out of box thinking. The goal is of this phase is also to show a simulation of how the process will appear in the future, to show the way towards the achievement of the project objectives.

The *Launch* phase is the conclusion of the project and accounts for nearly 20% of the work. Benefits that will be generated by the reengineering of the process have to be indicated as well as possible risks which can be encountered. Then, a blueprint has to be created to present the case to management and make them able to take a decision about starting the project proposed.

Kettinger

Kettinger presents a 6 stages-21 activities framework, with the activities that are split among the different phases.
Six stages are *Envision, Initiate, Diagnose, Redesign, Reconstruct* and *Evaluate.*
Envision is related to the appointment of a BPR project champion to win the management support and target business processes that can be improved: once reengineered, the business processes will bring benefits in terms of better performance to the company. *Initiate* is about assigning the responsibilities to a reengineering team, making a plan, getting stakeholders involvement and setting the project objectives.
Diagnose consists of the understanding of the current process and sub-processes, if any, to identify roles, responsibilities, activities, communication and resources as well as problems and non value-adding activities. Brainstorming and creativity contribute to the

Redesign of the new process; a prototype of the new solution is then put in place to evaluate the capability to meet project goals and the fitting with human and IT architectures. *Reconstruct* manages the phase of migration from the old system to the new system taking care of the change of roles and responsibilities by training people as IT systems are being implemented. To conclude, the *Evaluate* phase monitor the new process and its performance to verify if goals of the projects are achieved and at which degree.
Kettinger presents then various techniques to use as support of the BPR project and their relevance for the different stages of the framework is then considered. Among all of them, there are Process mapping which are described as useful when doing Diagnose and Redesign; then Process simulation and data modelling are relevant for Redesign; force field analysis for reconstruct.

Motwani

Motwani et al. propose a 6-stages framework derived from a literature review and to use for reengineering plan when conducting BPR within organisations, covering the projects from the start to the implementation. The figure below shows the framework and its 6 phases.

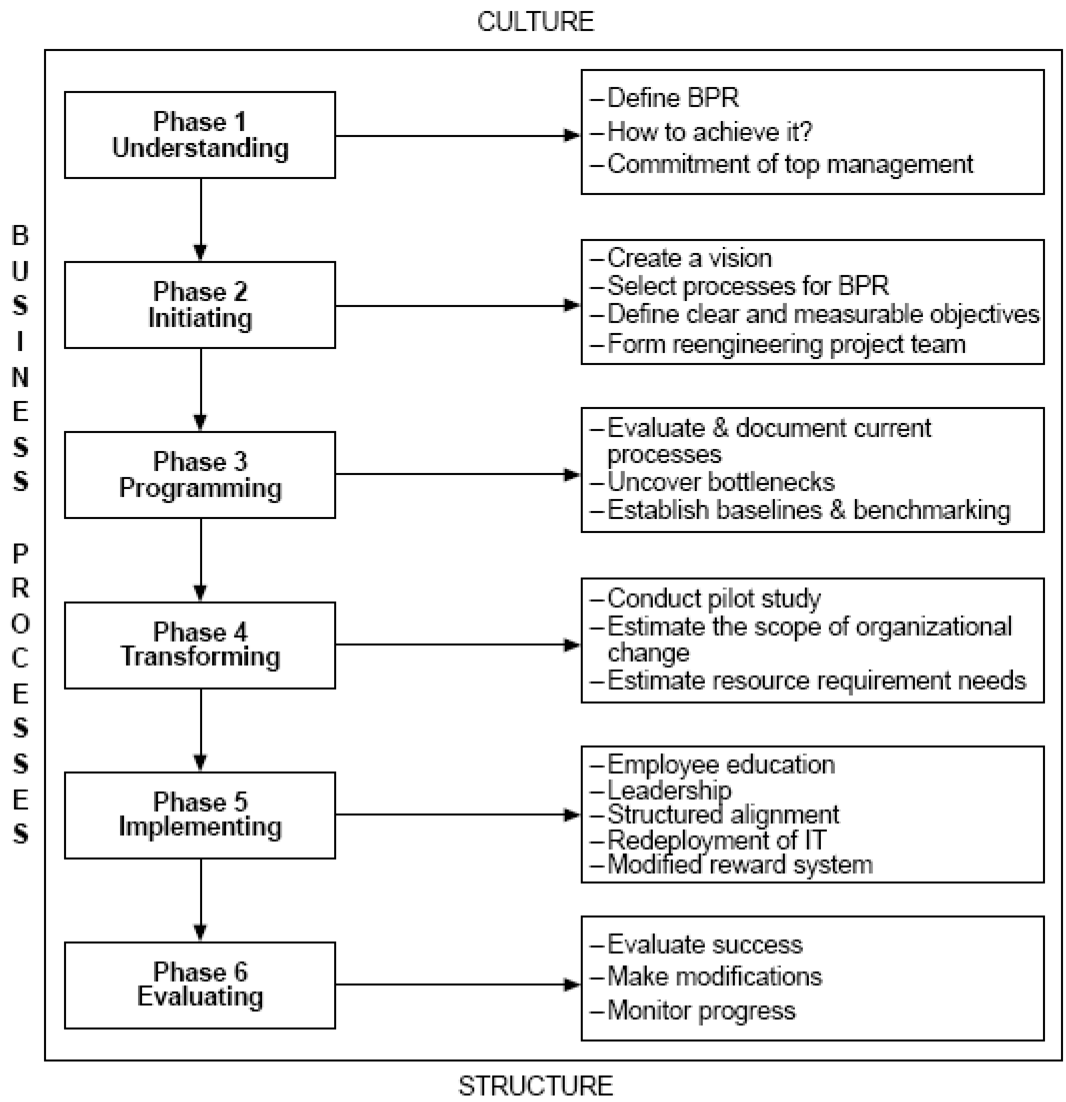


Figure: The BPR phases (Motwani et al.,1998).

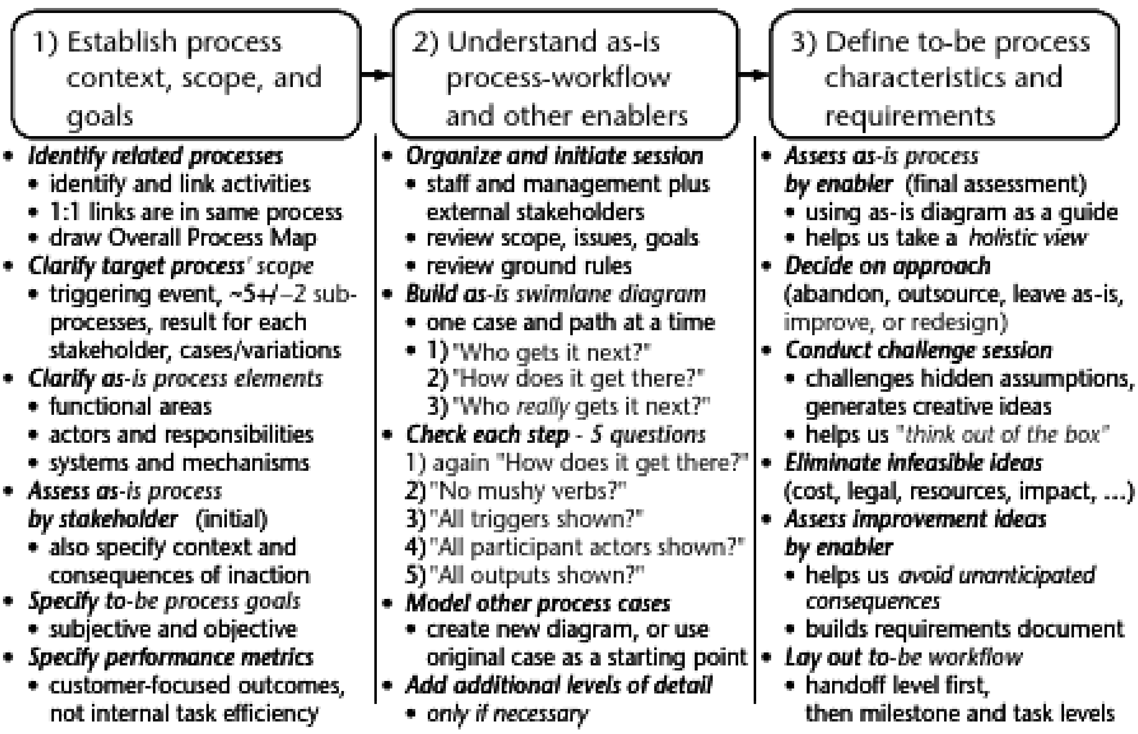
The six phases of the framework proposed by this research are: *understanding, initiating, planning, programming, transforming, implementing and evaluating*. The first phase consists of management realising the need of change and *Understanding* the basics of the initiative. *Initiating* is about creating a vision for the change, selecting the process to reengineer, setting the objectives and forming the reengineering team, which should be composed of people with different expertise, including people with IT capabilities. In the *Planning* phase the current process is documented, bottlenecks are identified as well as other areas of improvement. Then it follows the *Transforming* phase when the new designed process is implemented by using a small pilot environment with the purpose of test, fine-tune the new process, enhance organisational understanding of the process and estimate the impact of the change on the organisation and in matter of costs. *Implementing* phase comprises several actions in order to be successful as: employee education, leadership, structural alignment and redeployment of technical and human resources with a appropriated reward system.

Last phase is about *Evaluating* the results obtained by the reengineered process against the objectives set during the second phase.
Furthermore, Motwani et al. also indicate the main factors when dealing with BPR projects, which are:

- Beware of the reengineering label;
- BPR should be a deliberately planned endeavour;
- Start small;
- Customer should always be the focus;
- Agree on a redesign before setting cost-saving targets;
- Include key functions and personnel as early as possible;
- Study and highlight linkages between projects;
- Use a systematic approach to managing change;
- The key critical factors are executive commitment and leadership, an effective reengineering team, and reengineering technology and methodology.

<u>Sharp</u>

Sharp's view on a BPR project is summarised by the 3 phases framework, which is shown in the figure below.



Pag 84. Sharp

Establish process context, scope and goals

It is considered by Sharp as the most important phase because it happens in a short time and highly affects the prosecution of the activity: if executed well, it will have positive benefits on the project; otherwise, the consequences may create obstacles. This first phase includes actions as: identifying the process to reengineer and its targets (who, what and how), review organisational context (including strategy, mission etc), set project objectives and goals

Understand "as-is" process

Once the project objectives and targets are set the questions is to assess why the improvements to make, were not achieved before and why that could be done. A suggestion is to not get into details during these phase, but just to understand they way the process is and works. Main actions for this phase comprehend mapping the existent process, documents important observations and the other process enablers (IT, measures, etc), keep track of ideas for improvement and the way they will act on the process.

Design "to-be" process

This phase is divided by Sharp in two main activities:

- Characterize the to-be process;
- Design the to-be process workflow.

The first activity revolves around the final assessment of the as-is process, the strategy to choose for reengineering as well as generation of new ideas or rejection of existing ones, final development of the to-be model and revision of the conceptual data model.

The second activity consists of drawing down the new workflow, assessing each level and decide what to keep of not to get the final process layout.

It has to be pointed out that Sharp proposes a method to reengineer workflows but not how to reengineer a process. However, given the type of project conducted for this Thesis Sharp's a theory on workflow modelling become relevant.

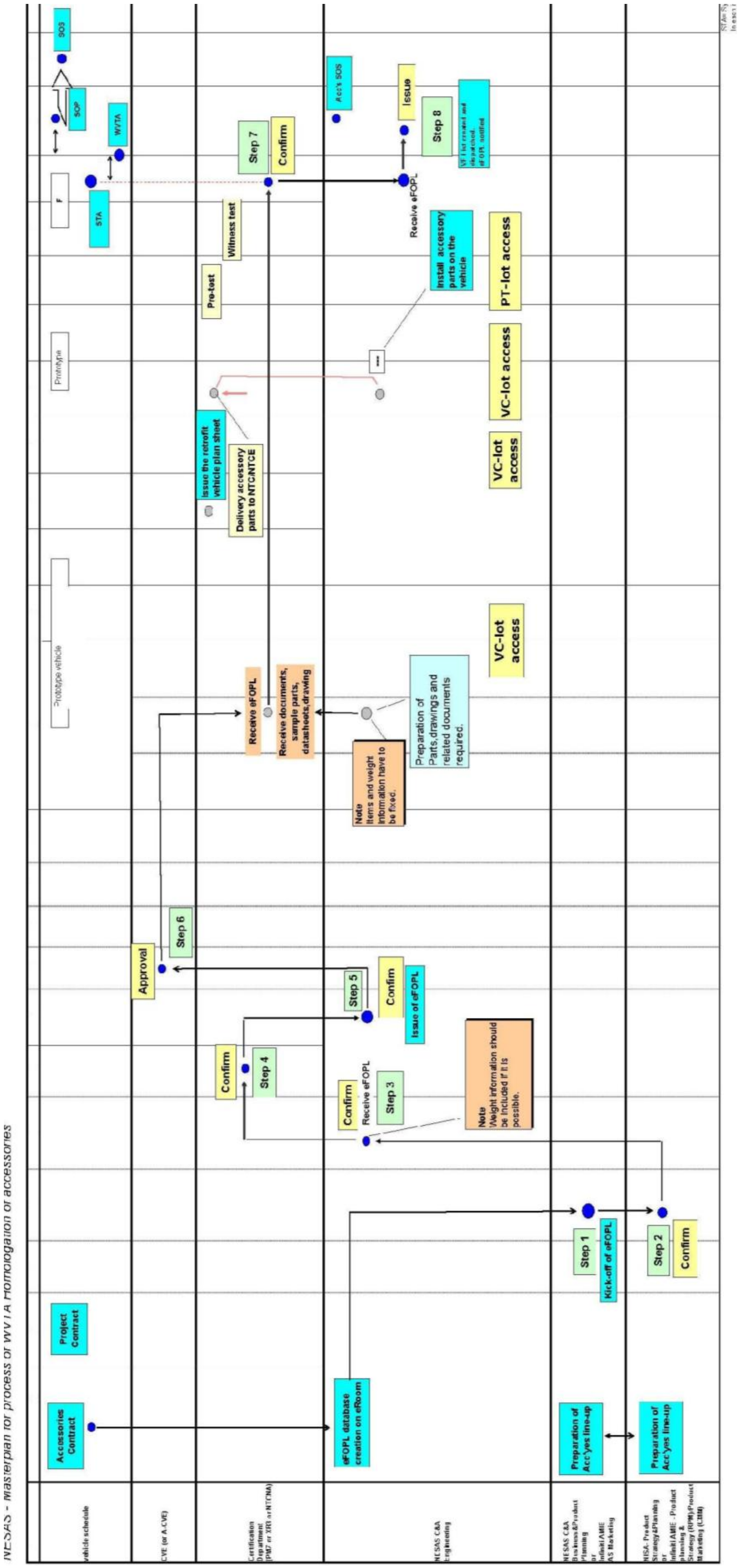
PBWD (Product-Based Workflow Design)

This methodology covers the technical side of a BPR project and its approach consists of a four phases framework with the following phases: *Scoping*, *Analysis, Design* and *Evaluation.*

During the *Scoping* phase the workflow that will be subjected to redesign is identified as well as the performance targets and possible limitations of the project. The *Analysis* is done to decompose the workflow and understand the dependencies for the purpose of its evaluation and the design of the new workflow. Then, bearing in mind the project objectives, the *Design* phase generates different alternatives of the workflow structure which indicate task or information processing. After that, the Evaluation phase verifies the proposed workflow structures and considers the achievement grade of the performance targets. The workflow designs are then evaluated by the management and a final choice is made.

The workflow design gets more into details, more specific theories and concepts are used (e.g. Petri Nets): as the purpose of this Thesis is not to apply or test these theories with workflow design, the PBWD methodology will not be further analysed.

Appendix B: WVTA workflow diagram (EUR Production)



Appendix C: WVTA workflow diagram (JPN Production)