Leire ORUE-ECHEVARRIA ARRIETA

FROM SOFTWARE AS A GOOD TO SOFTWARE AS A SERVICE (SAAS): A METHODOLOGY TO DEFINE THE TRANSFORMATION TOWARDS THE SAAS BUSINESS MODEL

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Resumen

Se habla de Cloud Computing o computación en la nube como una tecnología disruptiva. Sin embargo, cloud computing es ante todo un modelo de negocio. Empresas proveedoras de software, que distribuyen sus aplicaciones en base a un modelo de licencias se encuentran con la necesidad de cambiar su modelo de negocio para adecuarse a los nuevos tiempos y no perder así cuota de mercado. El enfoque utilizado en este trabajo comienza con una caracterización, basada en estándares, de la aplicación en su estado actual y en el estado ideal futuro en aspectos de tecnología, modelo de negocio y procesos organizacionales, con el objetivo de detectar cómo de lejos se está de ser una aplicación cloud. Una vez realizado este análisis se estudia el impacto que esta migración causa a nivel de procesos organizacionales, costes, beneficios y resultados financieros. El objetivo de esta solución es proveer a los órganos de decisión de la empresa con los mecanismos adecuados para seleccionar la opción más viable que garantice la sostenibilidad de la empresa.

Una vez que la decisión de migrar esas aplicaciones legadas ha sido tomada, se comienza con el proceso de migración que, en el caso de las aplicaciones como servicio (SaaS), incluyen una reflexión estratégica de cuál es el modelo de precios y el modelo de negocio asociado y que incluye la reestructuración de la empresa para poder afrontar ese nuevo modelo. En el caso de aplicaciones SaaS, la determinación de la política de precios depende en gran manera del proveedor cloud seleccionado, privado o público, sobre el que desplegar la aplicación, a lo que hay que añadir otras variables como analizar las funcionalidades que demanda el mercado o que el cliente considera de valor añadido y que permiten una entrada más fácil en el competitivo mercado SaaS. Decidir qué estrategia de precios permitirá que la aplicación SaaS sea sostenible a largo plazo puede ser una tarea complicada. Este trabajo presenta una solución sistemática para analizar qué estrategia de precios es la más conveniente para que una aplicación SaaS sea sostenible en el largo. Se han modelado y descompuesto tres estrategias de precios comunes en el mundo de SaaS (pago-por-uso, freemium, por capas), se han calculado los beneficios, así como el efecto de elegir una u otra estrategia en el balance de resultados y en otros indicadores económicos relevantes. Por último, este trabajo presenta una metodología para definir, paso por paso, el modelo de negocio de un proveedor SaaS de acuerdo con cinco pilares: la propuesta de valor, la provisión de valor, el cliente, el mercado o fuerzas externas y las actividades financieras, que incluyen la definición de la estrategia de precios comentada anteriormente. Todas las herramientas presentadas en este trabajo se han ejecutado en distintas pruebas de concepto y reportadas asimismo en este documento.

Resum

Cloud Computing o computació en el núvol pot ser entesa com a una tecnologia disruptiva. Tanmateix, el cloud computing és sobretot un model de negoci.Empreses proveïdores de software que distribueixen les seves aplicacions sobre la base d'un model de negoci de llicències es troben amb la necessitat de canviar el seu model de negoci per adequar-se als nous temps i així no perdre quota de mercat. L'enfocament utilitzat en aquesta tesi doctoral parteix d'una caracterització de l'aplicació –basada en uns estàndards– ex ante (estat present) i ex post (ideal futur) en aspectes de tecnologia, model de negoci i processos organizatius. L'objectiu és determinar com de lluny s'està de ser una aplicació cloud.Una vegada realitzat aquesta anàlisi s'estudia l'impacte que aquesta migració causa a nivell de processos organitzatius, costos, beneficis i resultats financers. L'objectiu d'aquesta solució és proveir els òrgans de decisió de l'empresa d'uns mecanismes adequats per seleccionar l'opció més viable que garanteixi la sostenibilitat de l'empresa.

Un cop la decisió de migrar d'aquestes aplicacions llegades ha estat presa, es comença el procés de migració, que en el cas de les aplicacions com a servei, inclouen una reflexió estratègica sobre quin és el model de de preus i el model de negoci associat i que inclou la reestructuració de l'empresa per poder afrontar aquest nou model.
En el cas d'aplicacions provisionats com a servei, la determinació de la política de preus depèn en gran manera del proveïdor cloud seleccionat, privat o públic, sobre el qual desplegar l'aplicació, al que cal afegir altres variables com analitzar les funcionalitats que demanda el mercat o que el client considera de valor afegit i que permeten una entrada més fàcil al competitiu mercat SaaS, sobretot quan el producte o la tecnologia no es comprenen prou bé. Però decidir quina estratègia de preus permetrà que l'aplicació SaaS sigui sostenible a llarg termini és una tasca complicada. Aquest treball presenta una solució sistemàtica per analitzar què estratègia de preus és la més convenient perquè una aplicació SaaS sigui sostenible en el llarg. S'han modelat i descrit tres estratègies de preus comuns al món de SaaS (pagament-per-ús, freemium, per capes); s'han calculat els beneficis, així com l'efecte de triar una o una altra estratègia en el balanç de resultats i en altres indicadors econòmics rellevants. Finalment, aquest treball presenta una metodologia per definir, pas a pas, el model de negoci d'un proveïdor SaaS d'acord amb cinc pilars: la proposta de valor, la provisió de valor, el client, el mercat o forces externes i les activitats financeres, que inclouen la definició de l'estratègia de preus comentada anteriorment. Totes les eines presentades en aquest treball s'han executat en diferents proves de concepte i s'han reportat en aquest document.

Abstract

Cloud computing is still considered as a disruptive technogloy. However, cloud computing is above all a business model. Software providers that distribute their applications following a license-based model are facing the need to change their business model in order to adjust to the new times and thus not lose market quota. The decision of migrating into a SaaS business model against staying with the current business model is challenging. The approach presented in this work begins with a standard-based characterization of the application in its current status and in the ideal future one, in terms of technology, business model and organizational processes, with the aim of deciphering how far the application is of being cloud-compliant. Once this analysis is performed, the impact of this migration is studied, in terms of organizational processes, costs, benefits and financial results. The ultimate goal of this approach is to provide decision makers with mechanisms to select the most viable option so as to guarantee the sustainability of the company.

Once the decision of migrating those legacy applications has been taken, and is positive, the migration process starts, that in the case of changing to a SaaS delivery model, includes a strategic reflection of which is the best pricing strategy and accompanying business model, which also involves a complete re-structuring of the organizational processes of the company in order to be able to face such a new business model. In the case of SaaS applications, the determination of the pricing model depends highly on the selected target platform upon which to deploy the application (private cloud or a public one), added to other issues such as determining which features offer added value to the customer and which ones will allow an easy entry in the market, especially when the technology and the product is not well. Deciding which pricing strategy will allow a long-term sustainable SaaS application can be a difficult task. This work presents a systematic approach to analyse which pricing strategy is the most convenient one for a SaaS application to stay sustainable. Three commonly used SaaS pricing strategies have been modelled (pay-per-use, freemium and tiered) and decomposed, recurring revenues calculated and the effect of selecting one or the other in the profit and loss account as well as in other economic indicators in the medium term is presented. Finally, this work presents a methodology to determine the business model of a SaaS provider following a step-by-setp procedure, based on five pillars: the customer, the value proposition, the market or external driving forces, the value delivery and the financial activities, related to the pricing strategy method also described in this work. All the approaches presented along this work have been proven in a set of different proof-of-concepts, that are also reported in this document..

Palabras clave / *Keywords*

Cloud Computing ─Business Strategy ─ SaaS ─ Business Process – Business Model – Pricing Strategy – Methodology to define a SaaS business model – Tiered pricing model – Freemium pricing model – Pay – per – use business model – Cost – Benefit Analysis – Organizational Processes

Summary

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ABBREVIATIONS

CBA: Cost-Benefit Analysis

IaaS: Infrastructure as a Service

NPV: Net Present Value

PaaS: Platform as a Service

ROI: Retun On Investment

SaaS: Software as a Service

SLA: Service Level Agreement

SLO: Service Level Objective

SOA: Service Oriented Architecture

VM: Virtual Machine

CHAPTER I. MOTIVATION AND CONTEXT

1. Introduction

New developments in the way services can be delivered over the internet have opened up tremendous business opportunities to software companies. The Internet got faster and more reliable so that data is transferred quicker and more reliably among customers and providers. This has made it possible to offer even basic IT appliances such as servers for storage or computing clusters as a service, i.e. providers provide the hardware and infrastructure and clients provide the data. The decoupling of responsibilities accelerates the development of new service platforms and software products.

Since the rate of innovation is accelerating, software products in the age of the Internet have to evolve constantly. Consider how within the space of just five years innovations such as cloud computing, smartphones and social networks have totally transformed the way we work together. Innovations in the technological space affect the systems that the software has to support or needs to adapt to. Innovations in the business space also affect the licensing and usage model. Software products have to be improved with regard to these new circumstances but without disrupting the business continuity of existing customers.

However, managing software modernization is still a significant challenge in today's software life cycle. This challenge is usually considered as inevitable, unpredictable, costly, technically difficult, time-and resource-consuming, and poorly supported by tools and techniques or formalisms. The complete lifecycle of software, from requirements to run-time and delivery has to be re-adapted to the new technological and business conditions, requirements and challenges, since there is an increasing need for tools/means to support software evolution and adaptation as a key value for next generation service based software modernization.

The first challenge that companies face is the decision whether to migrate their existing products or to start from scratch. Questions such as cost and effort of the migration, impact of new business models in the company or return of the investment need to be answered before tackling the actual modernization. If the estimates they obtain suit their expectations and they finally decide on the migration to a service-based software, reusing as much as possible from the old one, they will face further challenges and difficulties, not only in with respect to the usage of new technologies, or architecture but

also with respect to assumptions that companies usually take for granted and afterwards are no longer valid.

The software evolution process is becoming more and more difficult, boundless and unpredictable as many new factors have to be considered: hardware evolution, new (non-) functional requirements, current and future business models, etc. As result, the estimation of the impact and effort required to implement the modernization of a system is difficult and uncertain. Tools and processes are needed to estimate the costs, resources and the financial, technical and cultural feasibility of the system modernization are required. Moreover, the new set of (non-) functional requirements such as security, privacy, reliability, availability, application monitoring, automatic billing mechanisms, dynamic upgrades during execution for ensuring business continuity or the possibility of accessing the same application on different devices need to be covered.

Another changing dimension in software development is time-to-market. Google famously releases many products as beta versions, and users overwhelmingly accept unfinished and in-development projects, provided the core benefits are good and reliable. This shift in user attitude, the often low barriers to competition, and rapid adoption cycles mean that first-mover advantage is very high in the software industry. Consequently, time-to-market is now, more than ever, critical and therefore the software development cycles need to change, from requirements to provision, from migration to new developments, from maintenance to evolution to new technologies still on the periphery, such as multicore processing. The software development and provision lifecycle needs to address the evolution of a software product over time.

Software is no longer sold as a package but rather as a service and this requires new capabilities in the software, such as the ability to support multi-tenancy or providing monitoring and billing. This leads to at times profound changes in the company, such as pricing models, business models or changes in the business processes as emphasis switches from making sales at a point in time to serving customers over time. This thesis will give a respond to that.

Current development frameworks focus mainly on the technical development of new applications but they do not support the needs for an automatic transformation of existing applications into service-based ones, considering current constraints like multi-tenancy or future ones like parallel programming. Other issues such as the inclusion of

the business model aspects in the architecture of the application, critical for cloud-based applications are often also ignored.

For instance, finding the right strategy to put price to the SaaS application is a key issue to ensure the sustainability of the company due to the existence of so many variable costs. There exist several pricing models that have proven successful in certain companies such as Amazon or Salesforce. However, to find the right one and how to implement them remains today a research challenge due to the many variables that need to be taken into consideration. The determination of the pricing strategy is one major challenge but not the only one, since the revenue and business model need to be accordingly defined, taking into consideration the market segment where the application is targeted to. The user must also perceive an added value of the service, independently of the composition and topology of the application. This problem is not unique to SMEs. Big companies such as HP and IBM have struggled or are still struggling in the determination of their pricing strategy and business models of some of their products. HP, for instance, invested a big amount of money in their cloud offering, Helion Cloud (Hewlett Packard, 2014), aimed to provide a public cloud infrastructure. The selected pricing strategy was a freemium model, time – based, that is, free for a limited period of time after which the user is charged for the service. From the technology point of view, Helion Cloud also suffered some shifts, as it first announced partnerships with key players such as VMWare, Microsoft, Open Stack and Cloud Stack but decided later on to solely build upon Open Stack, so as not to be accused of being followers. (ZDNet, 2014). Recent news (ZDNet, 2015) (Venture beat, 2015) have been published informing that HP has decided to drop out of the cloud offering claiming that they cannot keep up with Amazon AWS, the market leader. Clearly, HP did not have clear neither their price strategy nor the business model for Helion Cloud. This thesis will provide methods and tools to define innovative business models, revenue and pricing strategies that aid companies in the difficult SaaS market.

2. Objectives of this research

The objective of this research is threefold. Firstly, to develop a set of methods and tools capable of evaluating the feasibility of the migration of a non-cloud application to the cloud through a business feasibility analysis, as well as an estimation on the impact, in terms of economics and organizational processes, caused by such cloudification. Secondly, this thesis will provide a methodology to help companies define their SaaS business model. Finally, to determine which SaaS pricing strategy is the most adequate for that company and its cloudified product and how the sale of this new cloudified

product affects the economic indicators of the enterprise. Part of these assets rely on a technical feasibility analysis, a parallel research that has been carried out in the European – funded project ARTIST (ARTIST Consortium, 2013) between 2012 and 2015, which also serves as input for this research but out of the scope of this thesis. The validation activities were carried out in the Spanish funded project mCloud, running from 2011 to the end of 2014.

The main outcomes of this research shall be:

1. *R1: A maturity assessment tool*. The objective of this step is to assess how mature the application is in terms of business (i.e. business model, billing mechanisms, etc.) and in terms of organizational processes (existence of SLA, maintenance and upgrades procedures, customer service, etc.) in its current status, and then these very same two aspects once the application is migrated. The main outcome of this maturity assessment tool is a gap analysis of the current and the ideal situation of a servitized application and a set of recommendations of the steps that should be taken to reach the desired situation.
2. *R2: A Business Feasibility Analysis and a Process Kit*. This business feasibility analysis is aimed to provide on one hand, the enterprise context analysis – economic information about how ROI, or payback metrics –, delivered in the form of a Cost-Benefit Analysis (CBA) and on the other hand, the impact in a company's organizational processes of offering a service and no longer a product, – by means of a set of processes for an ideal Saas-based company – and presented in the form of a Process Kit.
3. *R3: A Methodology to define a SaaS Business Model* for a company that offers a cloudified product.
4. *R4: An Analysis of different SaaS Pricing Strategies and the effect on the Profit and Loss accounts of the enterprise*. Several SaaS pricing strategies have been studied and modelled. The result is an analysis of which pricing strategy is the most convenient one in the long term and how it affects the Profit&Loss Accounts.

The results obtained in both the maturity assessment (R1) and the business feasibility analysis (R2) will guide decision makers in the strategy of migrating a legacy application, totally or partially, or if it is better to start from scratch. The analysis of different SaaS pricing strategies (R4) and the methodology to define the SaaS business model (R3) will guide business people in the way of making the new service and the company sustainable.

Thus, the main hypothesis of this research are:

H1: It is possible to characterize a cloud-compliant application in terms of business model and the supporting organizational processes.

Via the maturity assessment tool and based on proven best practices, applications can be characterized and classified. The maturity assessment shall not be a comparison or a benchmark with other applications but with existing standards and best practices common in the software industry. The assessment shall be performed at high level for the current application (as-is) and the desired application (to-be).

H2: It is possible to determine a gap analysis of applications currently offered as product and determined to be cloudified, as well as to provide recommendations on the issues that need to be considered in the cloudification of the application.

The as-is and to-be situations will be represented in a graphical manner, thus allowing to perceive in an easy way the gap between both situations. Furthermore, recommendations will be provided to decision-makers so as to let them analyze the difficulty and impact of implementing such recommendations.

H3: It is possible to identify which organizational processes will be affected by a cloudification

Upon a close study of different standards and best practices, it is possible to determine which processes will be affected by the servitization of the company and the cloudification of a software application.

H4: It is possible to determine the cost and benefit of an application that is about to be cloudified.

Based on the gap analysis and the input received from there, as well as from the organizational processes analysis along with manually inserted data, it is possible to determine the cost, benefit, ROI and payback of the investment that means to change delivery models.

H5: It is possible to define the business model of a company providing SaaS

Once determined the feasibility of the migration, the processes that need to be updated or created from scratch as result of the SaaSification, and the pricing strategy, it is possible to determine the business model for a SaaS provider.

H6: It is possible to determine which pricing strategy is the most adequate one for a certain SaaS application.

Based on the modeling of the most used pricing strategies in the SaaS business (freemium, tiered and pay-per-use), it is possible to determine which pricing strategies has a better impact in the sustainability of the company in the long run.

3. Methodology and approach of this research

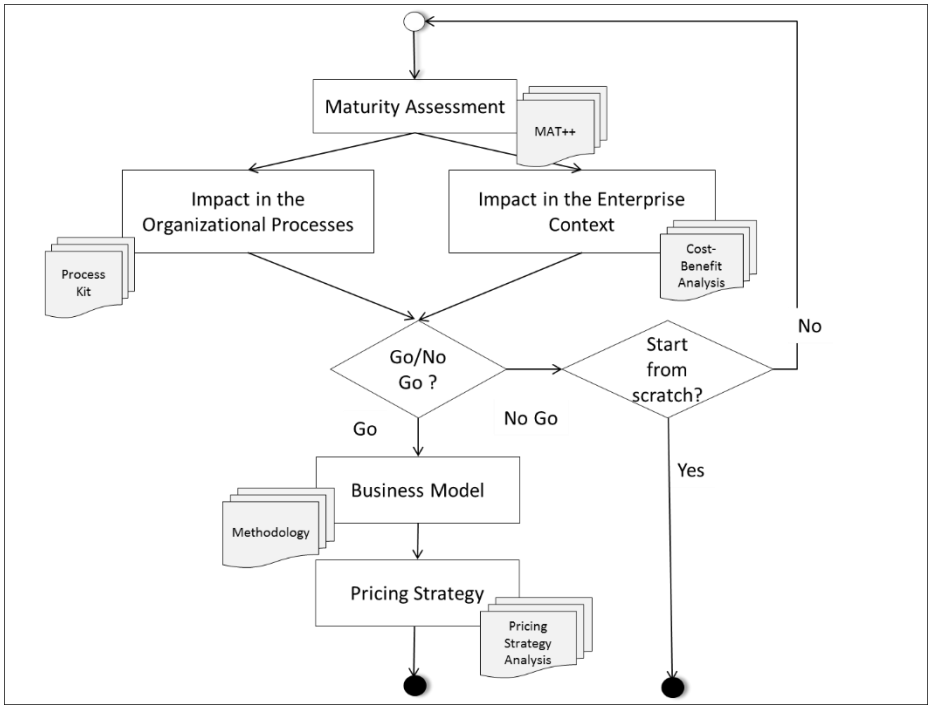
This research is the result of almost seven years of work. While the goal of this research has not changed over these years, the approach has varied as consequence of the intermediate results that were attained. The different outcomes and results reported in this thesis have followed an iterative development approach. In each iteration, certain functionalities, deemed as priority and core, were developed and then the outcome was validated in a controlled environment, which in turn, provided feedback to improve and extend these results in the next iterations. Each of the results that will be presented along this thesis had its own path and a different number of versions. For instance, the Maturity Assessment Tool (R1) that will be presented in Chapter II had a total of four versions. The Cost-Benefit Analysis and the Process Kit (R2) had three iterations. The modelling of the different SaaS pricing strategies (R4) and the methodology for the definition of the SaaS business model (R3) were released twice and three times respectively. These results (R2, R3, and R4) are presented in Chapter III. All tools have been validated in real use cases and their report can be found in Chapter IV. For simplification purposes, only the last versions of each of the main results are reported in this thesis.

Cloud computing has evolved greatly in the last years. When this work started, there were few official related standards and most of the knowledge and the references available were industry-driven. In addition to that, cloud computing is understood as a stack of three service types (IaaS, PaaS and SaaS) that need to comply with certain characteristics (e.g. on On-demand self-service, Broad network access, Resource pooling, Rapid elasticity and Measured service (NIST, 2011)), but each service has its own constraints due to the layer of the stack where they are placed, as it is not the same to design an application (SaaS) than to design a platform (PaaS), even though the basic characteristics must remain the same. That said, an empirical analysis of different resources such as developers' websites, technical manuals and architecture of existing applications was initially performed in order to assess the main differences of provisioning a SaaS application compared to provision a traditional client-server application with a special focus on both the technical architectural concerns and their business models. Once the differences were understood, the research work started by

analyzing the current situation in modernization approaches, the limitations of current tools and procedures and the formulation of the hypothesis as stated beforehand.

The work on this PhD thesis follows the same approach that a company aiming at servitizing its software product shall follow. This approach is depicted next.

Figure 1. Approach followed in this thesis



Source: author's own contribution

1. *Perform a maturity assessment analysis*. The objective of this step is to analyze how mature the application is in terms of business (i.e. business model, billing mechanisms, etc.) and in terms of organizational processes (existence of SLA, maintenance and upgrades procedures, customer service, etc.) in its current status, before the migration, and then these very same two aspects once the application is migrated. The main outcome of this maturity assessment tool is a gap analysis of the current and the ideal situation of a servitized application.
2. As next step, two activities are executed in parallel:
    a. *A Business Feasibility Analysis:* The business feasibility analysis is aimed to provide the enterprise context analysis – economic information about ROI, or payback metrics –, delivered in the form of a Cost-Benefit Analysis (CBA)
    b. *Analysis of the Organizational processes* that need to be reformulated because of the migration: Provide a support tool that guides companies in

the analysis of which organizational processes must be updated or defined because of the servitization, that is, from offering a service and no longer a product. The associated tool for this is the Process Kit.

The results obtained in both the maturity assessment and the business feasibility analysis will guide decision makers in the strategy of migrating a legacy application, totally or partially, or starting it from scratch. Shall the decision be positive, then the next steps are executed:

1. *Decide on the most adequate business model for the SaaS application:* the surrounding business model towards the servitzed product needs to be re-defined.This involves the analysis of the external market forces, re-organization of the development and operation of the service that will be provisioned, definition of the service's new value proposition, financial – related activities as well as the new relationship with the customers. To achieve that, a systematic methodology that takes into consideration the most relevant aspects to define a SaaS business model has been developed.
2. *Analyze the most adequate pricing strategy for the SaaS application:* In this step, companies shall have the means to decide which the most adequate pricing strategy is for her own SaaS application, based on existing and newly created metrics for online applications. For the purpose of this thesis, out of the SaaS pricing strategies studied, three have been modeled (freemium, tiered and pay-per-use) and decomposed. The selection of these pricing strategies has been done by empirical observation. Once the values of each field that determine the price strategy has been filled in, the profit and loss account is shown as well as other accounting metrics. The purpose of this activity is to show which pricing strategy is, in principle, the most profitable in the long run. The determination of the price value metric is, however, out of the scope of this work.

4. Structure of the work

The PhD thesis is structured as follows. Chapter II starts off with a state-of-the-art analysis of existing modernization assessments and then presents approach developed to characterize the maturity of an application in terms of its business model and the organization's surrounding processes, in the as-is and to-be situation, that is, now and after the migration has taken place. This characterization is based on existing standards such as EFQM, ITIL or ISO. Chapter III presents the theoretical framework of this work, that is, the cost-benefit analysis, the study on the organizational processes affected because of the servitization, the analysis and decomposition of several SaaS pricing

strategies, as well as a systematic approach for a business model definition. Chapter IV focuses on the empirical validation of the theoretical framework in real cases. Finally, chapter V presents the conclusions and future work. A Glossary and a list of common abbreviations used in this work can also be found at the end of the document.

3. Acknowledgments

I would like to thank all the people that have helped me in the compilation and writing of this PhD thesis. This research work is actually the result of three collaborative research projects in which my organization, TECNALIA, and my team, participated. These projects are the Spanish funded one, mCloud, and EU funded projects ARTIST and PROCEI, in this case, also partly funded by PROCEI Mexico.

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Hereby, I would also like to thank the consortium members of the mCloud and ARTIST projects. Their feedback, after testing these tools in different iterations, helped me enormously to improve them, and to re-think some of the approaches I had taken, to finally go into a complete different path.

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CHAPTER II: MATURITY ASSESSMENT OF SOFTWARE APPLICATIONS AT TECHNICAL AND BUSINESS LEVEL

1. Introduction

A company striving to improve its position in the market has to know very clearly where it stands and where it wants to go. Moving an application from an enterprise environment to a cloud platform requires a careful evaluation of the application and the target platform with factors such as suitability, maturity and cost-benefit ratio as part of the initial cloud modernization assessment. Therefore, a benchmark, which allows a company to measure its position in the cloud market is needed (Orue-Echevarria L. , Alonso, Gottschick, & Restel, 2011).

The main idea behind this benchmark is that if the actual characteristics of a company's solution in the cloud market can be identified and characterized against existing industry standards, the actions required to improve the current characteristics rated as weak can be derived.

This chapter is structured as follows. Section 2 presents a brief state of the art with current approaches for determining how to start a migration process. Section 3 details the maturity assessment process and the tool developed to characterize applications. This assessment is based on existing standards in order to foster the uptake by the industry.

2. Overview of Current Approaches

This section provides an analysis of different approaches of how an enterprise should start a modernization process. The approaches analyzed cover both academia and industrial solutions and are targeted to the evolution / modernization of legacy software, both to cloud and non-cloud delivery models. This section ends with a table comparing these approaches against a set of aspects identified as must-have's in the process of cloudifying legacy applications.

2.1 Butterfly method

The objective of the Butterfly Method (Wu, et al., 1997) is to guide the migration of a mission-critical legacy system to a target system, in principle, non-cloud.

The Butterfly Method for legacy system evolution consists of five phases, namely: justification, legacy system understanding, target system understanding, migration, and testing. These phases are detailed below:

- Phase 1- Justification phase: it involves the investigation of the risk and benefits associated with the legacy system evolution, based on which the decision of evolution or redevelopment has to be taken. To support such decisions, various activities are carried out, for instance, a cost benefit analysis to determine the economic benefits of evolution, or extraction of software quality metrics to determine the technical feasibility.
- Phase 2 - Legacy system understanding: it involves the reverse engineering of the legacy system in order to identify the components, recreate documentation, understand the static and dynamic behavior of the legacy system, and create the presentations of the system at a high level of abstraction.
- Phase 3 - Target system development: it involves the elicitation of requirements/specifications of the target system and choosing the most appropriate architecture and standards for the target system. These specifications are derived from the knowledge gathered from the legacy system understanding phase.
- Phase 4 - The migration phase: this phase is concerned with the physical transformation of the whole legacy system to the target system. The migration is typically performed incrementally in order to reduce the risk of failure and impact on the operational legacy system.
- Phase 5 – Testing: Finally, testing is carried out throughout the evolution process to ensure that the target system delivers the functionalities specified at the starting of the evolution.

2.2 Renaissance method

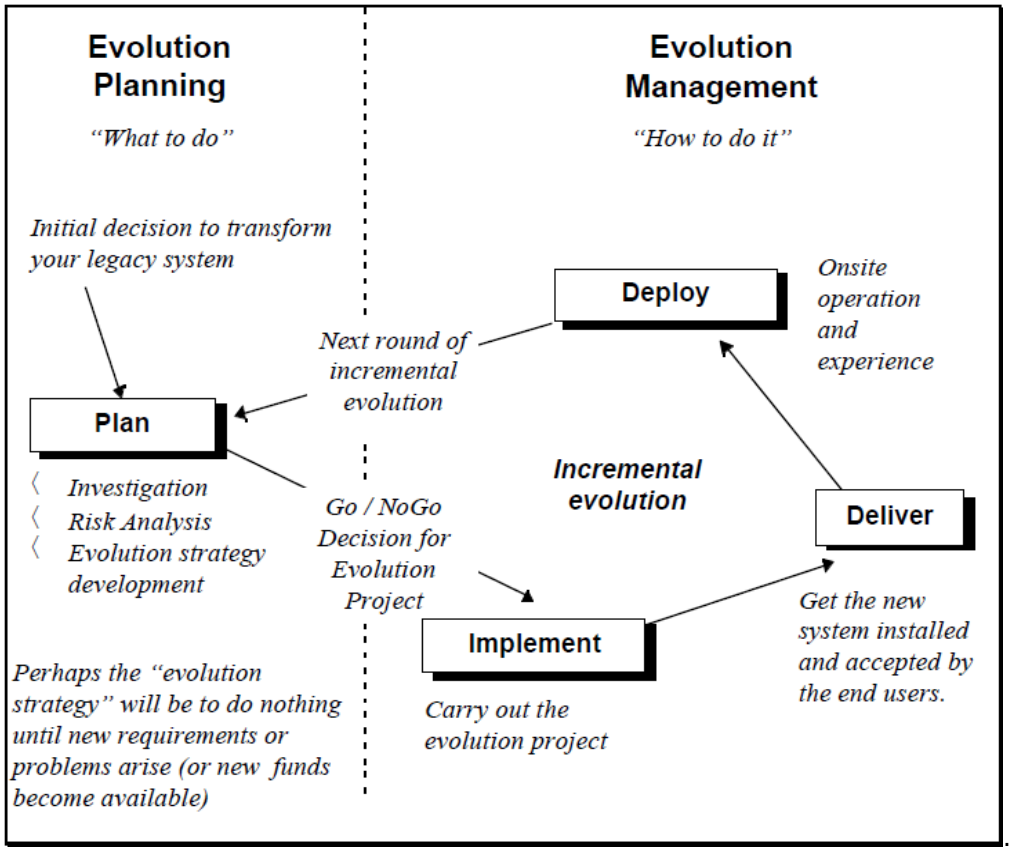
In (REINASSANCE Consortium, D3.3, 1998) and (Ransom, Sommerville, & Warren, 1998) it is presented an assessment method that examines a legacy system from its technical, business and organizational perspectives. This method guides users through an analysis of these perspectives by selecting certain assessment characteristics and assigning them values.

According to this approach, a system assessment is used to gain an understanding of a legacy system, which is fundamental to any system evolution exercise. According to the authors, a system assessment should be an initial activity for all evolution projects.

Figure 3 presents the different phases of the RENAISSANCE method. The “Evolution Planning” phase is the one that is suitable for the purpose of this section. The objective of this evolution planning phase is to justify an approach to transform a legacy system in

order to formulate and undertake a realistic and workable evolution project plan bearing in mind that the current system must remain operational until the moment the re-engineered system goes live.

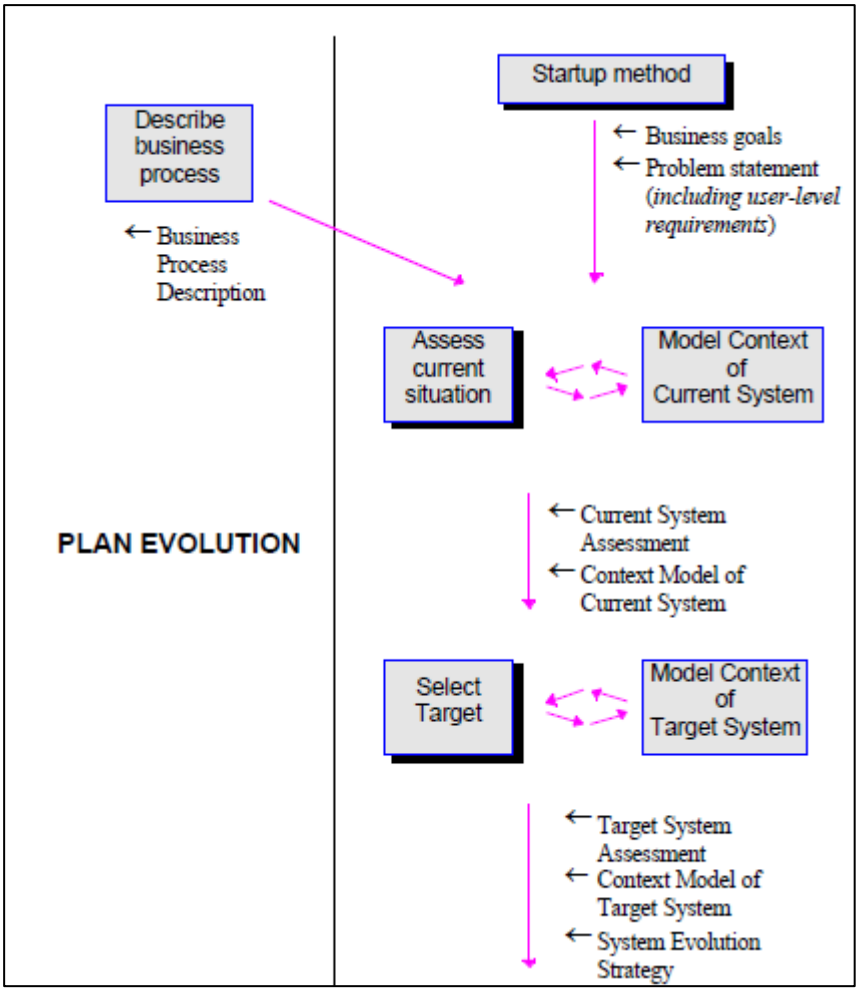
Figure 2. Phases of the RENAISSANCE Method



Source: adopted from (REINASSANCE Consortium, D3.3, 1998)

As stated in (REINASSANCE Consortium, D4.2, 1998) the first important milestone in the REINASSANCE method is to develop a viable, cost effective system evolution strategy that can be presented to the higher management. The goal of this Plan phase within the Evolution Planning is to determine a set of candidate REINASSANCE reengineering strategies needed to address the business goals of the company and to develop an overall approach—supported by various kinds of assessment artifacts such as risk analysis and size/cost estimation—that applies one or more of these individual evolution strategies to different components of the system to achieve the desired effect in the most efficient manner. The outcome of this phase is a Go/NoGo.

Figure 3. RENAISSANCE Plan Evolution Phase



Source: adopted from (REINASSANCE Consortium, D3.3, 1998)

The RENAISSANCE's assessment for the evolution of the current system (REINASSANCE Consortium, D3.3, 1998) starts with the investigation of the current system as depicted in Figure 4. This investigation aims to acquire knowledge of both systems (current and target), the organization using these systems, the application domain, the technology trends and the business priorities. To assess the current system, RENAISSANCE models the context of the system, making use of context models. A context model is used to define the enclosing environment of the system under study. In other words, the context is the surrounding element for the system, and a model provides the mathematical interface and a behavioural description of the surrounding environment (Wikipedia, Wikipedia Context Model, 2012). This context modeling activity is carried out in order to increase the level of knowledge about the

system on a conceptual level (e.g. its logical structure, functionality, performance characteristics, etc.).
As seen in Figure 3 , both the assessment and the modeling are carried out iteratively. Each iteration of the assessment and the modeling therefore allows to obtain progressively more detail and accuracy, until a sufficient level of understanding and evaluation of the current system has been reached. This sufficient level depends on the purposes of the organization.

The next step they propose is to identify a set of possible strategies that can be applied to the current system to be migrated towards the target system. As in the previous case, this process of strategy selection and evaluation is also supported by modeling the conceptual context of the target system, in order to gain a deeper understanding of the envisioned logic and architecture of the future system. Likewise, the strategy selection and the modeling are carried out iteratively, so that the level of detail and accuracy grows gradually and can be stopped when a sufficient level has been reached.

The process of determining candidate strategies consists of (REINASSANCE Consortium, D4.2a, 1998):

- assessing the technical quality and business value of the current system;
- refining this value according to the business goals; and
- assessing the desired system and providing a transformation mapping between the existing system and the desired one.

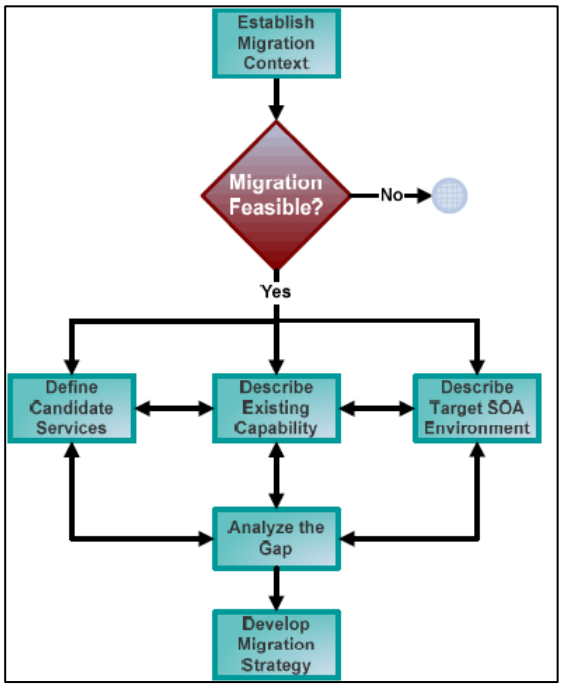
Hence, from the text above it can be seen that in the case of RENAISSANCE, the understanding of the system is not only necessary but also one of the stages of the system assessment process. RENAISSANCE's system understanding aims at providing the inputs required to determine the quality of a system candidate for evolution. In order to enable this system quality assessment, RENAISSANCE suggests identifying and documenting both the business goals (e.g. Market value, Contribution to Profit, Information significance) and the business processes by performing a business process (re)engineering exercise. RENAISSANCE does not prescribe any specific tool but requires that the result of this exercise is placed in a repository. Moreover, the organizational infrastructure in which the system is used is also considered in RENAISSANCE. This kind of assessment is aimed to understand factors such as the type of organization and system users, the skill levels of the system support, and the organizational attitude to change.

2.3 SOA Migration, Adoption and Reuse Technique (SMART)

Service Oriented Architecture (SOA) Migration, Adoption and Reuse Technique, from now on SMART (Lewis, Morris, Smith, & Simanta, 2008), helps organizations to make initial decisions about the feasibility of reusing legacy components as services within a SOA environment. SMART considers the specific interactions that will be required by the target SOA environment and any changes that must be made to the legacy components. To achieve this, SMART gathers information about the legacy components, the target SOA environment, and candidate services to produce:

- a preliminary analysis of the viability of migrating legacy components to services;
- an analysis of the migration strategies available; and
- preliminary estimates of the costs and risks involved in the migration

Figure 4. SMART Process



Source: adopted from (Lewis, Morris, Smith, & Simanta, 2008)

The SMART process has six activities and one major decision point as shown in the previous figure. These activities can be outlined as follows:

1. Establish migration context. The main objective of this phase is to gather all the necessary information for:
    - Understanding the business and the technical context of the migration;

- Identifying the different key stakeholders (e.g. who is the sponsor, who knows the legacy system and the target environment, who is creating the demand for the migration);
- Understanding the legacy *Source: adopted from (Lewis, Morris,*
- Identifying a set of candidate services for migration. The selection of candidate services is both a top-down and a bottom-up approach guided by business or mission goals as well as the functionality that exists in the legacy system.

2. Migration Feasibility Decision Point. In this phase it is determined whether the legacy system is a candidate for the migration or not. In the event that the legacy system is not a good candidate, stopping at this time will save money. SMART considers a decision stop as a positive outcome because it saves valuable resources for other activities. The most important determinations are:
    - There is enough migration potential to continue the analysis.
    - Migration goals are clear and shared among stakeholders.
    - There is a high-level understanding of the legacy system and the target SOA environment.
    - Candidate services and potential service consumers have been identified.
    - A very preliminary mapping of services to legacy components has been done.
3. Define Candidate Services. The goal of this phase is to select a small number of services from the initial list of candidate services that were identified as part of the Establish Context activity. Good candidate services are the ones that perform concrete functions, have clear inputs and outputs, and can be reused across a variety of potential applications.
4. Describe Existing Capability. The objective of this phase is to gather information about the legacy system components that contain the functionality meeting the needs of the services selected in the Define Candidate Services activity. Technical personnel are questioned about system aspects such as: descriptive data about legacy components, architecture views, and designs paradigms.
5. Describe Target SOA Environment. The goal is to gather information about the target SOA environment for the selected services, including:
    - major components of the SOA environment
    - impact of specific technologies and standards used in the environment
    - guidelines for service implementation

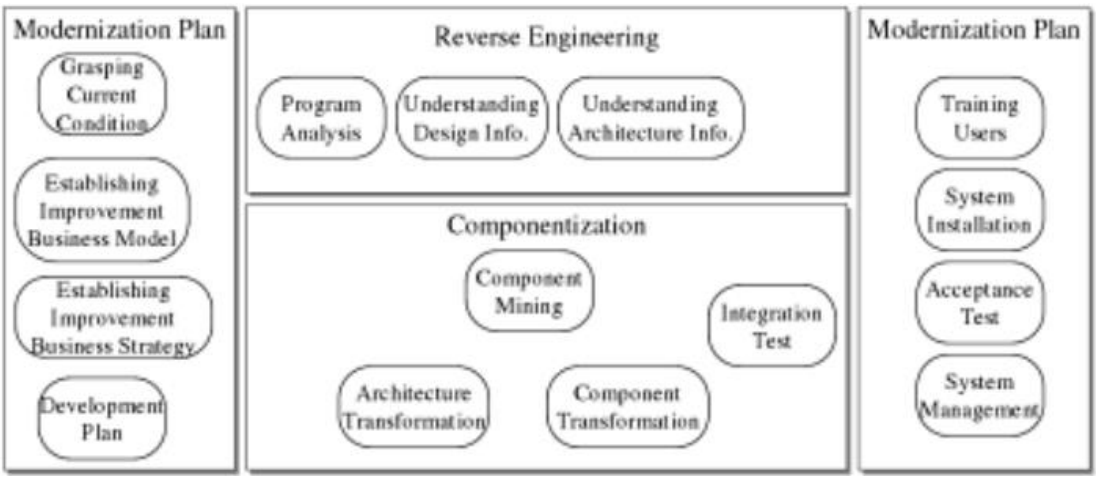
- state of target environment
- interaction patterns between services and the environment
- QoS expectations and execution environment for services

6. Analyze the Gap. Preliminary risks, effort and cost to convert the candidate legacy components into services based on the service requirements and target SOA characteristics are provided in this phase. The input to calculate these preliminary estimations are the carried out discussions of the changes necessary to convert the legacy components into services. Additionally, in some cases, additional analysis methods may be needed, such as evaluation of code quality using code analysis tools or architecture reconstruction.
7. Develop strategy. The objective of this phase is to develop a migration strategy that may include:
    - Feasibility, risk, and options for proceeding with the migration effort.
    - Identification of a pilot project to migrate a simple service (or set of services) that has high visibility and low risk, especially if the organization is new to SOA.
    - Specific migration strategies to follow. A migration strategy may present a set of options for migration. For example, an approach may be to wrap the existing legacy code initially and rewrite the components in a different language in the future.
    - Needs for additional information or training. Any gaps identified by the migration issues need to be addressed through, for instance, technology evaluation, market research, training and so on.

2.4 MARMI-RE Methodology

This methodology (Eun, Jung, & Young, 2006) presents a reengineering method and tools for software modernization or evolution.

Figure 5. MARMI-RE Methodology phases



Source: adopted from (Eun, Jung, & Young, 2006)

Figure 5 shows the different phases that compose the MARMI-RE Methodology. For the scope of this document, this analysis is focused on the phase called Modernization Plan. The MARMI-RE method proposes a modernization plan before tackling the actual reengineering of the current legacy system. This modernization plan is designed to understand and estimate the organization and status of the current system the reengineering costs, future complementary components, and so on.

MARMI-RE divides the execution of the modernization plan into four main activities

- Grasping current conditions, focused on the analysis of the following aspects:
  - Business environment, that is, the organization structure, business workflows and internal issues;
  - Legacy system, namely the functionalities of business tasks, application system analysis and system environments analysis;
  - Maintenance tasks.
- Establishing Improvements in the Business Model: the focus of this activity is to identify the business use case model, to establish the vision and the improved architecture.
- Establishing Improvement in the Business Strategy: during this activity the scope of the reengineering/modernization is determined and based on this, an improvement strategy is defined.
- Development plan: this activity has as main objective the definition of the development process for the modernization of the legacy system.

2.5 BusinessFirst™ Software Modernization Assessment

BusinessFirst™ Software Modernization Assessment (Point Source, 2013) claims to be a quick and cost-effective way to ensure the right approach for modernizing software. The BusinessFirst™ Software Modernization Assessment is a commercial solution provided by the company Point Source and their main claim is to help organizations improve their business.

The BusinessFirst™ Software Modernization Assessment is sold as a consultancy service by means of an assessment where, as outcome, an action plan is provided. This action plan is designed for sustaining, enhancing and leveraging the investments that have been made in the legacy systems portfolio.

The proposed assessment is carried out through the collection of information about the legacy application including the database, the main technologies, and the architecture. The information is obtained with different on-site interviews with key business and technology stakeholders and, in parallel, reviewing the code of the legacy application. In addition to this collection of information and in order to understand the current solution, an off-site activity is also performed so as to research and document one or more potential approaches for modernizing the software. The result of these activities is a roadmap for the modernization a legacy application giving the management action plans to achieve that.

2.6 Software Associates Modernization

Software Associates (Software Associates, 2013) presents an approach to help organizations in the modernization of the whole business, not only the applications, but also the internal skill sets and methodologies. The approach they propose is incremental seeking to obtain a successful modernization of IT environments.

The activities carried out in this approach are classified in three different phases. Only the two first are in the scope of this document: Legacy Modernization Assessment and Legacy Modernization Analysis and Design. The third phase is the Legacy Modernization Integration and the Implementation itself, which would happen in the event the decision for the modernization is positive. The first and second phase are outlined next:

- Legacy Modernization Assessment: The objective of this phase is to obtain an initial understanding of the IT environment and the tentative scope of the Legacy

System modernization at hand. This assessment includes the so-called Pilot Phase on a sample of the system in order to ensure that the proposed solution will achieve the business objectives from a technical, operational and business perspective in the most optimal way.

- Legacy Modernization Analysis and Design is, on the other hand, performed on the entire IT inventory, and it provides a detailed analysis of the Legacy system and of the target solution including analyzed complexities. This analysis is performed at three different levels:
    - Enterprise Roadmap: This roadmap analyze s the way in which to evolve in order to meet current and future business objectives. This roadmap is focused on opportunities to streamline business processes, increase market share, maximize productivity and increase innovation.
    - Architecture Analysis & Design: This step analyze s the current software architecture and how this architecture should evolve in the modernization. The focus is on leveraging existing systems, identifying hardware and software preferences, and understanding business requirements related to interoperability, flexibility, redundancy and security.
    - Application Analysis & Design: The objective of this step is similar to the previous one but the focus is on the application instead of on the architecture. The new business and functional requirements for the modernization will have to be identified and mapped with the existing ones.

2.7 Application Transformation to Cloud Assessment

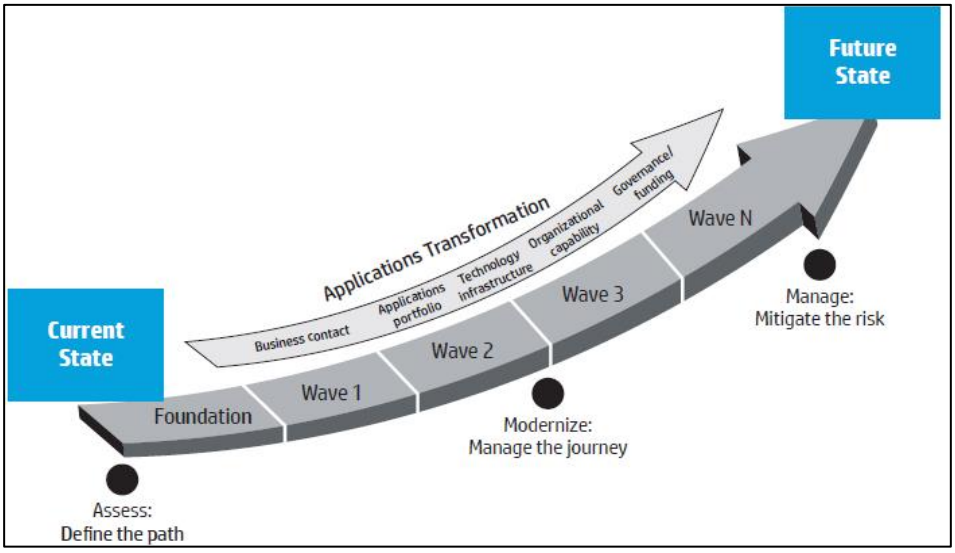
The Application Transformation to Cloud Assessment (Zavala, 2012) is a consulting service provided by Hewlett Packard (from now on HP), directed at evaluating if an application can be cloudified or not.

This approach claims that any transformation should begin with a rigorous assessment of business and technology requirements. Based on that evaluation, they provide a roadmap documenting the phases, solutions, benchmarks, and the expected results of the planned transformation of the application.

In order to achieve the maximum success and return from the effort that implies a transformation, HP suggests organizations the need to minimize this risk by ensuring

that the cloud is integrated closely with the existing business so as to deliver cloud-based business value quickly, while minimizing disruption to on-going operations.

Figure 6. HP's transformation to cloud applications



Source: adopted from (Zavala, 2012)

HP recommends a three-phase approach for an application modernization (Figure 6), namely, 1) assess to define the transformation pathway, 2) modernize to manage the journey, and 3) manage to mitigate the risk.

In guiding organizations from the current to future state, the Application Transformation model focuses on the key elements of the business context, including the applications portfolio, technology infrastructure, organizational requirements, governance, and financing.

For the scope of this document, only the "Assess" phase is relevant. In any successful transformation, the key step is the assessment since it enables organizations to develop a business case to define the road ahead. This step begins with an evaluation of the current environment where the application subject-matter experts and cloud specialists evaluate simultaneously applications. Both stakeholders generate a profile for each application by making use of automated tools and predefined criteria. This profile is later on utilized by cloud specialists to determine the target platforms where on to deploy the applications as well as the methods needed to shift those applications onto those target platforms. Moreover, the selected target platforms might include external enterprise cloud services, utility services, web hosting, or other external providers.

Some of the questions that need to be addressed in the assessment include, but are not limited to:

- What applications should be moved to the cloud?
- To what kinds of platforms should those applications be migrated?
- How should the applications be prepared for the cloud?
- How can cloud-based applications be integrated with other systems?

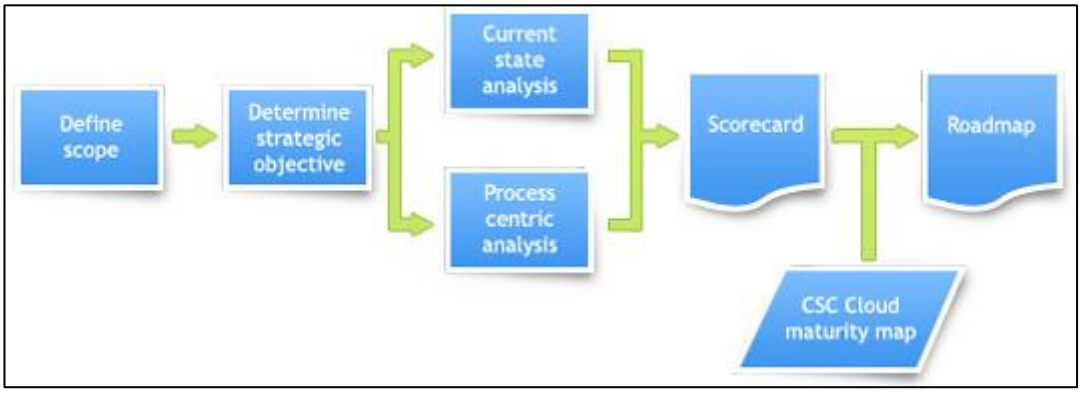
Applications candidate to be cloudified are those that yield measurable value from running on the cloud. Nonetheless, to evaluate the suitability of each application both the technical and the business perspectives need to be aligned. This means that a thorough analysis has to be performed since not all applications are suitable to be migrated as several variables come into play such as legacy status, current platform, business processes and data security requirements. The outcome of this analysis is a report identifying a specific cloud platform and mapping of the strategic business, technical, and financial value of each application.

2.8 CSC Cloud Adoption Assessment

CSC Cloud Adoption Assessment (CSC, 2010) helps to:

- Determine the right business processes to move to a cloud-based model;
- Decode all the "as a service" possibilities – infrastructure as a service, software as a service, platform as a service;
- “Demystify” the cloud delivery options – private cloud, hybrid cloud, community cloud, public cloud;
- Prioritize the cloud migration and cloud transformation projects

Figure 7. CSC cloud adoption assessment



Source: adopted from (CSC, 2010)

CSC provides two tools in order to help with these processes. These tools are the following:

- Suitability scorecard: the suitability scorecard provides the ideal level at which companies should be looking for a cloud-based alternative, - process as a service, software as a service, platform as a service or infrastructure as a service –, not just whether a process is prone to be migrated to a cloud-based model;
- Cloud adoption roadmap: the roadmap is targeted to identify the processes that will ensure the most benefit to the organization if delivered through an appropriate cloud model. CSC claims to possess extensive knowledge of the maturity of diverse types of cloud service, due to their expertise in the service delivery and hence they are able to recommend the type of cloud that each process is suitable for — public, private, community or hybrid.

2.9 Maturity Assessment

The Maturity Assessment Tool (MAT) has as main objective the analysis of the current (initial) and desired (final) situation of an application subjected to be migrated (Alonso, Orue-Echevarria, Escalante, Gorroñogoitia, & Presenza, Cloud Modernization assessment framework: Analyzing the impact of a potential migration to Cloud, 2013) (Orue-Echevarria, Alonso, & Escalante, 2013) (Orue-Echevarria L. , Alonso, Escalante, & Schuster, 2012). Unlike the approaches shown beforehand, which focus mosty only on one axis (either technical or business), MAT focuses on two perspectives, business (including organizational processes) and technical in both situations (initial - before the migration - and final - after the migration).

MAT stresses on the characterization of metrics and indicators (metrics weighed and combined) of the business and technical dimensions of the legacy application as well as the business, such as the pricing model, the targeted market, the product sustainability, SLAs, legal issues, etc. This assessment requires knowledge not only related to source code and architecture, development process, GUI, source environment and desired environment, source and target infrastructure, covered and uncovered non-functional requirements, but also to knowledge related to licenses, determination of legal issues, SLA's, fulfillment of data privacy laws, supporting processes (marketing, help desk, updates and maintenance), and so on.

The approach followed for the MAT is based on the realization of online questionnaires. These questionnaires are to be answered by either a person with a good knowledge of the architecture of the application, either a person with a good knowledge of the related business model or someone who knows both aspects fairly well.

Based on the results attained in the questionnaires, an analysis is executed. The yielded metrics are weighted following a certain criteria and aggregated into indicators of interest, which define a characteristic used to calculate the maturity of the business model and the maturity of the technology model, both before the migration and after the migration takes place.

There are several ways to perform this positioning. In the case of the MAT the way selected has been in a two-axis form, as a quadrant. As stated previously, this kind of bi-directional approach has been proven in several models and methodologies. Besides, it allows the repositioning of the application (from the initial to the final situation) following different paths in one single axis or in both of them.

This quadrant analyze s the information under two axes, one focusing on Technology (architecture, performance, reliability, how coupled the code is, security, data base design, etc.) and the other one on Business, namely pricing model, business internal processes and sustainability.

The positioning on this quadrant is made by analyzing the answers to the different types of questions and getting the maturity and thus in the position for each of the two axis. Static positions that indicate different levels of maturity and that will serve as a basis to position the different applications according to its maturity for being cloud-compliant have been defined. In the axis, the (0,0) position is the less mature while the (3,3) position is the most mature one.

The authors state that the current maturity levels of the Technology and Business axis have been established based on their professional experience and state-of-the-art studies. The maturity of each axis is defined as follows:

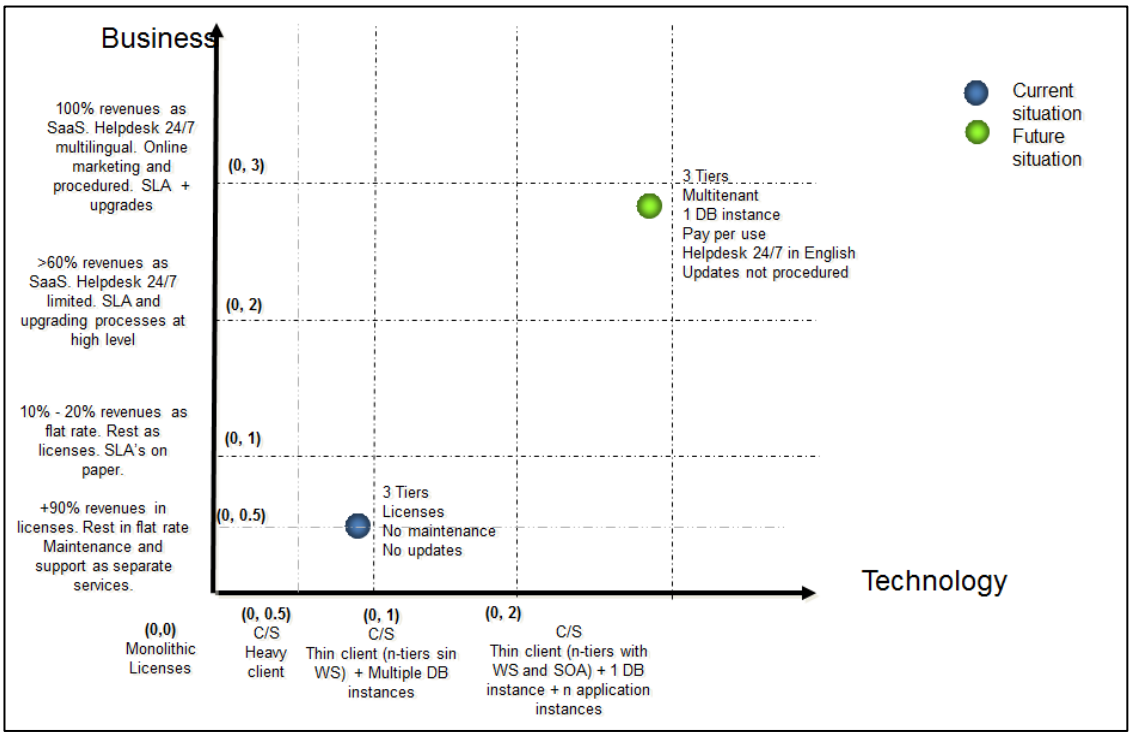
- Technology axis
    - (0,0) Monolithic: interface logic, business logic, data logic are in the same machine

    - (0,0.5) Client-server with a thick client (i.e. VB application), event driven. Code tightly coupled to the interface. DB is in the local network or on a server outside but all the logic remains in the same machine.
    - (0,1) Client-server with a thin client (i.e. j2EE application, 2-n tier), with no usage of web services. Multiple DB instances
    - (0,2) Client-server with a thin client such as Mozilla, Opera, Chrome or Internet explorer (i.e. J2EE application, 2-n tier), with usage of web services. A unique instance of the DB. Multiple instances of the application
    - (0,3) client-server with a thin client, 1 DB instance, 1 DB application, n appearance customizations
- Business axis
    - (0,0) license (installment), support, updates, upgrades, maintenance are paid under a different fee model than the license. No helpdesk. No SLA. No upgrade protocol and procedures.
    - (0.5,0) Most revenues are obtained from sales of licenses. Even though, there exist some sales (less than 10% of the total amount) that are made in a service form with a flat rate model.
    - (1,0) Most revenues are obtained from sales of licenses. Between 10-20% are from the product sale as service with pay per use, flat rate, hybrid pricing models. SLA is being defined. Upgrade protocol and procedures are being defined.
    - (2,0) More than 60% of the sales are from the product as a service. Helpdesk is institutionalized but not 24x7 and only in certain languages. Existence of SLA, upgrade protocol but upgrades are still seldom, legal department
    - (3,0) 100% of the sales are from the product as a service. Existence of a 24x7 helpdesk, multilingual, Marketing mostly done through the Internet (social media), SLA, upgrade protocol and procedures, Long Tail

MAT provides three main results:

- A picture with the position in a quadrant of the initial and the final situation of the application (Figure 9).
- A set of high level migration recommendations.
- A set of migration goals (non-functional and busines related)

Figure 8. Application positioning



Source: adopted from (Orue-Echevarria, Alonso, & Escalante, 2013)

This MAT approach has been proven in twelve companies (eight from the Basque Country, one from Spain, one from Italy, one from Greece, and one from Belgium). Some of the feedback received includes: 1) it is not based on standards and thus it is difficult to know against which criteria the application is being compared to, 2) the meaning of the maturity levels is not clearly explained, 3) the information given along with the position is not self-explanatory, 4) some of the questions asked in the questionnaires are not sufficiently clear and they do not let the option of including free text to insert additional information, 5) business, process and technically related questions are occasionally mixed, 6) the idea of having a bi-dimensional approach was perceived as positive, considering that cloud computing is a business model, 7) the inclusion of the analysis of how the organizational processes will change after the migration will take place is also considered as innovative.

2.10 Conclusions

All the approaches presented above cover some important aspects to be tackled in a migration to the cloud. However, neither of them covers all aspects affecting the cloud computing business model. A modernization assessment tool, taking into consideration

the technical, internal and external aspects of a cloud-based company should be able to cover the following issues:

- Collect information from three perspectives: technical aspects (programming language, architecture, data base...), business aspects (model pricing, licensing model, accountability, etc.), and organizational processes (marketing, incidence management, update, development …) of the current legacy application and how the company wants to deal with these aspects in the future.
- Identify a set of metrics and indicators for characterizing the legacy application as-is and to-be in three dimensions: technical, processes and business
- According to the aspects and metrics defined, a gap analysis should be provided.
- Base all these aspects on existing standards such as ITIL, EFQM, ISO, OASIS.
- On top of that, provide a vendor independent tool which facilitates the collection of the information and produce the gap analysis in an automatic way.

Table 1 below summarizes the main aspects that a maturity analysis for characterizing legacy applications to be cloudified should cover and how these are covered in the different approaches presented in this state of the art.

Table 1. Benchmarking of the Assessment modernization approaches

	Business aspects	Organizaional Processes aspects	Technical aspects	Self-assessment tool/ Consultancy service	Vendor dependant	Cloud aspects (Target plataform, multitenancy…)	Gap Analysis/ modernization Strategy
Butterfly method	✓	X	✓	X	NA	X	X
Renaissance method	✓	X	✓	X	NA	X	X
SMART	X	X	✓	✓	X	X	✓
MARMI-RE Methodology	✓	✓	✓	X	NA	NA	✓
BusinessFirst™ Software Modernization Assessment	✓	X	✓	X	✓	X	✓
Software Associates Modernization	✓	✓	✓	✓	✓	X	✓
Application Transformation to Cloud Assessment	✓	✓	✓	✓	✓	✓	X
CSC CloudAdoptionAssessment	X	✓	✓	✓	✓	✓	✓
MAT	✓	✓ (merged in the business aspects)	✓	✓	X	✓	✓

Source: Author's own contribution

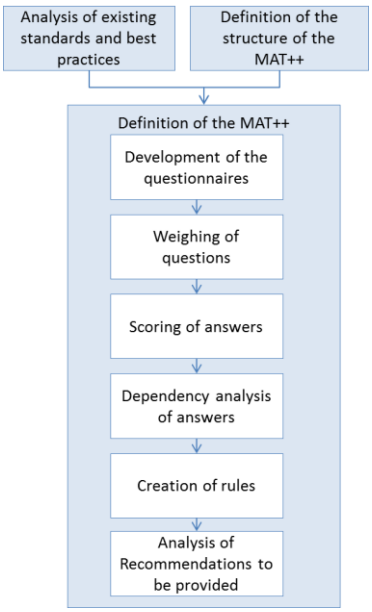
3. Maturity Assessment Tool ++

This section introduces the second iteration of the Maturity Assessment Tool, named for the purpose of this thesis as MAT++. The first version of the MAT presented lights and shadows, as mentioned above. While the bi-dimensional approach was seen as innovative, the questions asked to the companies were not based on standards. In the Information and Communications Technology (ICT) industry, standards are a key point. As reported verbally by the participants, any solution that is not based on existing standards will not be up-taken.

This enhanced version of the MAT (Alonso, Orue-Echevarria, & Escalante, 2015) is born with the following objectives in mind: 1) be a comprehensive tool for all stakeholders in the software industry whatever profile they may have (e.g. business-oriented, technical-oriented, process-oriented) to be able to decipher and describe the main characteristics of their application, 2) request information in a structured and clear way so that the respondents do not hesitate in giving the answers, 3) base it on standards widely adopted in the industry.

In order to fulfill those requirements, the following procedure has been performed, as shown in Figure 9. The process is described in detail in the following sections.

Figure 9. Procedure followed to create the MAT++



Source: Author's own contribution

3.1 Analysis of existing Standards

Thus, this new version of the MAT is based on the following standards:

- For the technical point of view: ISO/IEC 17789:2014 (ISO/IEC JTC 1/SC 38 Distributed application platforms and services (DAPS), 2012) and OASIS TOSCA (Organization for the Advancement of Structured Information Standards (OASIS),, 2013), in addition to several best practices by IBM. This is out of the scope of this PhD thesis.
- For the business point of view: ISO/IEC 17789:2014 (ISO/IEC JTC 1/SC 38 Distributed application platforms and services (DAPS), 2012) and EFQM (EFQM, 2014).
- For the organizational process point of view: ISO/IEC 17789:2014 and ITIL (Osiatis ITIL Service Desk) (ITIL,, 2013) (Wikipedia, ITIL, 2014).

ISO/IEC 17789:2014 is a way for describing, discussing, and developing a system-specific architecture using a common framework of reference. The goal for developing a Cloud Computing Reference Architecture (CCRA) has been to enable the production of a coherent set of international standards for cloud computing. The CCRA supports the following critical standardization objectives:

- enable the production of a coherent set of international standards for cloud computing,
- provide a technology-neutral reference point for defining standards for cloud services,
- encourage openness and transparency in the identification of cloud computing benefits and risks.

CCRA supports a viewpoint approach to describe Cloud computing systems:

1. User view: The user view addresses the activities, roles, parties and services.
2. Functional view: The functional view is a technology neutral view of the functions necessary to create a cloud computing system and it describes the distribution of functions necessary for the support of cloud computing activities.
3. Implementation view: The distribution of functions necessary for the implementation of a cloud service
4. Deployment view: This view represents how the functions of a cloud service are technically implemented within already existing infrastructure elements.

The implementation and deployment view are related to technology and vendor specific cloud computing implementations and actual deployments and are therefore out of scope of this standard.

ITIL (ITIL,, 2013) is the most widely adopted approach for IT Service. It provides a framework for identifying, planning, delivering and supporting IT services to the business. ITIL seeks an alignment of the IT services with the needs of the business and tackles the core business processes. The 2011 edition consists of five publications:

1) ITIL Service Strategy, that focuses on helping IT organizations improve and develop over the long term, relying upon a market-driven approach. This book covers topics such as IT service management, Service portfolio management, Financial management for IT services, Demand management and Business relationship management.
2) ITIL Service Design, that provides a guidance on the design of IT services, processes, and other aspects of the service management effort. The topcis covered in Service Design include Design coordination, Service Catalogue management, Service level management, Availability management, Capacity Management, IT service continuity management, Information security management system, and Supplier management.
3) ITIL Service Transition which relates to the delivery of services required by a business into live/operational use, and often encompasses the "project" side of IT rather than what is called “business as usual”. The topics included in this book are: Transition planning and support, Change management, Service asset and configuration management, Release and deployment management, Service validation and testing, Change evaluation, and Knowledge management.
4) ITIL Service Operation which seeks to achieve the delivery of agreed levels of services both to end-users and customers. This is the part of the lifecycle where the services and value are actually directly delivered. The topics treated in this book include: Event management, Incident management, Request fulfillment, Problem management, and Identity management.
5) ITIL Continual Service Improvement that aims to align and continuously realign IT services to changing business needs by identifying and implementing improvements to the IT services that support the business processes. The approach followed in this case is similar to the Deming cycle Plan-Do-Check-Act.

EFQM or European Foundation for Quality Management (EFQM, 2014) was created in 1991 as a response to the work of W. Edwards Deming and the development of the concepts of Total Quality Management. The main goal of EFQM is to offer a self-evaluation framework so that organizations can evaluate themselves against some fundamental concepts. These concepts are (EFQM, 2014):

- Adding Value for Customers: related to the value - add provided to customers by understanding, anticipating and fulfilling needs, expectations and opportunities.
- Creating a Sustainable Future: achieve a positive impact on the world around them by enhancing their performance whilst simultaneously advancing the economic, environmental and social conditions within the communities they touch.
- Developing Organizational Capability: related to the effective management of change within and beyond the organizational boundaries.
- Harnessing Creativity & Innovation: apply continual improvement and systematic innovation by harnessing the creativity of their stakeholders to increase value and levels of performance.
- Leading with Vision, Inspiration & Integrity: related to a leadership attitude that have the ability to act as role models.
- Managing with Agility: related to the ability to identify and respond effectively and efficiently to opportunities and threats.
- Succeeding through the Talent of People: identification and recognition of the value of their people and creation of a culture of empowerment for the achievement of both organizational and personal goals.
- Sustaining Outstanding Results: in relation to the achievement of sustained outstanding results that meet both the short and long term needs of all their stakeholders, within the context of their operating environment.

3.2 Definition of the MAT++ Structure

In parallel to the analysis of the relevant standards, the basic structure has been defined. Thus, the MAT is structured as follows:

- Dimensions: there are three dimensions, being these: technical, business, process;
- Areas: Areas are thematic concerns, e.g. Business strategy;
- Sub-areas: sub-areas are the minimum categorization of a certain topic. For instance, under business strategy, the sub-areas could be: 1) Creation of the

business plan for the new service offerings and 2) Management of the business plan;

- Other: this epigraph contains relevant information about the programming language, the target platform (e.g. which cloud provider has been selected onto which deploy the application), and other non-functional properties.

The resulting structure is presented in the following table:

Table 2. MAT++ Structure

Dimension	Area	Sub-area
Technical	Security	• Authentication & Identity Management • Authorization & Service Policy Management • Data protection
	Operational support	• Monitoring and reporting • Service policy management • Service Level management auditing • Incident & problem management
	Business Operational support	• Business operational support components • Account Management • Subscription Management • Billing: Metering and rating, and generation of invoices • Accounts: Provider control
	Architectural and programming aspects of the application	• Architecture • Multi tenancy level & elasticity
	Other aspects:	• Target platform • Non-functional properties /requirements

Dimension	Area	Sub-area
• Business	Pricing patterns	• Pricing patterns
	Business strategy	• Creation of the business plan for the new service offerings • Management of the business plan
	Customer relationship	• Customer relationship
	Financial management	• Provider accountability • Own accountability
	Account management:	• Account management
	Product catalogue:	• Product catalogue
	Regulatory	• Regulatory
Process	Customer relationship / problem resolution	• Incidence management and resolution • Customer interaction
	Financial management	• Metering and rating the use of the services • Billing
	SLA Management	• SLA definition • Auditing & reporting
	Cloud Provider Management:	• Requirements and agreement • Auditing & reporting
	Development	• Development process • Update & maintenance process
	Roles Alignment	• Definition and adaptation of new roles • Communication & training

Source: Author's own contribution

3.3 Definition of the content of the MAT++

MAT++ is based on questionnaires, following the same approach as the MAT. The user is asked a question and presented possible answers and occasionally free text to explain the answer or to provide further details.

Both questions and answers have been defined based on the analysis of the standards mentioned beforehand. All questions refer to the current and future situation, seeking always to characterize an application as “cloud-compliant”, that is, an application that fulfils all technical, business and process requirements established by the reference standards, ISO/IEC 17789:2014, ITIL, EFQM and TOSCA OASIS.

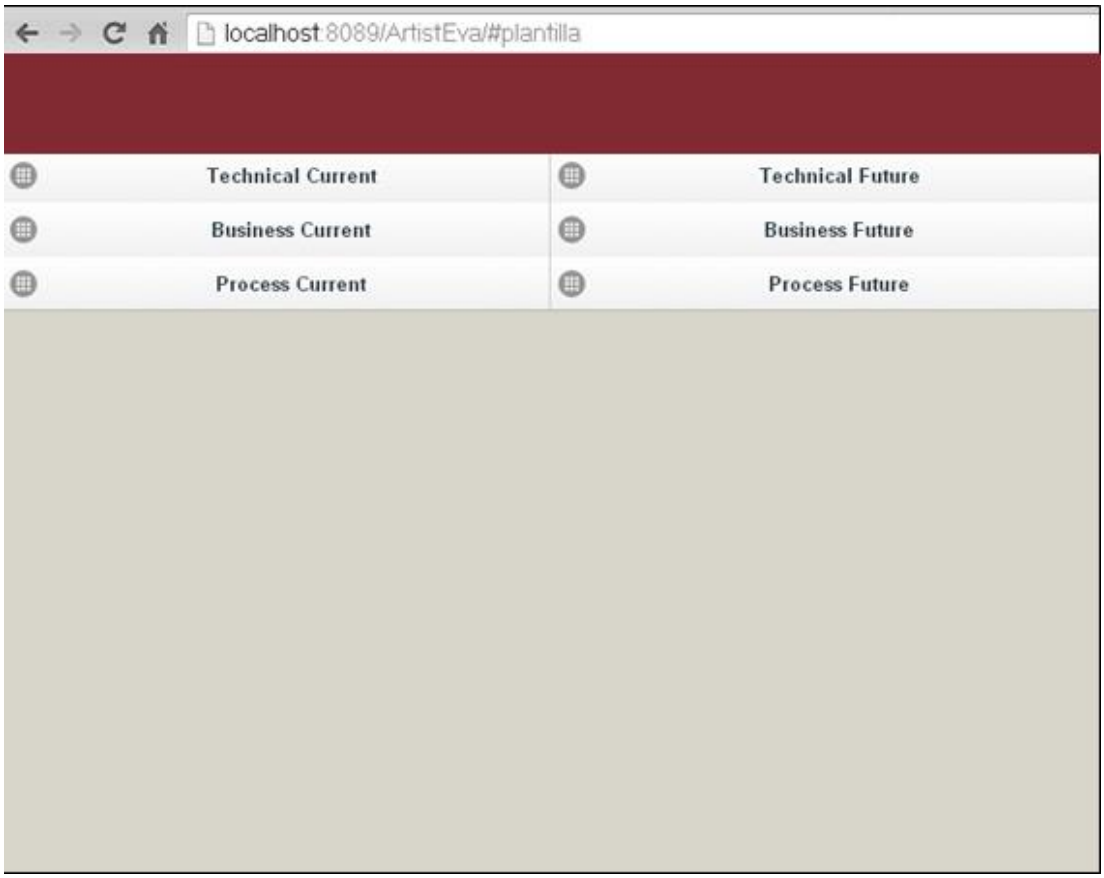
As explained before, the MAT++ is composed of dimensions, areas and sub-areas. Each dimension, area and sub-area have been given a maximum score. This score is based on an interpretation of the stress given in the standard to that particular area by analyzing the keywords used (e.g. must, should, shall) and the number of clauses related to it in the text of the norm. Additionally, each area is given a certain weight. The criteria for this weight is primarily based on the standard ISO/IEC 17789:2014, but without forgetting ITIL and EFQM for the process and business related aspects. This given weight is also based on the interpretation of the literature and standards that deepen on the main characteristics of what a cloud-compliant application should have, and also how an organization offering a cloud-compliant application should act and which aspects she should be centered on. Finally, each answer is also given a maximum score. This score is the result of analyzing once more the standards and interpreting the meaning of what it is to support a certain aspect compared to another in terms of cloud compliancy. It is important to note that several questions present dependencies on others and to provide a specific answer has an effect on the overall positioning logic. Also, providing one answer or another means that an additional question is presented to the user to gather more specific information. The final set of questions and answers, as well as their scores and weights, can be found on Annex 2. The dependencies among questions can also be found on Annex 2.

Finally, when all questions have been answered, the user can access to a set of recommendations. These recommendations are the result of a deep analysis of the standards and best practices and provide the user with guidelines on how to tackle, at a very high level, the challenges to move from the as-is to the to-be situation. The set of recommendations can be found in Annex 2.

3.4 MAT++ Implementation

In order to ease the use of MAT++ to all stakeholders, MAT++ is offered as a service, that is, as an online questionnaire. As soon as the user has inserted the organization data requested to contact him/her, (s)he sees the following screen, where (s)he selects which dimension (s)he wants to focus on as well as which situation (e.g. current or future one):

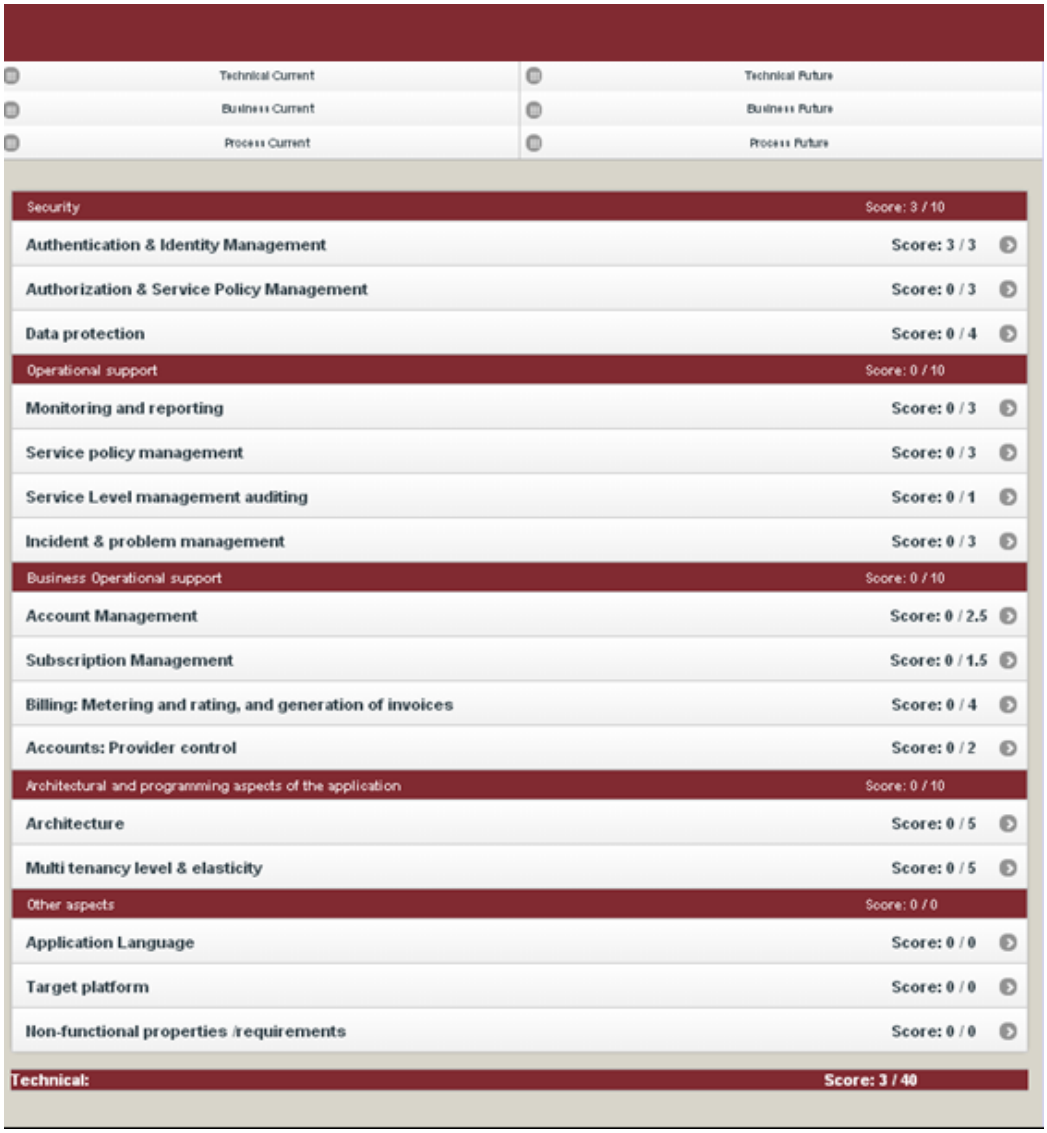
Figure 10. Screenshot to select the dimension



Source: Author's own contribution

Once the user has selected the dimension and the moment, (s)he will get the screen with the score by dimension:

Figure 11. Scores by dimension

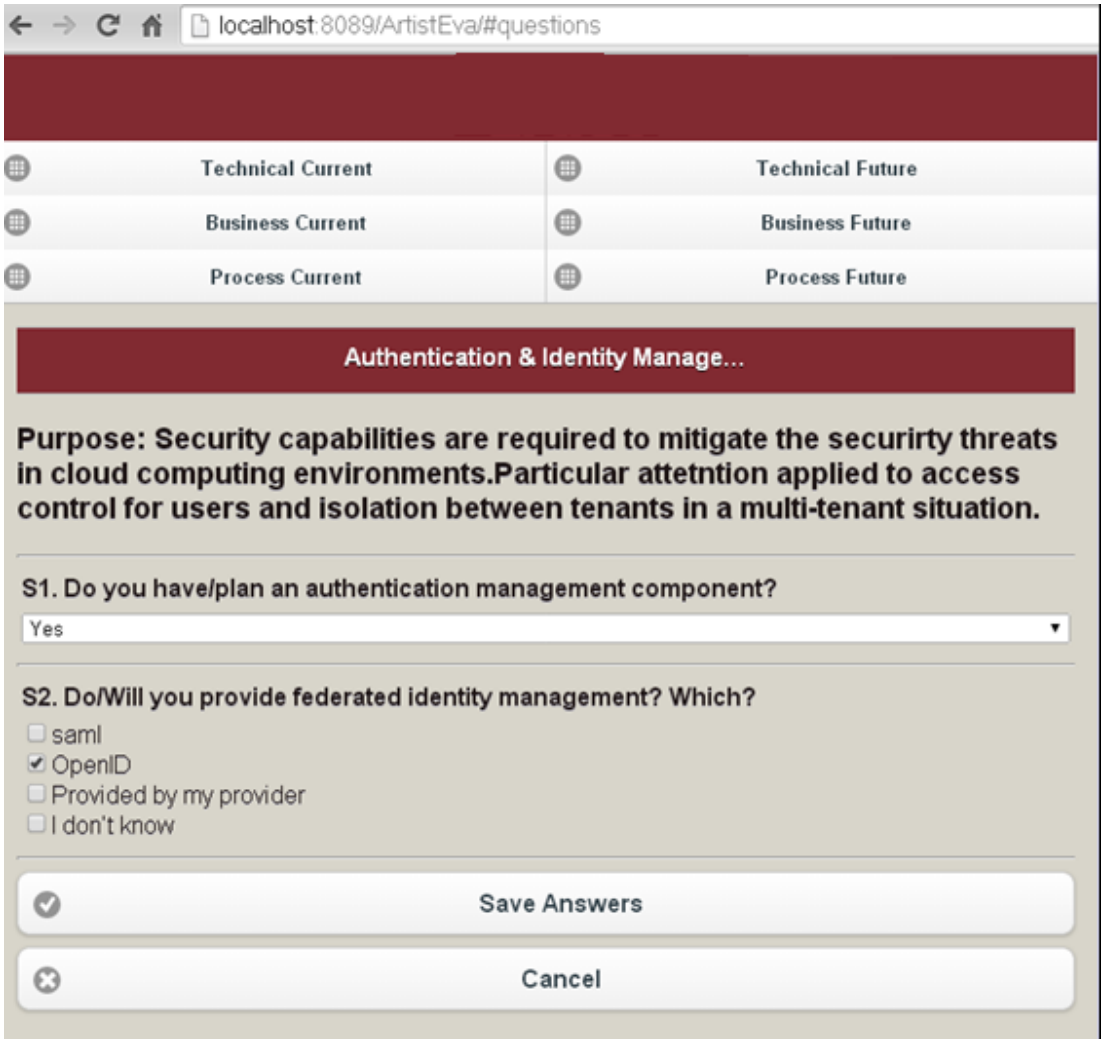


Source: Author's own contribution

Once the dimension and the scope are selected, the category window is opened. In this window the user can view all the categories to be evaluated for a certain dimension/scope. Here the current status of the score achieved (based on the current status of the questionnaire that is the answers already provided) and the maximum score for each of the areas inside a dimension. Besides, the total score per dimension is showed.

Clicking in any area will allow the user to access the Question window.

Figure 12. Excerpt of MAT++ Questions



Source: Author's own contribution

Once the user has finished answering all questions, (s)he will receive the following screens with the results. Each Dimension can be clicked and further information on the different areas is displayed. Next, the technical dimension is shown as example:

Figure 13. MAT++ Technical Dimension

Source: Author's own contribution

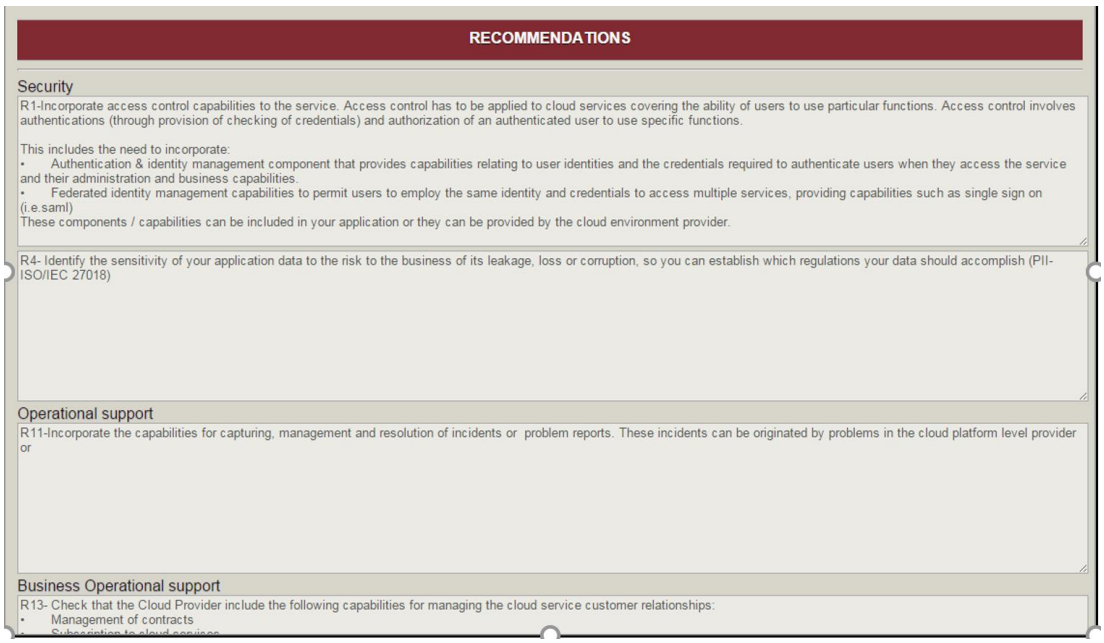
If the user wishes to obtain more detailed information on each of the areas, (s)he can click on it getting the following figures.

Figure 14. Example of the situation (current and future) for Security

Source: Author's own contribution

The tool also offers the possibility to access to a set of recommendations, an example of which is provided next.

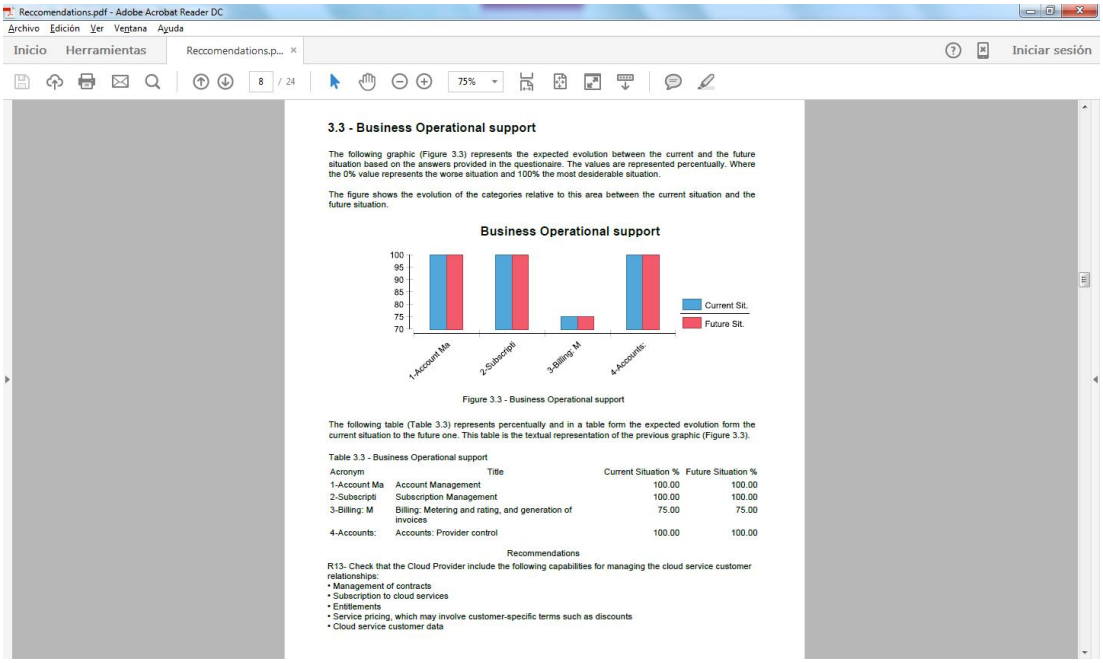
Figure 15. Example of how recommendations are shown to the end user in the tool



Source: Author's own contribution

In addition to the figures shown above, MAT++ provides the user with a report (in pdf) containing the questions and answers, the graphs, and recommendations derived from the answers. An example is shown next.

Figure 16. Example of the report provided to the user



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8 / 24 75%

3.3 - Business Operational support

The following graphic (Figure 3.3) represents the expected evolution between the current and the future situation based on the answers provided in the questionaire. The values are represented percentually. Where the 0% value represents the worse situation and 100% the most desiderable situation.

The figure shows the evolution of the categories relative to this area between the current situation and the future situation.

Business Operational support

Figure 3.3 - Business Operational support

The following table (Table 3.3) represents percentually and in a table form the expected evolution form the current situation to the future one. This table is the textual representation of the previous graphic (Figure 3.3).

Table 3.3 - Business Operational support

Acronym	Title	Current Situation %	Future Situation %
1-Account Ma	Account Management	100.00	100.00
2-Subscripti	Subscription Management	100.00	100.00
3-Billing: M	Billing: Metering and rating, and generation of invoices	75.00	75.00
4-Accounts:	Accounts: Provider control	100.00	100.00

Recommendations

R13- Check that the Cloud Provider include the following capabilities for managing the cloud service customer relationships:
- Management of contracts
- Subscription to cloud services
- Entitlements
- Service pricing, which may involve customer-specific terms such as discounts
- Cloud service customer data

Source: Author's own contribution

CHAPTER III: CURRENT AND FUTURE ENTERPRISE CONTEXT IMPACT ANALYSIS

1. Introduction

The servitization of an application tha is sold as a product entails many challenges in the organization, that need to analysed and quantified. The organization itself and how she faces the day-to-day activities need to change (e.g. organizational processes) in order to keep the business sustainable. However, before taking any final decision, it is also important to know how this new change of business model will impact in economic terms the feasibility of the company and how soon the investment will be recovered. These two activities are aimed to support decision-makers in the decision of whether the migration shall take place or not. Should the response be positive, another challenges start, namely, the definition of the business model of the servitized product as well as the selection of the most adequate pricing strategy to make the servitized product profitable, exploitable and sustainable.

This chapter is structured as follows. Firstly, it aims to present which organizational processes need to be updated or created from scratch in order to be able to offer an application as a service and maintain a sustainable business in the long term and the basic considerations that need to be taken into account. Secondly, it presents the economic impact analysis that has been developed in the context of this work and that is presented in the form of a Cost – Benefit Analysis. These two activities aid in the decision of whether a migration is feasible or not. Once the decision has been taken and it is positive, the business model and the pricning strategy for the servitized prodcut need to redefined. Section 4 of this chapter presents a systematic approach to define the new business model for the migrated application and the surrounding activities in the organization. Finally, section 5 presents the modelling of three common SaaS pricing strategies nowadays and how each of them affects the profit and loss account of the company, accompanied by several other relevant economic indicators.

2. Impact in the Organizational Processes

For the effective provision of an integrated cloud offering, it is necessary to align the processes that are supporting the design, changes and delivery model of a product and service. The shift between providing a product towards providing a service needs a change in the organization’s strategy because otherwise it will not be able to deliver what has been promised to the end customer (Martinez, 2010). The company needs to become more customer – centric which involves a cultural change, a redefinition of several processes, new definition of others and a roles inside the organization also need

a transformation. Both the processes and the metrics running in the company were designed for a product-centered organization and thus, require a re-alignment when transforming herself towards a service-centered company. Such fundamental changes will not easily be implemented in an organization.

In the case of the provision of software as a service (SaaS), an additional problem adds to the ones mentioned beforehand being that the product lifecycles are shorter (Creese, 2010) (Key, 2013). SaaS companies must be able to rapidly release new functionalities whilst not disrupting the customer's environment. Moreover, software upgrades become more complex due to the need to update the software without interrupting the system or, in the most benevolent case, during a maintenance window.

A feasibility analysis of a business model change also needs to study the required changes in the processes of the company performing the migration. The objective is to know in advance which key processes in the company will have to be modified to be cloud compliant due to the migration process.

The main goal of this section is to study the required changes in the organizational processes of a company that is facing the migration from software as a product to software as a service. Considering the core processes as well as those processes related to the provision of a service, a total of eight processes may be affected when becoming an ideal SaaS-based company, namely: software development, software update and maintenance, incidence management and resolution, SLA management, helpdesk, marketing, cloud provider management, and roles alignment.

As stated above, the processes of a servitized company change with respect to the ones the company already had in use. In the case of software companies delivering now a service and no longer a product, the core processes, identified by the author of this thesis which need to be modified are, at least, nine. These processes range from the development and maintenance of the software itself to the provision of the service without forgetting how to manage the cloud provider or the set up of the marketing strategy. In the case of cloud-based companies, the roles of the employees is also shifting towards more specialized functions (McKendrick, 2011) (Ranger, 2013) (Wray, 2013). The following section describes briefly these core processes affected by the shifting towards a service-based company.

2.1 Update and maintenance Process

The objective of this process is to deploy releases into production and establish effective use of the service in order to deliver value to the customer and be able to handover to service operations.

For this process it is important to ensure that:

- There are clear and comprehensive release and deployment plans that enable the customer and business change projects to align their activities with these plans
- A release package can be built, installed, tested and deployed efficiently to a deployment group or target environment successfully and on schedule.

Effective update process enables the service provider to add value to the business by:

- Delivering change faster and at optimum cost and minimized risk.
- Assuring that customers and users can use the new or change service in a way that supports the business goals

Before starting the update process, it is important to take into account the different options for the release and deployment strategy could be:

- Big bang vs. Phased
    - Big bang option: the new and changed service is deployed to all the user areas in one operation
    - Phased: The service is deployed to a part of the user base initially, and then this operation is repeated for subsequent parts of the user base via a scheduled plan.
- Push and Pull
    - Push approach is used where the services component is deployed from the centre and pushed out to the target locations
    - Pull approach is used where the software is made available from a central location but users are free to pull the software down to their own location at a time of their choosing or when a user workstation restarts.
- Automation vs. manual.
    - Automation. The mechanisms to release and deploy correctly configured service components should be established in the release design phase and tested.

- Manual. It is important to monitor and measure the impact of many repeated manual activities. Too many manual activities will slow down the release ream and create resource capability issues that affect the service levels.

Tasks of the update process

- Planning the releases. It is important to develop release and deployment plans in order to avoid problems or an uncontrolled impact. This task should establish the approach to building, testing and maintaining the controlled environments prior to production.
- Build and test. Key aspects that need to be managed during the activities to build and test a new release of service are:
  - Usage of build and test environments
  - Standardization and integration aspects
  - Management of the configurations:
    - Version control and baseline management, control of input and outputs
    - Recording the complete record of the build so that can be rebuilt if required
    - Maintaining evidence of testing
    - Checking that security requirements are met
- Release testing and piloting. This task aims to:
  - Determine whether a release and its underlying service assets can be release into the production environment, the first time and subsequent deployments
  - Ensure that business processes, customer, user and service provider interface are capable of using the service properly
  - Ensure that service teams are capable of operating the service.
- Perform transfer, deployment and retirement. During this task some important aspects should be taken into account:
  - Transfer financial assets. Changes and transfers in the financial assets need to be completed as part of the deployment.
  - Transfer/transition business organization.
  - Deploy processes and materials.
  - Deploy and publish the processes and materials ready for people involved in the business.

- Verify, review and close a deployment

Required Inputs

- Environment requirements and specification for build, test, release, pilot and deployment
- Release strategy
- Build models and plans
- Exit and entry criteria for each stage of the release and deployment

Outputs

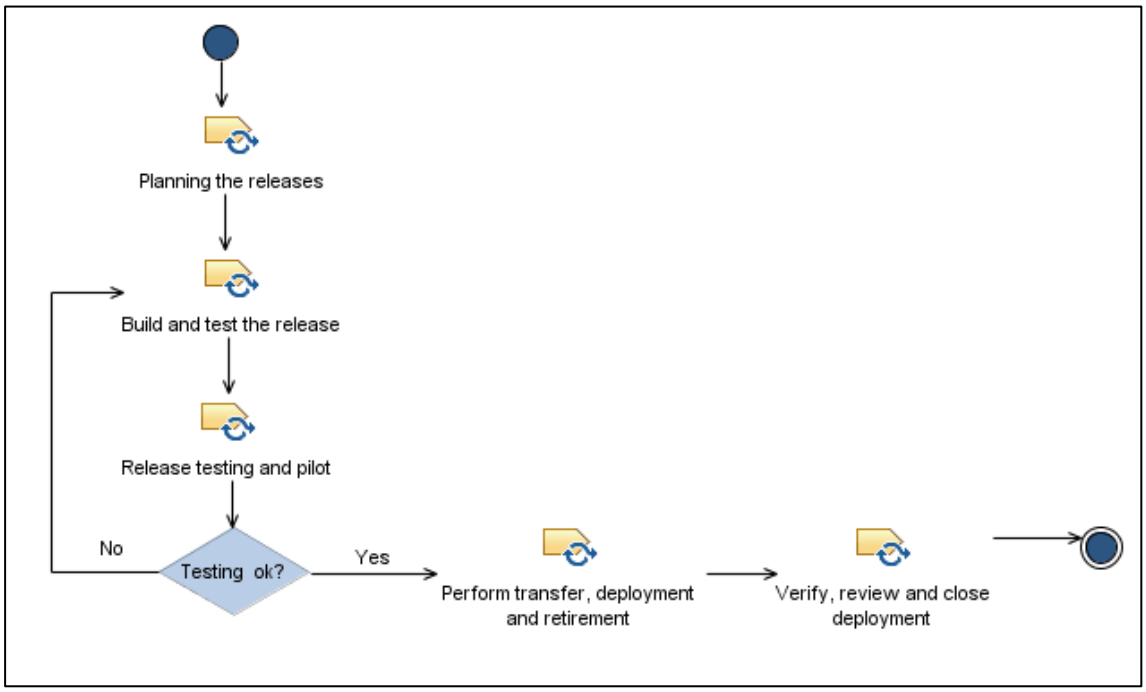
- Release and deployment plans. This output should define: Scope and content of the release, risk assessment, organization and stakeholders affected by this release, team responsible for the release, approach to determine: delivery and deployment strategy, resource for the release and deployment, and the amount of changes that can be absorbed. This plan should be authorized by change management.
- Update service catalogue with relevant information about the new or changed service.
- New tested service capability and environments including:
    - SLA and other agreements
    - Changes in the organization
    - New documentation.
- Deployment ready release package for future deployments

Roles

- Analyst
- Technical Manager.
- Application Owner
- Business Manager
- Business Analyst

EPF Implementation

Figure 17. EPF implementation of Update and Maintenance Process



Source: Author's own contribution

2.2 Incidence management and resolution process

Objective

The primary goal of the Incidence Management and Resolution process is to restore normal service operation as quickly as possible and minimize the adverse impact on business operations, thus ensuring that the best possible levels of service quality and availability are maintained.

Incidence Management includes any event which disrupts, or which could disrupt, a service. This includes events which are communicated directly by users through the Helpdesk service and also incidence can be reported and/or logged by technical staff (if, for example, they notice something untoward with a hardware or network component they may report an incidence and refer it to the Helpdesk service).

There are some basic issues that need to be taken into account and decided when this process is defined:

- Timescales: for all incidence-handling stages (these will differ depending upon the priority level of the incident) – based upon the overall incidence response and resolution targets within SLAs. All the groups involved in this process should be made fully aware of these timescales.

- Incidence models: It is advisable to pre-define “standard” Incidence model. An Incidence Model is a way of pre-defining the steps that should be taken to handle a process dealing with a particular type of incidence in an agreed way. The incidence model should include at least:
    - The steps that should be taken to handle the incidence
    - The chronological order these steps should be taken in, with any dependencies or co-processing defined
    - Responsibilities; who should do what
    - Timescales and thresholds for completion of the actions
    - Escalation procedures; who should be contacted and when
- Major incidence: A separate procedure must be defined for “major” incidence. A definition of what constitutes a major incident must be agreed and ideally mapped on to the overall incident prioritization. One important difference for these major incidences is the shorter timescales and greater urgency.

Tasks of the Incidence Management process

- Incidence identification. It is important to detect potential incidence before receiving an incidence from the Helpdesk service.
- Incidence logging. All incidents must be fully logged and date/time stamped, regardless of whether they are raised through the Helpdesk or whether automatically detected via an event alert or detected by the technical staff.
- Incidence categorization. All organizations are unique and it is therefore to give generic guidance on the categories an organization should use, particularly at the lower levels. And incidence may be categorized following a multi-level categorization.
- Incidence prioritization. Prioritization can normally be determined by taking into account both the urgency of the incidence (how quickly the business needs a resolution) and the level of impact it is causing. Factors that should take into account for determining the impact:
    - The number of services affected – may be multiple services
    - The level of financial losses
    - Effect on business reputation
    - Regulatory or legislative breaches.

  It should be noted that an incidence´s priority may be dynamic – if circumstances change, or if an incidence is not resolved within SLA target times, then the priority must be altered to reflect the new situation.

- Incidence escalation.
    - Functional escalation: If the incidence is dealt as an incidence this implies that cannot be solved by the Helpdesk team. If it is obvious that the incidence will need deeper technical knowledge, the incidence must be immediately escalated to the appropriate level support group
    - Hierarchic escalation: If incidences are of a serious nature (for example Priority 1 incidences) the appropriate technical managers must be notified, for informational purposes at least. Hierarchic escalation is also used if the 'Investigation and Diagnosis' and 'Resolution and Recovery' tasks are taking too long or proving too difficult.
- Investigation and diagnosis. This task should include actions such as:
    - Establishing exactly what has gone wrong or being sought by the user
    - Understanding the chronological order of events
    - Confirming the full impact of the incident, including the number and range of users affected.
    - Identifying any events that could have triggered the incident (e.g. a recent change, some user action?)
    - Knowledge searches looking for previous occurrences by searching previous Incidence/Problem Records.
- Resolution and Recovery. When a potential resolution has been identified, this should be applied and tested. Even when a resolution has been found, sufficient testing must be performed to ensure that recovery action is complete and that the service has been fully restored to the user(s).

Required Inputs

- Incidence log
- Timescales
- Incidence model
- Types of categorizations

Outputs

- Incidence logging. This output should record at least the following information:
    - Unique reference number
    - Incidence categorization (often broken down into between two and four
    - levels of sub-categories)
    - Incidence urgency

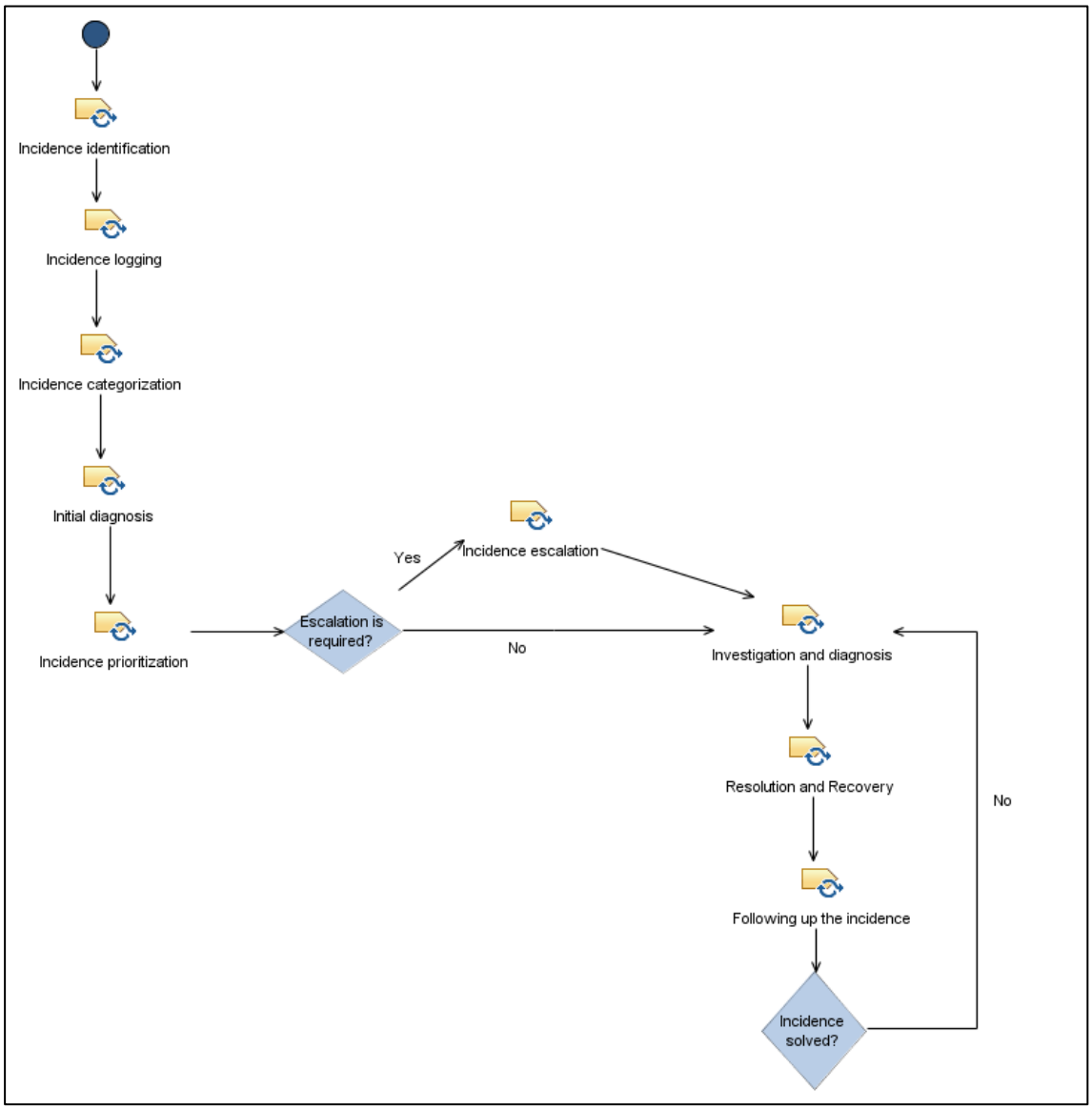
- Incidence impact
- Incidence prioritization
- Date/time recorded
- Name/ID of the person and/or group recording the incident
- Method of notification (telephone, automatic, e-mail, in person, etc.)
- Name/department/phone/location of user
- Call-back method (telephone, mail, etc.)
- Description of symptoms
- Incidence status (active, waiting, closed, etc.)
- Support group/person to which the incidence is allocated
- Related problem/Known Error
- Activities undertaken to resolve the incidence
- Resolution date and time

Roles

- Technical Manager**.** This person is the responsible of prioritization of the incidences classified as Incident, and he will be the contact point with the Incidence management process.
- Analyst.

EPF Implementation

Figure 18. EPF implementation of Incidence Management and Resolution Process



Source: Author's own contribution

2.3 SLA Management Process

Objective

The goal of SLA management process is to ensure that an agreed level of IT services is provide for all current IT services and that the future services are delivered to agreed achievable targets. SLA management process should ensure that all operational services and their performance are measured in a consistent, professional manner throughout the IT organization, and that the services and the reports produced, meet the needs of the business and customers. SLA management process provides a consistent interface to the business for all service related issues. It provides the business with the

agreed service targets and the required management information to ensure those targets have been met. This process is not only concerned with ensuring the current services and SLAs are managed, but also involved in ensuring new requirements are captured.

Tasks of the SLA Management process

The key tasks carried out in this process should include

1. Design SLA frameworks. This process should design the most appropriate SLA structure to ensure that all the services and all the customers are covered in a manner best suited to the organization's needs. Some options could be:
    - *Service-based SLA* (cover one service for all the customers of that service)
    - *Customer- based SLA* (an individual customer group covering all the services they use)
    - *Multi-level SLAs* (three layer structure: corporate level, customer level, service level)
2. Determine, document and agree requirements for existing and new services. All those issues included in the SLA should be effectively monitored and measured in a commonly agreed point. Some content for the SLA could be:
    - Conditions under which the service is considered to be unavailable (e.g. if the service is offered at several locations)
    - Availability targets (exact definition of how the agreed availability levels will be calculated, based on agreed service time and downtime)
    - Reliability targets
    - Maintainability targets
    - Down times for maintenance
    - Restrictions on maintenance, e.g. allowed maintenance windows, seasonal restrictions on maintenance, and procedures to announce planned service interruptions
    - Definitions of major incidents
    - Requirements regarding availability reporting
    - Required capacity (lower/upper limit) for the service, e.g. Numbers and types of transactions, Numbers and types of users, Business cycles (daily, weekly) and seasonal variations.
    - Response times from applications
    - Requirements for scalability (assumptions for the medium and long-term increase in workload and service utilization)

- Requirements regarding capacity and performance reporting
- Time within which a defined level of service must be re-established
- Time within which normal service levels must be restored
- Responsibilities: Duties of the service provider, of the customer and of service users (e.g. with respect to IT security)
- IT Security aspects to be observed when using the service (if applicable, references to relevant IT Security Policies)
- Pricing model: Cost for the service provision, rules for penalties/charge backs.

3. Monitor service performance against SLA.
4. Review underpinning agreements. If the service providers are dependent to some extent in external partners or suppliers, they cannot commit to meeting SLA target unless supplier´s performances underpin these targets. Contracts with external supplier are mandatory, in these contracts should reflect the need to ensure that all the targets with in underpinning are aligned with and support targets agreed in the SLAs.
5. Produce service reports. Immediately after SLA is agreed and accepted, monitoring must be instigated and service achievements report should be produced. The SLA reporting mechanisms must be defined and agreed with the customer. The periodic reports should incorporate details of performance against all SLA targets. It is important for elaborating these reports to collect accurate information from all the areas and other processes and measured against the agreed business targets.
6. Review SLAs and underpinning agreements. All the SLAs and underpinning agreements must be kept updated. These reviews should ensure that the services covered and the targets for each are still relevant, and that nothing significant has changed that invalidates the agreement in any way.

Required Inputs

- Business information: Organization´s strategy plan, financial plans, business requirements, business impact analysis.
- Customer and user feedback.
- Information and input from other process like Helpdesk services or Incidence management.
- Information regarding relationship between the business services, the supporting services and the technology.

Outputs

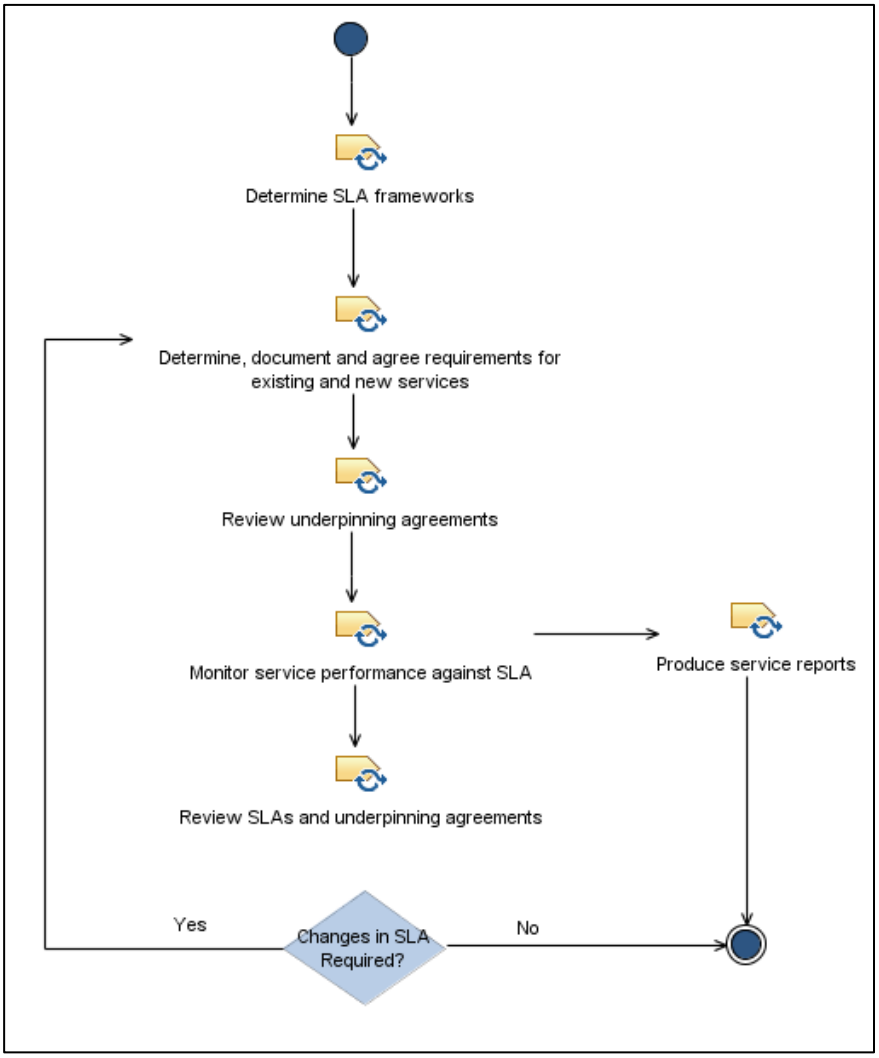
- Service level Agreement: This agreement collects a set of targets and responsibilities for each service.
- Service reports: providing details of the service levels achieved in relation to the targets contained within SLAs. These reports should include details of all the aspects of the service and its delivery.
- SLA review reports.
- Revised contracts: changes to the SLAs or new contracts to be negotiated and agreed.

Roles

- Application Owner
- Application Provider
- Platform Provider
- Infrastructure Provider
- Business Manager

EPF Implementation

Figure 19. EPF implementation of SLA Management Process



Source: Author's own contribution

2.4 Monitor customer request process

Objective

The main objective of this process is to provide a unique point of contact between users and the provider of the services in order to act as the center of all the service support. It is therefore essential that:

- It is accessible.
- It offers a uniform service of consistent quality.
- It keeps users regularly informed and logs all interaction with them.
- It provides support for the business.

To achieve these goals it is important to define an appropriate physical and logical structure that enables to create a **Monitor customer request process** whose objectives are aligned with the business processes, that improves customer satisfaction, optimises the view of the organization from the outside, and which serves as a platform on which to identify new business opportunities.

1. Logical structure.

   The members of the **customer request s**team must:

   - Be familiar with the protocols for interaction with customers: scripts, checklists, etc.
   - Be equipped with software tools they need to log their interactions with users.
   - Know when to escalate incidents to higher levels or contribute to discussions on the compliance with SLAs.
   - Have the relevant knowledge bases at their fingertips so as to give a better service to users.
   - Receive training on the company's products and services.

2. Physical structure.

   It is important to define the best structure for the helpdesks and this selection depends on the service needs (global, local, 24/7, etc.). There are three main basic formats:

   - Centralised
   - Distributed
   - Virtual

The two first structures are used in more traditional business, taken into account the SaaS business model the best structure for the helpdesk is the virtual one. The main aim of a virtual help desk service is to utilize the advantages of both centralized and distributed service desks. In a virtual Helpdesk service:

- Knowledge is centralised.
- Unnecessary duplication is avoided, with the consequent cost savings.
- A "local service" can be offered without incurring extra costs.
- The quality of service is uniform and consistent.

Tasks of the Monitor customer request process

1. Define the communication mechanisms with the users: This activity is focused on the definition of the mechanisms to communicate with the users and in accordance to the customer segment that user belongs to. This mechanism should define the way in which the company will interact with the user (email, Phone, sms...) and the way in which to measure the satisfaction of the users, collecting their feedback and analyzing it.
2. Define the appropriate physical and logical structure for the communication mechanisms: This activity is the responsible to define the appropriate structure that enables to create a communication mechanism whose objectives are aligned with the business processes.
3. Registration Communication: This activity is responsible to collect the communication of the users through the communication mechanisms and to assign a reference number that will enable the follow-up of the request as well as consult the status of this communication at any time.
4. Initial diagnosis: The objective of this activity is to investigate the reason of the communication with the information provided by previous activity. Based on this research, provide a proposal for a first initial classification of the reason for the communication. In the case the communication is for an incidence, go to the Incidence Management Process.
5. Inform the user: The objective of this activity is to communicate the user about the progress of his/her incidence
6. Incidence closure: The objective of this activity is to close the incidence and assure that all its related information is correctly collected in the incidence log. There are three main actions:
    - Closure categorization: Check and confirm that the initial incidence categorization was correct or, where the categorization subsequently turned out to be incorrect, update the record so that a correct closure categorization is recorded for the incidence
    - User satisfaction survey: Carry out a user satisfaction survey for the agreed percentage of incidences
    - Incidence documentation: Chase any outstanding details and ensure that the Incidence log is fully documented so that a full historic record at a sufficient level of detail is complete.
7. Measure and analysis user feedback: In order to improve the user satisfaction it is important to collect their feedback. There are three main actions:

- Collect the feedback of the users according to the process defined on the communication mechanism (satisfaction measures).
- Analyze the received feedback.
- Provide solutions or improvement to cover the problems detected by the satisfaction measures.

Required Inputs

- Feedback or contact for the user
- SLAs. The part when in the SLA is defined the agreements for resolving the incident, i.e., if the incident it is classified as a consult, the time response for a consult it is 6 hours.

Outputs

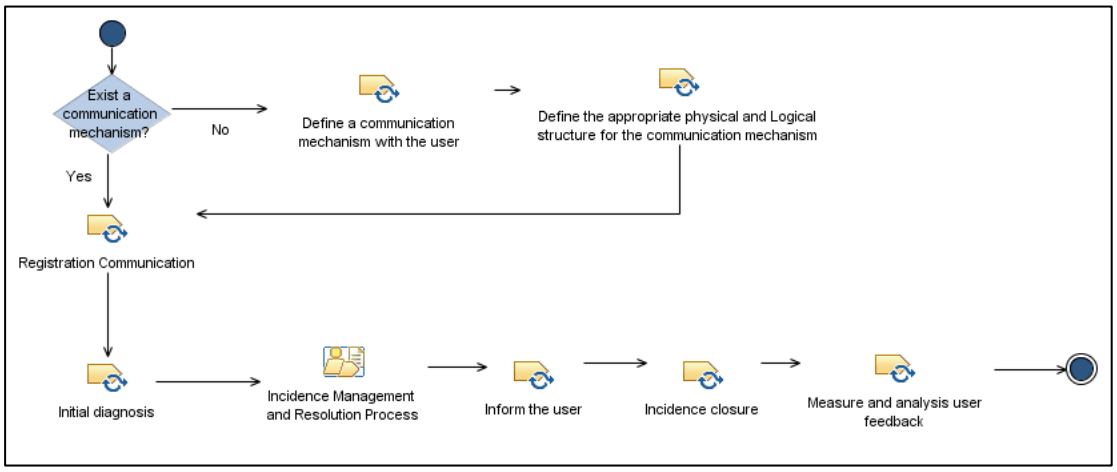
- Closure of the incident: This output should have at least: Date of the incident, time to be solved, categorization and priority, activities carried out for solving it.

Roles

- **Technical Manager.** This person is the responsible of prioritization of the incidences classified as Incident, and he will be the contact point with the Incidence management process.
- **Helpdesk manager.** This person is the responsible to manage the helpdesk service, to create the helpdesk team (a set of helpdesk operators) and to train them.
- **Helpdesk Operator.** The responsibility of this role is to classify the incident as a consult or an incident. If the incidence it is a consult, they are the responsible of solving it in the fixed time period, informing the user and closing the incident.

EPF Implementation

Figure 20. EPF implementation of Monitor Customer Request Process



Source: Author's own contribution

2.5 Marketing Process

Objective

The aim of marketing process is to know and understand the customer so well that the product or service suits him.

Tasks of Marketing Process

1. Analyze the market niche for the migrated solution. This task covers the relevant background information necessary for plans to be formulated and for decisions to be made. It shall include detailed analyses of the current market situation for the migrated application, the organization's existing products/services situation, the competitive situation and a SWOT analysis. The outcome of the current situation analysis and the SWOT analysis in particular provides a foundation for the next tasks in the process.
2. Identify the objectives. Marketing managers have to be fully aware of the factors in the organization's current situation which will influence its marketing activity. They will look at corporate objectives in the light of this information in order to develop marketing objectives and evaluate strategic alternatives. The management will have to identify new customers with whom they want to trade. The choice of the target markets will be influenced by the wealth consumers hold and the business' ability to serve them.
3. Identify the market strategy. The marketing strategy should be is tailored to offer value to customers, to communicate the offer and to make it accessible and convenient.

4. Start implementing the market strategy: This task is concerned with the operationalization of the marketing strategy. The strategy defines the broad areas of marketing activity which must be undertaken to enable the organization to meet its marketing objectives. These must be translated into programmes of action to be carried out by the various functions within marketing. In this task, the key questions to be addressed are:
    - "What needs to be done?" (defining appropriate action)
    - "When will it be done?" (scheduling and timing)
    - "Who will do it?" (designating clear areas of responsibility)
    - "How much will it cost?" (budget planning)
    - The marketing plan will focus on the various marketing activities which make up the organization's service offering within its chosen market(s):
    - The service package: features, benefits
    - Pricing policy
    - Promotional programmes
    - Distribution: making the service accessible
    - People aspects of successful service delivery
    - Process design
    - Physical evidence

    Each element of the marketing activities proposed must be carefully quantified and analysed for optimal use of organizational resources and to ensure the most suitable approaches are used so that marketing objectives can be met.

    Measurable targets should be built into the plan to allow for effective monitoring programmes. Clear areas of responsibility for carrying out designated tasks must be set down and understood by all concerned stakeholders for successful implementation.
5. Monitoring the market plan. This task sets in place control techniques for monitoring the plan's performance. Usually this implies a systematic review of all aspects of the plan against the targets set, usually on a monthly or quarterly basis. The review must be carried out regularly to ensure prompt attention and action plans in areas when the results do not achieve the targets set. Managers and others responsible for the implementation of all elements of the action programme should be involved in the monitoring process.
6. Market monitoring. The objective in marketing is to first attract customers, and then (most importantly) retain them by building a relationship. In order to do this effectively, they need feedback on customer satisfaction. They also need to feed this

back into product design and marketing mix as customer needs and the competitive environment changes.

Required Inputs

- Business objectives

Outputs

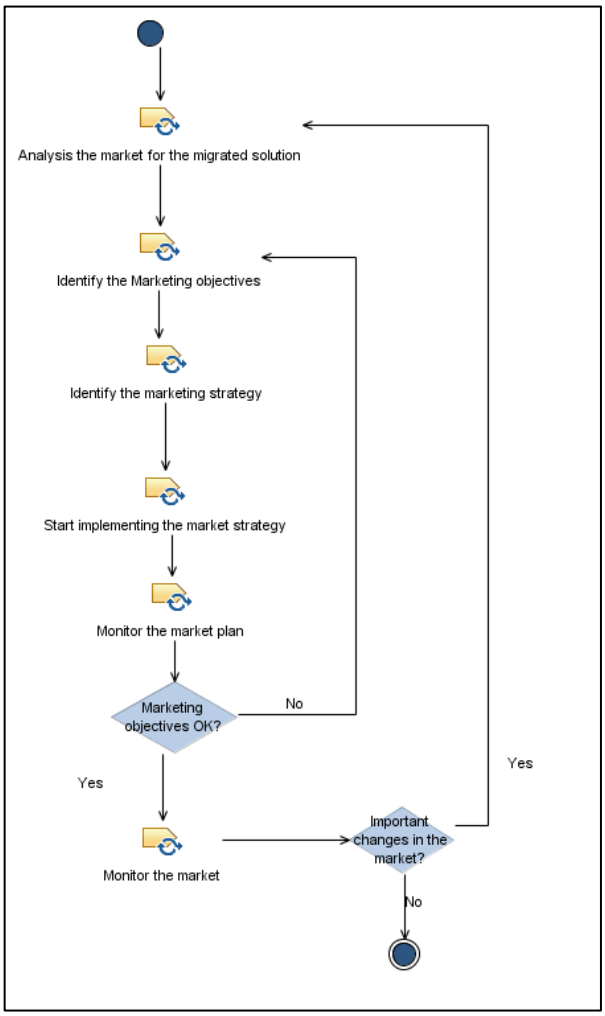
- Market Strategy
- Market analysis
- Marketing objectives
- Marketing plans
- Pricing policy
- Promotional materials (if planned)
- User feedback

Roles

- Marketing manager
- Marketing team
- Business Manager

EPF Implementation

Figure 21. EPF implementation of Marketing Process



Source: Author's own contribution

2.6 Cloud Provider Management Process

Objective

The objective of this process is to manage and control the service provided for the cloud provider in order to contract the most appropriate one for the organization´s requirements, and to monitor, measure and control that the agreement is fulfilled.

Tasks of the Cloud Provider Management Process

1. Define the main features to be fulfilled by the cloud provider. Features regarding to technical aspects such us type of Data base, programming language, availability, scalability metrics and to business aspects such us pricing model, standards compliance and so on.
2. Select the cloud platform provider based on an evaluation of their ability to meet the specified requirements and established criteria.

3. Establish the cloud provider agreement. This agreement can be a contract, license, service level agreement, or memorandum of agreement. The most common way to do this agreement will be a SLA with the cloud provider
4. Monitor the fulfilment of the conditions and characteristics defined by the agreement. Most of the cloud providers provide their own tools to facilitate the monitoring of their cloud services.
5. Report and control the non-fulfilment in order to assure the correct operation of the cloud service.

Required Inputs

- SLA
- List of cloud providers and information of their features

Outputs

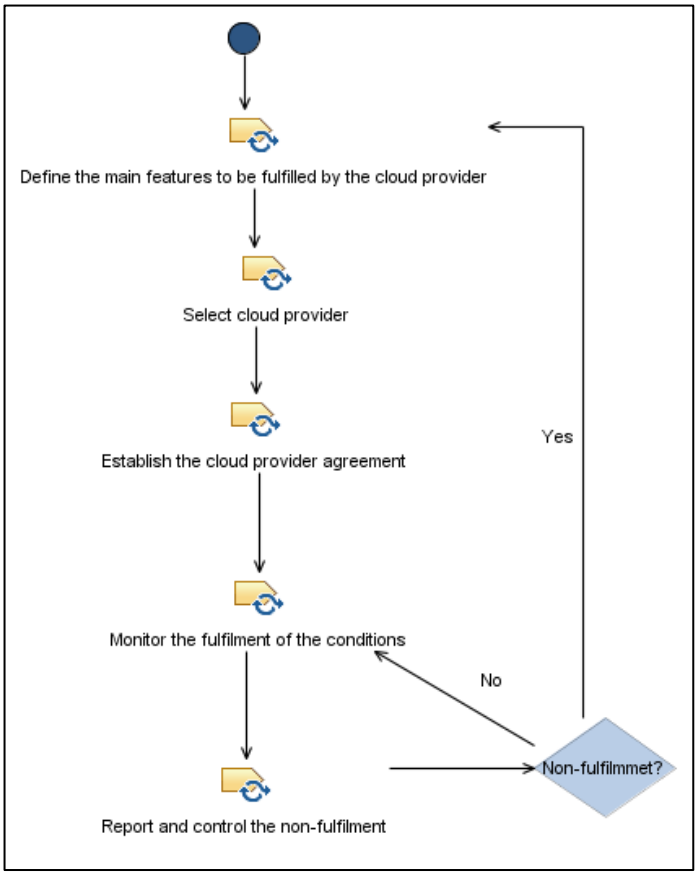
- Cloud provider SLA
- Reports on the monitoring of the cloud provider. These reports should include all the measurement and actions carried out to assure that the agreement is fulfilled

Roles

- Business Manager
- Application Owner

EPF Implementation

Figure 22. EPF implementation of Cloud Provider Management Process



Source: Author's own contribution

2.7 Roles Alignment Process

Objective

This process is focused on the adaptation and creation of new roles in the organization due to the new business model. It is essential to define the roles and responsibilities within the organization in order to cover all the activities created with the new business model. If new roles are necessary, these roles should have assigned activities and responsibilities, and those should be known by the people involved.

Tasks of the Roles Alignment Process

1. Study the organization and identify those roles that should be created, modified or disappeared. In order to do this in a methodological way, RACI model could be used. RACI Model (Valuebasedmanagement.net, 2013) is a model used to help define who is responsible / accountable; The RACI model is built around a 2-dimensional matrix which shows the 'involvement' of Functional Roles in a set of

Activities. 'Involvement' can be of different kinds: Responsibility, Accountability, Consultancy, etc.

2. Define the new roles, for example “service delivery manager”. In order to do this, it is required to identify which are the activities and responsibilities of this role and the required skills.
3. Modify the existing roles with the necessary changes in order to be aligned with the new business model.
4. Train the people assigned to the new roles. In order to complete this task is required to:
    - Collect the requirements for the new skills,
    - Look for them in the organization,
    - Prepare a training plan,
    - Train those people who are going to be assigned to the new or modified roles.
5. Communicate the affected people their new activities and responsibilities
6. Communicate the entire organization the new and modified roles.

Required Inputs

- Current roles, activities and responsibilities
- Organizational chart

Outputs

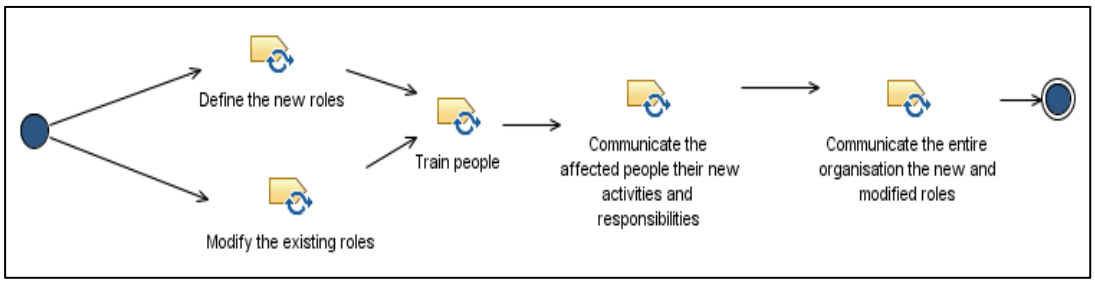
- Definition of the new and modified roles, activities and responsibilities
- New Organizational chart

Roles

- Business Manager
- Human Resource Manager

EPF Implementation

Figure 23. EPF implementation of Roles Alignment Process



Source: Author’s own contribution

2.8 Development process

Objective

The main objective of this process is to develop SaaS applications that fulfil the following characteristics using an agile method:

- Support multitenancy. It should be designed to support concurrent accesses by multiple tenants and handle their sessions in isolation
- High reusability: Services providers develop and deploy cloud services and expect that the services are reused by a large number of consumers.
- High availability: Cloud services are not just for specific users; rather they are for any potential unknown number of consumers who may wish to use the services anytime and anywhere.
- High scalability: cloud services should be highly scalable even in the situation of a extremely high number of services invocations as well as able to provide replies to requests of the associated resources.

In order to fulfil the above criteria, an appropriate manner is to follow an agile methodology for the development of SaaS applications.

SCRUM is an agile methodology that could be used to the development of this kind of applications. SCRUM adopts an empirical approach—accepting that the problem cannot be fully understood or defined, focusing instead on maximizing the team's ability to deliver quickly and respond to emerging requirements (Wikipedia, SCRUM, 2013). In SCRUM, projects are divided into succinct work cadences, known as sprints, which are typically one week, two weeks, or three weeks in duration. At the end of each sprint, stakeholders and team members meet to assess the progress of a project and plan its next steps. This allows a project’s direction to be adjusted or reoriented based on completed work, not speculation or predictions. Each sprint of SCRUM should be done following the tasks defined below, until all the requirements of the application are developed (SCRUM Methodology, 2009).

Task of the Development process

- Requirements elicitation. The objective of this phase is to acquire the set of requirements specifications for multiple stakeholders or to define the requirements by considering marketability. These requirements should be ordered and prioritized in order to facilitate the assignment to the sprints
- For each sprint:

- Select the requirements to be developed in the sprint.
- Analysis and modelling.
- Development.
- Testing of functional and non-functional requirements.
- Review and add if necessary the requirements.
- Test and deploy the final application.

Required Inputs

- User requirements / user stories

Outputs

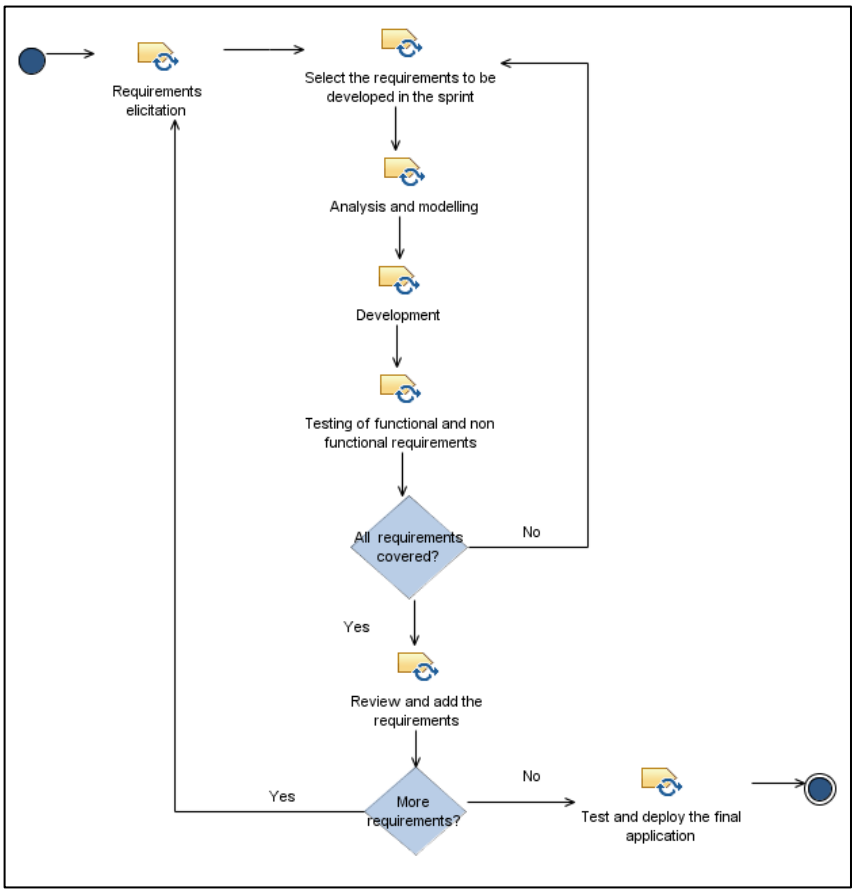
- List of requirements for each sprint
- Prioritised Requirements
- Design of each sprint
- Prototype of each sprint
- Tested Application

Roles

- Technical manager
- Analyst
- Application owner
- Modeller
- Developer

EPF Implementation

Figure 24. EPF implementation of Development Process



Source: Author's own contribution

2.9 Practical Implementation

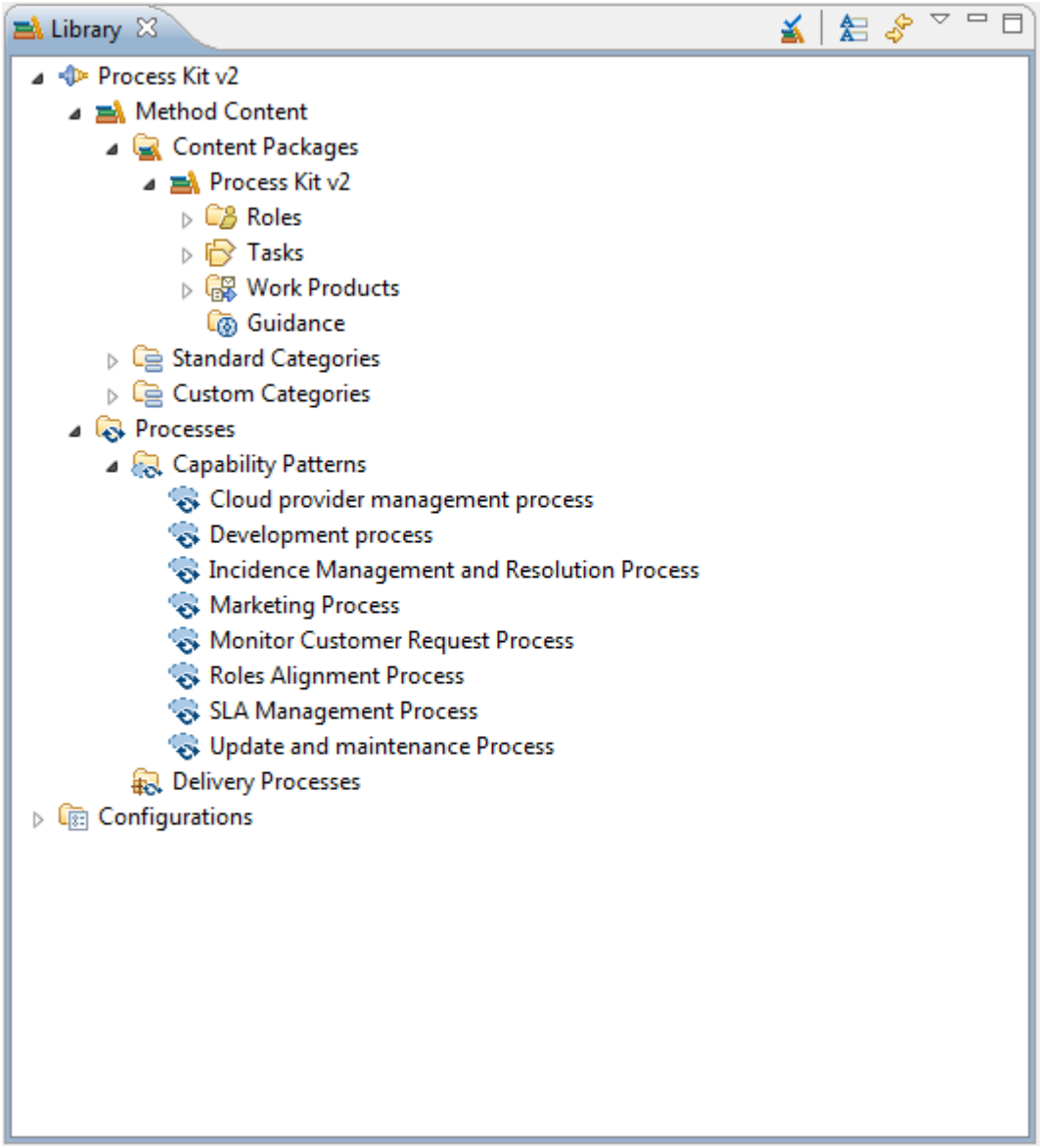
This prototype is implemented as an EPF (Version: 1.5.1.5) Method Plug-in.

The plug-in is composed of:

- A method content where the tasks, roles and work products are implemented and described.
- The processes themselves where all the processes are describe as capability process.

The structure is depicted in the following figure.

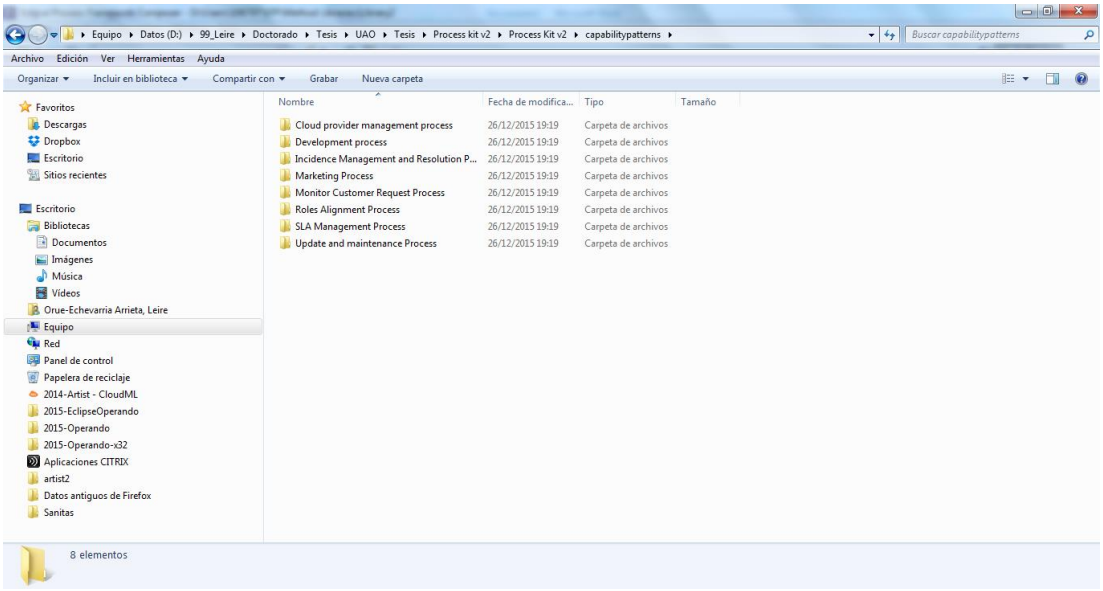
Figure 25. Process Kit Plugin Package Structure



Source: Author's own contribution

The plug-in has the structure shown in the next figure.

Figure 26. Plugin Process kit structure in Windows Explorer



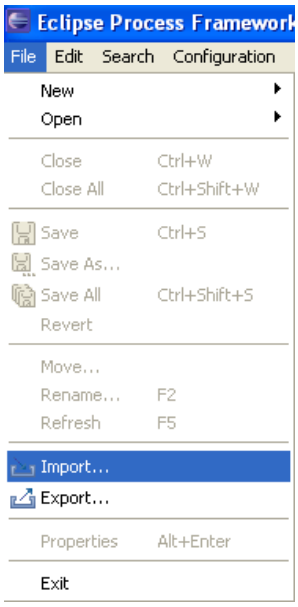
Source: Author's own contribution

Each role, task, work product and capability pattern is described as an XMI file in the correspondent folder.

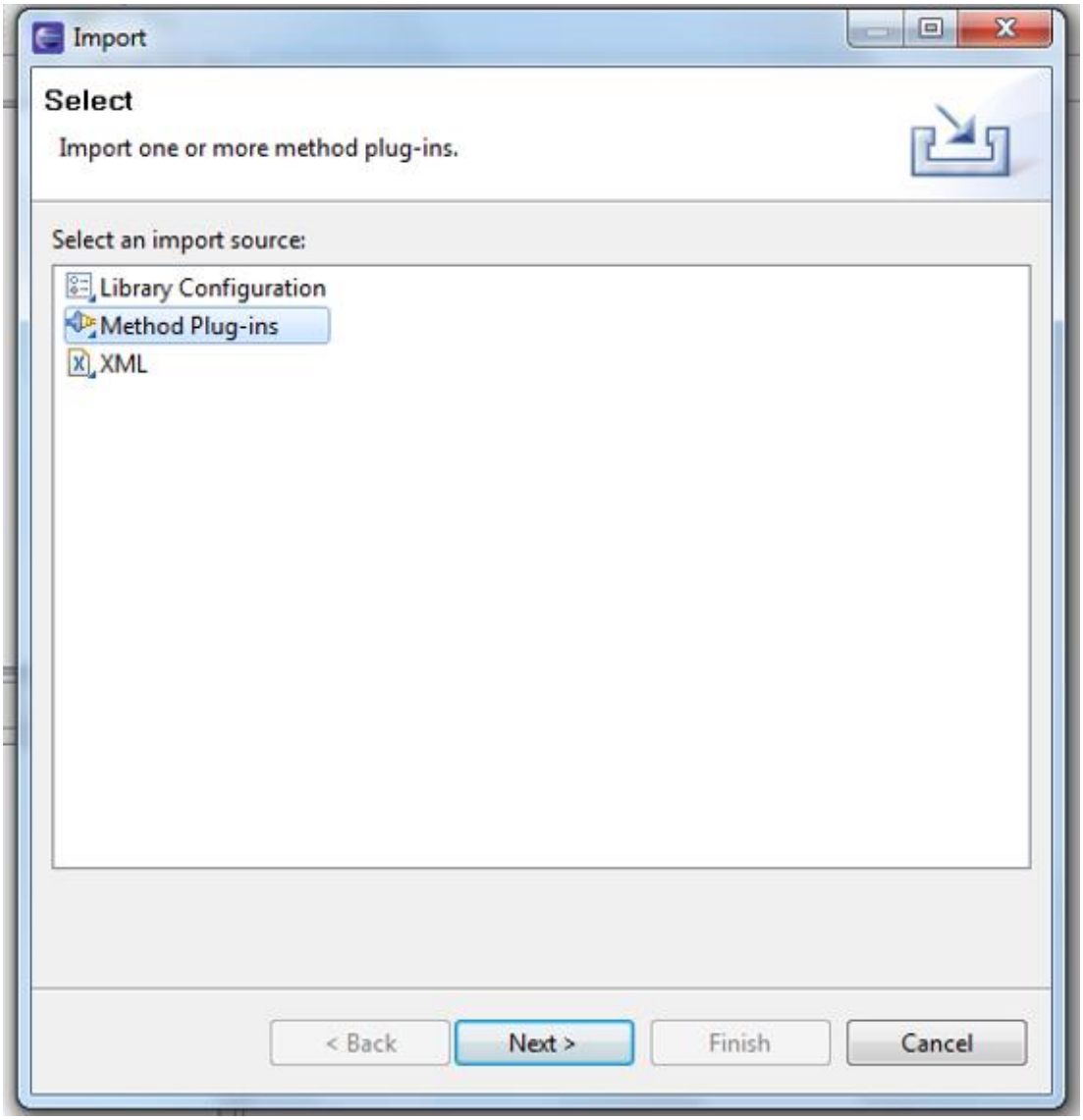
Installation instructions

In order to use this plug-in, it is required to import it in EPF using the following steps.

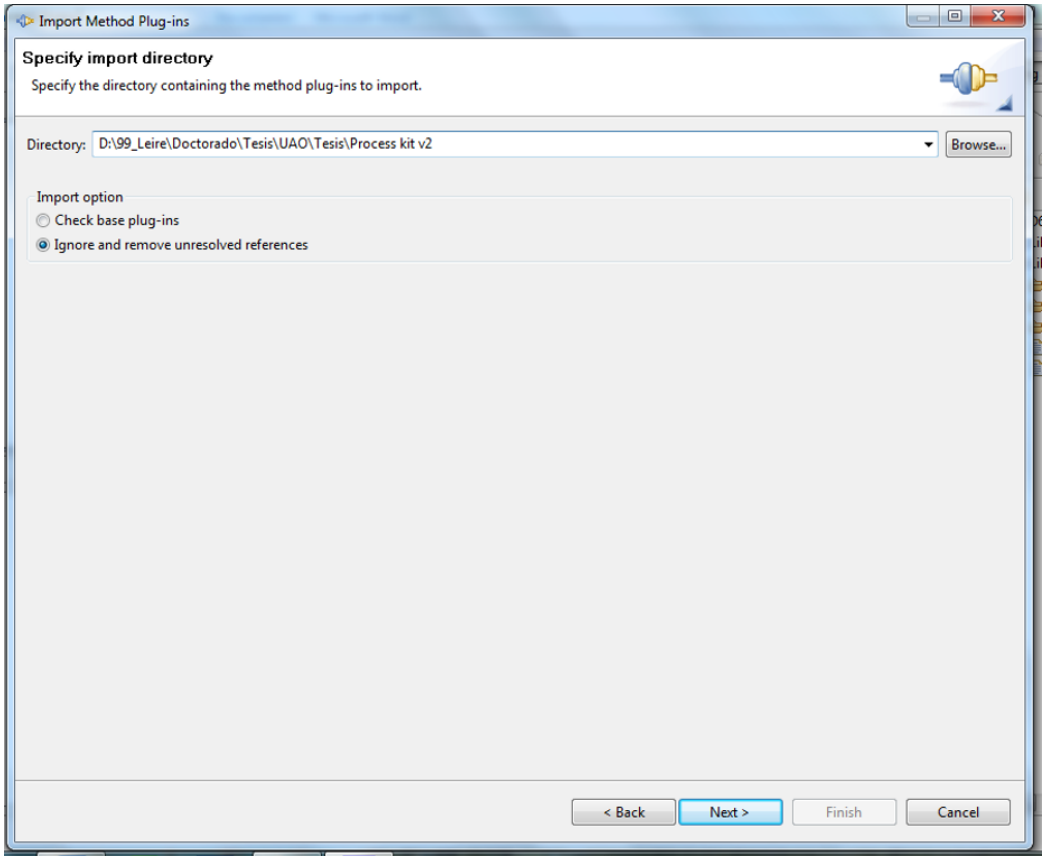
- Click File→ Import



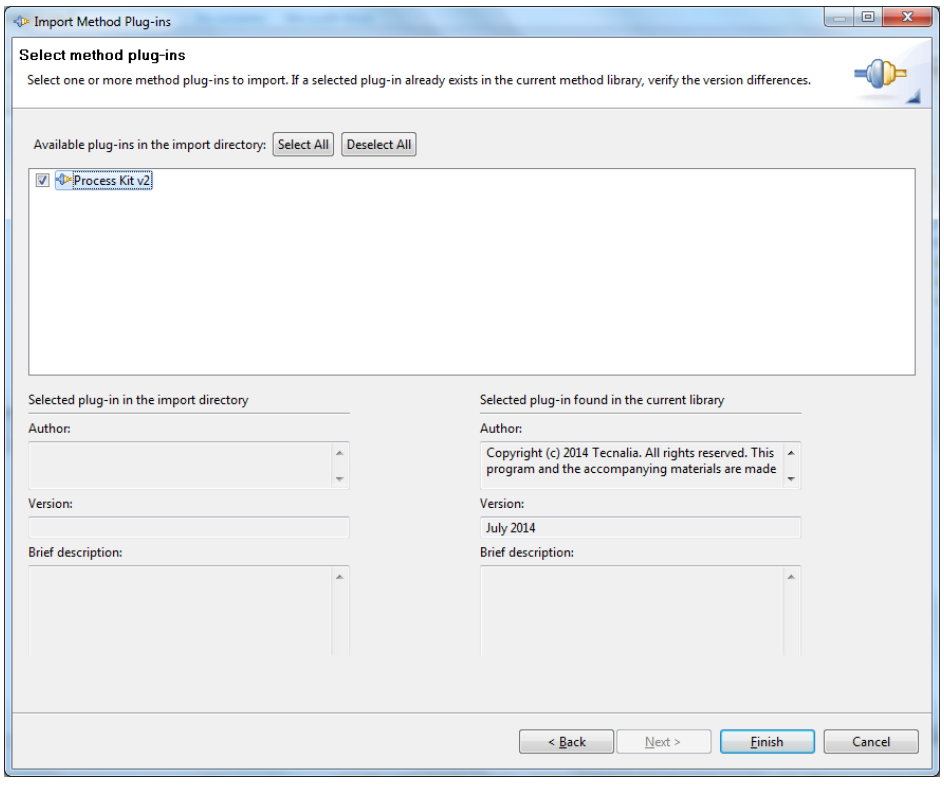
Select Method plug-in



Select the directory where the plug-in is stored



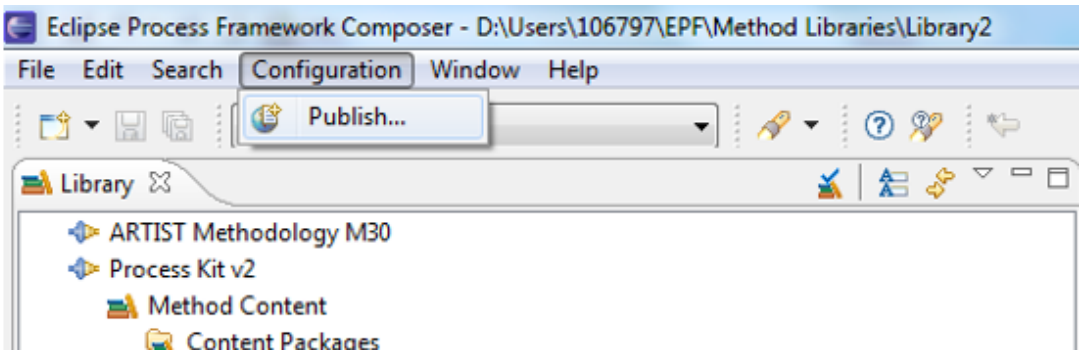
Select “Process kit”



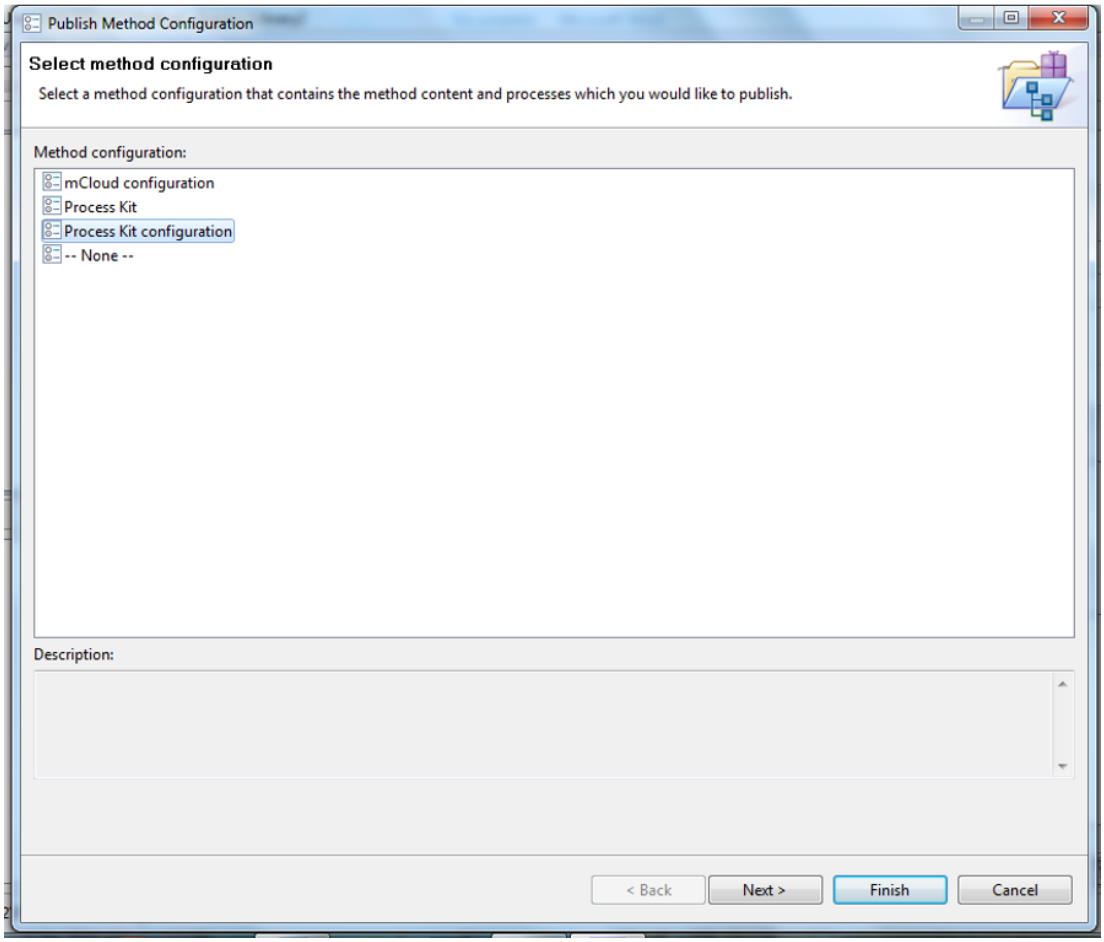
User Manual

If required, once the plug-in is imported in EPF, it can be published as a Web page. For doing this, it is required to follow these steps:

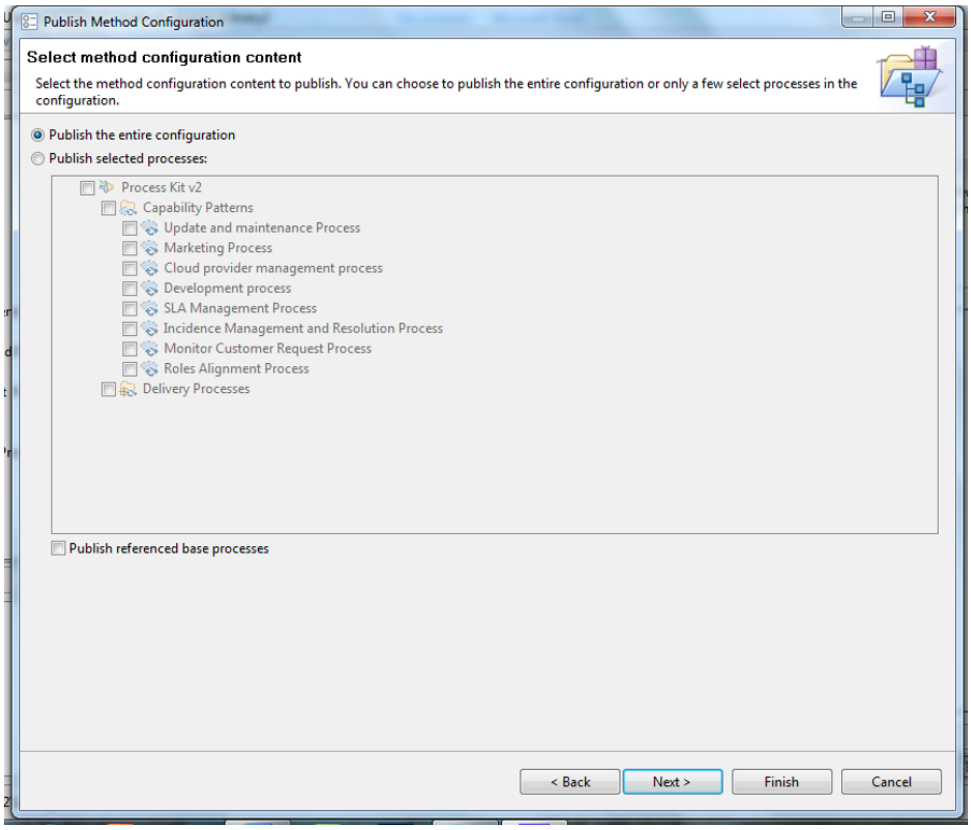
- Click on Configuration→ Publish



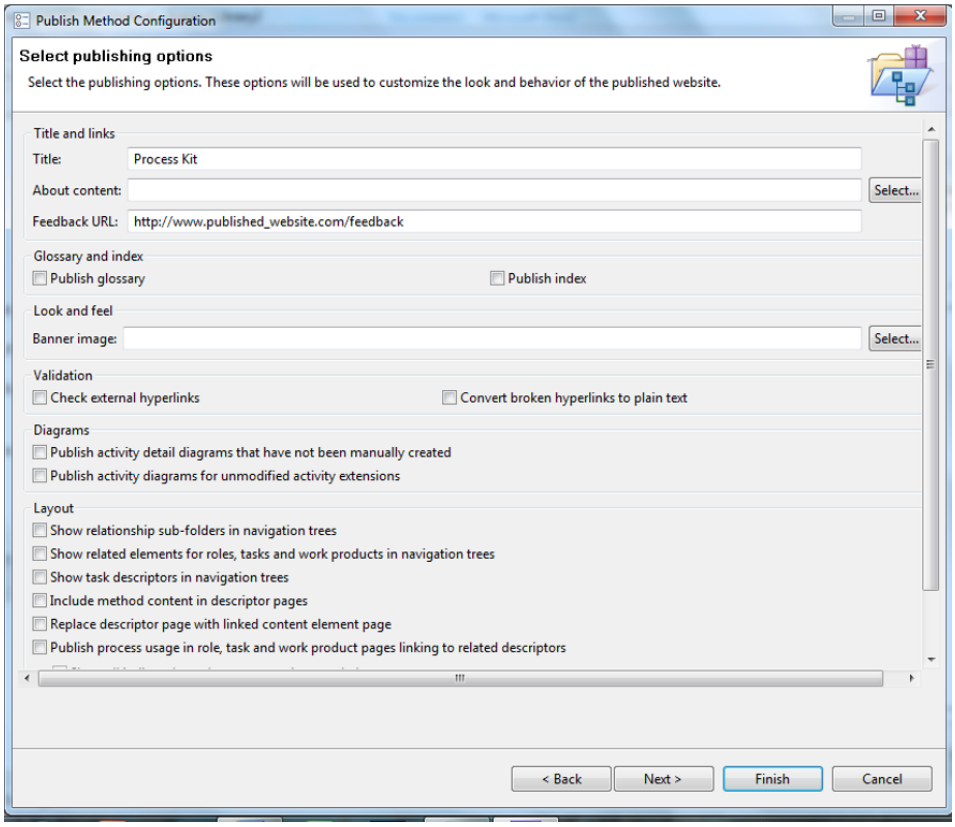
Select the method configuration “Process kit configuration”



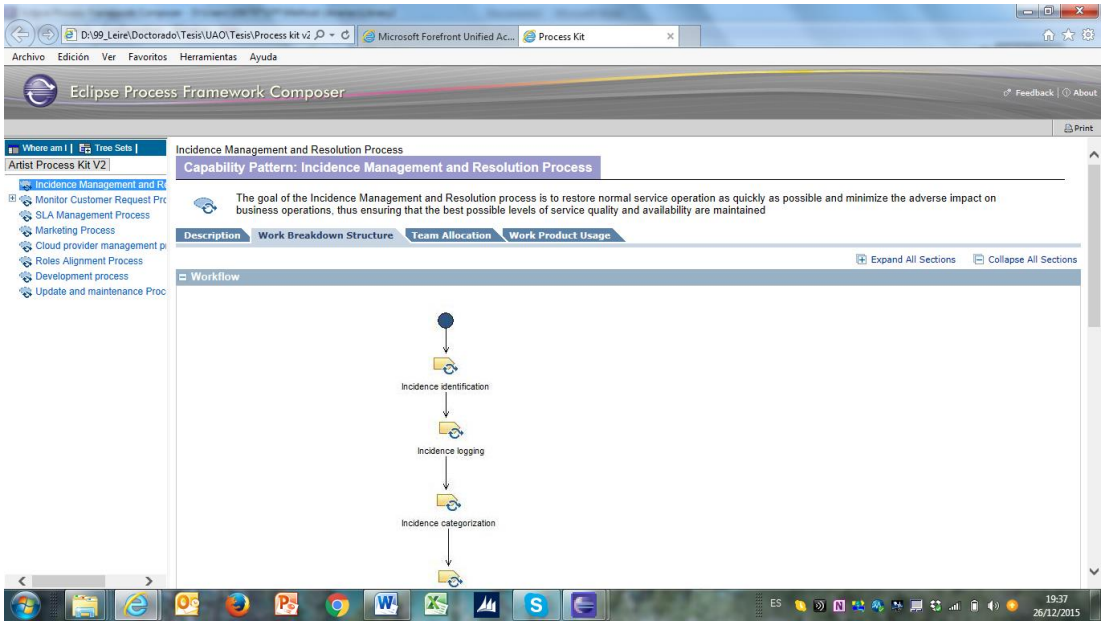
It can be selected whether to publish the entire configuration or a set of selected processes.



Select the publishing options. These options will be used to customize the look and feel of the published Web site.



Finally, select the destination directory and format for the published Web site. This is the result of this action, where all processes can be seein in a graphical manner and it can be navigated throughout them:



3. Economic Impact Analysis

Migration of legacy applications always assumes an investment decision involving weighting costs of the migration project against benefits coming from the exploitation of the rejuvenated application. The migration of legacy application to the cloud must be justified in the same way as any other system development is (REINASSANCE Consortium, D3.3, 1998).

The approach followed in this PhD thesis uses an economic and strategic approach for evaluating and justifying cloud migration projects. The reasons why this is so are explained next:

- Economic since it focuses on the the incentives/disincentives of the migration to Cloud.
- Strategic since it targets the assessment of long term implications of the migration, such as the processes that the company should change or adapt to the new situation (e.g. see Section 2 presented beforehand)

The main objective of this activity is to provide decision – makers with information of how much the modernization process will impact in the sustainability of the company.

Next, subsection 1 outlines the current state of the art in cost-benefit analysis for the modernization of legacy applications to the cloud, while subsection 2 presents a cost-benefit analysis from the application provider's perspective.

3.1 Current approaches

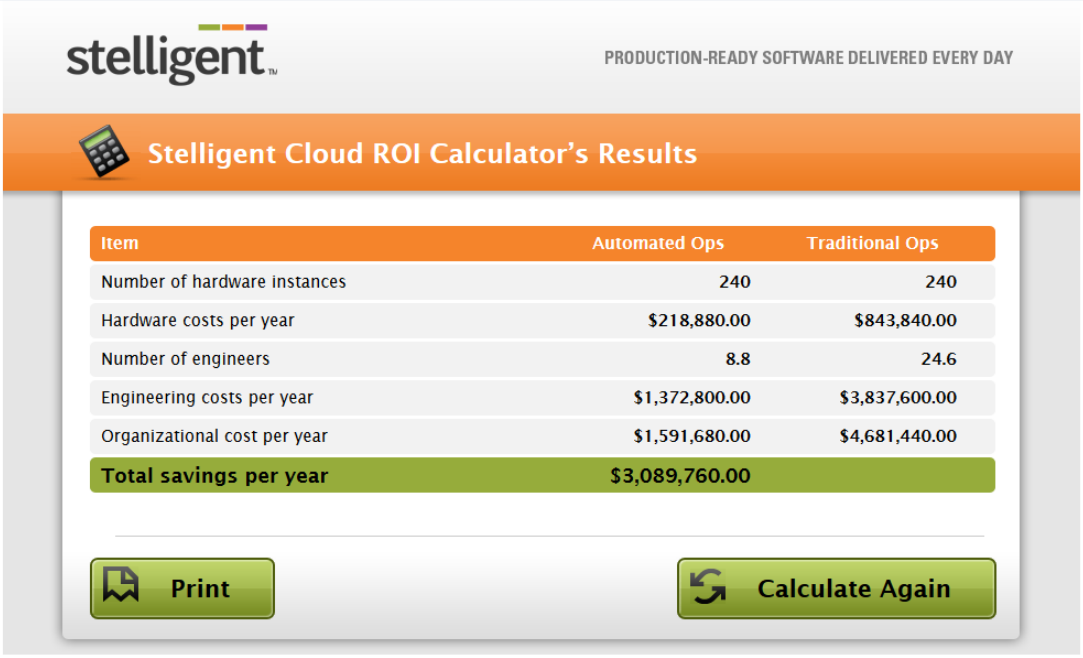
A CBA is a way of calculating and comparing benefits and costs of a project, investment or even government policies. The purpose of a CBA is twofold:

1. To determine if the investment to be made is feasible and justifiable;
2. To provide means to compare investments or decisions. In the case of a migration to the cloud, the comparison would be between migrating totally, partially or developing from scratch, with the main purpose of analyzing whether the benefits outweigh the costs and by how much.

CBA's are expressed in terms of monetary units and adjusted in real terms, so that all flows of costs and benefits are calculated on a common basis even though they occur in different moments and periods of time.

Companies currently offering IaaS, PaaS and SaaS often provide a cost calculator or a ROI calculator in order to help companies, that want to buy a service, analyze the convenience of paying for such a service instead of purchasing it in the form of a product, in a license-based model. An example of this approach is the one used by Google for Business, where they help companies analyze how much it costs to use Google's Gmail at corporate level so that the company can compare these costs against the acquisition of licenses of, e.g., Microsoft Exchange. In most cases, this comparison is done in the following terms: if a user decided to build his own data center (comparable to acquiring IaaS services), the purchase would include, among others, buying the hardware, the licenses of the software installed in the data centre and the labour cost of the IT people and this is compared to the cost of using an external IaaS. An example of such a cost calculator is shown next (Cloud Business Review, 2014).

Figure 27. An example of an existing ROI calculator to migrate to the cloud

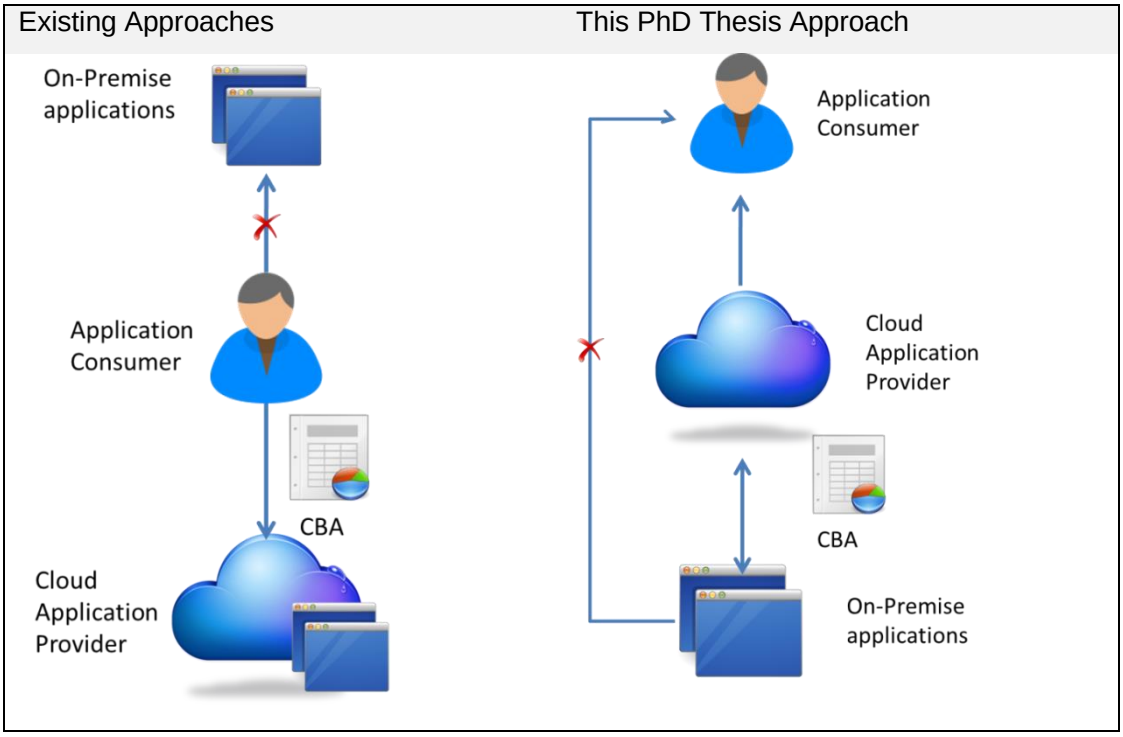


Source: adopted from (Cloud Business Review, 2014)

In the event of acquiring an application in contrast to acquiring a service, the approach to follow is similar. The comparison of a traditional application purchase would include the license fee, the customization and installation by the consultants and the maintenance recurring costs, in contrast to the pay-per-use or pay-as-you-go model that most SaaS providers follow. Software maintenance is usually included in the tariff.

However, the author of this thesis has not yet been able to found a similar cost or ROI calculator taken from the perspective of a service application provider. Additionally, specific CBA's to help decide on the convenience of migrating to the cloud versus developing from scratch, considering technological, organizational and cloud infrastructure issues among others, are yet to be found by the author of this work. Thus, the main motivation of this CBA is to provide companies that are thinking about migrating, with a tool to determine whether the investment is feasible in monetary terms and in a later stage, to provide them also with a comparative tool of what solution is better, a total migration, no migration or a development from scratch. This CBA exercise is the one that for instance Microsoft should have done when moving from the traditional license-based model of Office towards the current as a service Internet based Office 365 model, in order to analyze the convenience or not of such migration. The following figure depicts the approach followed on this PhD thesis.

Figure 28. Comparison of existing CBA approaches with respect to this PhD Thesis approach

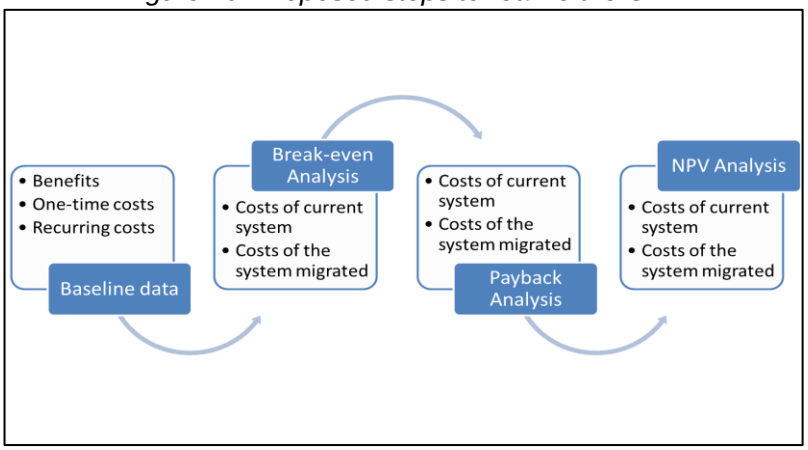


Source: Author's own contribution

3.2 Cost – Benefit Analysis (CBA)

The CBA presented in this thesis is a conceptual framework that suggests, prior to the migration, several issues that need to be considered. The CBA is provided as an Excel sheet and can be found in Annex 2. The following picture depicts proposed steps to perform the CBA.

Figure 29. Proposed steps to realize the CBA



Source: Author's own contribution

The starting point of this CBA is the acquisition of certain baseline data. This baseline data is completed by means of interviews with relevant stakeholders. The data set presented here is an initial approach that can be modified or improved any time depending on the nature of the company, the product, and the basic operational costs. In this first step, the data gathered mainly include tangible expected benefits, one-time costs and recurring costs. The data provided in that first phase is transmitted automatically to the following phases. The data used of this PhD thesis in section 2 is fictional and only for demonstration purposes. Section 3, however, shows real data from three real applications that haven been migrated to SaaS.

The following table explains the initial concepts considered in the current CBA. The details can be found in Annex 3.1 – CBA Template.

Table 3. CBA Concepts Breakdown

Type	Concept	Explanation
Benefits	Cost reduction or avoidance	Process of removing costs deemed unnecessary without having a negative impact on product quality
	Error reduction	More updates and with more frequency reduce the time spent in correcting grave errors. Regression tests in SaaS applications are continuously run every time a new version comes out. In traditional applications, regression tests are less frequently run, since in most cases, there is only a yearly update and that is when regression tests are mostly executed.
	Increased flexibility to customize solutions	In the case of SaaS only the presentation layer has to be customized. In the case of legacy applications, in most occasions, the application has to be customized ad-hoc for the customer (e.g. setting up the infrastructure, creation of a new DB schema, workflows, etc.)
	Savings for not having to travel to install the solution	On-premise applications, even when they are 2 or 3 tiered applications, need a certain configuration in the hardware (e.g. Database, Application server, etc.) that needs to be prepared by the software provider and its consultants. This

Type	Concept	Explanation
		involves trips and consultancy services. This concept can be calculated as Number of customers * travel costs.
	Savings for not having to maintain several versions of an application for different environments	Maintaining a version of a software system for several operating environments implies a huge number of costs: explicit teams dedicated to each configuration, dedicated configuration management servers, licenses and other infrastructure items. On the other hand, SaaS applications run on an IaaS (or multiple IaaS but with the entire same configuration) and thus, only development environment needs to be set up and maintained.
	Improvement in management planning and control	Controlling items of one configuration and one technology stack is easier in a SaaS application due to the need of maintaining only one operational environment.
	Savings for reusing code	Original source code may be reused in the event that the programming language of the old application coincides with the programming language of the target platform. In this case, a previous analysis of potential reuse of snippets of code has to be performed (mainly concerned with business logic). This reuse can imply savings compared to developing it from scratch or completing the automatically generated code.
One-time costs	Development costs	Cost of migrating the application or starting it from scratch
	Creation of the new IaaS (in the case of a private cloud)	If the company decides to run the application on a private cloud, they will have to set it up. This concept includes labour costs of setting it up and the purchase of the infrastructure
	New software licenses	For both the creation of the application and the IaaS in case of a private cloud

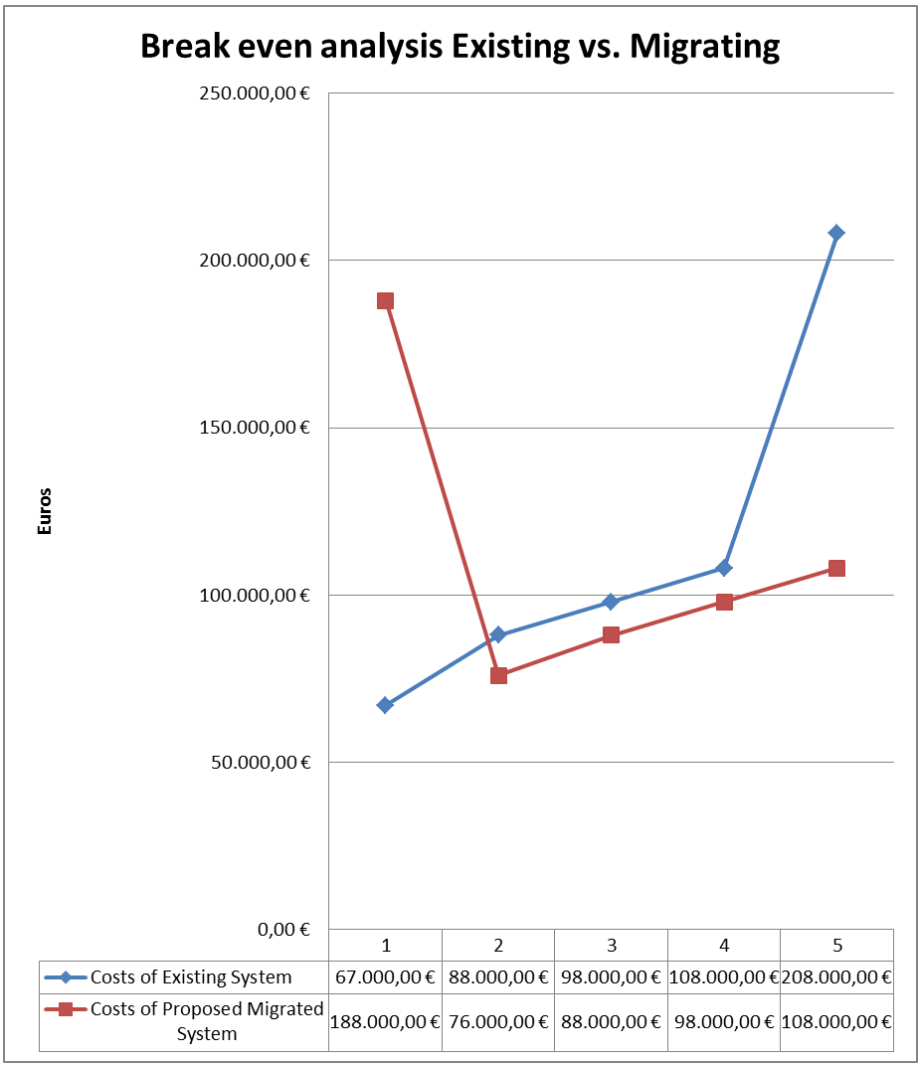
Type	Concept	Explanation
	User training	Roles will be changing now that the application is servitized. This includes the costs of the application of the roles alignment process. Not only the developers will have to be trained in new architectural concerns, implementation of business models (how to translate the functional concepts of a business model to the different application components), but also other roles will have to be changed to satisfy the helpdesk service (different levels), the marketing, customer services, etc.
	Adequation and institutionalisation of the organizational processes	Several organizational processes will have to be changed and then institutionalized. This cost is covering this activity, a similar cost to that of process improvement related activities, as shown beforehand.
Recurring costs	Application software maintenance and update	SaaS applications are continuously updated and maintained. New versions are released in short periods of time without the end user noticing. This continuous update impacts in the number and severity of errors since regression, unit and integration tests are run before each release.
	IaaS Maintenance (in the case of a private cloud)	In the case in which the SaaS is offered using a private cloud delivery model, this private cloud needs to be taken care of: updates, upgrades and patches need to be installed and set up, etc.
	Cloud provider (in case of a public cloud provider)	In the case of a SaaS deployed on a public cloud provider (although a private cloud), the platform and infrastructure costs will come in bills from the cloud provider. Most cloud providers follow a pay per use basis. The bills can be monthly or annually or any other period of time, depending on the customer's likes
	New application	In order for a SaaS to be competitive, new functionalities are commonly offered to the consumer. These new

Type	Concept	Explanation
	functionalities	functionalities are often the response of customer's requests and are offered following a tiered business model
	Marketing	Marketing efforts are key in a SaaS company since the market is now global and less local than before. This involves a new marketing strategy with a clear focus of the target customers.
	Helpdesk service	An incidence Management service must be established. This service is usually configured in levels, depending on the severity of the incidences and the established response time in the SLA.
	Customer service	Related to answering all concerns by the customers, new customer acquisition, SLA generation, monitoring and compliance.

Source: Author's own contribution

Once this data is gathered, a break-even analysis is performed. In this case, the break-even analysis consists on a comparison of the costs of the proposed migrated system against the costs of the current system. It can happen that due to the factors considered, the point of balance is never found, thus implying that the costs of the migrated system (or the existing one) are always lower than the other one. This can drive further the decision. An example of this situation can be found in the next figure.

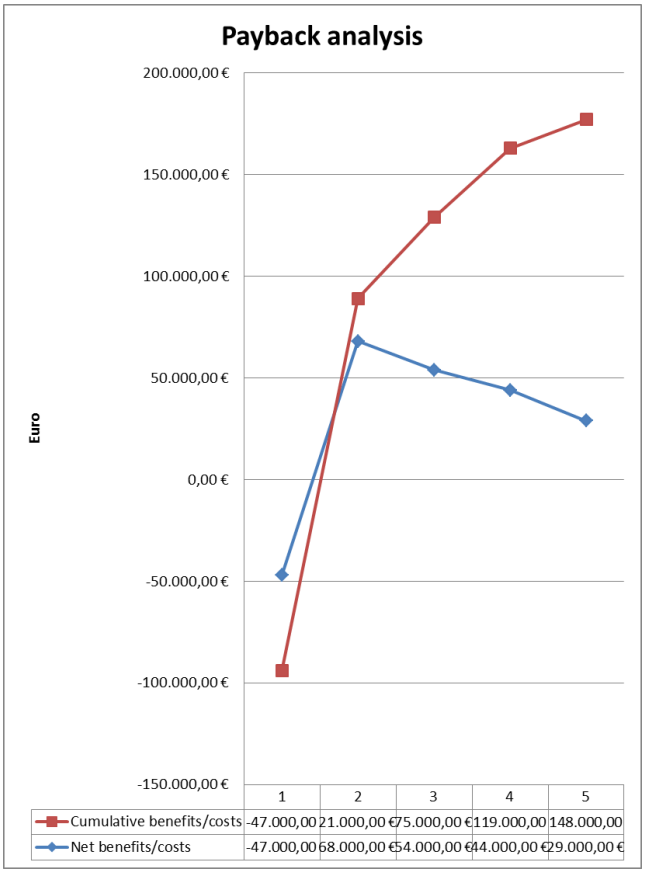
Figure 30. Break-even analysis of costs of existing system vs. migrated system



Source: Author's own contribution

Based on the same data and in parallel, without any user intervention, a payback analysis is performed. The aim of this payback analysis is to provide the user with an estimation of when the company will recover the investment, taking into consideration the net benefits and costs and the cumulative benefits and costs. In this theoretical exercise, payback = 1.69 years.

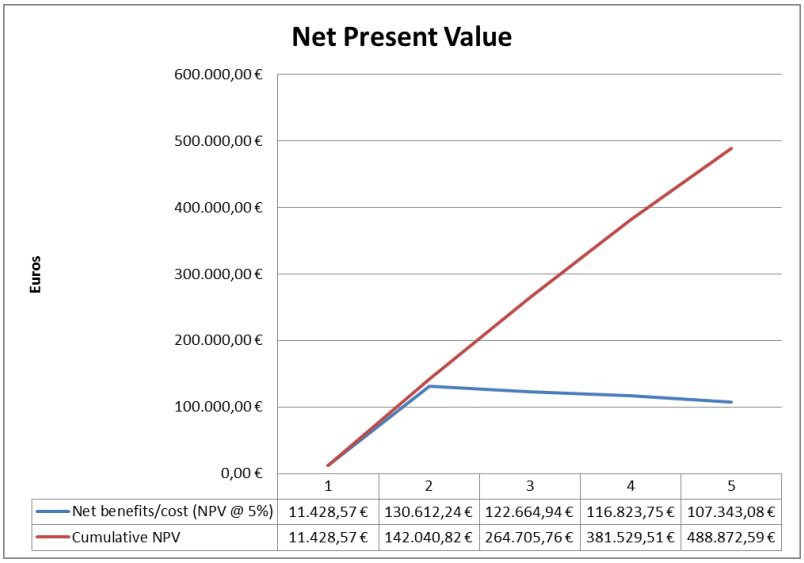
Figure 31. Payback Analysis



Source: Author's own contribution

Another economic value included in this CBA is the Present Value (PV) and it shows the value as of today of the investment of migrating the software system with a discount rate of 5%.

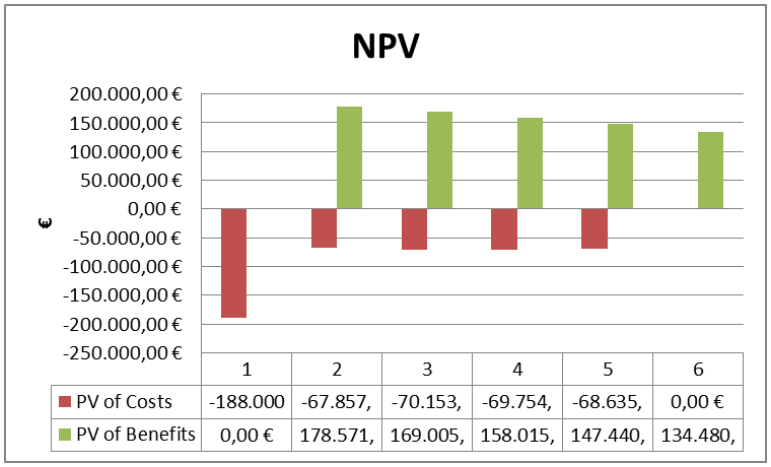
Figure 32. Net Present Value



Source: Author's own contribution

The final economic indicator provided to the user is an overview of all the previous data, showing him the Net Present Value of costs, of benefits and the cumulative difference. The discount rate remains 5%.

Figure 33. Net Present Value of Costs, Benefits and Cumulative Difference



Source: Author's own contribution

Finally, a ROI value is also presented. The ROI is calculated as follows:

$$ROI = \frac{NPV\ Benefits - NPV\ Costs}{NPV\ Costs}$$

For this theoretical exercise, the ROI results in:

	Year 1	Year 2	Year 3	Year 4	Year 5
ROI	-30,21%	6,62%	27,75%	40,62%	69,58%

4. Methodology to define a SaaS business model

4.1 Overview

In its most basic definition, a business model describes how a company creates value, generates revenue and profits from operations. (Al-Debei, El-Haddadeh, & Avison, 2008) revise the business model definition due to the prominence and growth of the digital world and the ICT industry. In their paper they present a study of already established definitions for what a business model is and they finally conclude that a business of model is "*an abstract representation of an organization, be it conceptual, textual and / or graphical, of all core interrelated architectural, co-operational and financial arrangements defined and developed by an organization, as well as all core products and/or services the organization offers based on these arrangements that are needed to achieve its strategic goals and objectives*".

Even though the business world has come to an understanding in what respects to the business model definition, the opinions divert on what the exact components of a business model are and how to design and to describe them. It is agreed, whatsoever, that a business model has several functions: (Chesbrough & Rosenbloom, 2002):

- It articulates the value proposition;
- It identifies a market segment and the competitive advantage with respect to its competitors;
- It defines the structure of the value chain;
- It details the revenue mechanism;
- It estimates the cost structure and profit potential;
- It describes the position of the firm within the value network linking;
- It formulates the competitive strategy.

In his thesis "*The Business Model Ontology - a proposition in a design science approach*" (Osterwalder & Pigneur, 2010) Alexander Osterwalder introduces four main areas of a business model: product, customer interface, infrastructure management and financial aspects. Each of these areas is complemented by a building block as shown in Table 4. The product area describes what a company is offering, either now or in the

future. Without something that can be of value to potential customers it is very difficult to define a business model. The second main area, the customer interface, describes the audience that is targeted with the product, how the distribution channel to reach this audience works and what the relation to the customer is, either direct or indirect via external partners. The third main area, infrastructure management, deals with the organizational aspects of creating the value, i.e. the product and the services, and comprises how the value is created for the customer and what resources and activities are required for it, describes the ability to create the value via a repeatable process and determines if partnerships are required if more expertise is needed to create the envisioned value. The fourth main area, financial aspects, comprises the cost structure and the revenue model. The cost structure summarizes all the expenses needed to create the value as they appear in the business model. The revenue model describes how the income is generated by selling the products or the services.

Table 4. Osterwalder's Four Areas and Nine Building Blocks

Area	Building Block
Product	• Value proposition
Customer Interface	• Customer segments • Customer Relationship • Distribution channel
Infrastructure Management	• Key partners • Key activities • Key resources
Financial	• Cost structure • Revenue streams

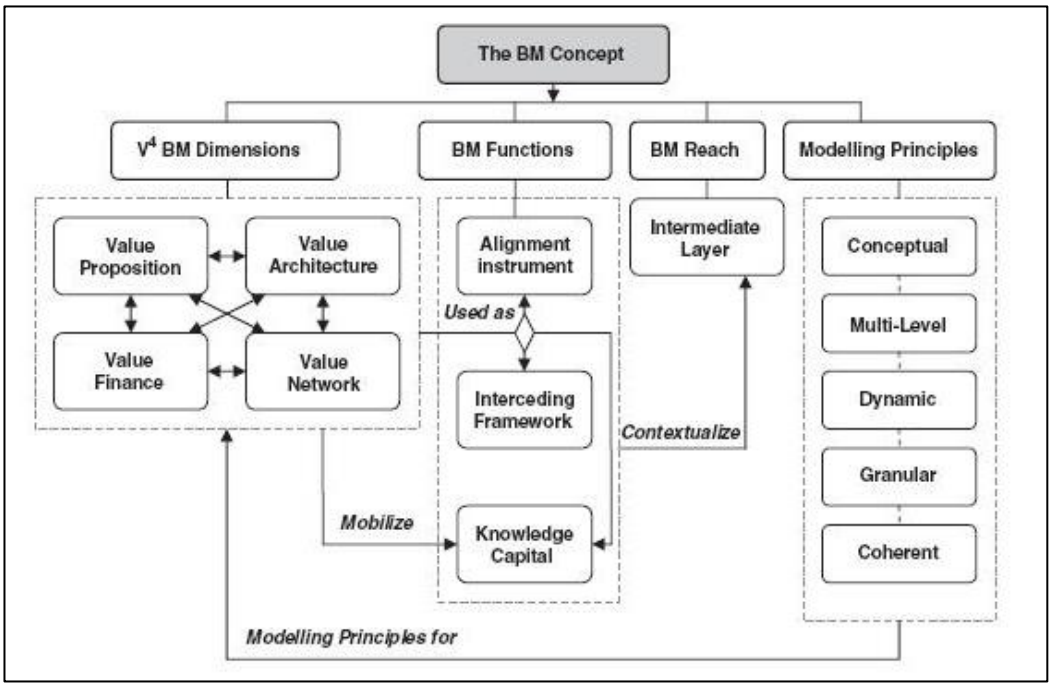
Source: author's own contribution

This model is a generic one that targets physical goods as well as virtual goods and is applicable to different kinds of companies and businesses. The generation of a specific

model is guided by the elaboration of each of the main areas. Current vendors of cloud-based software systems keep the details of their business models private. It is an open question how a successful business model for a new service can be created or how a given business model for a legacy system can be transformed to one that is suitable for the cloud. An additional challenge in this regard lies on the definition of value chains and revenue-sharing models in distributed service landscapes, challenge that will be aimed to be solved in the following section (see section 5 “SaaS Pricing Strategies”). Furthermore, and especially in the SaaS offerings, competition must be analyzed. SaaS providers must be aware that customers often do not select a certain SaaS application because of its price, but rather because of the features they offer, since it is the features that add value to a price. Osterwalder’s approach, however, does not consider market competition.

Another approach for the definition of the business model that is rising in popularity is the Unified Framework, also known as the V4 Business Model Framework (Al-Debei & Avison, Developing a unified framework of the business model concept, 2010), which is depicted in the following figure:

Figure 34. Unified Framework



Source: adopted from (Al-Debei & Avison, 2010)

For (Al-Debei & Avison, 2010) the business model concept consists of four dimensions identified as Value Proposition, Value Architecture, Value Finance and Value Network, plus three other elements: functions, reach and modelling principles. All these are explained next (Al-Debei & Avison, 2010):

- Value Proposition: the value proposition describes the services that the organization offers, along with its added value elements and the target market segments. To define the value proposition three questions must be answered: 1) What is the offering?, 2) What is the value that is incorporated within that offering?, 3) Who are the targeted customers that are most likely to desire the proposed offering?;
- Value Architecture: This dimension includes technological architecture, organizational infrastructure and the configurations of these two. (Al-Debei & Fitzgerald, 2010) understand the technological architecture as how the organization is built in order to operate efficiently and effectively. Organizational infrastructure is understood as the organization's structure, key processes and functions, task force, management mindsets, and culture;
- Value Finance: this includes all financial data, namely costs, revenues, and pricing methods;
- Value Network: this dimension aims at describing the position of an organization in the value chain and the relationship with the different stakeholders;
- Functions: three functions are considered:
    - Alignment instrument, as a business model can fill the gap between corporate strategy and business processes;
    - Interceding framework: as a business model mediates between the (technological) artefacts and the strategic goals and objectives;
    - Knowledge capital, as it represents the knowledge that is almost never shared with others but is only embedded in the minds of the managers of the organization;
- Reach: For (Al-Debei & Avison, 2010), a business model is not a substitute for the corporate strategy but rather a complement that it sustains it as the concept's configurations are strategically oriented;
- Modelling principles: this part contains the blocks coherent, granular, dynamic, multi-level, and conceptual. The concept is:
    - Coherent, because it maps the internal and external positions of the organization;
    - Granular, because it can be decomposed in different components that in turn can also be broken down into different elements;

- Dynamic, because it can cope with change derived from both external and internal forces, e.g., market competition;
- Multi-level, because it can be used in individual organizations but also in value networks;
- Conceptual, because it covers the key business components of a business model.

The four dimensions of the Unified Framework (V4 Business Model) correspond partially with the four areas of Osterwalder. The following table shows this correspondence:

Table 5. Comparison of Osterwalder's Business Model Building Blocks and V4 Dimensions

Osterwalder	V4
Product Customer Interface	Value proposition
Infrastructure	Value Architecture
Cost structure Revenue Streams	Value Finance
-	Value Network

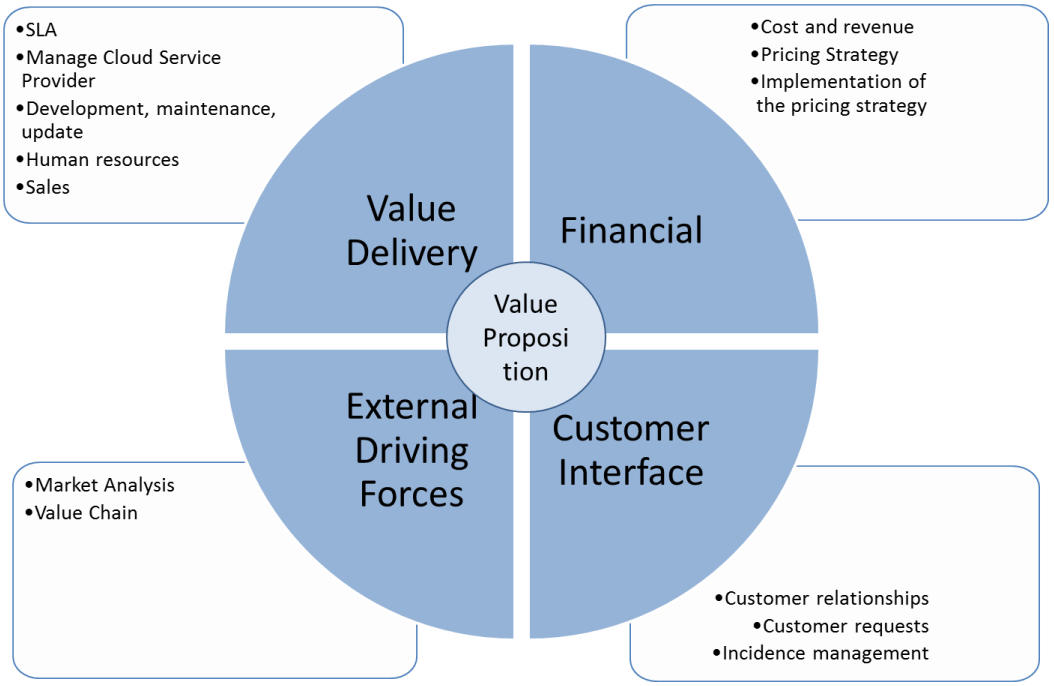
Source: author's own contribution

As it can be seen, all building blocks of Osterwalder are covered in the Unified Framework, except for the Value Network, which includes the analysis of the competition and as mentioned beforehand, Osterwalder's Business Model Canvas ignores.

The methodology presented in this PhD thesis builds upon existing approaches but its novelty relies on one hand, on the detailed guidance of the steps needed to be taken when defining the business model of a certain SaaS offering, and on the other, on the tailoring of existing approaches for SaaS offerings, tailoring that it is, up to the knowledge of the author of this PhD nowhere to be found (Orue-Echevarria L. , et al., 2014) (Menychtas, et al., 2014) (Bergmayr, et al., 2013).

The methodology developed for this thesis revolves around four pillars, as presented next.

Figure 35. Methodology pillars



Source: author's own contribution

The details of these pillars can be found on Annex 5 Methodology Tasks of this thesis, even though a brief description is now presented.

- Pillar 1 – Value Proposition: the value proposition is the core aspect of a SaaS offering. The value proposition describes the value that will be delivered to the customer. A good value proposition describes 1) how the SaaS offering solves customers' problems, 2) how it delivers benefits to the customers, 3) the differentiation points with respect to the competition.
- Pillar 2 – Value Delivery: this pillar is concerned with the provisioning of the SaaS application. Provisioning a SaaS means: 1) develop, update and maintain the software application, 2) select and manage the cloud provider where the application will be deployed, 3) define and monitor the SLA terms and SLOs that will be presented to the customer and that will rule the service provisioning, 4) align the human resources of the company to successfully deliver the SaaS application, 6) Deploy a sales team and a selling strategy to keep the company alive.

- Pillar 3 – External Driving Forces: this pillar describes on one hand the value chain of this SaaS offering, in order to know which are its dependencies, suppliers and so on; and on the other hand, the external market conditions, namely, a market analysis, a competitor's analysis (features, offers, pricing strategies), market pivoting and so on.
- Pillar 4 – Customer Interface: in this ase, all interactions with the customers are registered. Firstly, the definition of the relationship that customers expect to have with the SaaS provider; secondly, how customers requests will be handled, and finally, how incidences reported by the customers will be processed.
- Pillar 5 – Financial: this pilar is concerned with the definition, technical implementation and pivoting of the pricing strategy for the SaaS offering.

This section is organized as follows. In subsection 2, the structure of the methodology as well as the different elements that compose the methodology are introduced. In subsection 3, the actors that are involved in the different tasks of the methodology are defined. The following section, subsection 4, presents the task taxonomy identified for the methodology tasks. This taxonomy aims to organize better the different methodology tasks. The different tasks and activities of the methodology following the structure presented in section 2 can be found on Annex 5 Methodology Tasks.

4.2 Methodology Elements and Structure

For the effective definition of the methodology the following aspects have been identified:

- **Task:** tasks are related to the business activities needed to redefine the business model as well as the technical activities needed to be performed to implement the business model.
- **Activities:** Each task is decomposed in several activities, which is the minimum representation.
- **Discipline:** Each phase and task will be identified as technical, process or business. Disciplines in this case are like categories:
    - **Business tasks** are those related to the activities to be performed to update the business model to the new product or service.
    - **Process tasks** are those related to the activities required to accommodate the business processes of the company to the new situation with the new product or service

- **Technical tasks** are those related to the technical activities to be executed to be able to cloudify an application. In the context of this PhD, these activities encompass only the implementation of the business model within the application, for instance, by including a metering component or a billing one.

For the effective identification and definition of the various tasks a specific structure has been used:

- **Task id: A unique string for referencing to the task.**
- **Task description:** the main purpose of the task, that is, the description of what this task aims at.
- **Predecessors and Successors tasks** to this task and the dependencies of it with respect to other tasks.
- **Activities:** fine-grained tasks. These activities should cover different modernization projects and different component types affected so that the activities can be specialized for each of the migration projects.
  - **Activity ID**
  - **Activity Name**
  - **Activity description**
  - **Activity taxonomy** that defines the category of the activity
  - **Predecessors and Successors activities** and how this activity depends on others, conditions that need to be fulfilled in order to advance further and exceptions that can occur.
  - **Input documentation/artefacts** that must exist in order to be able to execute the activity. These inputs are classified in:
    - **Mandatory:** the activity cannot start if the corresponding artefacts are not present
    - **Optional:** the activity can start if the corresponding artefacts are present
  - **Output documentation/artefacts** that will be created by the execution of this task. These inputs are classified in:
    - **Mandatory:** the activity cannot start if the corresponding artefacts are not present
    - **Optional:** the activity can start if the corresponding artefacts are present

- **Roles**: these specify which people in the company should participate in this task; e.g. Developers, architects, project manager, financial manager, etc.
- **Supporting tools and material**: which tool or functionality of the different existing tools are the most adequate ones to be able to execute successfully that task.
- **Migration project characteristic**: Specificities of the migration project

4.3 Actors

This section presents definitions for the roles that participate in the various tasks of the methodology. A role is a well-defined set of related skills, competencies, and responsibilities. Roles can be filled by one person (actor) or multiple people while one person may fill several roles.

In addition, the identified roles have been classified in business and technical roles to provide a better understanding regarding their relationship with the methodology tasks.

4.3.1 Business Roles

In the following table, the business roles expected to participate in a business model definition and implementation are described

Table 6. Definition of business roles

Name		Description
Providers	**Application Provider**	An entity that manages and distributes software-based services and solutions to customers across a wide area network from a central data centre.
	3rd party application provider	An external entity that manages and distributes software-based services and solutions to customers across a wide area network from a central data centre.
	Platform Provider	The company that manages and maintains the administration service that underpins the distribution platform. In other words, the platform provider is the company that provides the administrative service that is being sold by the distributor to its investors. The platform provider may be viewed as the

Name		Description
		administrator of the platform or gateway infrastructure.
	Infrastructure Provider	A hosting provider that offers a full set of infrastructure services for hosting online applications.
Application Owner		An application owner is the entity/person of whom the application belongs to. He/She has the final decision on the migration requirements (technical, business), and the acceptance of the migrated application and its associated business model.
Business Manager		A Business Manager is a person who drives the work of others in order to run a major business efficiently and make a large profit. He or she should have working knowledge of the following areas, and may be a specialist in one or more: sales, marketing, and public relations; economics; production; finance; accounting, auditing, tax, and budgeting; purchasing; and personnel.
Business Analyst		A Business Analyst is someone who analyses the existing or ideal organization and design of systems, including businesses, departments, and organizations. Business Analysts also assess business models and their integration with technology.
Human Resource Manager		A Human Resource Manager (HRM) is responsible for the attraction, selection, training, assessment, and rewarding of employees, while also overseeing organizational leadership and culture, and ensuring compliance with employment and labour laws.
Marketing Manager		A Marketing Manager is responsible for influencing the level, timing, and composition of customer demands. A Marketing manager works very close to the Business Manager.

Source: author's own contribution

4.3.2 Technical Roles

In the following table, the technical roles expected to participate in the technical implementation of business model definition are described. The aim of this table is not to present an exhaustive list of technical roles that partake in a modernization project, but

rather the most relevant profiles that need to collaborate closely with business people so as to implement the business model in the SaaS application.

Table 7. Definition of technical roles

Name	Description
Software Analyst	Software Analyst is the person who studies the software application domain and prepares the software requirements and specification (Software Requirements Specification) document. They convey the demands of the software users to the developers. One of the responsibilities of Software Analysts is the creation of the various application models. The Software Analyst is also responsible to include the business aspects related to the implementation of the business model in the requirements.
Software Architect	Software architect is a computer programmer who makes high-level design choices and dictates technical standards, including software coding standards, tools, and platforms. They decide on technologies for the whole solution. The Software Architect is the person who decides the best way of including the business concepts in the application by specifying for instance, which metrics need to be monitored and on which basis in order to implement the selected pricing strategy. Other business-related concepts to be included, but not limited to, are: a billing component, an SLA monitoring component for potential customer claims of SLA violation.
Developer	Developer is the person concerned with facets of the software development process: researching, designing, implementing and testing software. They may, also, take part in the design, or software project management.
Integrator	A systems integrator is a person that specializes in bringing together component subsystems into a whole and ensuring that those subsystems function together (system integration). Systems integrators may work in many fields but the term is generally used in the information technology (IT) field, the defence industry or in media.

Name	Description
Tester	A tester is a person that validates and verifies that a computer program/application/product meets the requirements that guided its design and development, works as expected, can be implemented with the same characteristics, and satisfies the needs of stakeholders.
Quality Manager	Quality managers ensure that the product or service an organization provides is fit for purpose, is consistent and meets both external and internal requirements. This includes legal compliance and customer expectations.

Source: author's own contribution

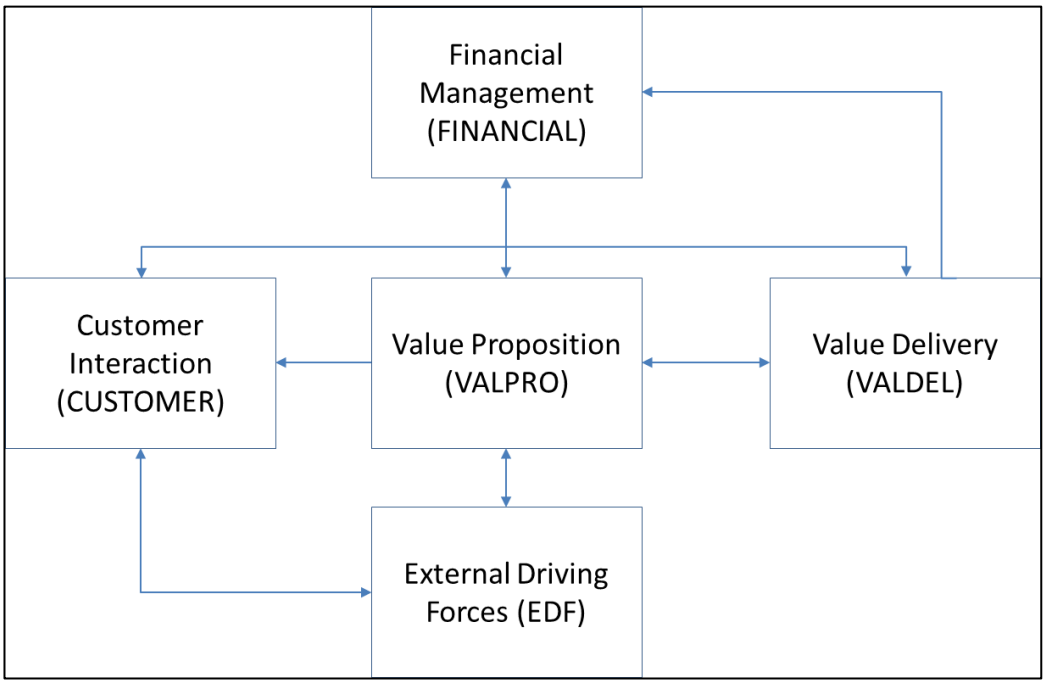
4.4 Task Taxonomy

Each of the tasks and activities considered in the methodology has a taxonomy associated. This taxonomy allows a better understanding as well as the characterisation of the different tasks that allows a better task grouping. Following, a description of the Task Taxonomy:

- **Matchmaking Task**: this task involves any matchmaking process that matches candidates from a pool to given matching criteria
- **Ranking Task**: this task involves any classification process that prioritizes candidates from a pool that fulfll a certain criteria
- **Business analysis task:** this involves any task related to the definition and update of the business model.
- **Simulation task:**
    - **Pricing model simulation task**: it involves the dynamic simulation of the profitability of a cloudified application.
    - **Profit and Loss / Balance simulation task**: it involves the dynamic simulation of how a pricing strategy affects the balance sheets of a company.
- **Monitoring task:** this taxonomy involves the continuous observation of economic indicators, task needed to pivot the pricing strategy, the business model or any other related activity.
- **Support task:** this involves any task needed to effectively carry out the operational activities concerning the provision of the SaaS application.

4.5 Tasks Interaction

Figure 36. Methodology tasks interaction



Source: author's own contribution

5. SaaS Pricing Strategies

5.1 Analysis of SaaS Pricing Strategies and their components

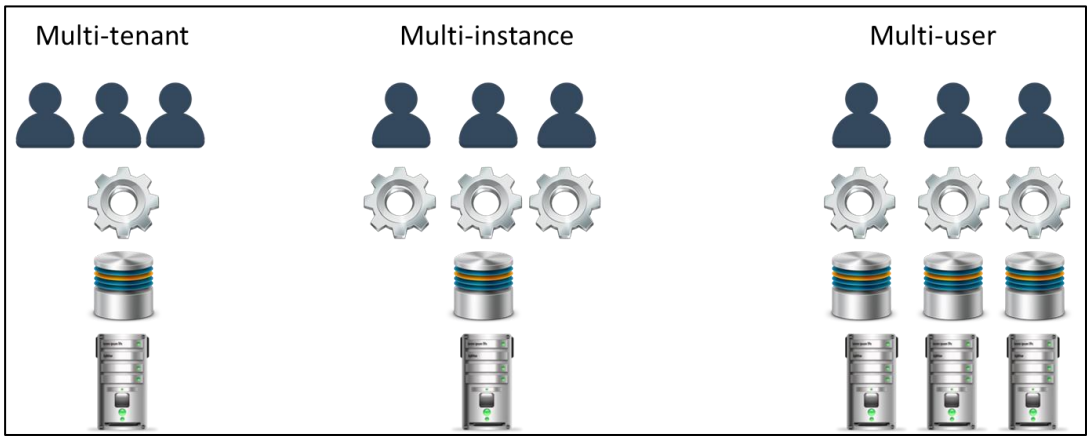
Offering an application as-a-service has several implications in terms of cost, use, architecture and as shown beforehand, the supporting processes around it.

There are several SaaS architecture approaches and definitions (IBM, 2009) (Zaidman, 2010) but they can all be wrapped up in three topologies, which are also shown in the next figure:

- Multi–user: All consumers use the same application with little configuration options. Resource sharing is inexistent.
- Multi–instance: Each consumer gets his own instance of the application by making use of virtualization techniques. Resource sharing is, at maximum, at infrastructure level.

- Multi–tenant: Each consumer is seen as a tenant and all resources are shared (application and infrastructure).

Figure 37. SaaS architecture approaches



Source: Author's own contribution

Economically speaking, the most advantageous ones for SaaS application providers are the last ones, where all resources are shared and the configuration for the tenants usually only implies the change of the interface layer. Also the costs of the infrastructure and the application are shared among the tenants. This is not the case for the other two topologies where no resources are shared or at most the infrastructure is shared. The rationalization of costs is therefore not completely exploited, generating a smaller margin for SaaS providers or less competitive prices in the market affecting the company's entry in the market.

In terms of maintenance and development costs, multitenancy applications are also more advantageous, since the update is performed once and deployed onto all tenants in the same operation. No further customized deployments or travels to deploy the new version of the application are needed, helping therefore in the cost saving processes of moving to SaaS, while at the same time, increasing the potential market share. There is a controversy of whether this architecture schema significantly eases maintenance operations (Gao, et al., 2011) or on the other hand introduces additional problems since the applications can be highly configurable (Zaidman, 2010) or due to the sharing of resources (Aulbach, 2008). However, for the end users, SaaS applications present certain advantages such as the possibility to always have the latest version of the application (Kwok, 2008).

Another issue that must be considered in the costs breakdown has to do with the infrastructure costs. In this context, infrastructure is understood not only as hardware costs but also includes licenses costs (e.g., DB licenses). The hardware costs in this context are a one to one match with the costs coming from the platform providers. These costs follow themselves an as-a-service model like pay-per-use ore flat-rate.

Additional costs come into play when migrating to the cloud. The roles and responsibilities are no longer valid and must be updated. This implies training and a shift of functions from several personnel as well as the creation of new roles that did not exist previously. This is an upfront investment that the company must make but does not influence the final pricing strategy as the costs mentioned above.

Finding the right strategy to put price to the SaaS application is a key issue to ensure the sustainability of the company due to the existence of so many variable costs. There exist several pricing models that have proven successful in certain companies such as Amazon or Salesforce. However, to find the right one and implement them remains a research challenge due to the many variables that need to be taken into consideration.

Following, a list of the most common pricing models observed in the industry is presented:

- Licenses / perpetual model, the traditional software model with upfront costs.
- Flat rate (fixed price)
- Number of total users
- Pay as you go:
    - Simultaneous users
    - Time
    - Transaction (DB queries, storage, …)
    - Feature (modules, functionality)
- Fixed monthly fee + variable fee
- Peak Load (more expensive at certain hours of the day because the infrastructure is at its peak)
- Tiered model (each feature has a different price)
- Freemium
    - Capacity-based: Customers are given a free version up to a capacity, usage, or number of users threshold.

    - Feature-based: Customers are allowed to use a free version of the product which has certain key features locked until the customer converts to a paid customer.
    - Time-based: This is a typical free trial that expires after a fixed period.
    - Use-case: This is a less common model in which customers can use the offering for free provided they fall under certain specified categories (i.e. non-commercial use, educational, non-profit, etc.).
- Feature – Limited
- Various pricing models depending on the customer

The next paragraphs focus on the explanation of some of these models.

In the **feature limited model** (Safenet, 2013), the service provided is a sort of low-cost version of the software with the aim of encouraging a rapid adoption but with limited features to promote upgrade sales. This model is mostly used for software vendors that offer a SaaS solution that was traditionally provided by on-premise ones in order to use the market value as an entry point. This model also leverages on discounts from the market value with the objective of emphasizing the benefits of SaaS towards the end customer (time to value, lower upfront costs for deployment, less commitment, etc.). This is the model that is most similar to the traditional offerings running for years in the industry but with the following differences:

- A feature-limited model is best suited to SaaS offerings that do not rely on collaboration or community interaction to drive business growth.
- A feature-limited model is better suited to offerings that have an established market value.
- This can be the best approach for those providers that are unable to shoulder the costs of delivering a free service in scale.

This model is recommended:

- To overcome entry barriers by setting a low price point for a limited set of functionalities and avoiding as many setup fees as possible.
- When time limited commitments are sought for, that is, short-term contracts lasting about a year or less.
- When no contracts are wished to be set up.

- To incentive customers to contract more expensive services, that is richer in features with longer term commitments.

Salesforce.com has applied this model and consistently done a good job with the feature-limited model in their entry level offering, with revenue growth derived from organizations that increase their user bases, as well as move up to higher-priced, more feature-rich editions.

The **pay-as-you-go** model (Safenet, 2013) is a usage-based or transaction-based model in which customers only pay for what they use, with no recurring or base fees. As stated by Safenet, this model is dynamic and allows the most flexible pricing for customers. With this model, customers take on very little up-front risk. Pricing is on a metered or per-unit basis and is generally higher than fixed or tiered plans.
The measurement units range depending on the provider. The most common ones observed are:

- Simultaneous users: number of users using simultaneously a tenant of the application
- Time: time spent consuming the services.
- Transaction (DB queries, storage, …): by transaction or use of the infrastructure, database, application
- Feature (modules, functionality): monitoring of the use of a certain application module or a specific feature.

This model is recommended when seeking a growth in the customer base. An example of this model is for instance Amazon Web Services (AWS).

The **freemium** model is a business model that offers core services or features for free and charges a premium for more sophisticated components. The main idea behind it is that instead of expensive sales and marketing efforts, a company wants to create a low barrier for interested customers to sample their offering. The key is to generate sufficient interest and combine this with a minimal barrier and a low cost for users to try the product.

The freemium model is recommended when:

- The value of the offering is derived from a collaboration
- When the technology and the functionality is not comprehended by the market

- When there is a substantial increase in value to the user if they upgrade from the free version to the paid version

One of the most critical issues in this model is related to the decision of what functionality is offered as free and what functionality must be paid for. The value offerings of both must be clearly distinguished and the user must appreciate that the value of the paid version increases with respect to the free one. If this is not properly done, the risk of not acquiring a large customer base is very high.

This model is used by LinkedIn. LinkedIn, a social networking site for business professionals, is a good example of a successful freemium model. LinkedIn provides a free framework upon which users can maintain their professional network of present and prior work associates, industry colleagues, and contacts. LinkedIn generates revenue in three ways—premium subscriptions, corporate solutions (such as recruiting services), and advertising.

Tiered pricing is the most common model for enterprise SaaS, and has a long history as an effective means of price discrimination dating back to enterprise software in the 1980s. In this model, the pricing is tied to some driver of value and usage that can be for instance modules, data volumes, servers, and so on with the main purpose of encouraging customers to move onto the next level. The telecom industry has been applying this model for many years with their minute bundles. The philosophy behind this pricing is the search for a long term relationship with the customer. This implies that in this model the sales cycles are longer in order to prove its value proposition.

In the tiered model the market segmentation becomes a key issue and thus KPI's are more important than ever. The perception of growth on the part of customers is an important part of psychological pricing that compares favorably to the perception of "being charged more for a service level that I barely need." The selection of the value metric is an important part of this growth perception. For the company, there are advantages to a tiered model that include predictable recurring revenues, lower average cost of acquisition relative to lifetime value as more revenues come through renewals and upsells, and more stable average selling price as less discounts are needed to keep existing customers.

In this layered model, each tier sets up different levels of service. These level of services are usually divided into the hours of included service (e.g. when a customer request will

be processed and resolved), or the value of included services (e.g. on-site support included, response time in case of an incidence, etc.). The lower the tier is (e.g. Silver), the higher the revenue will be from additional services, as they are not included in the lower level and can thus be billed to the customer if requested by them. The higher the tier is, the bigger the number of services is included within the contract.

This model is recommended when the customer relationships management is thoroughly involved from the definition of the service offering to the handling of billing and customer concerns.

An example of this is the Technical Support services for the Google Cloud Platform.

5.2 SaaS Pricing Strategies decomposed

To assess the profitability of a SaaS business models several metrics need to be used. The most important ones are CAC and LTV. The cost to acquire a customer (CAC) measures how much it costs to convince a customer to buy the services and is commonly defined, in its most simple way, in ecommerce, as follows (Blog Ometria, 2014) (Iconsive, 2014).

$$CAC = \frac{Marketing\ and\ Sales\ Campaign\ Costs\ for\ customer\ acquisition}{New\ Customers}$$

The numerator involves all expenses from the sales and marketing teams, mostly costs of the different campaigns that need to run in order to engage new customers. The denominator measures the number of new customers buying the product. CAC is usually calculated on a monthly or on an annual basis.

LTV or customer lifetime value measures the financial value of each customer in the period of time in which they are in the company. There are several formulas to calculate the LTV but in the most common one used is presented as follows (Farris, Bendle, Pfeifer, & Reibstein, 2010):

$$Customer\ Lifetime\ Value\ (LTV) = Margin * (\frac{Retention\ Rate}{1 + Discount\ Rate - Retention\ Rate})$$

However, in the world of SaaS, the LTV is often calculated as shown next (Skok, 2014)

$$LTV = \frac{ARPA)}{(Customer\ Churn\ Rate)}$$

Where

- ARPA is the average monthly recurring revenue per customer lifetime value.
- Customer churn rate is measured as the lost clients from the total number of customers[1]

Since in this PhD thesis the measuring unit is years, both ARPA and customer churn rate must be measured in terms of years.

Several ratios are deemed very important to assess the viability of a SaaS solution. One of these is a critical ratio mainly used in the ecommerce application world but potentially extendable to the SaaS industry, which is the LTV:CAC ratio. This ratio is calculated as:

$$LTV{:}\ CAC\ ratio = \frac{LTV}{CAC}$$

In (Blog Ometria, 2014) the following values for this ratio are presented, being their explanations as follows:

- Less than 1:1: the SaaS company is in a very bad position and it will soon disappear.
- 1:1: the SaaS company is losing money
- 3:1: the SaaS company has a solid business model and an offering perceived by the customer as value-added. This is the optimal value. Higher values may imply that the company is possibly not investing enough and it has potential to grow faster.

The second important ratio is the Months to recover the CAC (Iconsive, 2014) and it can be defined as the number of months a customer needs to continue paying for the SaaS to generate enough revenue to cover their CAC. This ratio is calculated as shown next:

$$Months\ to\ recover\ CAC = \frac{CAC}{MRR * Gross\ Margin\ \%}$$

A SaaS business can only function if it has subscriptions. Subscriptions in SaaS are mostly measured in an annualized or a monthly manner, even when the contract

duration is longer than one year. In the case of monthly subscriptions, the customer is obliged to pay completely the annual contract. Since in SaaS, the metric for subscriptions can be a mix of different durations (e.g. monthly, annual …), to understand the business, other issues must be considered. These issues are related to what has happened with new customers and what has happened with the current customer base e.g. renewals, lost customers, upgrades,). Subscriptions are often therefore calculated as follows:

$$Monthly\ Subscriptions = (Monthly\ Recurring\ Revenue) * (Total\ Number\ of\ customers)$$

Annual subscriptions will be therefore calculated as follows:

$$Annual\ Subscription = (Monthly\ Recurring\ Revenue * 12) * (Total\ number\ of\ customers\ annualized)$$

The downside of Subscriptions is the Churn rate, which is the percentage of the monthly revenue lost from the existing customers. This value is measured each month.

$$Churn\ Rate = \frac{(Sum\ of Monthly\ Revenue\ from\ lost\ customers\ or\ downgrades - Sum\ of\ Monthly\ Revenues\ via\ upgrades)}{Total\ Monthly\ Revenue}$$

For estimating the price and revenue of a SaaS application, charging the development costs in the price for each tenant is not convenient, since the same application is used by multiple tenants. In the SaaS industry, the basic issues for defining the cost model are the following ones:

- IaaS Instance price: this can be a fixed price, for instance when the application is deployed on a private cloud and thus estimated by the SaaS provider following a pricing schema as the public cloud providers, or it can be a variable price if the cloud provider where the application is deployed is a public one. This value will come directly from the provider, and it is mostly given as use of the CPU, GB of storage, memory or size of the Virtual Machine (VM), being this the most common one. Estimating the individual IaaS instance use of each application tenant can be as complex as wished.

- Development costs: related to the set-up and launching of a working version of the SaaS offering.
- Operational costs: these are related to the added-value provided to the customer. This added-value includes the regular updates of the SaaS offering (e.g. to correct errors, to provide new features, to improve existing features), marketing and sales costs channels, the customer relationship management and helpdesk support, and also the novelty of the features / modules with respect to the ones offered by the competitors, etc.
- Human capital: costs needed to keep the people as part of the staff.
- Software licensing fees

The deployment of a SaaS application on a public cloud infrastructure imposes additional challenges to estimate the costs that do not occur when deploying it in a private infrastructure, owned by the SaaS provider.

In private cloud infrastructures, the maintenance of the IaaS, the installation of patches, launching of additional VM's (when auto-scaling mechanisms are not used), monitoring of the use of the infrastructure, monitoring of performance aspects, are costs that can be considered fixed costs for the SaaS provider and they are totally tied up to the operation of the SaaS offering. The better the infrastructure is maintained, the higher the impact will be in performance (e.g. response time, availability, and so on) and the higher the added value will be perceived by the customer, especially when analyzing the satisfaction on non-functional aspects of the application.

However, in public cloud infrastructures, estimating the amount that the IaaS provider will charge the SaaS provider is very difficult. In the case an application is already deployed on a public cloud provider, the forecasting of an annual price can be done through the extrapolation of historical data. However, this is not recommended for long-term prediction. As a recommendation, for any given time frame, there should be at least an equal amount of historical data. In the case of seasonal influences (e.g. the last day of the month in payroll applications, the last day to pay the taxes, etc.), it is recommended to have at least two seasonal cycles before working on the extrapolation. In the case of an application that has not been yet deployed on a cloud infrastructure, the approach presented in the ARTIST project can be relevant to estimate initially which instance type should be selected in order to deploy the application and also the price that the public cloud provider charges for such instance. The ARTIST solution (ARTIST Consortium, 2014) presents a two-phase approach. In the first phase, the profiling

phase, both the application on a virtual machine and the ARTIST profiling tool are hosted in the same physical environment and it needs be ensured that the profiling tool does not interfere with monitoring results (ARTIST Consortium, 2014). In the second phase, the classification phase, the ARTIST classification tool classifies an arbitrary application component to a predefined and known benchmark application category and then matches the application component with a cloud service offering (VM instance type). The matching occurs by selecting the VM instance type which provides the best performance score for the detected benchmark profile in combination with the respective service offering cost. The goal of this tool is to suggest the Application Developer the most fitting solution based on specific user interests (such as performance and cost) during the development of an application for the Cloud (ARTIST Consortium, 2014).

The revenues from a SaaS offering also differ from traditional software applications. In traditional software applications, the license price is fixed, and then services are always charged in the case consultancy services are needed for e.g. installation of the tool, customization, or updating. In SaaS, none of these additional charges are relevant since customization is marginal and reduced to the presentation layer, there is no installation costs, and updates come automatically, without the user noticing them. SaaS providers offer mostly two distinct services: commodity SaaS applications, such as email or antivirus, and value added services. Those SaaS providers that offer commodity services such as email or antivirus should focus their strategy on an economics-based model, that is, search for a cheaper price than the competition. However, SaaS providers that offer value-added services should focus their strategy on defining the value the customer is willing to pay for. Value-based SaaS offerings are therefore priced not after cost, but after what the market can bear. In thi case, it is vital to align the features with customer goals and ensure the maximum benefit. Value based services are often considered as “premium” services but they are obliged to deliver a very high value to the customer. Usually, these high value services are associated with critical business functions or applications, meaning that the SaaS provider is providing an offering that is core to the customer’s business and critical for the customer’s business operation. In any case, SaaS offering being a commodity or a value-based service, it is recommended that the price established for the SaaS offering reaches the vast majority of the customers. This needs to be this way so as to lower the barrier entry to buying the SaaS application.

In order to estimate the price of a SaaS, the recommendation is to set up a payback period, and based on that and the estimated operational costs and the pricing model

selected, choose carefully the price quantity. The estimation of a price quantity, the value metric, is out of the scope of this thesis as there are already some works on the matter.

An empirical observation of the most used SaaS pricing model leads the author of this thesis to conclude that the most commonly used pricing strategies in the SaaS industry range between the tiered (feature limited) model, pay as you go, and the freemium model. In the next sections, built upon the approach of SaaSMetrics (Skok, 2014) these three pricing strategies are being decomposed and modelled.

The main hypothesis for the decomposition of these pricing strategies is that the subscriptions, that is, the contracts, are annual, as this simplifies greatly the calculations. A common practice in the SaaS world by SaaS companies is to offer on their website or in their marketing strategies a monthly price, but contracts need to be purchased for a complete year. This PhD thesis presents an approach to forecast the impact of selecting one pricing model versus another one to aid decision-makers in the selection of the most profitable pricing strategy, and that is the main reasoning of doing it on an annual basis. However, when working on the follow-up of the SaaS offering, this is recommended to be performed on a month-to-month basis so as to be able to pivot the pricing strategy as soon as the churn rate increases and the CAC:LTV ratio decreases, in order to stay sustainable.

All three pricing strategies presented in this PhD thesis are modelled following the same structure, which is shown in the next table:

Table 8. Structure of the decomposition of the pricing strategies

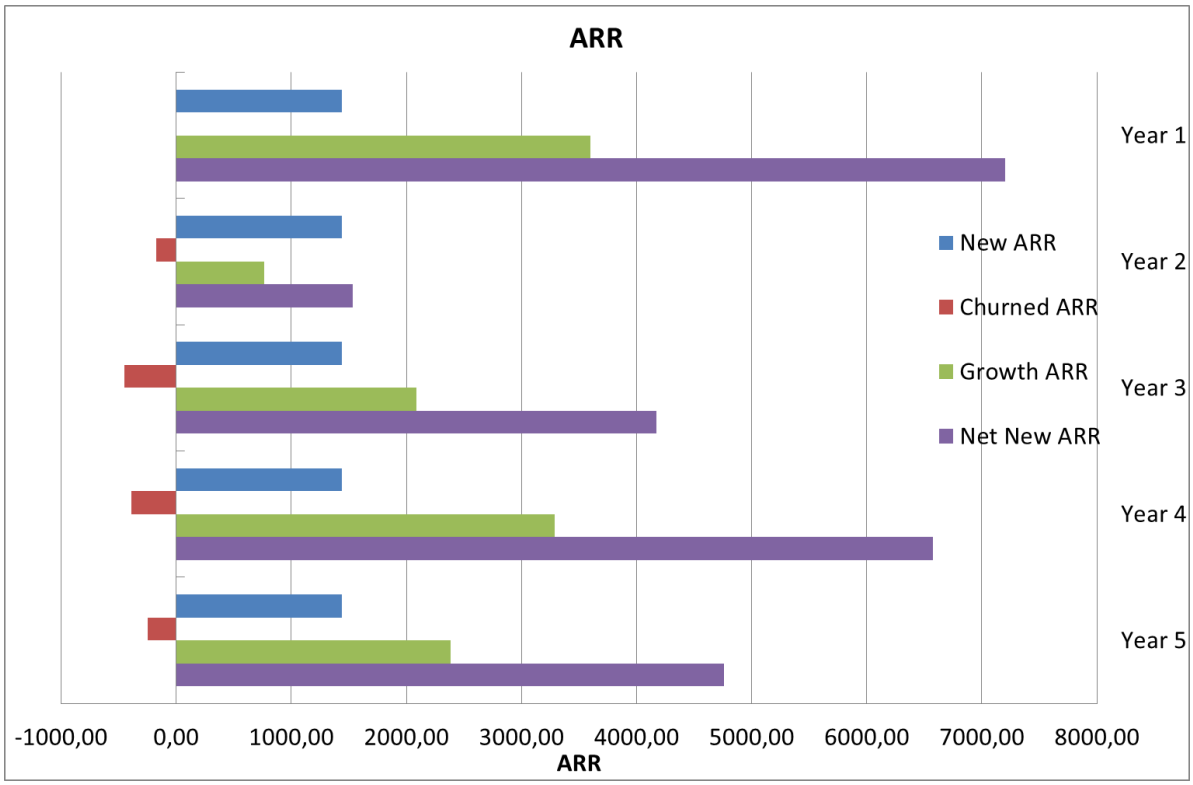
Item	Explanation
Subscription	This calculates the total economic value of the subscriptions (contracts). This is calculated by new customers and also by the total number of customers. In addition to that, the average monthly recurring revenue per customer (ARPA) is calculated for new customers and also across the customer base. In the case of the tiered model and the freemium model this is calculated for each of the tiers.
Annualized	Here the revenues per new customers, churned customers and net

Item	Explanation
Run Rate (ARR)	new customers are calculated on a yearly basis.
Churn Rate of a customer base	Here the following aspects are considered: the total number of customers, which is the customers of the previous year added to tne net new customers acquired for that year. The net new customers are calculated as the new customers minus the customers that cancelled their subscription (customer churn)
% Customer Churn Rate of a customer base	This area calculates the percentage of customers that cancelled their contracts compared to the total number of customers in a certain period of time.
New Customers	These metrics are those related to how much it costs to acquire new customers and how much time they remain as customers.
Profit and Loss	This is an overview of how this pricing model affects the profit and loss accounts of a company.

Source: Author's own contribution

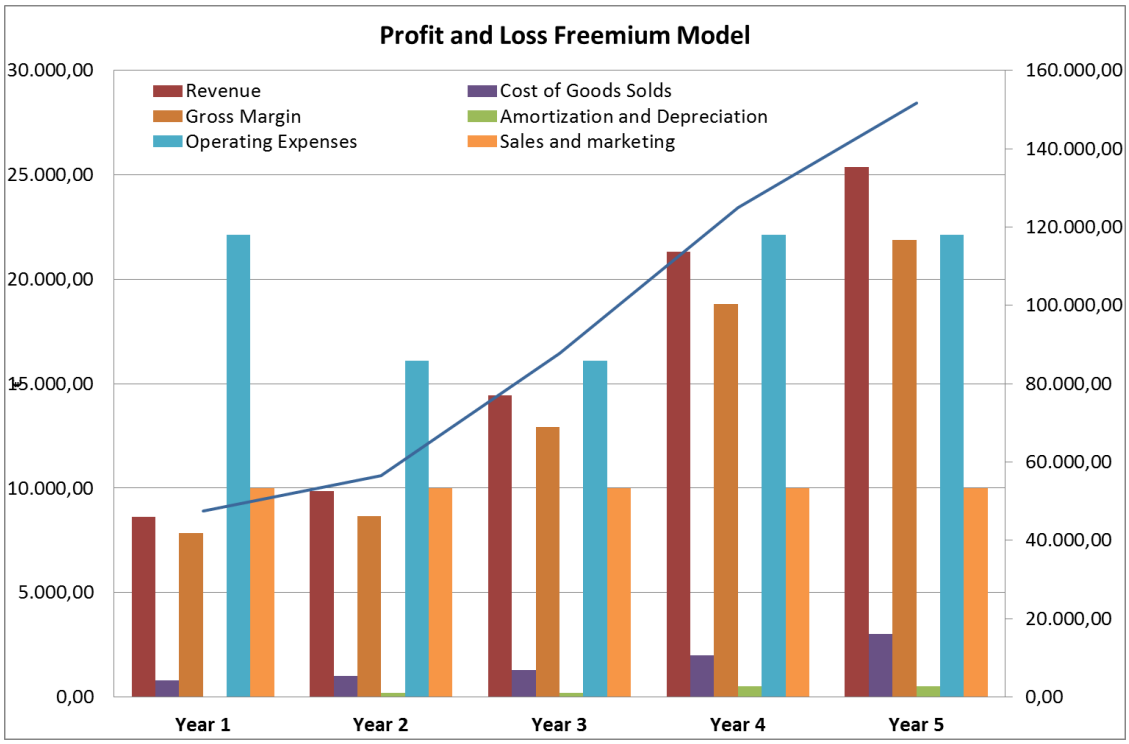
For an easier analysis, a graphical representation of the ARR values and the profit and loss are provided. An example of both is depicted next.

Figure 38. ARR graphical representation



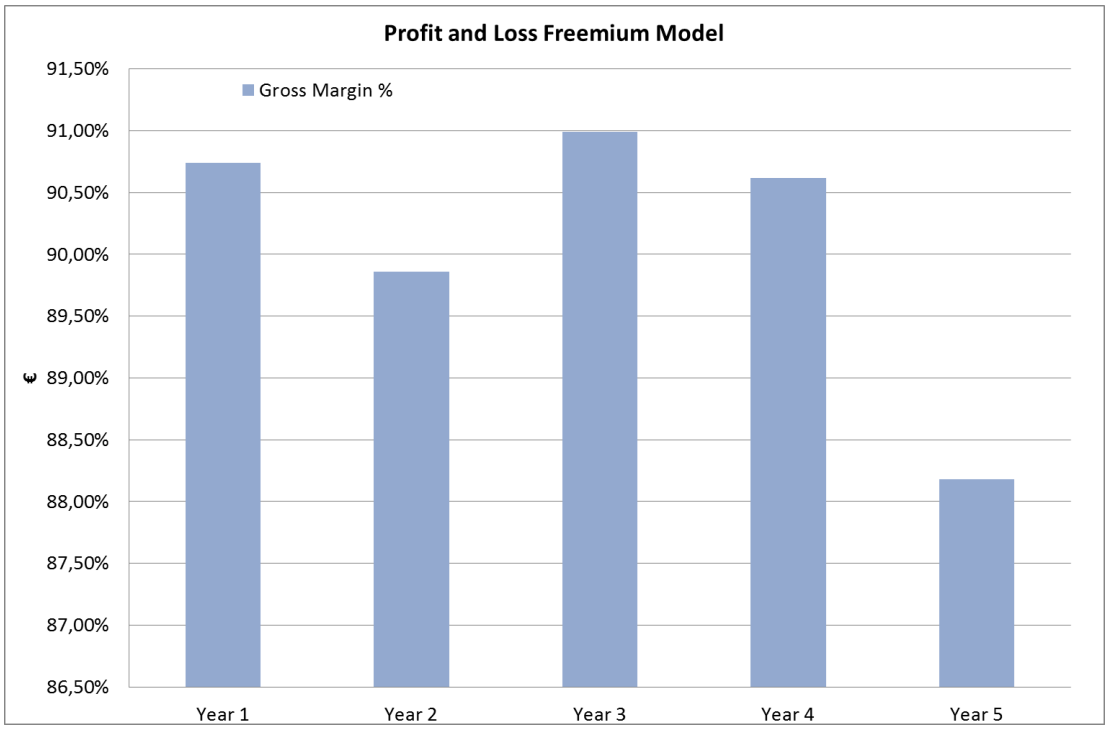
Source: author's own contribution adopted from (Skok, 2014)

Figure 39. Profit and loss graphical representation



Source: author's own contribution adopted from (Skok, 2014)

Figure 40. Profit and loss Gross margin evolution



Source: author's own contribution adopted from (Skok, 2014)

A summary tab containing all three graphs to facilitate the decision is also provided.

Finally, the profit and loss account is shown. The user has to insert relevant data for his company (e.g. cost of goods, operational expenses, amortizations, etc.) and the provided excel sheet will calculate relevant financial ratios for the analysis of the situation of the company.

Table 9. Profit and Loss concept breakdown

P&L item	Explanation
Sales	Total value of the sales
Revenue	Total value of he revenues. This value is equal to the Ending ARR
Cost of Goods Sold	COGS are all the costs associated with maintaining a customer during a particular period. In SaaS to calculate COGS aspects such as hosting fees, licenses, 3rd party fees (CDN), customer support personnel costs, costs of subscriptions, training personnel costs

P&L item	Explanation
	are taken into account (Valchev, K., 2010) (Pipetop, 2015). A good SaaS business, COGS is of about 10-20% of the revenue.
Gross Margin	This value is calculated as: $revenue - COGS - amortization\ \&\ depreciation$
Gross Margin %	This value is calculated as: $\frac{(Revenue - COGS)}{Revenue}$. A good SaaS company usually has a Gross Margin between 80-90% (Valchev, K., 2010)
Amortization and depreciation	Here software licenses and hardware are included.
Operating expenses	Costs incurred by running the business
EBITDA	Earnings before interest, taxes, depreciation and amortization, calculated as: $EBITDA = Gross\ Margin - Expenses\ (excluding\ taxes, interest, depreciation\ amortization)$
EBIT	$EBIT = EBITDA - Amortization$
Ordinary benefits	This is calculated as: $EBIT + Financial\ income - Financial\ expense$
Earnings before income taxes (EBT)	$EBT = Ordinary\ benefits + extraordinary\ income - extraordinary\ expense$
Net income	$Net\ income = EBT - Income\ Tax$

Source: author's own contribution

In addition to that, several financial ratios are calculated. These are:

- ROE: Net income / Equity
- ROA = Operating Income / Total assets
- Asset Turnover = Sales / Total Assets
- Current asset turnover = Sales / Current assets
- Customer rotation = customers / (sales*365)
- Cashflow = EBIT + amortizations - changings in working capital

Furthermore, each of the pricing models has its own characteristics, which are explained in the corresponding sections. The final structure used for the calculations of the different pricing models is mostly based on the approach by (Skok, 2014) and can be found on Annex 4.

3.2.1 Pay As You Go Model

For the purpose of this thesis, only the transactional option will be modelled. The Pay-per-resource-use is the case in which the customer pays in relation to its use of the infrastructure. The IaaS Instance Use comes from the provider but the application does not monitor anything herself. In this pricing strategy, the cashflow is as follows: the IaaS provider charges the SaaS provider for the usage of their infrastructure. The SaaS provider charges, in return, the SaaS user for the application but also for the usage of the infrastructure where the application is deployed.

For this PhD thesis, the following aspects are taken into consideration for determining the price on the pay-as-you go model:

- Average Number of tenants per year: this value matches the total number of customers that the SaaS offering has. As a reminder, a tenant counts as a customer in the SaaS world, while a tenant might have multiple users. E.g. Company A, contracts a payroll SaaS offering. The company estimates that around five employees will use the software. For the SaaS provider in the pay-as-you-go model, company A counts as a tenant but the number of users is transparent for her as only the usage of the payroll system will be billed to Company A.
- Average Instance Cost per tenant (avg price per month): this cost can come from extrapolation of historical costs or through approaches such as the one presented beforehand and developer in ARTIST (ARTIST Consortium, 2014).

- Average Instance Cost per tenant (avg price per year): this is: Average Instance Cost per tenant * 12
- Total Infrastructure Costs, that is, how much all tenants cost in a year. Average Instance Cost per tenant * Average Number of tenants

With that in mind, a possible approximation of a price can be:

$$Price = (1 + Margin) * Total\ Infrastructure\ Costs$$

The details of the modeling of the pay-as-you-go pricing strategy can be found on Annex 4.1.

3.2.2 Freemium Model

For this exercise, we are assuming that the core components are offered as free and modules that provide added-value to the application have a price, hence, the customers will have to pay as they are considered premium. This added – value may be features that provide higher value for the customer (e.g. they are critical for the customer's business), or they allow to manage more data, more concurrent users, more storage, more CPU cycles, etc.

Price strategy:

- Low value components / core components = free
- Added-value components = sum of prices of the contracted modules = $\sum_{m=1}^{n} p$. These components should generate revenue enough for the company to be profitable.

In the case of this pricing strategy, it is important to note how many customers upgraded (from free to premium) and how many customers downgraded (from premium to gree), in addition to knowing about the new ones and the churn rate. This will provide the SaaS provider with an insight of how valuable is her offering in the eyes of the customers. If many customers are downgrading and the proportion of upgrades do not match the upgrade, then it is time to study where the failure is (e.g. response time is low because the number of free customers increased too much but the infrastructure investments did not grow in the same proportion, a competitor is offering a similar application with better prices for its value, etc.). Furthermore, all other metrics (ARR, Customer Churn Rate, % Customer Churn Rate) have to be also calculated both for the Free and the Premium

offering, in order to be able to analyze the behavior of the customer base in each offering.

The details of the modeling of the freemium pricing strategy can be found on Annex 4.1.

3.2.3 Tiered Model

The tiered and feature based model rely on the same principles. To identify the tiers, the steps that could be taken include the following:

1. Analyze the frequency of use and the value delivered with each feature to determine which features should go in which editions. It is important to consider offering some options as add-ons, with low appeal but high value. The features that are most commonly used and with the less value (but still with value) should be placed in the lowest tier.
2. Evaluate the functional differences between tiers in terms of value (e.g. integration with existing business critical applications), features provided (e.g. generation of reports or statistics) and price relative to each other.
3. Find a balance for the entry-level price (the basic edition) and the prices of the higher value editions.
4. Price the additional services that are offered in the higher tiers but not in the low tiers, as these will be billed to the customers of the lower tiers.

As in the freemium model, here it is also important to know about the upgrades and the downgrades. In the tiered model, this can get more complicated as there are often at least three tiers (and in most cases, there are more than three tiers). The SaaS provider must therefore analyze how many subscriptions can be forecasted in each of the tiers and how the revenues will be accounted for. In this PhD three tiers have been modelled following the common practice of silver – gold – platinum, or basic – limited – enterprise.

The details of the modeling of the tiered pricing strategy can be found on Annex 4.3

CHAPTER IV: EMPIRICAL VALIDATION

1. Introduction

The theoretical framework presented beforehand in Chapter Ii: Maturity Assessment Of Software Applications At Technical And Business Level and Chapter Iii: Current And Future Enterprise Context Impact Analysis has been validated in a total of eleven companies, eight companies in Mexico and three companies in Spain, in the context of two research projects, PROCEI, funded by the European Commission and the Mexican PROCEI and mCloud ("Migración avanzada hacia la cloud"), funded by the Spanish Ministry of Economics (MINECO). However, this thesis will report only the experience of the validation cases carried out in the three companies in Spain. The main reason behind this selection is related to the fact that the relationship with them was a closer one, with monthly interactions and frequent face-to-face meetings. The business contexts of all three proof-of-concepts are, therefore better understood and can be thus better justified and reported in this PhD thesis.

Proof-of-concept A comes from a private university, who developed a software to manage remote labs that allow schools and other univerisities consume remote labs provided by other entities as well as to create their own labs and share their access. A remote lab is a software and hardware system that allows students to access to physical labs deployed on a university in such a way that they can use them as if they were in it, enabling them to do practical exercises or test a certain device. Even though the system is always available, it has very high peaks in certain periods of time (e.g. when the students must hand in the practical exercises). The initial idea is to deploy the software on a private cloud based on OpenStack and following a freemium model: free when a maximum of 100 connections happens in a month and premium whenever the number of connections is bigger than 100 in a month.

Proof-of-concept B comes from a large multinational. The main income in this company is obtained from the software factory business and therefore, the business of selling productized applications is marginal. For this proof-of-concept an experimental application, resulting from an R&D project, has been used. This experimental application follows the concept of Personal Rapid Transport, with the main goal of building a travelers' transportation system with no driver in well-known areas. The system is composed of two subsystems: 1) the vehicle with no driver, and 2) the operations control center, which manages the customers' travel requests and organizes the routes that the vehicles need to follow. The latter subsystem is the one that was aimed for a modernization. The current business model includes its exploitation as an integrated

system and also as two separate subsystems. The exploitation strategy is not aimed to change after the modernization, although some considerations will be taken into account.

Proof-of-concept C comes from a large software engineering company. The major income of this enterprise, as in Proof-of-concept B, comes from its software factory, more concretely from developing turn-key software for Public Administrations, mostly web content management systems and eAdministration services. One of the software applications that they developed for a Public Administration was a Business Process Modeler for Educational institutions that later on evolved in a Business Process Modeler (BPM) for any domain and was decided, by the General Management and the R&D department, to sell it as a product. Target customer profile is SMEs that are beginning to work in management by processes and needed an easy-to-use tool to start with. This tool followed a 3-tier architecture and needed to be personalized and installed in a dedicated server at the customer's site for every customer. The business model was a license-based one, plus consultancy and maintenance. Seeing that the product was being accepted by the market, even though the incomes of this BPM are still marginal compared to the main business of the company, the R&D department decided to modernize it to be able to sell it as a SaaS in a first stage on Google App Engine and in a second stage on a private cloud deployed at the company's premsises, built upon OpenStack, and set up a new business model, a tiered model being the tiers a range of number of users. The pricing strategy they defined is: 10€ 1 to 3 users; 15€, 4-10 users; 20€, 11-20 users and the rest by volume.

This chapter is structured as follows. First, the validation of the MAT++ in two proof-of-concepts (A and B) is presented. Secondly, the CBA validation in all three companies is shown. Then, the validity of the pricing strategies simulation as well as the methodology for defining a new business model are demonstrated through the proof – of – conpcet of company C.

2. MAT++ Validation

As stated in the introduction of this thesis, concretely on Chapter I, Section

3. Methodology and approach of this research, four iterations of the MAT++ have been carried out and validated, even though here it is only reported the results of the last validation.

MAT++ is an online application that can be accessed through a web browser. For companies to validate it, the URL was provided. Following the instructions provided in the online application, the companies filled in the different questionnaires and the results that will be shown next, were obtained. Taking into consideration the broad coverage of the questionnaires, it was requested to companies that on one hand, business people answered the business related concerns while technical people (e.g. software architects) responded the technical concerns.

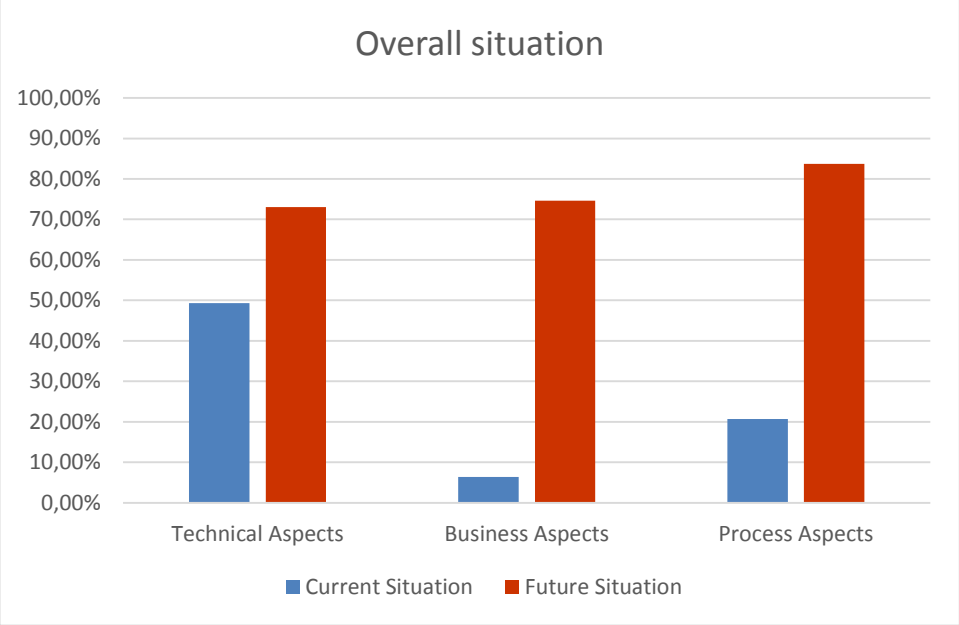
The MAT++ has been validated by Companies A and B.

2.1 Proof –of – concept A

Once all the questions from the questionnaires are answered, the following figures and tables show the results for this proof-of-concept A. The figures that can be seen next are taken from the pdf report generated for the final user.

Concretely, four graphs will be depicted. These graphs present the general results as well as the results by dimension (technical, business and organizational processes). The tables will break down these results and will present them in a more detailed way.

Figure 41. Overall results of the maturity analysis for Proo-of-concept A

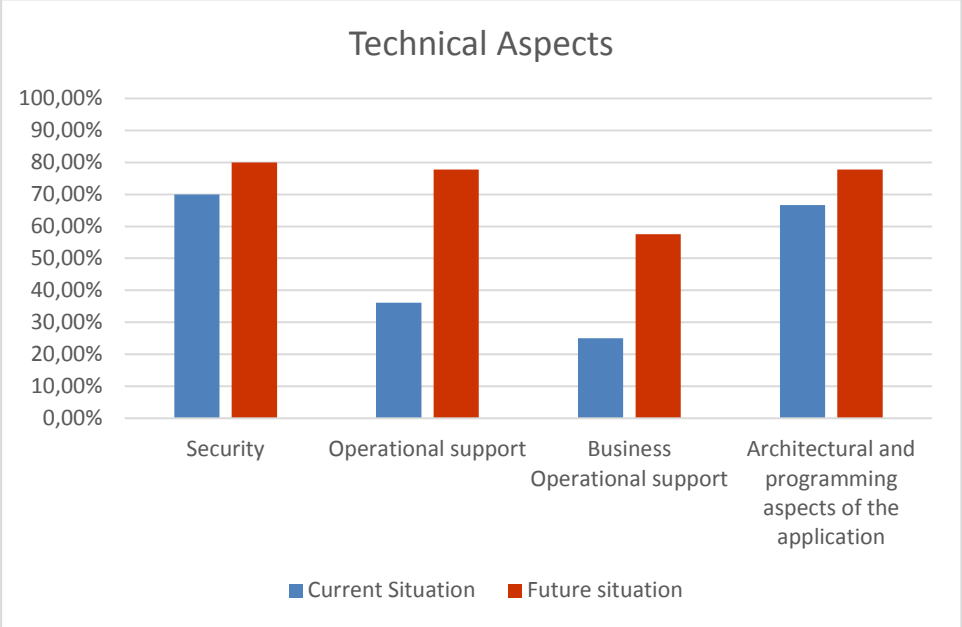


Source: Author's own contribution

As it can be seen from the reported answers, the advance of the application in all three areas is expected to be substantial once the application is migrated.

The following figures and tables detail these results in all three dimensions: technical, business and organizational.

Figure 42. Proof-of-concept's A results for the Technical dimension



Source: Author's own contribution

More detail of the attained results is provided in the next table:

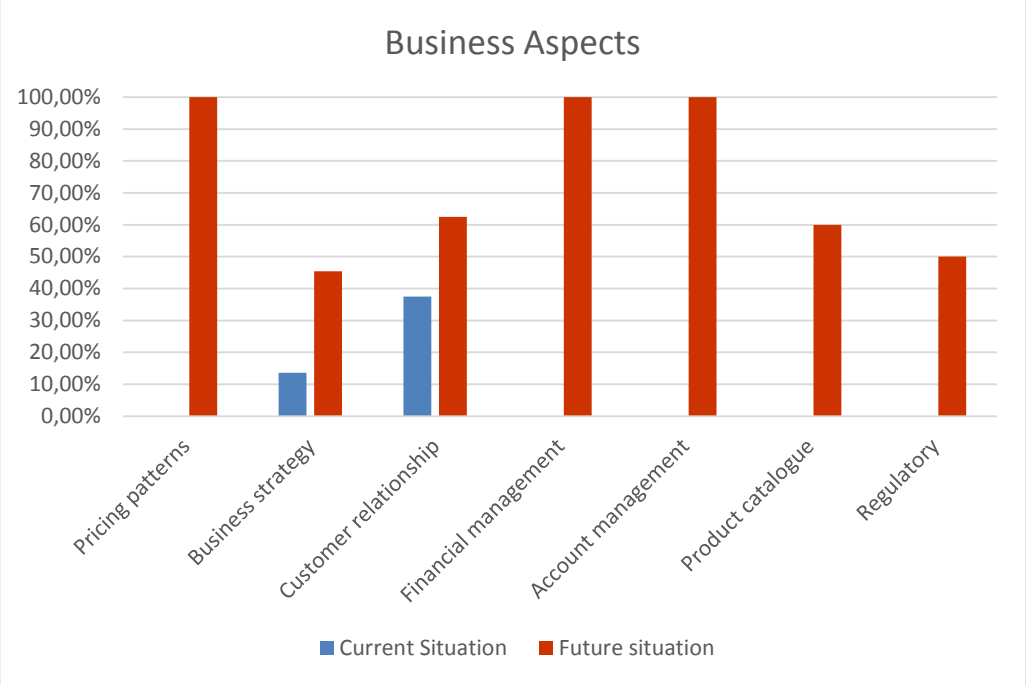
Table 10. Proof-of-concept's A detailed results for the Technical Dimension

Area	Subarea	Current Situation	Future situation
Security	Authentication & Identity Management	75.00%	75.00%
	Authorization & Service Policy Management	66.67%	100%
	Data protection	33.33%	33.33%
Operational support	Monitoring and reporting	100%	100%
	Service policy management	16.67%	100%
	Service Level management auditing	100%	50.00%
	Incident & problem management	0.00%	0.00%
Business Operational support	Account management	0.00%	0.00%
	Subscription Management	0.00%	100%
	Billing	62.50%	75.00%
	Accounts: Provider control	0.00%	0.00%
Architectural and programming aspects of the application	Architecture	40.00%	70.00%
	Multi tenancy level & elasticity	75.00%	75.00%

Source: Author's own contribution

Next, the results attained for the business dimension are shown.

Figure 43. Proof-of-concept's A results for the Business dimension



Source: Author's own contribution

More detail is provided in the next table:

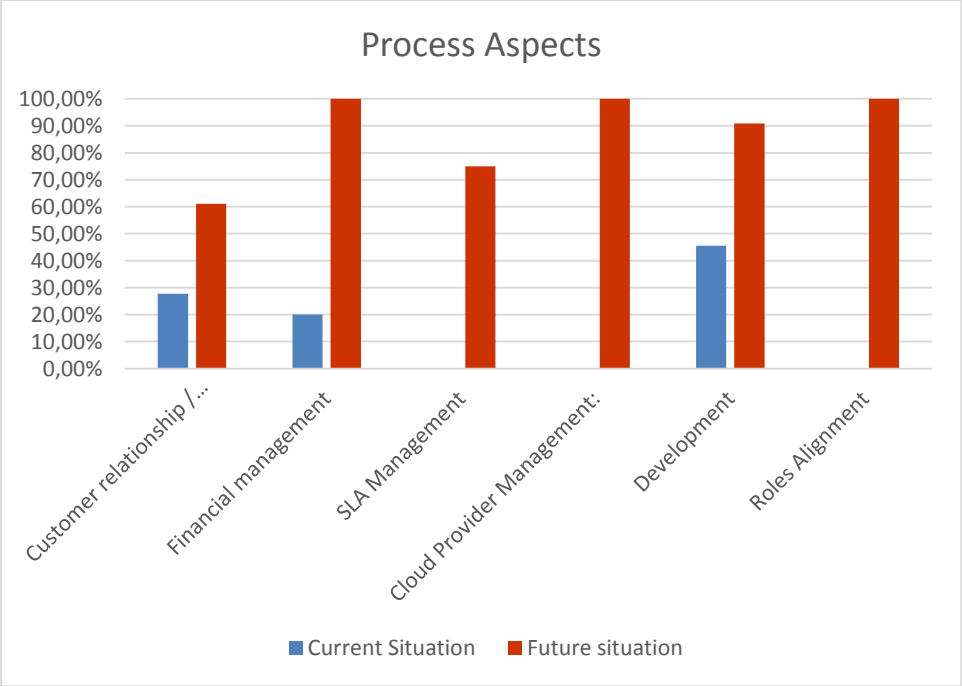
Table 11. Proof-of-concept's A detailed results for the Business Dimension

Area	Subarea	Current Situation	Future situation
Pricing patterns	Pricing patterns	0.00%	100%
Business strategy	Creation of the business plan for the new service offerings	25.00%	37.50%
	Management of the business plan	33.33%	33.33%
Customer relationship	Customer relationship	0.00%	37.50%
Financial management	Provider accountability	0.00%	0.00%
	Own accountability	0.00%	0.00%
Account management	Account management	0.00%	0.00%
Product catalogue	Product catalogue	0.00%	100%
Regulatory	Regulatory aspects	0.00%	60.00%

Source: Author's own contribution

Finally, the results for the process dimension are provided next:

Figure 44. Proof-of-concept's A results for the Process dimension



Source: Author's own contribution

More detail is provided in the next table:

Table 12. Proof-of-concept's A detailed results for the Process Dimension

Area	Subarea	Current Situation	Future situation
Customer relationship / problem resolution	Customer interaction	56.25%	87.50%
	Incidence management and resolution	20.00%	66.00%
Financial management	Metering and rating the use of the services	50.00%	100%
	Billing	0.00%	100%
SLA Management	SLA definition	0.00%	80.00%
	Auditing & reporting	0.00%	50.00%
Cloud Provider Management:	Requirements and agreements	0.00%	0.00%
	Auditing & reporting	0.00%	0.00%
Development	Development process	80.00%	80.00%
	Update & maintenance process	83.33%	100%
Roles Alignment	Definition and adaptation of new roles	100%	100%
	Communication and training	62.50%	87.50%

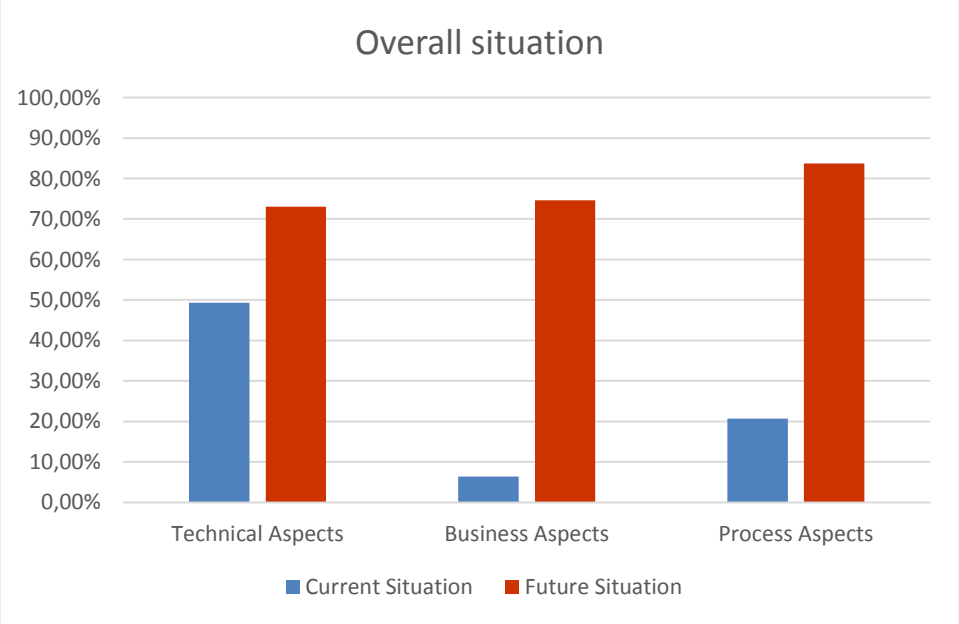
Source: Author's own contribution

2.2 Proof –of – concept B

The same approach was followed by Company B. The URL was provided to both technical and business responsibles of the application and they proceeded to answer the questions. Once answered all the questions from the questionnaires, the following figures and tables show the results for this proof-of-concept B. The figures that can be seen next are taken from the pdf report generated for the final user.

Concretely, four graphs will be depicted. These graphs present the general results as well as the results by dimension (technical, business and organizational processes). The tables will break down these results and will present them in a more detailed way.

Figure 45. Overall results of the maturity analysis for proof-of-concept B

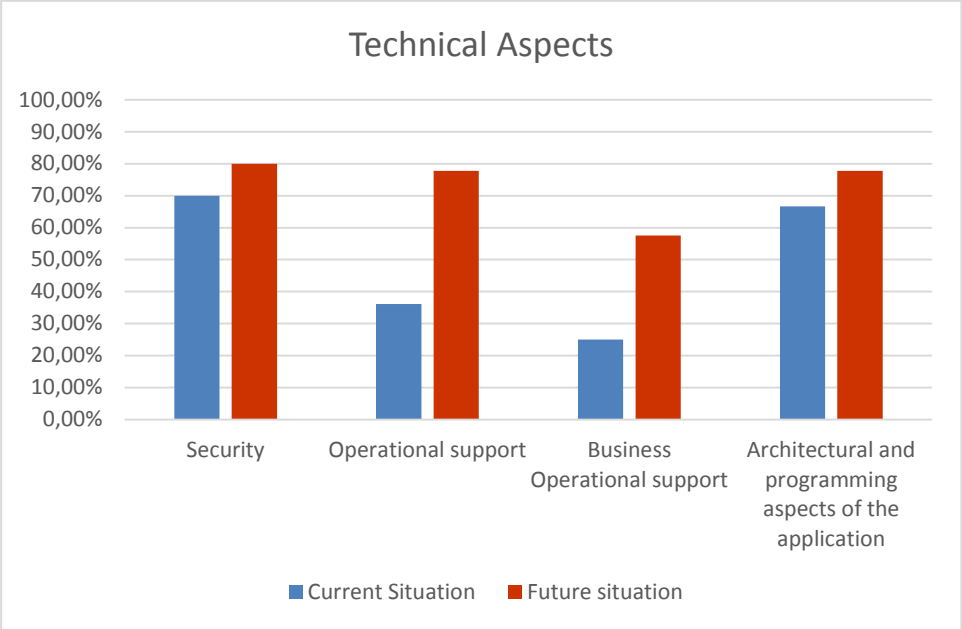


Source: Author's own contribution

As it can be seen from the reported answers, the advance of the application in all three areas is expected to be substantial once the application is migrated.

The following figures and tables detail these results in all three dimensions: technical, business and organizational.

Figure 46. Proof-of concept's B results for the Technical dimension



Source: Author's own contribution

More detail is provided in the next table:

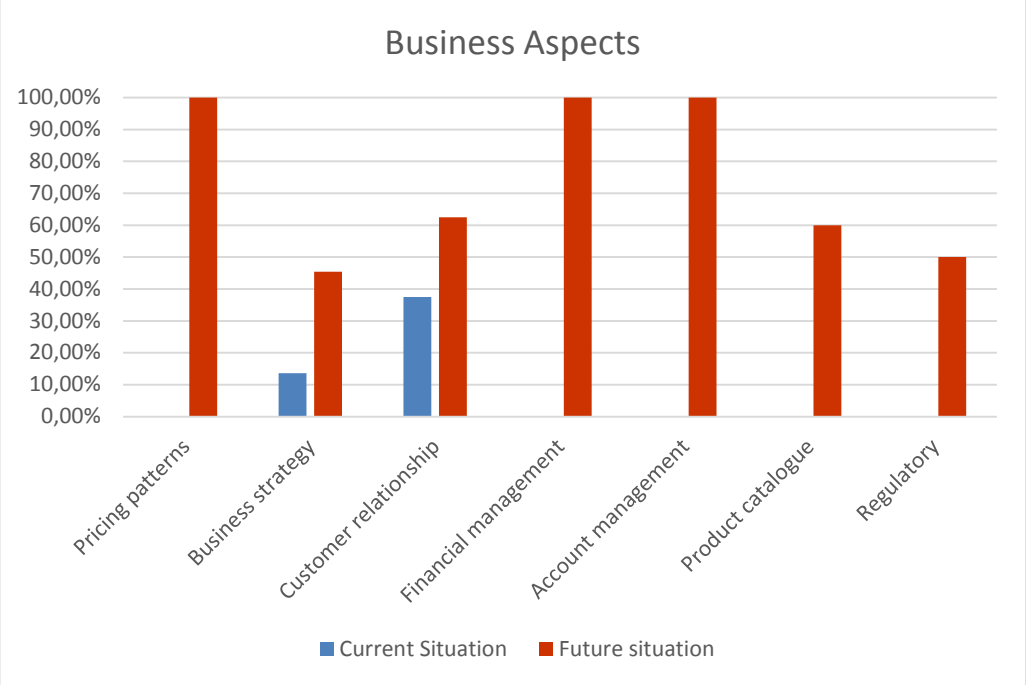
Table 13. Proof-of-concept's B detailed results for the Technical Dimension

Area	Subarea	Current Situation	Future situation
Security	Authentication & Identity Management	50.00%	75.00%
	Authorization & Service Policy Management	66.67%	66.67%
	Data protection	100%	100%
Operational support	Monitoring and reporting	33.33%	100%
	Service policy management	75.00%	75.00%
	Service Level management auditing	0.00%	50.00%
	Incident & problem management	0.00%	62.50%
Business Operational support	Account management	100	50.00
	Subscription Management	0.00%	100%
	Billing	0.00%	75.00%
	Accounts: Provider control	0.00%	0.00%
Architectural and programming aspects of the application	Architecture	60.00%	80.00%
	Multi tenancy level & elasticity	75.00%	75.00%

Source: Author's own contribution

Next, the results attained for the business dimension are shown:

Figure 47. Proof-of concept's B results for the Business dimension



Source: Author's own contribution

More detail is provided in the next table:

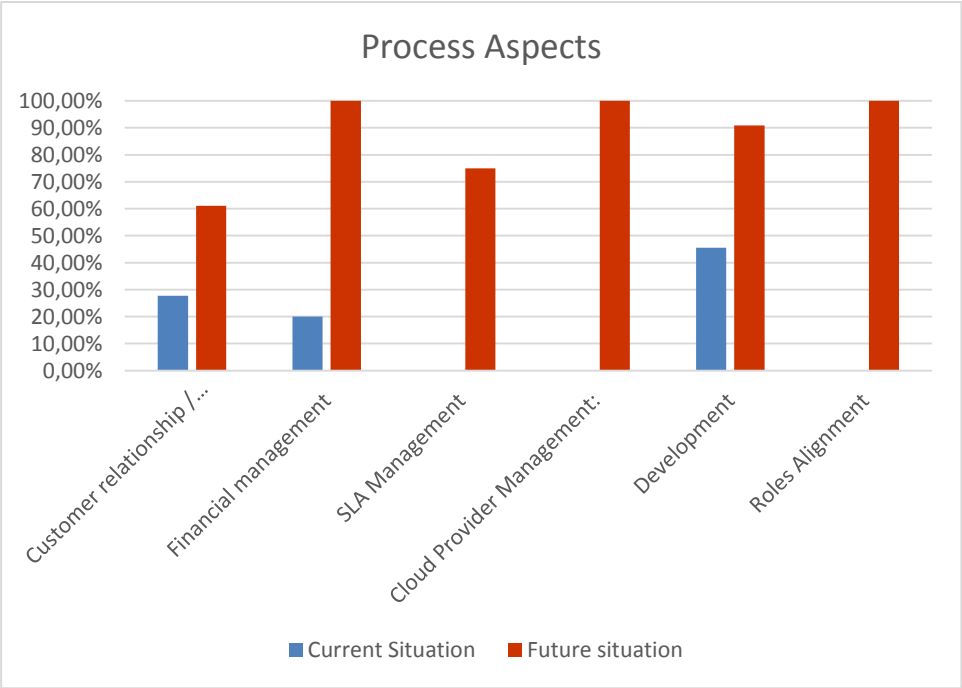
Table 14. Proof-of-concept's B detailed results for the Business Dimension

Area	Subarea	Current Situation	Future situation
Pricing patterns	Pricing patterns	0.00%	100%
Business strategy	Creation of the business plan for the new service offerings	12.50%	50.00%
	Management of the business plan	16.67%	33.33%
Customer relationship	Customer relationship	37.50%	62.50%
Financial management	Provider accountability	0.00%	100%
	Own accountability	0.00%	100%
Account management	Account management	0.00%	100%
Product catalogue	Product catalogue	0.00%	60.00%
Regulatory	Regulatory	0.00%	50.00%

Source: Author's own contribution

Finally, the results for the process dimension are provided next:

Figure 48. Proof-of concept's B results for the Process dimension



Source: Author's own contribution

More detail is provided in the next table:

Table 15. Proof-of-concept's B detailed results for the Process dimension

Area	Subarea	Current Situation	Future situation
Customer relationship / problem resolution	Customer interaction	62.50%	62.50%
	Incidence management and resolution	0.00%	60.00%
Financial management	Metering and rating the use of the services	0.00%	100%
	Billing	33.33	100%
SLA Management	SLA definition	0.00%	83.33%
	Auditing & reporting	0.00%	66.67%
Cloud Provider Management:	Requirements and agreements	0.00%	100%
	Auditing & reporting	0.00%	100%
Development	Development process	20.00%	80.00%
	Update & maintenance process	83.33%	100%
Roles Alignment	Definition and adaptation of new roles	0.00%	100%
	Communication and training	0.00%	100%

Source: Author's own contribution

3. Cost-Benefit Analysis Validation

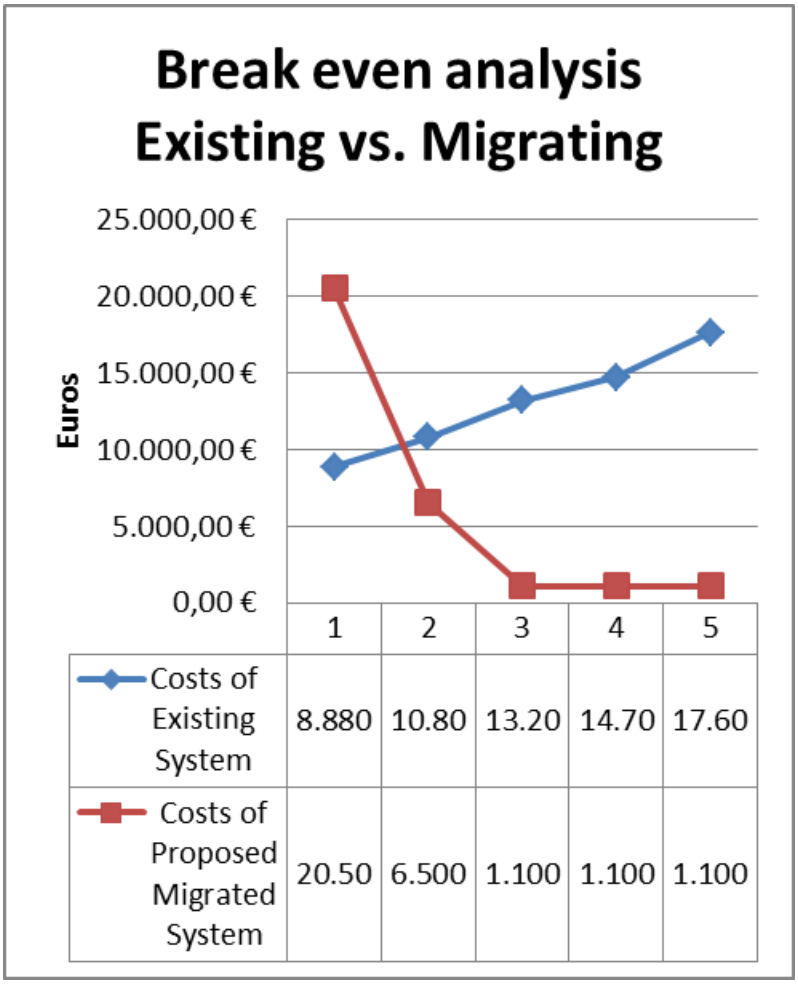
The validation procedure followed for the CBA has been as follows. The CBA was distributed to the companies, along with a tutorial, an example of a fictional company and an explanation of the different fields that needed to be filled in as well as an explanation of the cells that the CBA calculates automatically. Initially, the companies filled in the CBA with their data, but direct and close contact was held for unclear issues. Later on, interviews were held with the different companies to understand the values inserted and to correct any misunderstanding or mismatch that may have happened. This continuous and close work allowed the author of this thesis to correct the different formulas presented in the CBA.

The CBA has been validated in Companies A, B and C. Next, the main results for each of the validation use cases will be presented. The detailed breakdown can be found on Annex 3.2 (Proof of concept A), Annex 3.3 (Proof of concept B) and Annex 3.4 (Proof of concept C).

3.1 Proof –of – concept A

The following figure shows the breakeven analysis resulting from the data inserted. In this case, the costs of the existing system are expected to increase, mostly due to the increase of the maintenance costs and the correction of errors. However, the costs of the migrated system are expected to remain constant due mainly to the application of good software engineering practices, such as regression tests, tests non-existing in the current system.

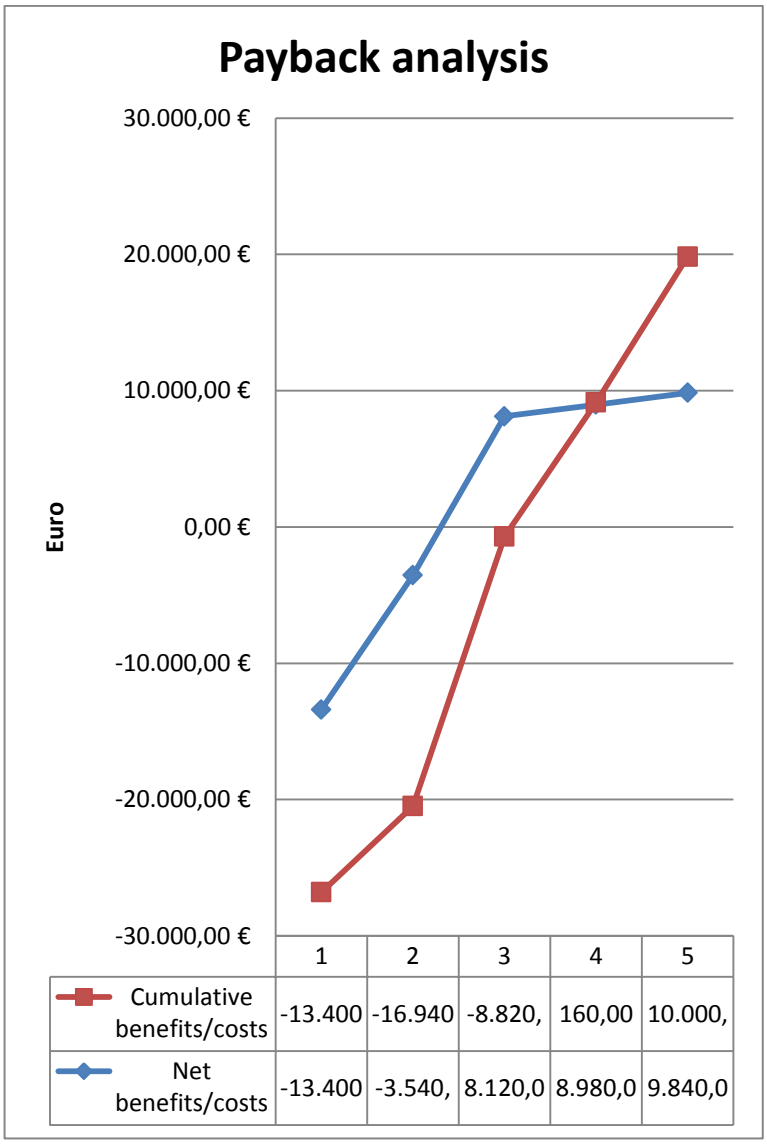
Figure 49. Company A's Breakeven analysis



Source: author's own contribution

The payback is expected in 3.98 years, as it can be seen in the following figure.

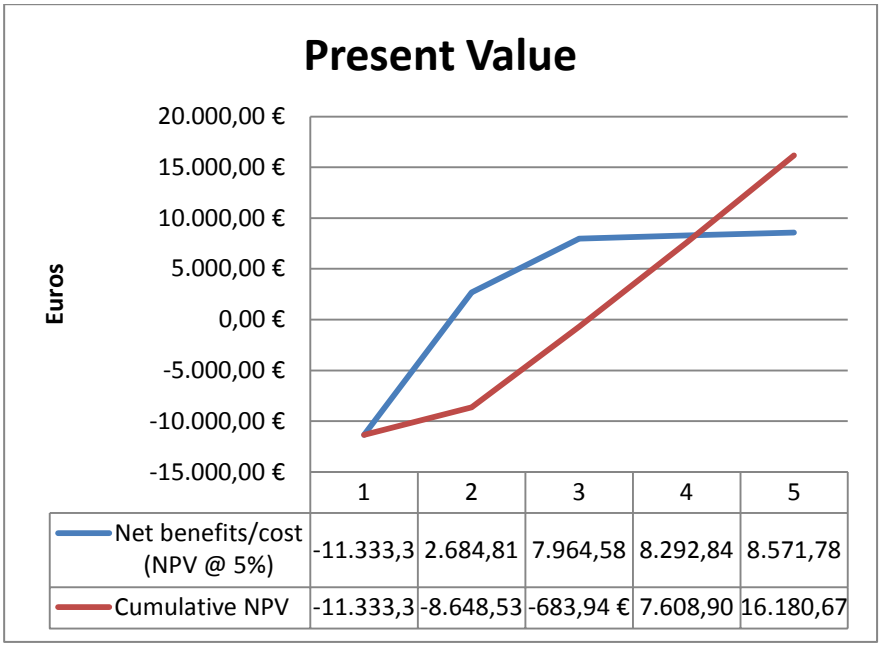
Figure 50. Company A's Payback analysis



Source: author's own contribution

The Present Value of this application is shown next.

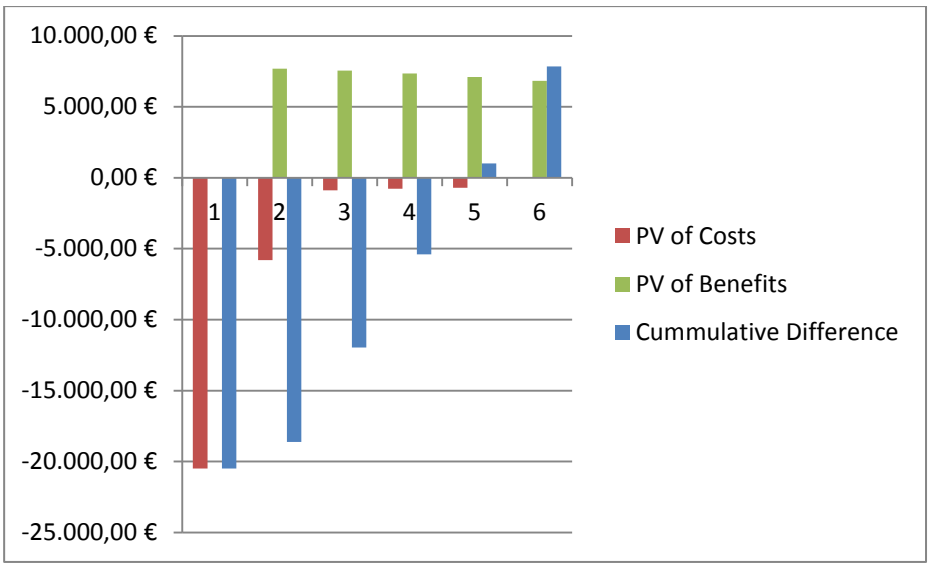
Figure 51. Company A's Present Value



Source: author's own contribution

Finally, the estimated Net Present Value is depicted next.

Figure 52. Company A's Net Present Value



Source: author's own contribution

The final figures of this proof-of-concept as well as its ROI are shown in the following table:

Figure 53. Company A's Net Present Value

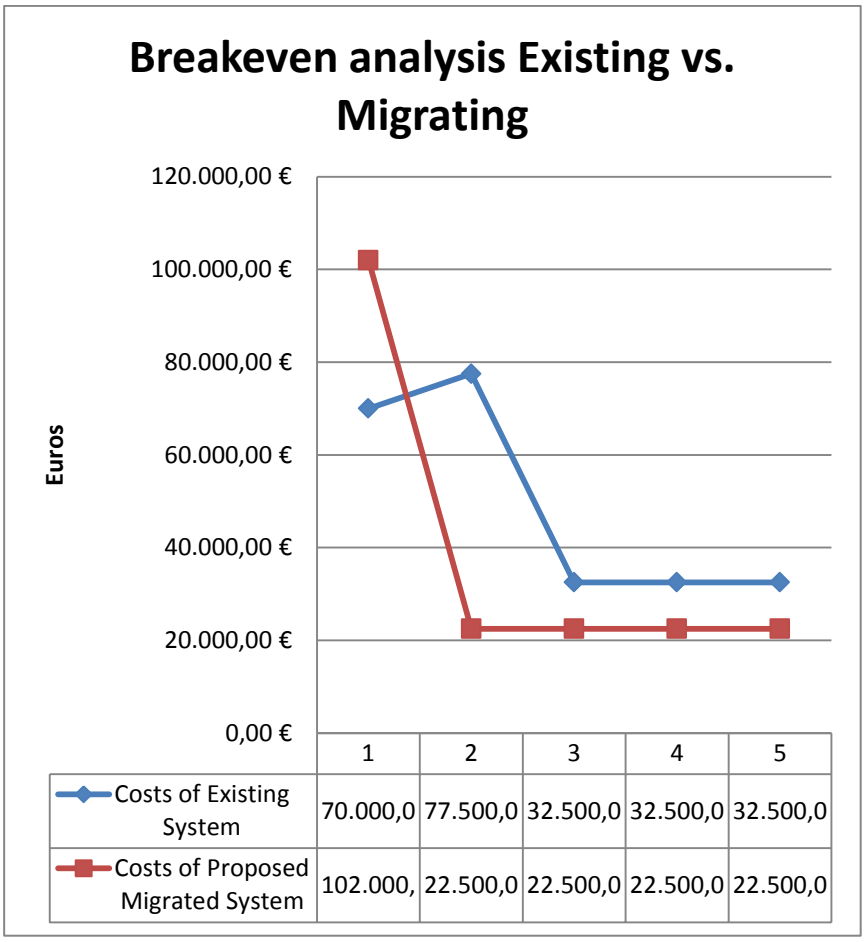
Economic Feasibility Analysis							
YEAR OF PROJECT	**0**	**1**	**2**	**3**	**4**	**5**	**Total**
Net economic benefit	0,00 €	8.600,00 €	9.460,00 €	10.320,00 €	11.180,00 €	12.040,00 €	
Discount rate (12%)	1,00 €	0,89 €	0,80 €	0,71 €	0,64 €	0,57 €	
PV of Benefits	0,00 €	7.678,57 €	7.541,45 €	7.345,57 €	7.105,09 €	6.831,82 €	
NPV of all BENEFITS	**0,00 €**	**7.678,57 €**	**15.220,03 €**	**22.565,60 €**	**29.670,69 €**	**36.502,51 €**	**36.502,51 €**
One-time COSTS	-19.000,00 €						
Recurring Costs	-1.500,00 €	-6.500,00 €	-1.100,00 €	-1.100,00 €	-1.100,00 €	0,00 €	
Discount rate (12%)	1,00 €	0,89 €	0,80 €	0,71 €	0,64 €	0,57 €	
PV of Costs	-20.500,00 €	-5.803,57 €	-876,91 €	-782,96 €	-699,07 €	0,00 €	
NPV of all COSTS	**-20.500,00 €**	**-26.303,57 €**	**-27.180,48 €**	**-27.963,44 €**	**-28.662,51 €**	**-28.662,51 €**	**-28.662,51 €**
Cummulative Difference	**-20.500,00 €**	**-18.625,00 €**	**-11.960,46 €**	**-5.397,85 €**	**1.008,18 €**	**7.840,00 €**	
ROI		**-70,81%**	**-44,00%**	**-19,30%**	**3,52%**	**27,35%**	

Source: author's own contribution

3.2 Proof –of – concept B

The figure below presents the breakeven analysis for this application in Company B. This case is particularly interesting because Company B estimates that the maintenance costs of the existing application after year 2 decrease and they remain constant in time. This can be due to various reasons, being the most probable one a well-established and mature verification and validation strategy, as well as a well-managed configuration management system. This company has been certified in high levels of known maturity models such as CMMI-DEV.

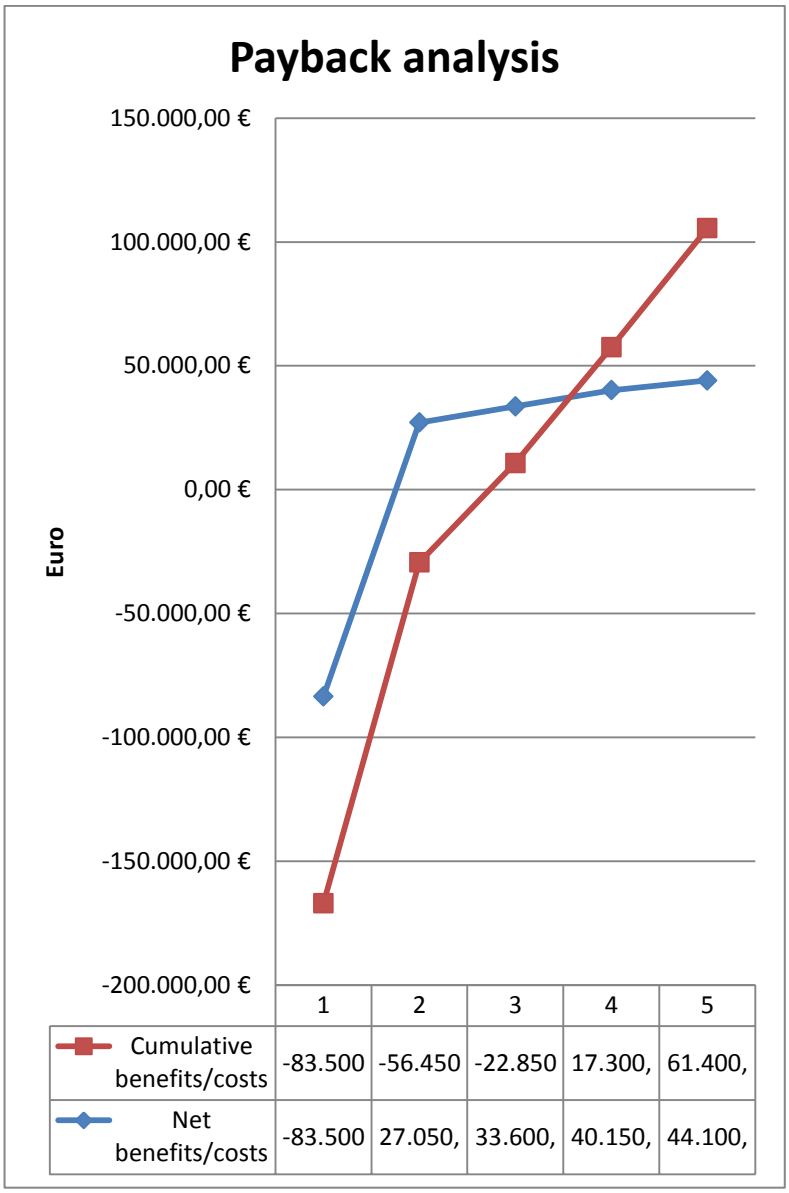
Figure 54. Company B's Breakeven analysis



Source: author's own contribution

Observing the figure below with the data inserted the payback results in 3.57 years.

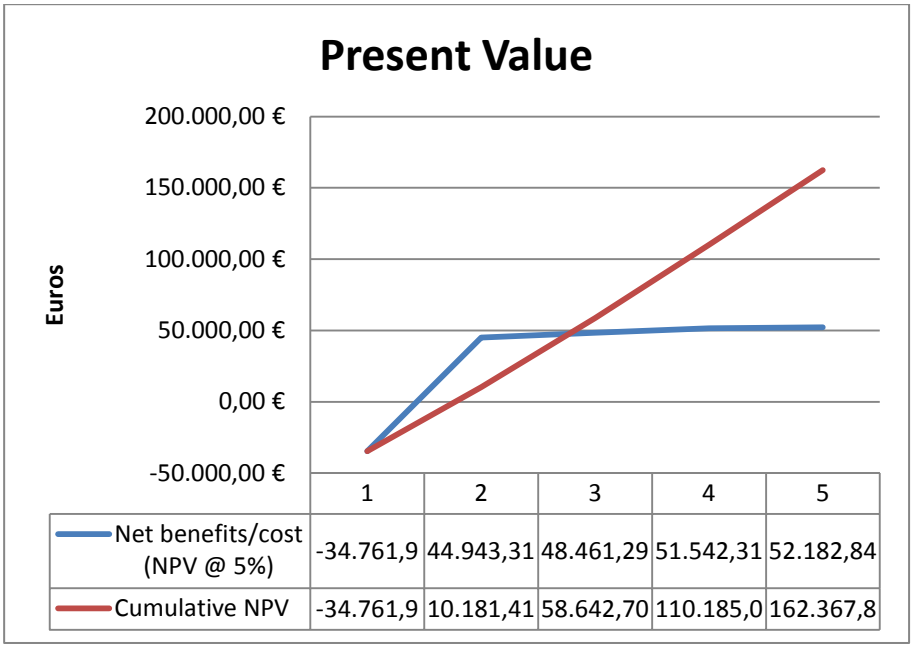
Figure 55. Company B's Breakeven analysis



Source: author's own contribution

The Present Value Analysis is presented in the following figure:

Figure 56. Company B's Present Value

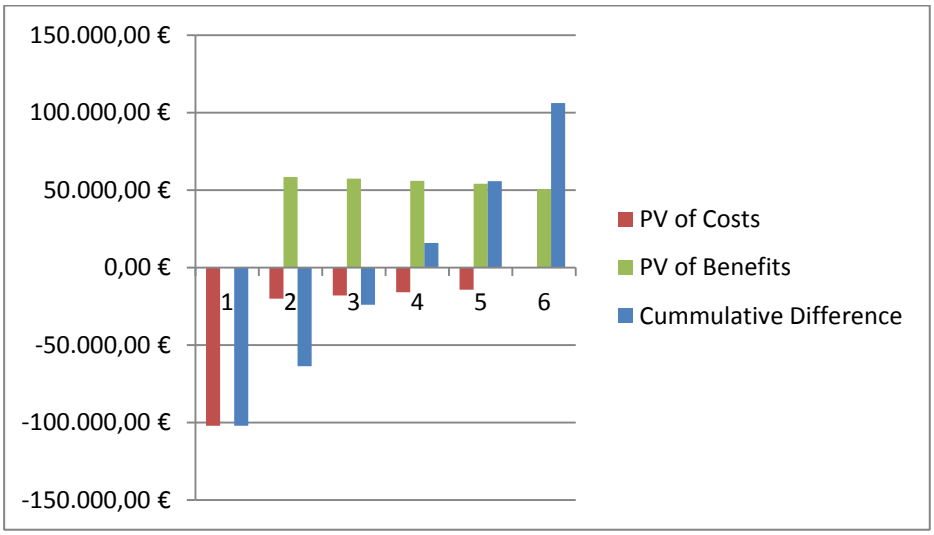


	1	2	3	4	5
Net benefits/cost (NPV @ 5%)	-34.761,9	44.943,31	48.461,29	51.542,31	52.182,84
Cumulative NPV	-34.761,9	10.181,41	58.642,70	110.185,0	162.367,8

Source: author's own contribution

Finally, the resulting Net present value is:

Figure 57. Company B's Net Present Value



Source: author's own contribution

And the final numbers of the Economic feasibility analysis including its ROI is depicted in the following table:

Figure 58. Company B's Economic Feasibility Analysis

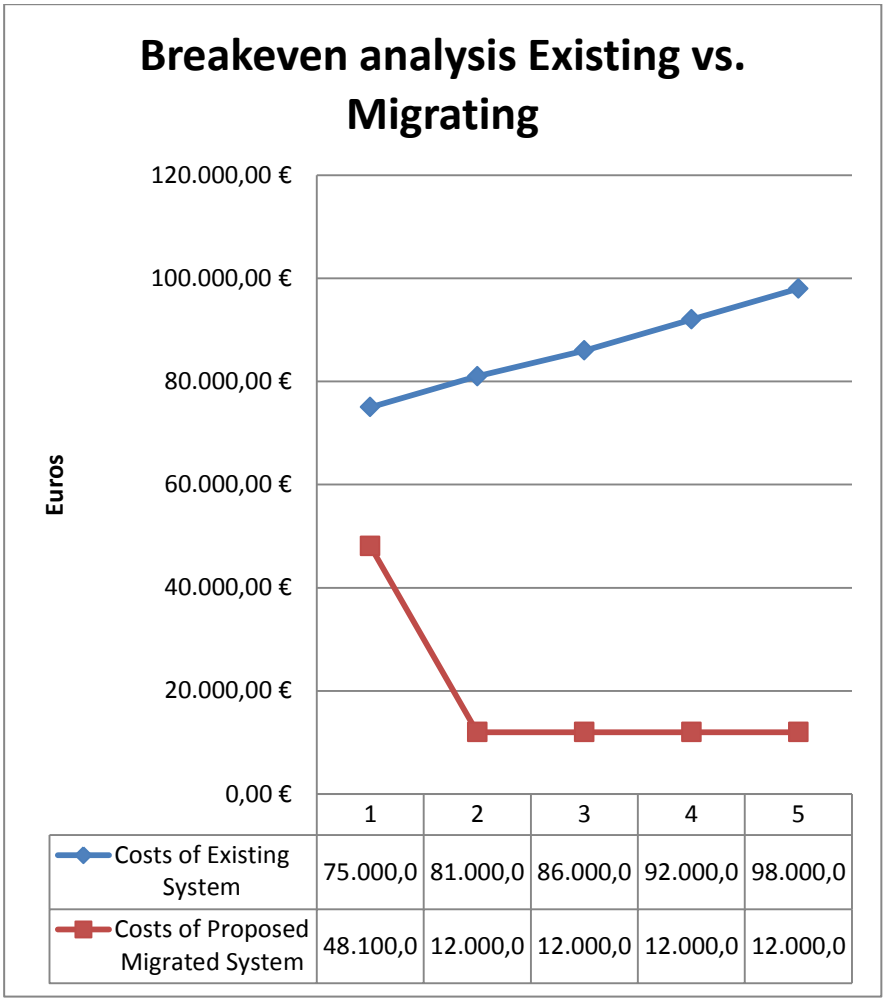
Economic Feasibility Analysis							
YEAR OF PROJECT	**0**	**1**	**2**	**3**	**4**	**5**	**Total**
Net economic benefit	0,00 €	65.500,00 €	72.050,00 €	78.600,00 €	85.150,00 €	89.100,00 €	
Discount rate (12%)	1,00 €	0,89 €	0,80 €	0,71 €	0,64 €	0,57 €	
PV of Benefits	0,00 €	58.482,14 €	57.437,82 €	55.945,93 €	54.114,36 €	50.557,73 €	
NPV of all BENEFITS	**0,00 €**	**58.482,14 €**	**115.919,96 €**	**171.865,89 €**	**225.980,25 €**	**276.537,99 €**	**276.537,99 €**
One-time COSTS	-55.000,00 €						
Recurring Costs	-47.000,00 €	-22.500,00 €	-22.500,00 €	-22.500,00 €	-22.500,00 €	0,00 €	
Discount rate (12%)	1,00 €	0,89 €	0,80 €	0,71 €	0,64 €	0,57 €	
PV of Costs	-102.000,00 €	-20.089,29 €	-17.936,86 €	-16.015,06 €	-14.299,16 €	0,00 €	
NPV of all COSTS	**-102.000,00 €**	**-122.089,29 €**	**-140.026,15 €**	**-156.041,20 €**	**-170.340,36 €**	**-170.340,36 €**	**-170.340,36 €**
Cummulative Difference	**-102.000,00 €**	**-63.607,14 €**	**-24.106,19 €**	**15.824,69 €**	**55.639,89 €**	**106.197,63 €**	
ROI		**-52,10%**	**-17,22%**	**10,14%**	**32,66%**	**62,34%**	

Source: author's own contribution

3.3 Proof –of – concept C

The following graph shows the costs of the current system as well as the expected costs of the system once it is migrated. Company C estimates that while the costs for the legacy system increases rapidly, mainly due to maintenance issues and correction of errors, the migrated system costs remain more or less stable after the second year. The reason behind this is the regression tests that are executed whenever a new feature is deployed, which allow to detect errors before the application deployment (e.g. errors that occur because of dependencies among modules – one change in a module often implies that an error is propagated to other modules depending on it).

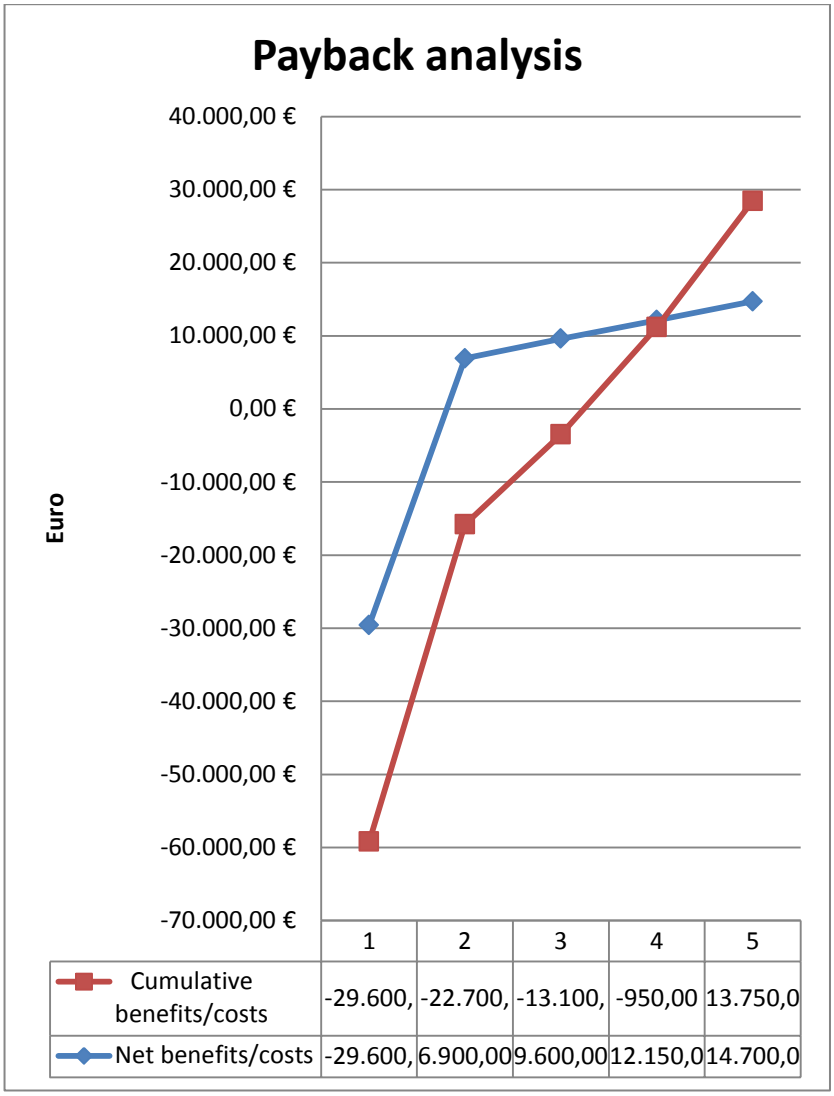
Figure 59. Company C's Breakeven analysis



Source: author's own contribution

Looking at the payback, it can be seen that the payback is established in 4.06 years.

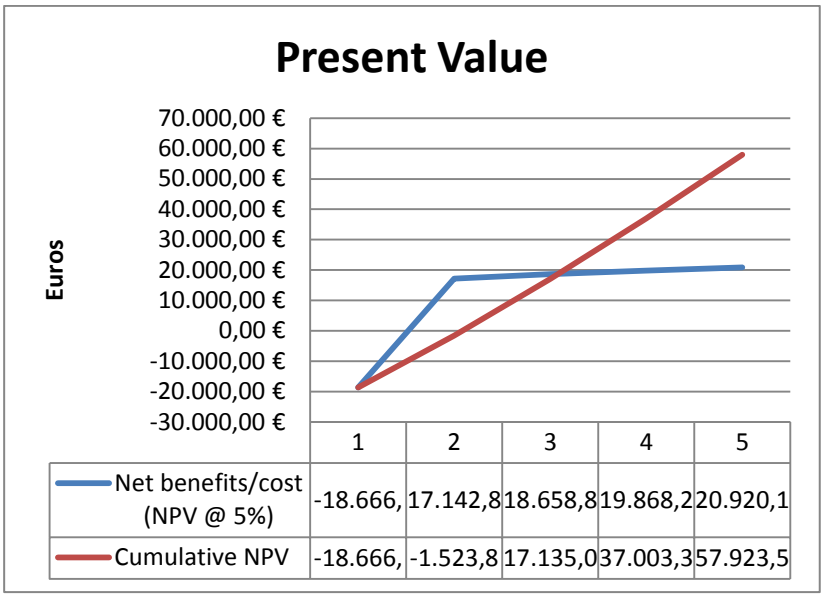
Figure 60. Company C's Payback analysis



Source: author's own contribution

With the data inserted, the Present Value and the Cumulative Present Value of the newly deployed application is presented in the next figure.

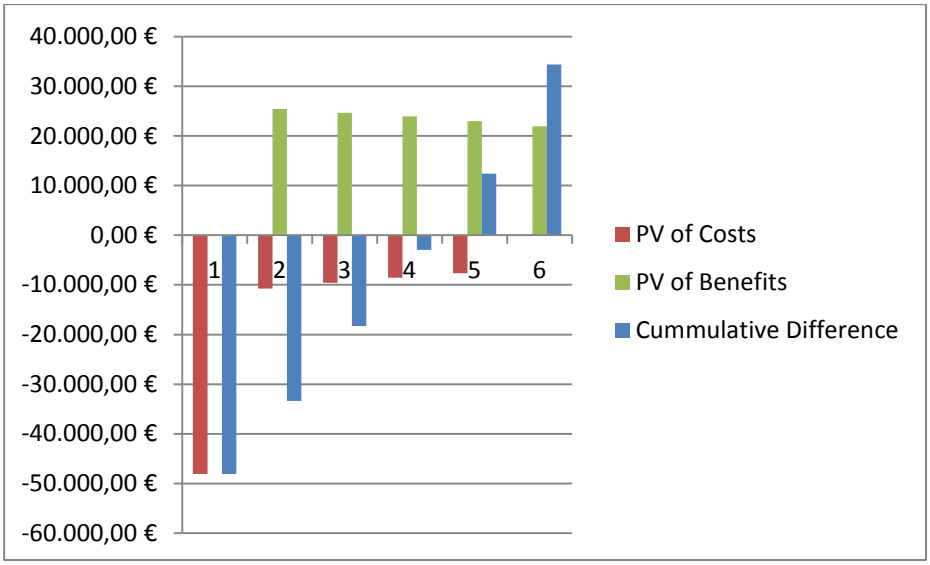
Figure 61. Company C's Net Present Value



Source: author's own contribution

Finally, the resulting Net Present Value is as presented in the following figure.

Figure 62. Company C's Net Present Value



Source: author's own contribution

The most relevant economic data for the migration of the application and the resulting ROI is depicted next:

Figure 63. Company A's Economic Feasibility Analysis

Economic Feasibility Analysis							
YEAR OF PROJECT	**0**	**1**	**2**	**3**	**4**	**5**	**Total**
Net economic benefit	0,00 €	28.500,00 €	30.900,00 €	33.600,00 €	36.150,00 €	38.700,00 €	
Discount rate (12%)	1,00 €	0,89 €	0,80 €	0,71 €	0,64 €	0,57 €	
PV of Benefits	0,00 €	25.446,43 €	24.633,29 €	23.915,82 €	22.973,98 €	21.959,42 €	
NPV of all BENEFITS	**0,00 €**	**25.446,43 €**	**50.079,72 €**	**73.995,54 €**	**96.969,51 €**	**118.928,93 €**	**118.928,93 €**
One-time COSTS	-38.100,00 €						
Recurring Costs	-10.000,00 €	-12.000,00 €	-12.000,00 €	-12.000,00 €	-12.000,00 €	0,00 €	
Discount rate (12%)	1,00 €	0,89 €	0,80 €	0,71 €	0,64 €	0,57 €	
PV of Costs	-48.100,00 €	-10.714,29 €	-9.566,33 €	-8.541,36 €	-7.626,22 €	0,00 €	
NPV of all COSTS	**-48.100,00 €**	**-58.814,29 €**	**-68.380,61 €**	**-76.921,98 €**	**-84.548,19 €**	**-84.548,19 €**	**-84.548,19 €**
Cummulative Difference	**-48.100,00 €**	**-33.367,86 €**	**-18.300,89 €**	**-2.926,44 €**	**12.421,32 €**	**34.380,74 €**	
ROI		**-56,73%**	**-26,76%**	**-3,80%**	**14,69%**	**40,66%**	

Source: author's own contribution

4. Methodology Validation

This methodology has been applied in the Company named as Proof-of-concept Company C in this thesis. First, the features of their SaaS application (a BPM tool that allows to model business processes) have been identified. This includes:

- the identification of new business processes that are aligned with the company strategy,
- description of each of the processes,
- classification of the processes in strategic, operative and support
- Follow-up and monitoring of the performance of the business processes,
- management and monitoring of business processes by following the KPIs defined in the different processes
- creation of a KPIs reports.

The product follows common approaches such as the balanced scorecard and the philosophy of management by process, and in agreement with ISO9000 and EFQM.

The market analysis performed showed that it is SMEs, especially small companies, in the Spanish market, that lack of solutions that are price competitive, to define and manage their processes. The market niche seemed to be even bigger in the case of Spanish small software application providers.

Thus, with the features and the market analysis in mind, the value proposition of the tool is defined as "KITE aims to provide software application providers that have a small management structure and who face continuous technological and market changes in

their products and services, with a tool that let them apply methods of management excellence in their management strategy".

Taking into consideration the market niche addressed, small companies, and the value proposition, the pricing model was established to be by number of concurrent users that can login into the application. The tool therefore monitors the number of users that have entered the system and launches a warning when an additional user to the number of allowed ones (or of course, a user that is not authorized) due to the option selected, logs in. An associated billing component has also been customized following the price-per-concurrent-user approach.

KITE was initially deployed on Google App Engine, but due to the difficulty of managing this cloud provider, the vendor lock-in and the lack of fulfillment of Spanish regulatory aspects, the company decided to port the application and deploy it onto a private cloud infrastructure, OpenStack, that the company set up in their own datacenter, as this provided them more freedom. KITE is developed using free Open Source Tools so no software licenses need to be acquired.

With respect to the relationship with the customers, the company focuses on a close and personal relationship (one-to-one) with the enterprises that buy their product. The product is currently not announced on the company's website. They have dedicated one person half of his time dedicated to the sales of KITE, but most of their clients come now from word of mouth. This is so, because this company provides additional consultancy services to tutor customers in the design of their business processes, training on EFQM, and quickly respond to technical incidences (usually, with a maximum response time of 4h). Technical support to customers is established on weekdays from 8am to 7pm, and depending on the classification of the incidences, the time to resolve them ranges from 30 minutes to 4 hours, following their ISO20000 procedures. This technical support is included in the price value. Business strategy support is however not included in the price value. They are billed separately.

Company C follows an iterative approach, using SCRUM but compliant with software industry standards such as CMMI-DEV (certified in level 2 at the time of the application of this methodology, nowadays certified in level 3) and quality standards such as ISO9000. Following the SCRUM methodology, for each sprint of three weeks a set of user stories (requirements) are set and thorough unit testing, integration testing and functional testing is performed. The release plan, however, has been established to only

release a new version when an error or a flaw has been found or has been reported by the customers.

For the pricing model, Company C has taken into consideration the development costs, the operational costs (1 junior person in the sales team half time, 1 junior programmer half time for the maintenance of OpenStack and release of new patches for KITE), and the upfront costs of installing OpenStack. The margin has been established to a fixed amount of 10% in all tiers. As demonstrated in the previous chapter, the current pricing strategy is not the most profitable one and Company C should reconsider moving into a more efficient one, such as the pay-per-use one.

The new business model, as defined in this thesis, is currently in place and working in an efficient manner, even though a revision of the pricing strategy is advised.

5. Pricing Strategies Validation

The SaaS pricing strategy developed in this thesis has been proven in Company C. As explained before, the major business line of this company is the development of turn-key software for Public Adminitrations, mostly web content management systems and eAdministration services. The crisis in Spain and the cuts in the Spanish Administrations for the development of new eAdministration services caused Company C to change the company strategy. This new strategy focused on the following: 1) Continue monitoring the local, regional and national bids coming from the Public Administrations, as it has been traditionally done in the company; 2) Consolidate the company in the European market, mainly through competitive bids and tenders, usually in collaboration with other major players of the EU, to provide software development services to the European Commission's General Directorates and European Agencies created under the umbrella of the European Commission; 3) Search for new markets, especially Latin America, a quite natural market for a Spanish enterprise; 4) Incentivize the sales of software products resulting from acquiring external companies but also from commercial projects to the Public Administration or from research and development projects.

In accordance to the last strategic line, the company decided to productize an application developed for a Public Administration. This software application was a Business Process Modeler for Educational institutions that later on evolved in a Business Process Modeler (BPM) for any domain and was decided, by the General Management and the R&D department, in charge of the implementation of this strategic

line, to sell it as a product. Target customer profile is SMEs that are beginning to work in management by processes and need an easy-to-use tool to start with. This tool follows a 3-tier architecture and needs to be personalized and installed in a dedicated server at the customer's site for every customer. The business model was a license-based one, plus consultancy and maintenance. Seeing that the product was being accepted by the market, even though the incomes of this BPM are still marginal compared to the main business of the company, the R&D department decided to modernize it to be able to sell it as a SaaS in a first stage deployed on Google App Engine and in a second stage on a private cloud deployed at the company's premises, built upon OpenStack, and set up a new business model, a tiered model being the tiers a range of number of users. The pricing strategy they defined is: 10€ 1 to 3 users; 15€, 4-10 users; 20€, 11-20 users and the rest by volume.

4.1 Tiered model simulation

For an easier understanding, the author of this thesis has named these tiers as Basic, Limited, Enterprise and Platinum. This is the equivalence:

Table 16. Initial pricing strategy by Company C

Name of the tier	Price (in €)	Number of simultaneous users
Basic	10	1-3
Limited	15	4-10
Enterprise	20	11-20
Platinum	By volume	More than 20

Source: author's own contribution

The input that that is available to start this simulation is the number of customers Company C has in every tier and the amount of money that this company obtains from the selling of this application. The margin of every selling is 10% of the price in every tier. The installed base of customers is shown next:

Table 17. Company C's customer base

Total installed base of customers	180
# of customers Basic	30
# of customers Limited	60
# of customers Enterprise	90
# of customers Platinum	0

Source: author's own contribution

This results in an income of:

Sales Basic	3.960,00
Sales Limited	11.880,00
Sales Enterprise	23.760,00
Total income from sales	**39.600,00**

The income from this new SaaS product was, in 2012, of about 0,20% of the total income of the company, amount, that as said before, is currenly considered marginal in the company, but expected to grow.

The first step is to estimate the growth in the number of customers as well as the ones that decide to abandon the product, that is the number of churned customers. In this case, the data for Year 1 and Year 2 are real. In the case of Year 3 data and beyond, we have estimated a growth of less than half the growth between Year 1 and Year 2. The reason for that is the target market to which this product is oriented to. The growth in between Year 1 and Year 2 was rather big and surprising and this company estimates that keeping that growth rate for a period of three more years is very optimistic. Therefore, they have considered a less optimistic choice, as explained beforehand.

Table 18. Churn metrics Company C tiered model

Churn Metrics						
Basic	**Y0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Total # of Customers	0,00	30,00	32,00	36,00	37,00	38,00
# of new Customers		30,00	4,00	6,00	2,00	2,00
# of churned Customers		0,00	-2,00	-2,00	-1,00	-1,00
Net New Customers		30,0	2,0	4,0	1,0	1,0
# of Customers Limited-Basic		0,00	0,00	0,00	0,00	0,00
# of Customers Enterprise-Basic		0,00	0,00	0,00	0,00	0,00
Limited	**Y0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Total # of Customers	0,00	60,00	76,00	112,00	165,00	203,00
# of new Customers		60,00	18,00	44,00	57,00	42,00
# of churned Customers		0,00	-2,00	-8,00	-4,00	-4,00
Net New Customers	0,00	60,00	76,00	112,00	165,00	203,00
# of Customers Basic-Limited		60,00	18,00	44,00	57,00	42,00
# of Customers Enterprise-Limited		0,00	0,00	0,00	0,00	0,00
Enterprise	**Y0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Total # of Customers	0,00	90,00	106,00	156,00	229,00	282,00
# of new Customers		90,00	20,00	60,00	83,00	58,00

	# of churned Customers		0,00	-4,00	-10,00	-10,00	-5,00
	Net New Customers		90,0	16,0	50,0	73,0	53,0
	# of Customers Basic-Enterprise		0,00	0,00	0,00	0,00	0,00
	# of Customers Limited-Enterprise		0,00	0,00	0,00	0,00	0,00

Source: author's own contribution

As it can be seen, due to the characteristics of the target market for this product and especially due to the pricing set up selected (by number of simultaneous users) it is very unlikely that downgrades and upgrades occur. Of course, companies buying this product may increase the number of employees and therefore may qualify for the next tier. However, what it has been perceived is that even if that occurs, companies prefer to stay in the initial tier to save costs and also because it is very rare that all users access simultaneously to the application for designing the processes or obtaining a KPI report.

Now that the number of customers are figured out and the price value is also known, the subscriptions need to be calculated, as these will be the primary income, billings, that the company will have from this product. This is shown next:

Table 19. Subscriptions Company C tiered model

Subscription	39600	51981,6	74923,2	118592,1	156046,44
Basic	**3960**	**4646,4**	**5227,2**	**5909,64**	**6069,36**
Subscriptions Basic (new custs)	3960,00	580,80	871,20	319,44	319,44
Total Subscriptions Basic	3960,00	4646,40	5227,20	5909,64	6069,36
ARPA for new customers	12,00	13,20	13,20	14,52	14,52
ARPA across the installed base	24,00	24,15	24,40	24,53	24,64
Limited	**11880**	**16552,8**	**24393,6**	**39530,7**	**48634,74**
Subscriptions Limited (new custs)	11880,00	3920,40	9583,20	10062,36	21322,62
Total Subscriptions Limited	11880	16552,8	24393,6	48634,74	59895
ARPA for new customers	18,00	19,80	19,80	21,78	21,78
ARPA across the installed base	36,00	36,76	37,67	40,31	40,92
Enterprise	**23760**	**30782,4**	**45302,4**	**73151,76**	**90082,08**
Subscriptions Enterprise (new custs)	23760,00	5808,00	17424,00	26513,52	18527,52
Total Subscriptions Enterprise	23760	30782,4	45302,4	73151,76	90082,08
ARPA for new customers	24,00	26,40	26,40	29,04	29,04
ARPA across the installed base	48,00	48,72	50,03	52,60	53,63

Source: author's own contribution

Currently the company has one junior sales member half time, and a developer also half time. The company expects that at operation time, the involvement of the developer is smaller and that of the sales team remain. The COGS which includes all procedures related to customer requests and helpdesk increase as the number of customer increase. The profit and loss account of Company C, if they only had this product in their catalogue would result in the following

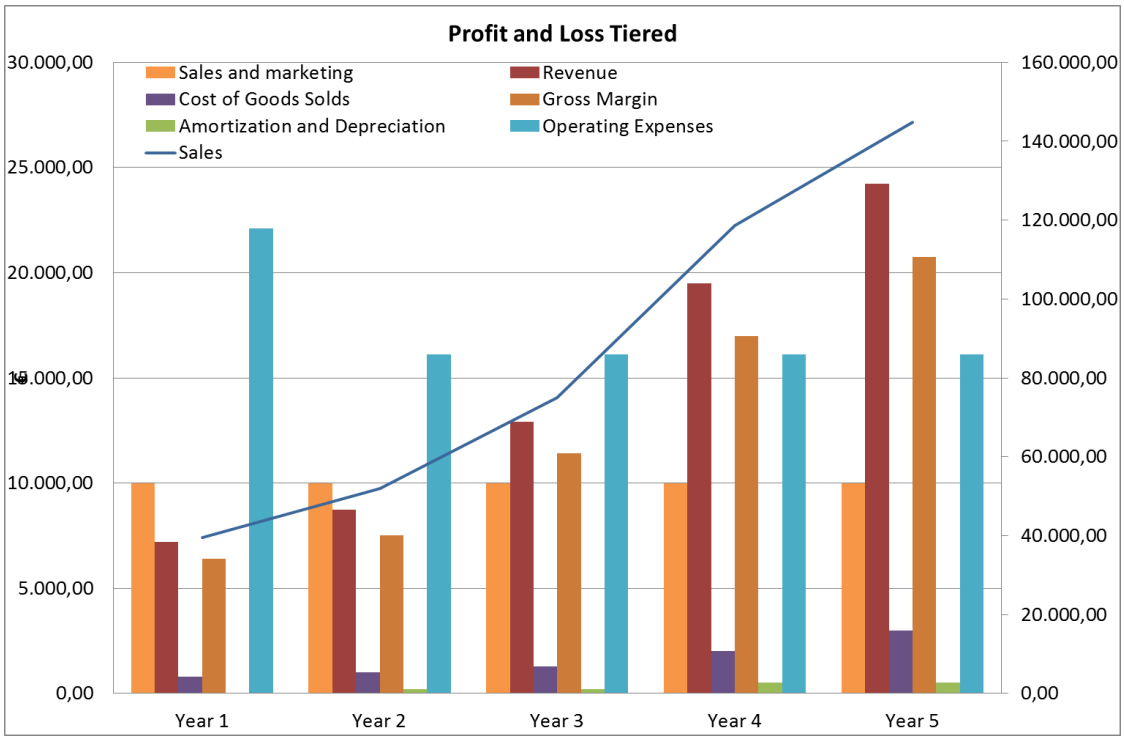
Table 20. Profit and Loss in the tiered model simulation

	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Billings	39.600,00	51.981,60	74.923,20	118.592,10	144.786,18
Revenue	7.200,00	8.731,20	12.902,40	19.479,96	24.242,52
	0,11	0,11	0,10	0,10	0,12
Cost of Goods Solds	800,00	1.000,00	1.300,00	2.000,00	3.000,00
Gross Margin	**6.400,00**	**7.531,20**	**11.402,40**	**16.979,96**	**20.742,52**
Gross Margin %	0,89	0,89	0,90	0,90	0,88
Amortization and Depreciation	0,00	200,00	200,00	500,00	500,00
Operating Expenses	**22.110,00**	**16.110,00**	**16.110,00**	**16.110,00**	**16.110,00**
Sales and marketing	10.000,00	10.000,00	10.000,00	10.000,00	10.000,00
Development	12.000,00	6.000,00	6.000,00	6.000,00	6.000,00
General / Adminsitrative	110,00	110,00	110,00	110,00	110,00
EBITDA	**-15.710,00**	**-8.578,80**	**-4.707,60**	**869,96**	**4.632,52**
EBIT	**-15.710,00**	**-8.778,80**	**-4.907,60**	**369,96**	**4.132,52**

Source: author's own contribution

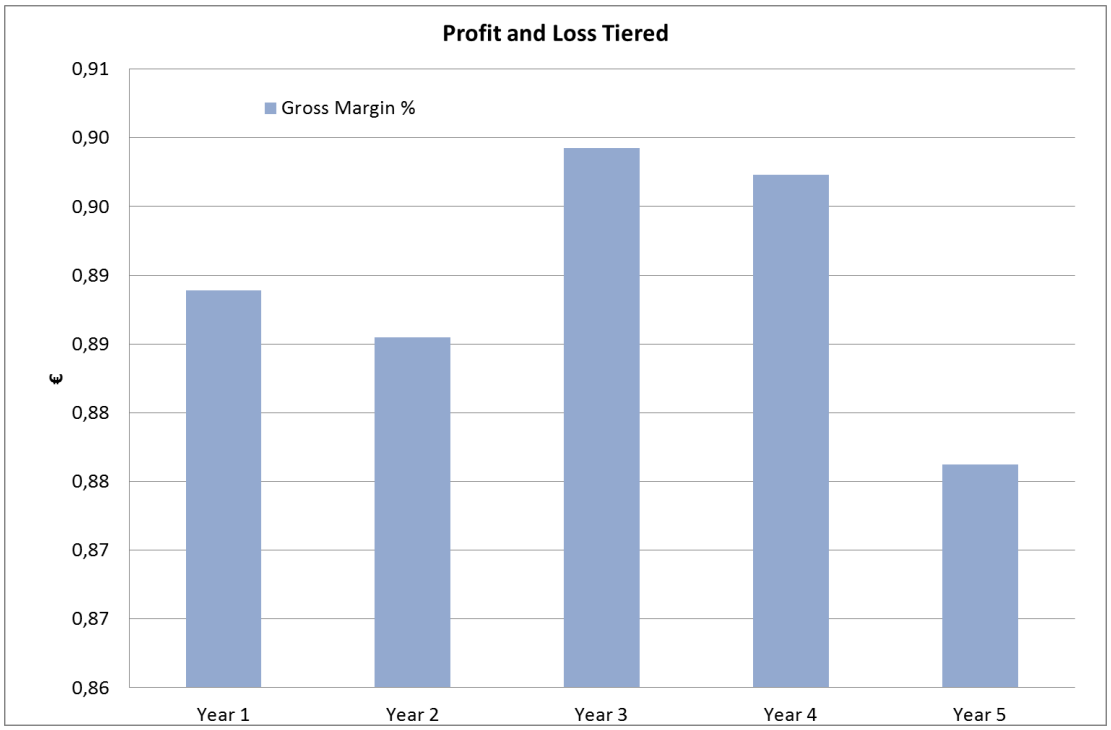
Graphically, this can be reflected as shown next.

Figure 64. Profit and loss Tiered model graphical representation



Source: author's own contribution adopted from (Skok, 2014)

Figure 65. Profit and loss Tiered model – Gross margin evolution



Source: author's own contribution adopted from (Skok, 2014)

Analysing these numbers it can be seen that:

- The amortization increases as the hardware where OpenStack was deployed on is depreciated.
- The gross margin is bigger than 80%, which can mean that this can be a good SaaS provider.
- Development costs decrease which may lead to think that the company has not taken into consideration that a failure in the SaaS would have a huge impact in the customer base, causing an increasing in the churn rate. In the event that would happen, they would consider it an extraordinary expense.
- The first three years this SaaS does not generate revenue to the company, even though it does have a number of customers who remain loyal to the offering. With the current costs, this SaaS is only profitable when the number of customers are greater than 550.

The next important indicators that need to be evaluated are LTV, CAC and the LTV:CAC ratio. With the data inserted beforehand, this is what results:

Table 21. LTV and CAC in the tiered model

Economics (new customers)	Year 1	Year 2	Year 3	Year 4	Year 5
Basic					
LTV	0,00	362,25	390,40	882,91	911,84
CAC	333,33	2500,00	1666,67	5000,00	5000,00
LTV to CAC Ratio	-	0,1	0,2	0,2	0,2
Months to Recover CAC	6,3	641,7	210,6	2.302,5	2.357,9
Limited					
LTV	0,00	1.102,7	357,9	1.107,8	1.662,8
CAC	166,7	555,6	227,3	175,4	238,1
LTV to CAC Ratio	-	2,0	1,6	6,3	7,0
Months to Recover CAC	1,04	11,88	2,13	1,02	1,97
Enterprise					
LTV	0,00	1.096,3	530,3	820,5	2.456,1
CAC	111,1	500,0	166,7	120,5	172,4
LTV to CAC Ratio	-	2,2	3,2	6,8	14,2
Months to Recover CAC	0,35	8,02	0,84	0,38	0,77

Source: author's own contribution

LTV in good SaaS companies is often three times the CAC, which happens in this company at least once in most of the offerings. The metrics that show how much it costs

them to recover a customer is extremely low in the case of the Enterprise tier and good in the Limited Tier, as good SaaS companies have this value under twelve months. This is probably due to the fact that the company tends to create strong personal links with her customers. However, in the case of Basic customers, this value is extremely high, which in the end will cause a huge churn rate of customers. The only thing that could save Company C from not having a set of abadonments from customers in the lower tier is that there is no similar SaaS offering for micro-small companies in the market which means that these micro-small companies must stay with this product if they still want to work with processes.

The biggest question mark of these pricing model is whether the tiers are correctly selected. As seen and discussed, companies prefer to stay in their current tier even if the number of potential simultaneous users increases, which means losing a huge opportunity for increasing the revenues in this SaaS product in company C. Companies that buy this offering do not see the value of upgrading to another version if they are still going to have the same functionalities. This leads us to think that another tiering definition would have been more adequate, one in which they buyers see the added value of purchasing the next tier.

In previous paragraphs the indicators of the Tiered pricing model, as defined by Company C, has been shown. In the next paragraphs, the same data will be shown for the Freemium model firstly and the Pay-per-use model secondly. In both cases, we assume that the customer base has the same progression as in the tiered model.

4.2 Freemium model simulation

In the case of the freemium model, there is a free option of the SaaS, with a limited set of functionalities, and a premium option, with all the functionalities and integration with other tools, such as MS Word or MS Excel for the creation of reports. The main difficulty here would be to determine which functionalities do not provide added value and which ones do. An example of free functionalities would be to be able to design a limited set of business processes and unable to create indicators per process or to generate reports. The premium offer, however, would allow an unlimited number of processes and the generation of reports. The next challenge is now to quantify how much the customer would be in favour in paying for this product, which in this case, after an interview with Company C, has been set to 30€.

For the calculation of the profit and loss and also for the calculation of other metrics, we consider that the customer base remains unchanged. Thus, the results are the following:

Table 22. Profit and Loss in the freemium model simulation

Summary Financial Metrics (P&L)	Year 1	Year 2	Year 3	Year 4	Year 5
Sales	71.280,00	84.744,00	131.551,20	187.308,00	227.383,20
Revenue	12.960,00	14.796,00	21.646,80	31.982,40	38.080,80
Cost of Goods Solds	800,00	1.000,00	1.300,00	2.000,00	3.000,00
Gross Margin	**12.160,00**	**13.596,00**	**20.146,80**	**29.482,40**	**34.580,80**
Gross Margin %	93,83%	93,24%	93,99%	93,75%	92,12%
Amortization and Depreciation	0,00	200,00	200,00	500,00	500,00
Operating Expenses	**22.110,00**	**16.110,00**	**16.110,00**	**22.110,00**	**22.110,00**
Sales and marketing	10.000,00	10.000,00	10.000,00	10.000,00	10.000,00
Development	12.000,00	6.000,00	6.000,00	12.000,00	12.000,00
General / Adminsitrative	110,00	110,00	110,00	110,00	110,00
EBITDA	**-9.950,00**	**-2.514,00**	**4.036,80**	**7.372,40**	**12.470,80**
EBIT	**-9.950,00**	**-2.714,00**	**3.836,80**	**6.872,40**	**11.970,80**

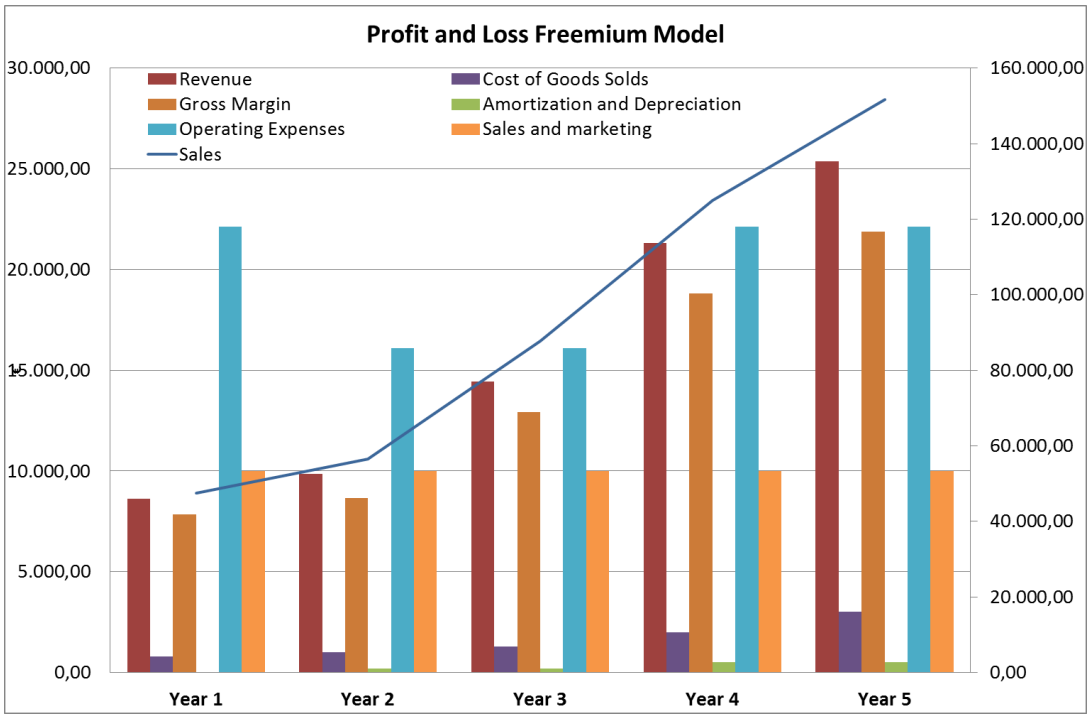
Source: author's own contribution

In the freemium model, the earnings come from the customers that contract the premium product and from the ones that initially start using the free product and then upgrade to the premium one because they consider that it fulfills their needs.

For this exercise, we have assumed that the customer base that contracted the product in the tiered model remains the same in the freemium model by contracting the premium product. It is of course clear, that for customers to subscribe to this new premium product, the value to the customer must be clear and the customers need to perceive that value. We have estimated that in the first two years approximately one third of the customers that use the free version of the product migrate to the premium version, with this number increasing to 50% in the fourth year and beyond that number in the fifth year. The reason for that, as it will be seen in the following chapter (Chapter VI) is due to the close relationship that Company C keeps with all her customers, as a differentiation point.

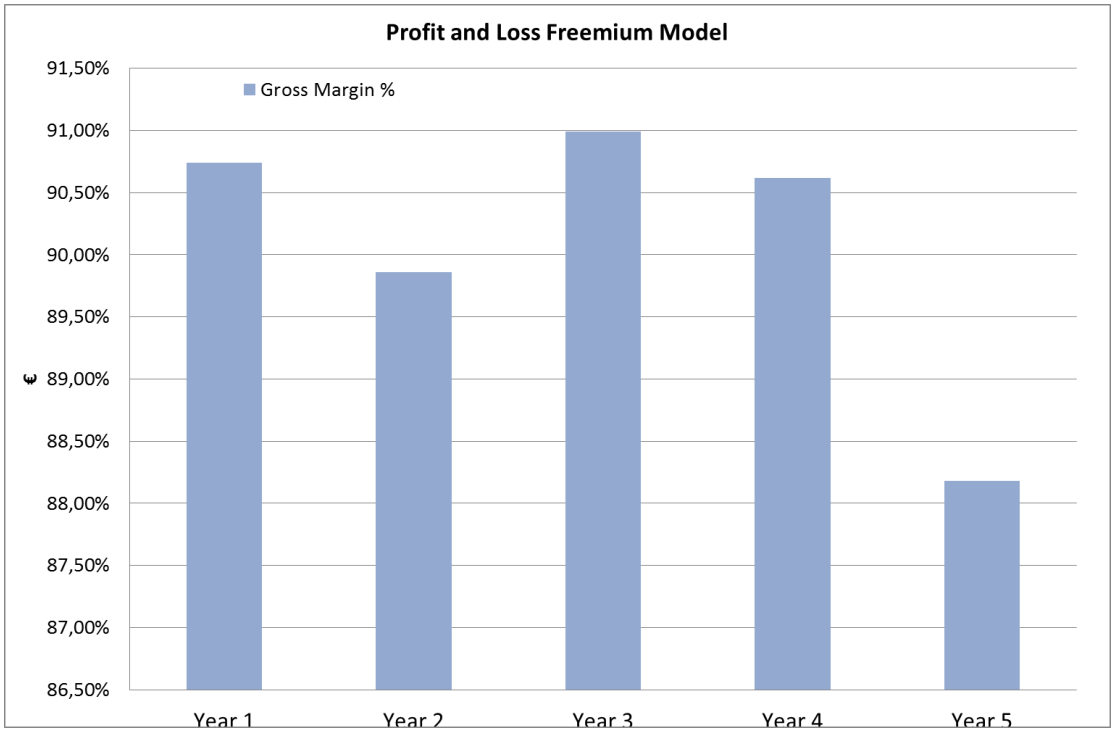
Graphically, this can be reflected as shown next.

Figure 66. Profit and loss Freemium model graphical representation



Source: author's own contribution adopted from (Skok, 2014)

Figure 67. Profit and loss Freemum model – Gross margin evolution



Source: author's own contribution adopted from (Skok, 2014)

Table 23. Subscriptions in the freemium model simulation

Subscription	Year 1	Year 2	Year 3	Year 4	Year 5
Free	**0**	**0**	**0**	**0**	**0**
Subscriptions Free (new custs)	0,00	0,00	0,00	0,00	0,00
Total subscriptions Free	0,00	0,00	0,00	0,00	0,00
ARPA for new customers	0,00	0,00	0,00	0,00	0,00
ARPA across the installed base	0,00	0,00	0,00	0,00	0,00
Premium	**71280**	**84744**	**131551,2**	**187308**	**227383,2**
Subscriptions Premium (new custs)	71.280,0	75.240,0	79.596,0	89.100,0	100.980,0
Total subscriptions Premium	71.280,0	84.744,0	131.551,2	187.308,0	227.383,2
ARPA for new customers	36,00	36,00	39,60	39,60	39,60
ARPA across the installed base	72,00	69,14	71,68	74,38	72,95

Source: author's own contribution

Following, the metrics regarding how much it costs to acquire new customers and to keep them in the customer base:

Table 24. LTV and CAC in the freemium model

Premium						
LTV		-	1.037,1	5.113,0	1.497,5	3.136,9
CAC		333,3	333,3	166,7	111,1	111,1
LTV to CAC Ratio		-	3,1	30,7	13,5	28,2
Months to Recover CAC		0,33	2,34	0,31	0,14	0,24

Source: author's own contribution

In the exercise for the freemium model, the LTV metric remains three times the CAC, which as explained before, is considered to be an optimum value for SaaS companies. Furthermore, the values that indicate how much time this company needs to recover a customer is also usually very low. The second year, in this exercise, this value increases a bit in this exercise but still, it remains in an affordable metric. This increase can be due to an error in the upgrade assumptions.

4.3. Pay-per use simulation

This SaaS is expected to be deployed on a private SaaS based on OpenStack. For the calculations of the pay-per-use price, we have based them on the average that Amazon, the lead market IaaS provider, calculates through its own calculator (Amazon, 2016). Due to the characteristics of this SaaS and its processing needs, we have estimated that for the first three years, we have enough with a machine `t2.small`, Linux-based, but

for the fourth and fifth year the estimation increases to `t2.medium`. It is to note this selection has been done following the rule of thumb, even though more systematic approaches exist, such as the one presented beforehand and developed in the ARTIST project (ARTIST Consortium, 2014).

The cost structure in this case is as follows:

Table 25. Cost structure for the pay-per-use simulation

		Year 1	Year 2	Year 3	Year 4	Year 5
Cost structure						
Avg # of tenants	per year	180,00	214,00	302,00	430,00	522,00
Avg Instance Cost	(avg price per month)	19,04	19,04	19,04	38,07	38,07
Avg Instance Cost	(avg price per year)	228,48	228,48	228,48	456,84	456,84
Total Infrastructure Costs	(price per year)	41126,4	48894,72	69000,96	196441,2	238470,48

Source: author's own contribution

It is important to remember that in the case of SaaS, tenants are the equivalent to customers, not to users. Each tenant may have several users.

The price charged to every customer will therefore be:

Table 26. Price per yearly subscription in the pay-per-use model

	Year 1	Year 2	Year 3	Year 4	Year 5
Price (per year and subscription)	251,33	251,33	251,33	502,52	502,52

Source: author's own contribution

As it can be seen, with this model, all customers are penalized for the increase of customers, as bigger instances are needed to respond to all customers with the highest quality standards as defined in the SLAs. This can impose a very high risk of customer churn rate.

The customer base, as explained beforehand, remains unchanged with respect to the current customer base as shown in the Tiered model. The operating expenses, in this case, also remain invariable.

Table 27. Customer base in the pay-per-use model simulation

Pay Per Use	Year 1	Year 2	Year 3	Year 4	Year 5
Total # of Customers (Total (Previous year) + net new (current year))	180,00	214,00	302,00	430,00	522,00
# of new Customers	180,00	52,00	93,00	137,00	106,00
# of churned Customers	-	(18,0)	(5,0)	(9,0)	(14,0)
Net New Customers	180,0	34,0	88,0	28,0	92,0

Source: author's own contribution

The incomes coming from the subscriptions in the case of the pay-per-use model are presented next:

Table 28. Subscriptions in the pay-per-use model simulation

Subscription					
Pay Per Use	**45239,04**	**53784,192**	**75901,056**	**216085,32**	**262317,528**
Subscriptions (new custs)	45239,04	13069,06	23373,50	68845,79	53267,54
Total Subscriptions	45239,04	53784,19	75901,06	216085,32	262317,53
ARPA for new customers	276,46	276,46	276,46	552,78	552,78
ARPA across the installed base	277,56	300,72	298,53	386,09	430,46

Source: author's own contribution

Out of all the three models presented, this model is the one that presents a more profitable revenue across the installed customer base. The freemium model presented a significant improvement with respect to the values attained in the tiered model but the pay-per-use model shows even more significant impovements.

Next, the profit and loss account is presented:

Table 29. Profit and Loss in the pay-per-use model simulation

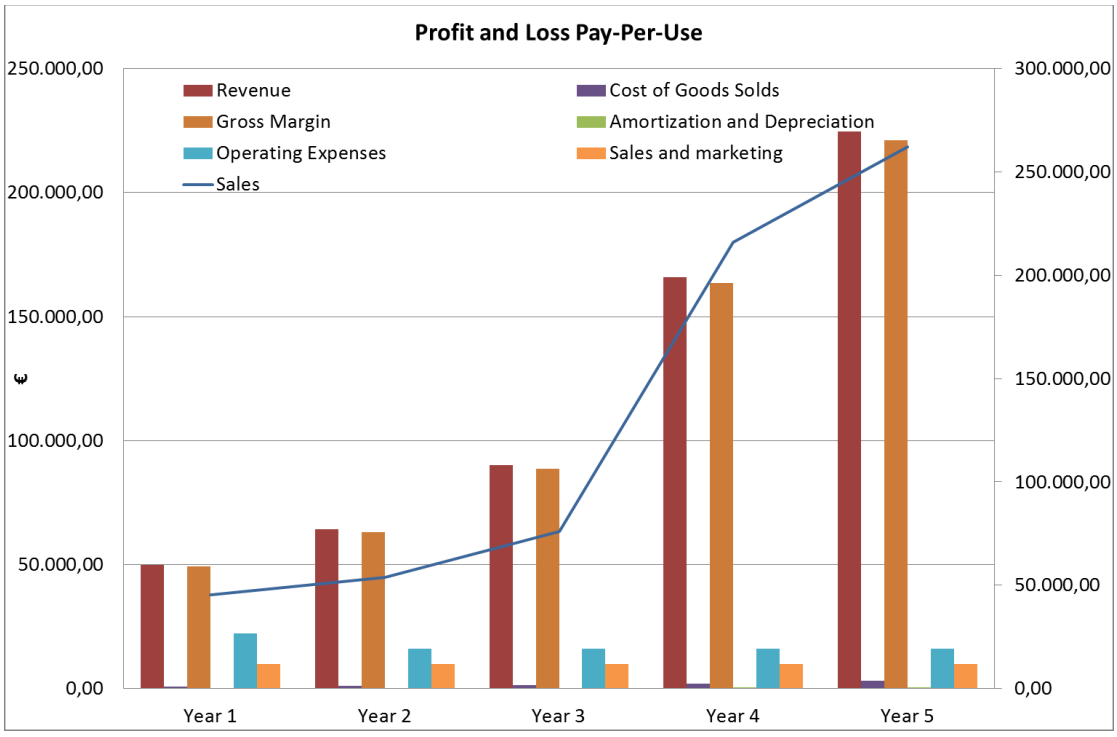
Summary Financial Metrics (P&L)	Year 1	Year 2	Year 3	Year 4	Year 5
Sales	45.239,04	53.784,19	75.901,06	216.085,32	262.317,53
Revenue	49.960,94	64.354,51	90.156,66	166.017,93	224.698,03
Cost of Goods Solds	800,00	1.000,00	1.300,00	2.000,00	3.000,00
Gross Margin	**49.160,94**	**63.154,51**	**88.656,66**	**163.517,93**	**221.198,03**
Gross Margin %	0,98	0,98	0,99	0,99	0,99

	Amortization and Depreciation	0,00	200,00	200,00	500,00	500,00
	Operating Expenses	**22.110,00**	**16.110,00**	**16.110,00**	**16.110,00**	**16.110,00**
	Sales and marketing	10.000,00	10.000,00	10.000,00	10.000,00	10.000,00
	Development	12.000,00	6.000,00	6.000,00	6.000,00	6.000,00
	General / Adminsitrative	110,00	110,00	110,00	110,00	110,00
	EBITDA	**27.050,94**	**47.044,51**	**72.546,66**	**147.407,93**	**205.088,03**
	EBIT	**27.050,94**	**46.844,51**	**72.346,66**	**146.907,93**	**204.588,03**

Source: author's own contribution

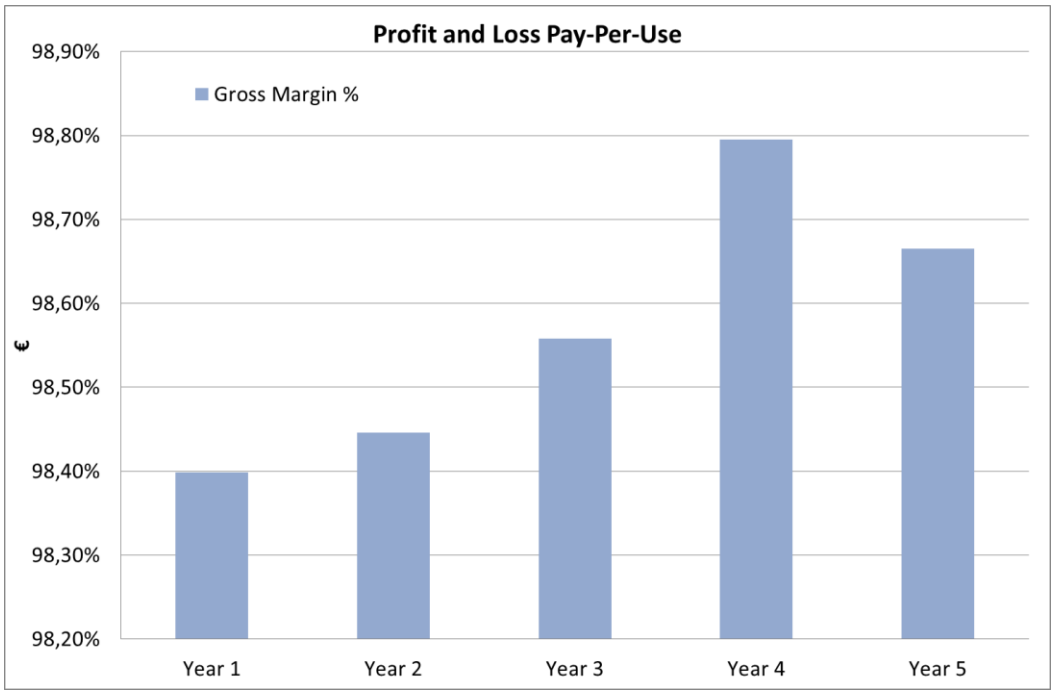
Graphically, this can be reflected as shown next.

Figure 68. Profit and loss Pay per use model graphical representation



Source: author's own contribution adopted from (Skok, 2014)

Figure 69. Profit and loss Pay per use model – Gross margin evolution



Source: author's own contribution adopted from (Skok, 2014)

With respect to the metrics corresponding the new customers, and how much it costs to acquire them and to maintain them, these are the values obtained in the pay-per-use model:

Table 30. LTV and CAC values in the pay-per-use model simulation

	Year 1	Year 2	Year 3	Year 4	Year 5
LTV	0,00	3007,22	12777,17	12955,40	13221,15
CAC	55,56	192,31	107,53	72,99	94,34
LTV to CAC Ratio	-	15,6	118,8	177,5	140,1
Months to Recover CAC	0,01	0,16	0,05	0,01	0,02

Source: author's own contribution

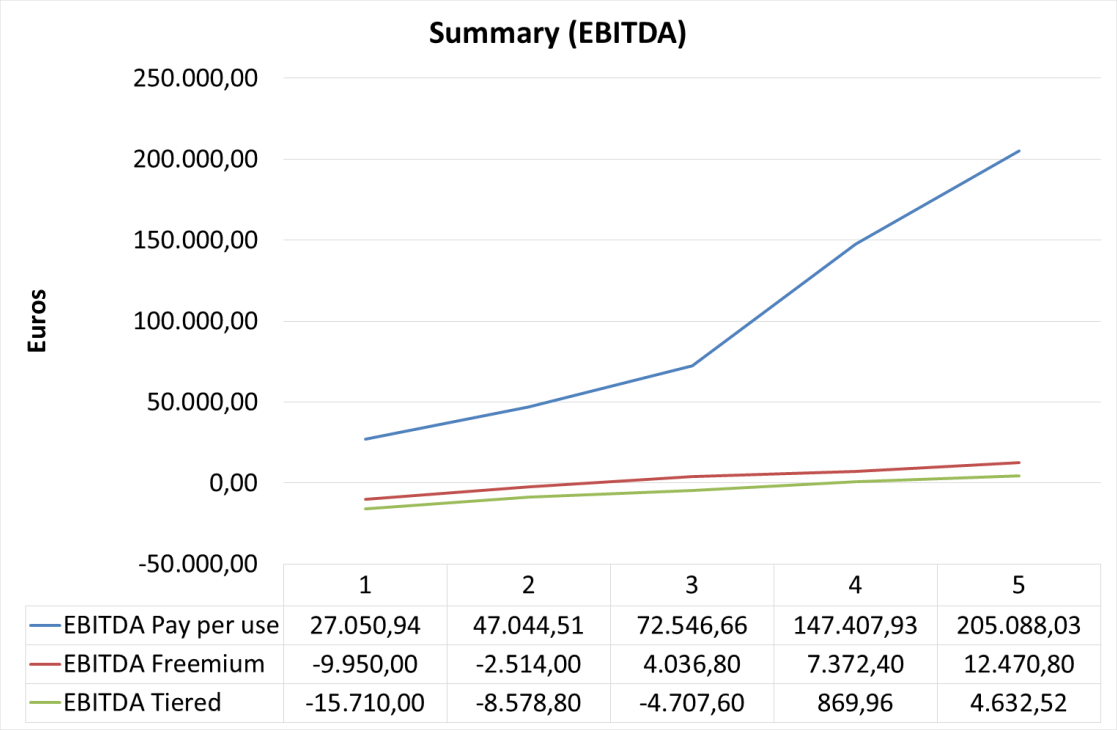
The resulting values are very similar to the ones achieved in the other pricing strategies.

4.4 Conclusions

The data and reasoning shown above can be summarized in the picture depicted next. This figures clearly show that for this application, from the economic perspective, the most adequate pricing model is not the tiered model as they have it defined now, but rather a pay-per-use one. The second best option would be to follow a freemium pricing strategy. The tiered model can be valid but as discussed before, not the way in which

they have currently defined it since users do not see the added value to move to an upper tier. The services offered in each tier must be easily identifiable and the customer must perceive them as valuable, otherwise, it will occur, as it is currently happening in Company C, that customers do not move to the upper layer. However, other aspects rather than the economic figures need to be taken into consideration to define the final pricing strategy such as discounts, extra services charged and duration of the contracts, issues that have not been considered in this example since Company C does not have currently the means for it..

Figure 70. Snapshot of the evolution of EBITDA in all three models



	1	2	3	4	5
EBITDA Pay per use	27.050,94	47.044,51	72.546,66	147.407,93	205.088,03
EBITDA Freemium	-9.950,00	-2.514,00	4.036,80	7.372,40	12.470,80
EBITDA Tiered	-15.710,00	-8.578,80	-4.707,60	869,96	4.632,52

Source: author's own contribution

Table 31. Pro's and Con's of the three pricing strategies analysed

Pricing model	Pro	Con
Tiered	• Good to overcome entry barriers by setting a low price to a limited set of functionalities • Good to incentive customers to contract more expensive services • Earnings come mostly from the customers in the lower tiers as they can be charged extra for services that upper tiers receive as included in the prices	• The upper tiers must show added value with respect to the lower ones, in order to favour upgrades • Generation of tiers by the number of users is not a good model, as customers do not see the added value
Freemium	• Good to enter the market when the technology or the product is not understood by the market • The premium version of the product must show a significant added value with respect to the free version, in order to favour upgrades	• The Premium customers may be penalized, especially in performance, when the Free version of the product becomes popular and this customer base increases exponentially. • Deep analysis on which functionalities show value added with respect to the ones that can be delivered for free

Pricing model	Pro	Con
Pay-per-use	• It allows the SaaS provider diversify the customer base, as it can be available to smaller customers that may not have the resources to buy a license-based software • Good for software products that are needed only occasionally, as customers only pay what they use • Additional services are charged extra, which means extra revenues	• Difficult to estimate the costs of the infrastructure, especially when using a public cloud provider. • When using a private cloud, it is difficult to estimate the needed hardware resources, which can eventually affect the overall performance of the application • The price structure can be complex to define • High risks of not covering the development costs, as contracts are usually very short

Source: Author's own contribution

CHAPTER V: CONCLUSIONS AND FUTURE WORK

1. Conclusions

This PhD thesis has presented an approach to aid software application providers firstly, in the decision of migrating from the traditional product licensing model towards the as-a-service one, profiting from the opportunities that cloud computing offers, and secondly, on the selection of the most convenient SaaS pricing strategy and accompanying business model.

The solution provided in this work starts off with a characterization of the application in its current status (software as a product) and in the desired one (software as a service). This characterization is based on existing and commonly adopted standards in the software industry in order to analyze how far or how close the application is, now and in the future, from being a “cloud-compliant” application, that is, that follows all architectural, business and processes principles as requested by such standards. The main outcome of this analysis is a gap analysis, along with a set of recommendations on the main issues that need to be considered in the migration of the application. As it has been proven, it is possible to characterize how far (or close) an application is from complying with cloud characteristics in terms of business, architecture and processes.

The second step within this approach is the economic analysis of what migrating an application means in terms of costs, benefits, payback, NPV and ROI. As it has been demonstrated, such a CBA can be realized, even at this earlier stage of the migration.

In parallel with the economic analysis, an analysis on the impact that the migration has inside the company needs to be performed. Companies are mostly governed by processes. As it has been shown, the processes of a product-oriented company diverge from those of a service-oriented company. Furthermore, developing SaaS has been proven to be different than developing traditional software, mainly due to market competition. This PhD thesis has presented an approach to help companies identify which processes need to be redefined (e.g. software development, customer requests) or defined from scratch (e.g. cloud provider management), which aspects need to be considered as well as in which order.

The previous steps support decision-makers in the decision of whether the migration should take place or not. Once a positive decision has been considered, and in parallel with the technical migration, the pricing strategy as well as the business model needs to be selected.

In this PhD, a study of pricing strategies commonly used in the SaaS world has been presented and three of them (pay as you go, freemium and tiered) have been decomposed and modelled. This modelling includes the cost structure as well as the revenue structure along with several metrics used to measure the satisfaction of the customers in an objective way. Finally, this modelling includes a simulation of how each pricing strategy affects the Profit and Loss account.

Finally, and also in parallel with the pricing strategy, the business model needs to be redefined. This PhD has presented a methodology to aid software application providers in the redefinition of their business model now that they are a servitized company.

In Chapter I, several research hypothesis were set up.. Following, the explanations of the achievement of those hypotheses are presented.

H1: It is possible to characterize a cloud-compliant application in terms of business model and the supporting organizational processes.

This hypothesis has been proven.

Cloud-based applications have certain characteristics that make them unique in terms of architecture, business model and processes that surround them at organizational level. The questionnaire developed for the MAT ++ (Annex 1) has proven that it is possible to characterize what a cloud application means in three axis: business, process and technology (Chapter II – Section 3). This characterization is based on existing standards, a strong requirement coming from the software industry. These standards include ISO 17799:2014, OASIS TOSCA, ITIL, CMMI-SVC, and EFQM among others.

H2: It is possible to determine a gap analysis of applications currently offered as product and determined to be cloudified, as well as to provide recommendations on the issues that need to be considered in the cloudification of the application.

This hypothesis has been proven.

MAT ++ provides the results of the questionnaires in a graphical form thus allowing to identify, in a visual manner, how far or close an application is or will be from complying with cloud computing characteristics (Chapter II – Section 3.3). Furthermore, MAT ++ has proven that it is also possible to provide recommendations in an automatic way for

critical aspects that need to be taken into consideration when cloudifying an application (Chapter II – Section 3.4, and Annex 2.2). The validity of the MAT++ has been proven in two real applications and reported in Chapter IV, Section 2.

H3: It is possible to identify which organizational processes will be affected by a cloudification

This hypothesis has been proven.

Developing and delivering applications under the SaaS model implies a change in the way things are done in a company. These involve aspects such as the way in which software is developed (from a less agile method to a more agile one), updated and maintained, the need to align roles to the new business model of the company, the supporting processes to manage, monitor and give response to customers' requests and incidences, the management of the selected cloud platform provider, SLAs that need to be defined, monitored and fulfilled to ensure customer satisfaction, new marketing ways to promote a service with an extended market and the financial management of the service, including automatic billing generation extracted out the monitored parameters of the application. All these processes have been identified, are described and modelled following the standard SPEM 2.0 in Chapter III – Section 2.

H4: It is possible to determine the cost and benefit of an application that is about to be cloudified.

This hypothesis has been proven.

Up to the knowledge of the author of this PhD's thesis, there is no systematic approach to analyze the economic feasibility that involves the migration of an application, compared to what it would mean to keep it as it is or developing it from scratch. Chapter III – Secion 3 presented a conceptual cost-benefit analysis with a set of issues that need to be considered when evaluating whether it is viable to shift business models or not. This conceptual framework is supported by commonly used economic indicators such as NPV, Payback or ROI. The validation of the CBA was executed in three companies and their results are presented in Chapter IV – Section 3 as well as in Annex 3.2, Annex 3.3, and Annex 3.4.

H5: It is possible to define the business model of a company providing SaaS

This hypothesis has been proven.

Changing the business model from selling an application as a product to selling it as a service implies not only selecting the right pricing strategy, and redefining the organizational processes (as shown beforehand) but also modifying the way in which the application is sold, maintained and supported, its sales channels, the relationships with the customers or the target markets, among other issues. A systematic approach for that can be found on Chapter III, Section 4 and its validation is reported in Chapter IV Section 4.

H6: It is possible to determine which pricing strategy is the most adequate one for a certain SaaS application.
This hypothesis has been proven.

Selecting the most adequate pricing strategy for a new SaaS application can be a challenge as it impacts directly in the Profit and Loss account of a company. Chapter III – Section 5 has decomposed and modelled the most common SaaS pricing strategies (based on an empirical observation). By inserting just a few data, companies can analyze how each of the modelled pricing strategies affect the profit and loss account, so they can decide on the one that affects more positively the economic results of the enterprise. All three pricing strategies have been proven in a company and reported in Chapter IV Section 5.

2. Future Work

This thesis has presented an approach with a twofold goal. On one hand, to support companies that are considering a cloudification of their application, characterize their application from a technical, business and process perspective, analyze the economic feasibility and the impact of this cloudification in the organizational context of the company, with the main aim of supporting them in the decision of whether this cloudification is economically feasible or not. This feasibility analysis has been performed in several proof-of-concepts, with near-field and experimental applications. However, further validation activities are needed both to debug the MAT ++ accuracy and the formulas, concepts and approach of the feasibility analysis.

The second goal of this thesis was to demonstrate that there can be a systematic way to select the SaaS pricing strategy as well as a methodological approach to define the business model of a cloudified application. The validity of this solution has been proven in a business case. Future work includes a validation in further near-field applications; the modelling of more pricing strategies; refining the cost structure of the already modelled pricing strategies; and finally, the revision of the methodology.

Annex 1: Difference between SaaS and Traditional Software

The table below contrasts the differences between a SaaS model and the traditional software model (Fineman, 2009)

Table 32. SaaS vs. Traditional Software

Components	Traditional software model	SaaS model
Product functionality over the Web	Developer company provides	Provided
Access anytime, anywhere	Developer company may provide	Included
Commitment to the solution	High	Low
Security	Developer company may provide	Included
Application Server	Customer company buys	None
Database server	Customer company buys	None
Capital outlay	High	None
Application costs	Mostly Paid upfront but it can also be leased or rented	Paid on a regular basis (i.e. monthly)
Database license	Customer company buys	None
Support fees	18% to 20% of license cost annually	Included
IT support	High	Minimal
Product updates and upgrades	Customer Company pays/installs	Mostly Included (although it depends on the business model)

Source: adopted from (Fineman, 2009)

Annex 2: MAT ++

Annex 2.1: MAT ++ Questionnare

Assumptions:

- All the questions will be referred to initial and future situations.
- Questions are categorized into dimensions, areas, sub-areas and other aspects.
- Each area has a maximum punctuation. Each sub-area has a maximum punctuation.
- Punctuation will be given by sub-area.

Questionnaire structure:

- Dimensions:
    - Technical: Areas
        - *Security:* Sub-areas:
            - Authentication & Identity Management
            - Authorization & Service Policy Management
            - Data protection
        - *Operational support:* Sub-areas:
            - Monitoring and reporting
            - Service policy management
            - Service Level management auditing
            - Incident & problem management
        - *Business Operational support:* Sub-areas:
            - Business operational support components
            - Account Management
            - Subscription Management
            - Billing: Metering and rating, and generation of invoices
            - Accounts: Provider control
        - *Architectural and programming aspects of the application*: Sub-areas:
            - Architecture
            - Multi tenancy level & elasticity
        - *Other aspects: Sub-areas*
            - Target platform
            - Non-functional properties /requirements
    - Business: Areas

- *Pricing patterns: Sub-areas*
    - Pricing patterns
- *Business strategy: Sub-areas*
    - Creation of the business plan for the new service offerings
    - Management of the business plan
- *Customer relationship : Sub-areas*
    - Customer relationship
- *Financial management : Sub-areas*
    - Provider accountability
    - Own accountability
- *Account management: Sub-areas*
    - Account management
- *Product catalogue: Sub-areas*
    - Product catalogue
- *Regulatory: Sub-areas*
    - Regulatory

- Process: Areas
    - *Customer relations process /problem resolution process: Sub-areas*
        - Customer interaction
        - Incidence management and resolution
    - *Financial management process: Sub-areas*
        - Metering and rating the use of the services
        - Billing
    - *SLA Management: Sub-areas*
        - SLA definition
        - Auditing & reporting
    - *Cloud Provider Management: Sub-areas*
        - Requirements and agreement
        - Auditing & reporting
    - *Development process*
        - Development process
        - Update & maintenance process
    - *Roles Alignment process*
        - Definition and adaptation of new roles

- Communication & training

TECHNICAL Dimension: Maximum score 40.

- *Security (10/40)*
    - **Authentication & Identity Management** (Maximum 3/10)
        - S1-Do you have/plan an authentication management component?
            - Yes (+2)
                - S2-Do/Will you provide federated identity management? Which?
                    - "saml" (+1)
                    - OpenID (+1)
                    - Provided by my provider
                    - I don't know?
            - No (0)
    - **Authorization & Service Policy Management (Maximum 3/10)**
        - S3-Do you control/manage the authorization of users to access specific capabilities/functionalities/data?
            - Yes (+2)
                - S4-How?
                    - Free text
            - No (+0)

    - **Data protection (Maximum 4/10)**
        - S5-Have/will you catalogued the data of your application? (+3)
            - No (Recommendation: Identify its sensitivity to the risk the business of its leakage, loss or corruption) (ISO 2700x on how to identify the sensitivity of data)
            - Yes
                - S6-Do you have sensitive data?
                    - Yes
                    - No
        - S7-Do you use any data encryption for your sensitive data?
            - Yes (+1)
                - S8-Which?

- Own encryption component based on (include technology):
  - Free text
- I rely/ will rely on the cloud service provider

- *Operational support requirements : (10/40)*
  - **Monitoring and reporting** (3/10)
    - O1-Do you have a monitoring component to monitor the usage of the your SaaS applications by the consumers? (1/3)
      - No
      - Yes
        - O2-Is it aligned with your pricing model? (2/3)
          - No
          - Yes
  - **Service policy management**: Provides capabilities to define, store, and retrieve policies that apply to cloud services. (3/10)
    - O3-Do you define different policies applying different services and customers? (2/10)
      - No
      - Yes (+2)
        - O4-Which ones?
          - General (+0,25),
          - technical (+0,25),
          - business (+0,25),
          - security (+0,25)
  - **Service Level management auditing**
    - O5-Do you have a component (in your application) for auditing & logging? (1/10)
      - No
      - Yes (+1)
      - I will rely on my cloud provider (+0,5)
  - **Incident & problem management: It provides capabilities for the capture of incident or problem reports. (3/10)**

- O6-Do you have a component for capturing the incidents or problems? (2/10)
    - No
    - I will rely on my cloud provider (+0,5)
    - Yes (+1)
        - O7-At which level:
            - Application level. How (+0,5)
            - Network level. How (+0,25)
            - Others (+0.25)

- *Business operational support components: (10/40)*
    - **Account Management**: contracts, subscriptions, service pricing (discounts), Customer data. (2,5/10)
        - BO1-Do you have /will you have a component for managing your cloud service customer relationships/account management?
            - Yes (2.5)
            - No
            - I will rely on my target platform (1)
    - **Subscription Management:** Recording of new, or changed subscription information (1,5/10)
        - BO2-Do you have/will you have a subscription management component?
    - **Billing: Metering and rating, and generation of invoices.(4/10)**
        - BO3-Do you/ will have a billing component?
            - Yes (2)
                - BO4-Which functionality/s does it support?
                    - Metering of the use of the service (+0,5)
                    - Rating of the use of the service(+0,5)
                    - Generation of invoices(+0,5)
                    - Transmission of invoices to the customer(+0,5)
            - No
    - **Accounts: Provider control (2/10)**
        - BO5-Do you have a component / API for receiving the charges/invoices of your platform provider?
            - Yes (2)

- No

Architectural and programming aspects of the application: (10/40)

- **Application Language**
  - OT1-The application to be migrated in which programming language was programmed?
    - Java
    - C#
- **Architecture (5/10)**
  - AP1-Is/will your application a (2/10)
    - Traditional client-server with a thick client (0)
    - Client Server with a thin client (2-3 tier architecture) (0.5)
    - Client server with a thin client (2-3 tier architecture with no usage or hardly usage of web services) (1)
    - Client-server with a thin client and usage of a SOA (1)
    - Multi instance (each customer has its own unique instance of the capability. It is the collection of customer of instance that makes it utility or Cloud-like in its provision) (1.5)
    - Multi-tenant (a single instance of some capability is shared by many customers) (2)
  - AP2-Is your application modeled? (3/10)
    - Yes (1,5)
      - AP3-Have you identified the following parts/components?
        - Logical set of component services that the application is based of: +0,5
          - Database: DBMS, OS, server tier.
          - Web application: Web application, web server, OS, Server, tier
        - Required artifacts (current scripts, files, software packages, etc) to deploy and install the application:+0,5
          - File artifact, script artifact, archive artifact, package artifact
        - Relationships that are able to describe the relationship types between the application

nodes.(connects to, depends on, hosted on…) +0,5

- No

- **Multi tenancy level & elasticity (5/10)**
  - AP4-What is your current level of multi-tenancy? (Note: 1 is the highest) (3/10)
    - Shared middleware with a single application instance (1)

    - Shared middleware with multiple application instances and shared address spaces (1.5)

    - Shared middleware with multiple application instances and separate address spaces (2)

- Virtualization with tenant specific virtual images (or Virtualization with a Mediation Layer) (2.5)

- Multiple instances on separate hardware (ASP) (3)

- AP5-Shall your future application a) have a component / self-made means to ensure its elasticity or b) be controlled by your chosen cloud provider? (2/10)
  - self-made means to ensure its elasticity: (+1)
    - Horizontal scaling
    - Auto-scaling
    - External Configuration Store
    - Runtime reconfiguration pattern
    - Circuit Breaker pattern
    - Pipes & filters
  - Database elasticity (+1)
    - Database sharding
    - Command and Query Responsibility Segregation
    - Event Sourcing Pattern
    - Index table pattern
    - Materialized view

- Controlled by your chosen cloud provider (0,5)

Other aspects:

- **Target platform**
  - OT2-Have you decided where you will place your migrated application?
    - No
    - Yes
      - OT3-Where?
        - Public Cloud
          - OT4-Which? GAE/AMAZON
        - Private Cloud
        - Hybrid

- **Non-functional properties /requirements**
  - OT5-Please check from the list the non-functional requirements most interesting for you:
    - SecurityPerformance efficiency:
    - Reliability
    - Cost
    - PortabilityScalability
    - Elasticity
    - Maintainability:
    - Usability: Compatibility
- **Additional Information**
  - OT6-Do you know the performance profile of the application ?
    - Yes
    - No
  - OT7-Does your application interoperate with any external tool?
    - Yes
    - No
  - OT8-Are unit tests of the legacy application available?
    - Yes

- No

- OT9. Do you have same storage technology on source and destination?
  - Yes
  - No
- OT10. Technology on source:
  - Relational Database
  - NoSQL Database

- OT11. Do you have same framework for data storage on source an destination?
  - Yes
  - No
- OT12. Technology on source:
  - JPA
  - Objectify
- OT13. Do you have same product for data storage on source and destination?
  - Yes
  - No

- OT14. Product on source:

  - Oracle
  - MySQL
  - Microsoft SQL Server
  - PostgreSQL
  - DB2
  - Other

- OT15. Stored procedures are being used?
  - Yes
  - No

- OT16. Data storage spcific functions are being used?
  - Yes

- No

BUSINESS DIMENSION: Maximum score 35

- *Pricing patterns: (5/35)*
    - **Pricing patterns**
        - P1-Which pricing model do you have?
            - Licenses / Perpetual (0)
            - Flat rate (fixed price) (+1)
            - Number of total users (+2)
            - Pay as you go: (+3)
            - Simultaneous users
                - Time
                - Transaction (DB queries, storage, …)
                - Feature (modules, functionality)
            - Fixed monthly fee + variable fee (3.5)
            - Peak Load (more expensive at certain hours of the day because the infrastructure is at its peak) (4)
            - Tiered model (each feature has a different price) (4)
            - Freemium (5)
                - Capacity-based: Customers are given a free version up to a capacity, usage, or number of users threshold
                - Feature-based: Customers are allowed to use a free version of the product which has certain key features locked until the customer converts to a paid customer.
                - Time-based: This is a typical free trial that expires after a fixed period.
                - Use-case: This is a less common model in which customers can use the offering for free provided they fall under certain specified categories (i.e. non-commercial use, educational, non-profit, etc.).
            - Feature - Limited (an initial set of functionalities are offered for a price and if the customer would like to have more, they have different prices)(4.5)
            - Various pricing models depending on the customer (5)

- *Business strategy (5)*
    - **Creation of the business plan for the new service offerings (3.5/5)**
        - BS1-Do you plan to...
            - create a business plan for the use of cloud services (0.5)
            - select and purchase of cloud service (s) from one or more cloud service providers(0.5)
            - track the use of the services and deal with accounting and financial management(0.5)
            - request of audit reports on the service(s) and the service provider(s), both before a purchase is completed and also periodically once the service is in use; (0.5)
            - handle billing/invoices received from the cloud service provider for the use made of cloud services; (0.5)
            - ensure that billing matches the actual usage of cloud services made by the consumer;
            - make payments to the cloud service provider; (0.5
            - keep accounts in relation to the use of cloud services. (0.5)
    - **Management of the business plan (1.5/5)**
        - BS2-Does the management of your business plan involve:
            - the offering of one or more cloud services to customers, (0.25)
            - handling both financial and technical aspects of the services, (0.25)
            - target customer set, (0.25)
            - management of contracts and SLAs, (0.25)
            - channels to market, sales targets, (0.25)
            - track the sales and service usage against the plan to ensure that financial targets are achieved for the cloud service provider. (0.25)

- *Customer relationship (4)*
    - **Customer relationship**
        - CR1-Does your customer relationships management involve...
            - the definition of the service offering; (0.5)

- the creation and maintenance content of a product catalogue; (0.5)
- the service marketing and customer acquisition; (0.5)
- providing the point of contact for the customer for all business matters; (0.5)
- discussing and resolving concerns or problems raised by the customer; (0.5)
- processing change requests (e.g. entitlement changes); (0.5)
- handling billing updates or challenges; (0.5)
- providing a channel for any requirements change requests from the customer. (0.5)

- *Financial management (5)*
  - **Provider accountability (2/5)**
    - FM1-Does your financial processing management involve...(2/5)
      - the management of the cloud provider's invoice for charges relating to the use of cloud services,(+1)
      - the receipt of payments from the cloud provider and their accounting,(+1)

  - **Own accountability (3/5)**
    - FM2-Does your financial processing management involve...(3/5)
      - the generation of the billing information or invoice to the cloud service customers relating to the use of cloud services, (+1)
      - the transmission of the billing information or invoice to the cloud service customer(+1)
      - the receipt of the payments by the customer(+1)

- *Account management (6)*
  - **Account management**
    - AM-Does your account management procedure provide capabilities for managing cloud service customer relationships, including:
      - management of contracts; (+1)

- subscriptions to cloud services; (+1)
- entitlements; (+1)
- service pricing, which may involve customer-specific terms such as discounts; (+1)
- cloud service customer data; (+1)
- and fulfilling the requirements for availability and security due to the importance and the sensitivity of the data related to customer accounts(+1)

- *Product catalogue (5)*
    - **Product catalogue**
        - PC1-Do you have a Product catalogue that provides capabilities for cloud service customers:
            - to browse a list of available service offerings which they can purchase, (+3)
            - plus a set of capabilities for the management of the content of the catalogue which are available to staff of the cloud service provider. (+2)
              N.B. Product catalogue entries consist of technical information about each of the service offerings (capabilities provided by the service, interface definitions for the service including available service operations, security information), plus related business information such as pricing or rating.

- *Regulatory (5)*
    - **Regulatory**
        - R1-Is your service compliant with regulatory frameworks such as:
            - National data protection laws (free text) (+1.5)
            - EC data protection laws (free text) (+1.5)
            - regulations on security (free text) (+1)
            - other (free text) (+1)

PROCESS DIMENSION: Maximum score 45

- *Customer relations process /problem resolution process (10/45)*
    - **Customer interaction (3/10) (Monitor customer request CCRA)**
        - CR1-Do you have a mechanism to communicate with the user? (1)

- Yes
    - CR2-This Point of contact with the user is: (multiple selection) (1)
        - Real time communication +0.25
        - By email +0.25
        - Helpdesk support +0.25
        - Webportals +0.25
- No (+0)

- CR3-Is customer satisfaction measured in some way? (2)
    - There is a defined process to measure customer satisfaction, but its implementation is not systematic +1
    - The customer satisfaction is analyze d, solutions if required are provided and communicate to the customer +2
    - Customer satisfaction is not measured +0

- **Incidence management and resolution (4/10) (perform initial problem analysis CCRA)**
    - CR41-Do you have a mechanism to record and solve the incidences?
        - Yes (2)
            - CR4-The incident log includes the following fields: (Multiple selection) (2)
                - Incidence categorization (often broken down into between two and four levels of sub-categories) (+ 0.2)
                - Incidence urgency & impact (+ 0.2)
                - Incidence prioritization(+ 0.2)
                - Identification of user(+ 0.2)
                - Description of symptoms(+ 0.2)
                - Incidence status (active, waiting, closed, etc.) (+ 0.2)
                - Support group/person to which the incidence is allocated(+ 0.2)
                - Related problem/Known Error(+ 0.2)
                - Activities undertaken to resolve the incidence(+ 0.2)
                - Resolution date and time (+ 0.2)

- NONE (+0)
- No (+0)

- CR5-This mechanism includes an escalation process? (2)
  - Yes
    - CR6-When the incidence should be escalated? (Multiple selection)
      - Escalation levels are defined and known (+0.5)
      - Escalation process is related to the incident impact & urgency (+1)
      - The resolution is propagated to all people involved (+0.5)
  - No (+0)

- *Financial management process (5/45)*
  - **Metering and rating the use of the services (2)**
    - FP1-Is it defined how and when the use of the services should be metering?
      - Yes (+1)
      - No (+0)
    - FP2-Are defined the pricing schedules (when, which discounts…) in the contract with the customer?
      - Yes (+1)
      - No (+0)
  - **Billing (3)**
    - FP3-The billing process is an automatic or non-automatic process that has into account the metering of the use of the services and the rating according to the contract with the customer?
      - Yes (+2)
      - No (+0)
    - FP4-Is there a monitoring with the account manager in order to check that the payments from the customer are according to the invoices
      - Yes (+1)
      - No (+0)

- *SLA Management (10/45)*
  - **SLA definition(6)**
    - SLA1-Is there a service level agreement (SLA-Service Level Agreement) that defines the services provided, as agreed between the service provider and the client? (1)
      - Yes (+1)
      - No (+0)
    - SLA2-Which of the following aspects are covered in your SLAs? (multiple choice each selection +0.2) (3)
      - Conditions under which the service is considered to be unavailable
      - Availability targets
      - Reliability targets
      - Maintainability targets
      - Down times for maintenance
      - Restrictions on maintenance, e.g. allowed maintenance windows, seasonal restrictions on maintenance, and procedures to announce planned service interruptions
      - Definitions of major incidents
      - Requirements regarding availability reporting
      - Response times from applications
      - Requirements for scalability (assumptions for the medium and long-term increase in workload and service utilization)
      - Requirements regarding capacity and performance reporting
      - Time within which a defined level of service must be re-established
      - Responsibilities: Duties of the service provider, of the customer and of service users (e.g. with respect to IT security)
      - IT Security aspects to be observed when using the service (if applicable, references to relevant IT Security Policies)

        - Pricing model: Cost for the service provision, rules for penalties/charge backs
    - SLA3-If the service provided depends, to some extent, on external suppliers, do you have an underpinning agreement?
        - Yes (+1)
        - No (+0)
    - SLA4-Do you periodically review the SLA definitions/conditions and the underpinning agreement?
        - Yes (+1)
        - No (+0)

- **Auditing &reporting (4)**
    - SLA5-During the service provisioning do you regularly review the service levels committed? (One option) (2)
        - Service levels are monitored regularly +2
        - Service levels are monitored but not in a systematic way +1
        - No control or review the levels of service provided +0
    - SLA6-Is there a mechanism in place to communicate the non-compliance with the SLA? (2)
        - There is a mechanism for informing of the problem and the actions to carried out +2
        - There is a mechanism for informing of the problem +1
        - There is no mechanism +0

- *Cloud Provider Management (5/45)*
    - **Requirements and agreement (2)**
        - CP1-Do you have formalized the agreement with the cloud provider in any way (the best way is to have a SLA agreement with the cloud provide) (2)
            - Yes (+2)
            - No (+0)
    - **Auditing and reporting (3)**
        - CP2-Do you monitor in a systematic way the fulfilment of the conditions and characteristics defined by the agreement? Most of

the cloud providers provide their own tools to facilitate the monitoring of their cloud services

- Yes (+1,5)
- No (+0)

- CP3-Do you report to the cloud provider the non-fulfilment in order to assure the correct operation of cloud service?
  - Yes (+1,5)
  - No (+0)

- *Development process (10/45) (CMMI for services &ITIL)*
  - **Development process (5)**
    - DP1-Do you have defined a development process for this kind of applications?
      - Yes (+1)
      - No (+0)
    - DP2-If yes, is the process you have defined an agile process?
      - Yes (+2)
      - No (+0)
    - DP3-If yes, do you have followed in a systematic way the following steps?
      - Select the requirements to be developed in the sprint.
      - Analysis and modelling.
      - Development.
      - Testing of functional and non-functional requirements.
      - Review and add if necessary the requirements.
      - Test and deploy the final application
        - Yes (+2)
        - Partially (+1)
        - No (+0)
  - **Update and maintenance process (5)**
    - DP4-Do you have a defined procedure where update mechanisms and frequency are defined? (once a year, every 6 months, persons/roles who update …)
      - Yes (+1)
      - No (+0)
    - DP5-Are people responsible for the updates defined?

- Yes (+1)
- No (+0)

- DP6-Do you have a maintenance process?
  - Yes (+3)
    i. DP7-This maintenance process covers the following activities: (multiple selection)
    ii. Corrective actions +1
    iii. Enhancements actions +1
    iv. Actions related to SLA noncompliance +1

  - No (+0)

- *Roles Alignment process (5/45) ITIL*
  - **Definition and adaptation of new roles (2)**
    - RA1-Select in the following list those activities you have done in order to adapt the roles of you organization to be cloud compliant (multiple choices)
      - Define new roles (i.e Service delivery management) +0.5
      - Review the existing ones and identify those that should have new functionalities +0.5
      - Define the responsibilities for the new and existing ones. +1
      - None +0
  - **Communication and training (3)**
    - RA2-Do you have Communicate the changes about roles? (2) (multiple choices)
      - To the affected people their new activities and responsibilities +1
      - To the entire organization the new and modified roles. +1
      - No +0
    - RA3-Which of the following actions do you carry out for training the affected? (1) (multiple choices)
      - Collect the requirements for new skills +0.25
      - Look for them in the organization. +0.25
      - Prepare a training plan +0.25
      - Train those people who are going to be assigned to the new or modified roles. +0.25

Annex 2.1: MAT ++ Questions Dependency Logic

Question	Depends on question	Dependency
S2	S1	S2 appears if S1 answer=yes
S4	S3	S4 appears if S3 answer=yes
S6	S5	S6 appears if S5 answer=yes
S8	S7	S8 appears if S7 answer=yes
O2	O1	O2 appears if O1 answer=yes
O4	O3	O4 appears if O3 answer=yes
O7	O6	O7 appears if O6 answer=yes
BO4	BO3	BO4 appears if BO3 answer=yes
AP3	AP2	AP3 appears if AP2 answer=yes
OT3	OT2	OT3 appears if OT2 answer=yes
OT4	OT3	OT4 appears if OT3 answer=public cloud
P2	P1	P2 appears if P1 answer=simultaneous users
P3	P1	P3 appears if P1 answer=Freemiun
CR2	CR1	CR2 appears if CR1 answer=yes
CR4	CR41	CR4 appears if CR41 answer=yes
CR6	CR5	CR6 appears if CR5 answer=yes
DP2	DP1	DP2 appears if DP1 answer=yes
DP3	DP2	DP3 appears if DP2 answer=yes
DP36	DP3	DP36 appears if DP3 answer= Test and deploy the final application

DP7	DP6	DP7 appears if DP6 answer=yes

Annex 2.2: MAT ++ Recommendations

Technical: Areas

Security: Sub-areas:

Authentication & Identity Management

If S1 ==No

R1-Incorporate access control capabilities to the service. Access control has to be applied to cloud services covering the ability of users to use particular functions. Access control involves authentications (through provision of checking of credentials) and authorization of an authenticated user to use specific functions.

This includes the need to incorporate:

- Authentication & identity management component that provides capabilities relating to user identities and the credentials required to authenticate users when they access the service and their administration and business capabilities.
- Federated identity management capabilities to permit users to employ the same identity and credentials to access multiple services, providing capabilities such as single sign on (i.e.saml)

These components / capabilities can be included in your application or they can be provided by the cloud environment provider.

If S1 ==Si & If S2 ==No

R2-You may include federated identity management capabilities to permit users to employ the same identity and credentials to access multiple services, providing capabilities such as single sign on (i.e.saml). This component/capabilities can be included in your application or it can be provided by the cloud environment provider

Authorization & Service Policy Management

If S3 ==No

R3-Incorporate capabilities for the control and application of authorization for users to access specific capabilities or data. Service policy management capabilities should be provided for the definition and application of security policies which relate to services. It is a need to design the access to the data and information so that particular tenants can only gain access to information about their own tenancy and about no other tenancy.

- **Data protection (Maximum 4/10)**

If S5 ==No

R4- Identify the sensitivity of your application data to the risk to the business of its leakage, loss or corruption, so you can establish which regulations your data should accomplish (PII-ISO/IEC 27018).

If S7 ==No

R5- Incorporate capabilities relating to the encryption of data, whether data at rest or data in motion. These capabilities should include encryption key management and encryption scheme selection. The encryption capabilities can be included in your application or provided by your cloud platform provider.

- *Operational support requirements: (10/40)*
    - **Monitoring and reporting** (3/10)

If O1==No

R6-Incorporate monitoring and reporting capabilities (through an own component or provided by the cloud platform provider) for:

- Monitoring the activities of the users such as access to capabilities, number of total accesses, time of use etc…
- Report and store the monitored data to analyze it afterwards.

All this information has to be aligned with the business model and the prizing model so that the information can be exploited to offer and quantify the different options inside the business model.

If O2==No

R7-Establish the information that is required to derive the prizing model, to be monitored.

All this information has to be aligned with the business model and the prizing model so that the information can be exploited to offer and quantify the different options inside the business model.

If O3==No

R8-Incorporate service policy management capabilities (through an own component inside your application/service or provided by the cloud platform provider) to define, store and retrieve policies that apply to your SaaS services. Policies should include:

- Business policies
- Technical policies
- Security policies

Some policies may be general and apply to a concrete service irrespective of the customer concerned. Other policies may be specific to a particular cutomer.

If O4==XXXX

If O5==No

R9-Incorporate capabilities for managing the service levels of your SaaS aiming at ensure that your service meets the requirements of the SLA which applies to specific service. These capabilities can be offered through an own component or through the cloud platform provider. This component shall provide the mechanisms to obtain monitoring information from the monitoring & reporting component in order to measure and record KPIs for the SaaS service, so the compliance of the SLA can be measured. This component should also have into account measures from cloud platform provider services if they affect the established SLA of your Saas.

If O5==I will rely on my cloud provider

R10-Check if your SLA description needs other metrics (internal to the service) apart from those provided by the target platform provided. If needed, incorporate the capabilities to compute those metrics.

If O6==No

R11-Incorporate the capabilities for capturing, management and resolution of incidents or problem reports. These incidents can be originated by problems in the cloud platform level provider or in the service itself.

- *Business operational support components : (10/40)*

If BO1==No

R12-Incorporate the capabilities for managing cloud service customer relationships (through an internal component or through the platform provider) including:

- Management of contracts
- Subscription to cloud services
- Entitlements
- Service pricing, which may involve customer-specific terms such as discounts
- Cloud service customer data

The account management component and its related database(s) are subject to stringent requirements for availability and security due to the importance and he sensitivity of the data related to customer accounts.

If BO1==I will rely on my platform provider.

R13- Check that the Cloud Provider include the following capabilities for managing the cloud service customer relationships:

- Management of contracts
- Subscription to cloud services

- Entitlements
- Service pricing, which may involve customer-specific terms such as discounts
- Cloud service customer data

If BO2==No

R14-Incorporate the capabilities to handle the subscriptions of SaaS service customers to particular and specific SaaS services, aiming to record new or changed subscription information from the customer and ensure the delivery of the subscribed service(s) to the customer.

If BO3==No

R15-Incorporate the capabilities for:

- Metering the use of the service by your customers, measuring the consumption of the services by each service customer.
- Rating the use of the service by your customers, by application of pricing schedules to the metering data. The form of the metering data depends on the nature of the service and the pricing schedules may involve customer-specific terms (i.e. discounts) and require algorithmic application against the metering data.
- Generation of invoices based on the charges for the use of the series created by the metering and rating function.
- Transmission of invoices to the service customers. Invoice data is also lodged with the account management component.

If BO5==No

R16-Incorporate a component that holds the capabilities relating accounting your platform provider.

Architectural and programming aspects of the application: (10/40)

If AP2 ==NO

R17- Model the application/service in order to identify :

Logical set of component services that the application is based of: +0,5

- Database: DBMS, OS, server tier.
- Web application: Web application, web server, OS, Server, tier

Required artifacts (actual scripts, files, software packages, etc) to deploy and install the application:

- File artifact, script artifact, archive artifact, package artifact

Relationships that are able to describe the relationship types between the application nodes.(connects to, depends on, hosted on…) +0,5

If AP4 current =! AP4 Future

R18-You have to re-design your application to transform it from AP4 current to AP4 future.

If AP5==No

R18- Applications under the SaaS model must be elastic, managing massive unpredictability of demand without incurring on unpredictable costs. Include in your application techniques and new architectural designs to incorporate:

Means to ensure its elasticity such as Horizontal scaling, Auto-scaling, External Configuration Store, Runtime reconfiguration pattern, Circuit Breaker pattern, Pipes & filters.

Means to support database elasticity such as Database sharding Command and Query Responsibility Segregation, Event Sourcing Pattern, Index table pattern, Materialized view.

If AP5==I will rely on my cloud provider

R19-Check that your cloud provider offers you means to ensure its elasticity such as Horizontal scaling, Auto-scaling, External Configuration Store, Runtime reconfiguration pattern, Circuit Breaker pattern, Pipes & filters and means to support database elasticity such as Database sharding Command and Query Responsibility Segregation, Event Sourcing Pattern, Index table pattern, Materialized view.

Standards explanation:

The Maturity Assessment Tool is born with the following objectives:

1) be a comprehensive tool for all stakeholders in the software industry whatever profile they may have (e.g. business-oriented, technical-oriented, process-oriented) to be able to decipher and describe the main characteristics of their application,

2) request information in a structured and clear way so that the respondents do not hesitate in giving the answers,

3) base it on standards widely adopted in the industry:

- For the technical point of view: ISO/IEC 17789:2014 (ISO/IEC JTC 1/SC 38 Distributed application platforms and services (DAPS), 2012) and OASIS TOSCA (Organization for the Advancement of Structured Information Standards (OASIS),, 2013), in addition to several best practices by IBM.

- For the business point of view: ISO/IEC 17789:2014 (ISO/IEC JTC 1/SC 38 Distributed application platforms and services (DAPS), 2012) and EFQM (EFQM, 2014).
- For the organizational process point of view: ISO/IEC 17789:2014 and ITIL (Osiatis ITIL Service Desk) (ITIL,, 2013) (Wikipedia, ITIL, 2014).

Based on the analysis of the different standards best practices, the dimensions and different areas are scored according to the answers given with respect to the compliance of those practices.

For more information please check the following document and tutorial:

- D5.1.2 More information about MAT
- D5.2.2 Tutorial

PROCESS DIMENSION

AREA: CUSTOMER RELATIONS PROCESS /PROBLEM RESOLUTION PROCESS

Subarea: Customer interaction

If CR1=NO

The objective of having a Communication mechanism is to provide a unique contact point to the user. The communication mechanism should be adapted to the type of user is going to be used the application or service. It is essential to define this communication mechanism and the infrastructure required for starting it.

IF CR1=yes → CR2

CR2

For taking the maximum advantage to the Communication mechanism, it is important to:

1.- Identify the target audience and the communication needs that they have. The organization could have different audiences and the way to communicate with them could be different.

2.- Evaluate on the bases of the needs which are the most appropriate communication channels and such as real communication, email, web portals.

3.- Assure that all the customer receive a prompt response to their concerns.

4.- Always use plain language when communicating. Ensure that the messages are clear, easily understandable, and readily available to clients.

CR3

By measuring and analyzing customer satisfaction, you can ensure that any strategies you put in place actually serve to improve your business and your services. By studying the attributes that contribute to high levels of customer satisfaction, you can refine your services to focus on improving the customer experience.

There are some main actions to carry out when putting in place a customer satisfaction measure mechanism:

1.- To establish the objectives and the dimensions you want to measure

2.- To analyze the responses. Use the data to validate your services and to improve business operations and customer satisfaction.

3.- Identify major issues that need to be addressed immediately for improving the customer satisfaction

Subarea: Incidence management and resolution

If CR4=NO

The idea of having a mechanism to record the incidence in a centered way is to restore the normal service operation as quickly as possible in order to minimize the adverse impact that a downtime may have on business operations, thus ensuring that the best possible levels of service quality and availability are maintained. For that reason, it is essential to have all the incidences that the customer communicate or those detected by the technical people identified and the most important information about them recorded.

If CR4=YES →CR5

CR5

For allowing solving all the incidences as quickly as possible it is important to maintain a correct record for each incidence.

These records could have several objectives:

1. To solve the incidences as soon as possible due to have all the relevant information collected and accessible.
2. To maintain inform the customer on the progress of the incidence and collect the feedback.
3. To have historical data that allow to solve potential incidence by consulting these records

IF CR6==NO

"Escalation" is often mentioned when dealing with Incident and Problem Management processes. Escalation Management is to bring order, structure, focused management attention and additional resources to those customer situations which could otherwise result in a high level of customer dissatisfaction and/or damage to the service provider's reputation. These are situations which could lead to significant loss of business or where significant costs may be incurred by IT Service Provider to resolve the customer situation.

The criterion to trigger an escalation depends on the organization or service provider. But it should be well defined.

IF CR6==YES→CR7

CR7

Escalations start with a Service Level Agreement (SLA) that defines the severity rules used in prioritizing incoming incidences, plus the response and resolution times promised according to severity. It's also necessary to prioritize support requests according to the impact on the business.

A possible matrix for defining the severity rules could be:

- Level 1: critical. Critical importance failure—mission-critical systems with a direct impact on the organization.
- Level 2: important . Single user or group outage that is preventing the affected user(s) from working.
- Level 3: normal. Single user or group outage that can be permanently or temporarily solved with a workaround
- Level 4: scheduled . Scheduled work

AREA: SLA MANAGEMENT

Subarea: SLA Definition

IF SLA1==NO

To have a good SLA is important because it sets boundaries and expectations for the following aspects:

- Customer commitments. Clearly defined promises reduce the chances of disappointing a customer. These promises also help to stay focused on customer requirements and assure that the internal processes follow the right direction.
- Key performance indicators for the customer service. By having these indicators established, it is easy to understand how they can be integrated in a quality improvement process By doing so, improved customer satisfaction stays a clear objective
- The price of non-conformance. If the SLA has penalties, non-performance can be costly. However, by having penalties defined, the customer understands that the provider truly believes in its ability to achieve the set performance levels. It makes the relationship clear and positive.

An SLA can comprise a few short pages up to a few hundred pages. The basic components are a statement of the parties' intent, an outline of the responsibilities of each party (including acceptable performance parameters with applicable metrics), a statement on the expected duration of the agreement, a description of the applications and services covered by the agreement, procedures for monitoring the service levels, a

schedule for remediation of outages and associated penalties, and problem-resolution procedures.

IF SLA1==YES→SLA2

SLA2

The SLA extends the service definition from the Service Catalogue, defining detailed service level targets, mutual responsibilities, and other requirements specific to a service provided for a certain (group of) customer(s). It focuses on the definition of requirements from a customer viewpoint.

Following you can find an example of Service Level Agreement Contents based on ITIL Standard. Depending on the type of services, some of these contents could be N/A.

Service name

Clearance information (with location and date)

- Service Level Manager
- Customer representative

Contract duration

- Start and end dates
- Rules regarding renewal and termination of the agreement (if applicable, also rules regarding early termination of the agreement)

Description/ desired customer outcome

- Business justification and benefits
- Business processes/ activities on the customer side supported by the service
- Desired outcome in terms of utility (example: "Field staff can access enterprise applications xxx and yyy without being constrained by location or time")
- Desired outcome in terms of warranty (example: "High availability required during office hours in locations …")

Communication between customer and service provider

- Responsible contact person on customer side with contact details
- Designated Business Relationship Manager on service provider side with contact details
- Service Reporting (contents and intervals of service reports to be produced by the service provider)
- Procedure for handling exceptions and complaints (e.g. details to be included in formal complaints, agreed response times, escalation procedure)
- Satisfaction surveys (description of the procedure for measuring customer satisfaction on a regular basis)

- Service Reviews (description of the procedure for reviewing the service with the customer on a regular basis)

Service and asset criticality

- Identification of business-critical assets connected with the service
- Vital Business Functions (VBFs) supported by the service
- Other critical assets used within the service (e.g. certain types of business data)
- Estimation of the business impact caused by a loss of the service or assets (in monetary terms, or using a classification scheme)

Service times

- Times when the service is required to be available
- Exceptions (e.g. weekends, public holidays)

Required types and levels of support

- On-site support
    - Area/ locations
    - Types of users
    - Types of infrastructure to be supported
    - Reaction and resolution times (according to priorities, definition of priorities e.g. for the classification of Incidents)
- Remote support
    - Area/ locations
    - Types of users (user groups granted access to the service)
    - Types of infrastructure to be supported
    - Reaction and resolution times (according to priorities, definition of priorities e.g. for the classification of Incidents)

Service level requirements/ targets

- Availability targets and commitments
    - Conditions under which the service is considered to be unavailable (e.g. if the service is offered at several locations)
    - Availability targets (exact definition of how the agreed availability levels will be calculated, based on agreed service time and downtime)
    - Reliability targets (required by some customers, usually defined as MTBF (Mean Time Between Failures) or MTBSI (Mean Time Between Service Incidents))

    - Maintainability targets (required by some customers, usually defined as MTRS (Mean Time to Restore Service))
    - Down times for maintenance (number of allowed down times, pre-notification periods)
    - Restrictions on maintenance, e.g. allowed maintenance windows, seasonal restrictions on maintenance, and procedures to announce planned service interruptions
    - Definitions of Major Incidents as well as Emergency Changes and Releases to resolve urgent issues, including procedures to announce unplanned service interruptions
    - Requirements regarding availability reporting
- Capacity/ performance targets and commitments
    - Required capacity (lower/upper limit) for the service, e.g.
        - Numbers and types of transactions
        - Numbers and types of users
        - Business cycles (daily, weekly) and seasonal variations
    - Response times from applications
    - Requirements for scalability (assumptions for the medium and long-term increase in workload and service utilization)
    - Requirements regarding capacity and performance reporting
- Service Continuity commitments (availability of the service in the event of a disaster)
    - Time within which a defined level of service must be re-established
    - Time within which normal service levels must be restored

Technical standards/ specification of the service interface

Mandated technical standards and specification of the technical service interface

Responsibilities

- Duties of the service provider
- Duties of the customer (contract partner for the service)
- Responsibilities of service users (e.g. with respect to IT security)
- IT Security aspects to be observed when using the service (if applicable, references to relevant IT Security Policies)

Pricing model

- Cost for the service provision
- Rules for penalties/ charge backs

IFSLA3==NO

If the service providers are dependent to some extent of external partners or suppliers, they cannot commit to meeting SLA targets unless the supplier´s performances underpin these targets. For that reason it is basic to have an Underpinning Contract. An underpinning contract is a contract between an IT service provider and a third party. The third Party provides goods or services that support delivery of an IT service to a customer. The underpinning contract defines targets and responsibilities that the service provider uses to determine service level targets and service level packages. This underpinning contract could be set up as an SLA between the organization and the third party provider.

SLA4

SLA must be considered as dynamically changed document, which should be periodically reviewed and changed in the following cases:

- external circumstances has been changed;
- customer's expectations and/or needs has been changed;
- working performance has been changed;
- better means or methods of performance measurement has been appeared.

Subarea: Auditing & reporting

IF SLA5==b or SLA5==c and SLA6==b or SLA6==C

In order to improve the customer satisfaction and to have the services under control, it is recommended to check regularly if the different commitments of the SLA are fulfilled. Ideally this task of monitoring should be detailed in the SLA including issues such as:

- How often the monitoring is carried out? Continuously, daily, weekly
- Which are the boundaries for alerting that something is wrong
- Which are the penalties
- How the potential non-compliances are going to be communicate to the user or vice versa.
- Who should be informed depending on the cause of the non-compliance: Technical people, customer, business manager and so on.

AREA: CLOUD PROVIDER MANAGEMENT

Subarea: Requirements and agreement

IF CP1==NO

In case your application required an external cloud provider for running it is important to formalize an agreement with him. The ideal way to do it is through a SLA with the cloud

provider. The Cloud Provider SLA could follow the same structure that the SLA you sign with the customer. It is important to deal with the following issues:

- Performance Service Level Objectives related to the performance of the cloud service and the performance of related aspects of the interface between the cloud service customer and the cloud service provider:
- Security Service Level Objectives: specifying measurable security level objectives in SLAs is useful to improve both assurance and transparency. At the same time, it allows for establishing a common semantics in order to manage cloud security from two perspectives, namely (i) the security level being offered by a cloud service provider and, (ii) the security level requested by a cloud service customer.
- Data Management Service Level Objectives As companies transition to cloud computing, the traditional methods of securing and managing data are challenged by cloud-based architectures. Elasticity, multi-tenancy, new physical and logical architectures, and abstracted controls require new data security strategies. These requirements should be clarified.

Subarea: Auditing and reporting

CP2 &CP3

As in the case of the SLAs the cloud provider SLAs should be monitored and the non-fulfilment reported in order to assure that the application that you have hosted in this cloud provider runs in an appropriate way and you can commit with your customers.

The most of the Cloud providers offer their own tools for monitoring and reporting the non-compliance. Use these tools could facilitate you to manage the monitoring and reporting activities.

AREA: DEVELOPEMNT PROCESS

Subarea: Development Process

IF DP1==yes or No and DP2=no

To have implemented an agile methodology for development SaaS application is the best option due to several reasons:

- The iterative nature of agile development means features are delivered incrementally, enabling some benefits to be realized early as the product continues to develop.
- Research suggests about 80% of all market leaders were first to market. As well as the higher revenue from incremental delivery, agile development philosophy also supports the notion of early and regular releases, and ‘perpetual.

- Agile development principles encourage active ‘user’ involvement throughout the product’s development and a very cooperative collaborative

One of the most common agile methodologies is called SCRUM. It is no required to implement SCRUM methodology rigorously, but to implement at least some of their principles. Scrum organizes the development in SPRINT. During each SPRINT a set of requirement should be implemented (This means: Analyze d, modeled, developed and tested). Once this set is implemented, the development team should start with the following according to the periodization. Once all the requirements are implemented; these should be reviewed in order to look for additional requirements. If no more requirement the application should be deployed.

Subarea: Update and maintenance process

If DP4==No or DP6==No

One of the beauties of SaaS applications is that new upgrades for corrective maintenance of for adding new functionalities are often accessible over the web. Unlike their on-premise predecessors, these applications support rapid deployment and redeployment of new releases —ranging between two and five new releases annually (some providers have continual rolling updates, so new fixes and features can appear almost weekly).

Your organization will benefit by identifying a consistent process by which to manage the frequent releases of SaaS upgrades to aid in quality control and to help in deploying applications consistently. Such a process can also alleviate the errors and integration missteps that can occur with software upgrades. The rationale for this planning and documentation is not only the ongoing maintenance and management of the system, but it can also serve as a focal point for continuous improvement.

AREA: ROLES ALIGNMENT PROCESS

Subarea: Definition and adaptation of new roles

IF RA1 == None

It is essential to define the roles and responsibilities within the organization and to review the existing ones in order to cover all the activities created with the new business model.

It is required to study the new functions essential for the business and look for these capabilities in the team. Some of these new functionalities could be:

- Management of the cloud provider
- Management of the SLA with the customer.
- Incidence resolution

If new roles are necessary for covering these functionalities, they should have assigned activities and responsibilities, and those should be known by all the people involved and communicated to all the organization.

Annex 3: Cost-Benefit Analysis (CBA)

Annex 3.1 CBA template

Input data

Category	In €
Cost reduction or avoidance	
Error reduction	
Increased flexibility to customize solutions	
Savings for not having to travel to install the solution	
Savings for not having to maintain several versions of an application for different environments	
Improvement in management planning and control	
Savings for reusing code	
Other	
Other	
Other	
Total Tangible Benefits	0,00 €

Tangible One-Time Costs	
Category	In €
Development costs	
Creation of the new IaaS (in the case of a private cloud)	
New software licenses	
User training	
Adequation and institutionalisation of the organizational processes	
Other	
Other	
Other	
Total Tangible One-Time Costs	0,00 €

Tangible Recurring Costs

Category	In €
Application software maintenance and update	
IaaS Maintenance (in the case of a private cloud)	
Cloud provider (in case of a public cloud provider)	
New application functionalities	
Marketing	
Helpdesk service	
Customer service	
Other	
Other	
Other	
Other	
Total Tangible Recurring Costs	0,00 €

Break even analysis

Break Even Analysis					
Costs of Existing System	Year 1	Year 2	Year 3	Year 4	Year 5
Development costs					
Hardware					
Operational costs					
Maintenance costs					
Total Cost of Existing System	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Costs of Proposed Migrated System	Year 1	Year 2	Year 3	Year 4	Year 5
One time-costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Development costs					
Creation of the new IaaS (in the case of a private cloud)					
New software licenses					
User training					
Adequation and institutionalisation of the organizational processes					
Other					
Other					
Other					
Recurring costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Application software maintenance and update					
IaaS Maintenance (in the case of a private cloud)					
Cloud provider (in case of a public cloud provider)					
New application functionalities					
Marketing					
Helpdesk service					
Customer service					
Other					
Other					
Other					
Total Cost of Proposed System	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Costs of System developed from scratch	Year 1	Year 2	Year 3	Year 4	Year 5

Development costs					
Operational costs					
Maintenance costs					
Cloud provider costs (on a public provider)					
IaaS setup (for a private cloud)					
Total Cost of Proposed System	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €

Payback analysis

Payback analysis					
Benefits of option	Year 1	Year 2	Year 3	Year 4	Year 5
Cost reduction or avoidance					
Error reduction					
Increased flexibility to customize solutions					
Savings for not having to travel to install the solution					
Savings for not having to maintain several versions of an application for different environments					
Improvement in management planning and control					
Savings for reusing code					
Total Benefits	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Costs of option	Year 1	Year 2	Year 3	Year 4	Year 5
One time-costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Development costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Creation of the new IaaS (in the case of a private cloud)	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
New software licenses	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
User training	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Adequation and institutionalisation of the organizational processes	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Other	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Other	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Other	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Recurring costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Application software maintenance and update	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
IaaS Maintenance (in the case of a private cloud)	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Cloud provider (in case of a public cloud provider)	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
New application functionalities	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €

Marketing	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Helpdesk service	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Customer service	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Other	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Total Costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Net benefits/costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Cumulative benefits/costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Payback	N/A	Years			

NPV

Cost Benefit Analysis using Present Value (5%)					
Benefits of option	Year 1	Year 2	Year 3	Year 4	Year 5
Cost reduction or avoidance	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Error reduction	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Increased flexibility to customize solutions	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Savings for not having to travel to install the solution	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Savings for not having to maintain several versions of an application for different environments	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Improvement in management planning and control	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Savings for reusing code	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Total Benefits	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Costs of option	Year 1	Year 2	Year 3	Year 4	Year 5
One time costs					
Development costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Creation of the new IaaS (in the case of a private cloud)	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
New software licenses	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
User training	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Adequation and institutionalisation of the organizational processes	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Recurring costs					
Application software maintenance and update	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
IaaS Maintenance (in the case of a private cloud)	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Cloud provider (in case of a public cloud provider)	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
New application functionalities	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Marketing	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Helpdesk service	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Customer service	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €

Other	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Total Costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Net benefits/costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Cumulative benefits/costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Net benefits/cost (NPV @ 5%)	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Cumulative NPV	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €

NPV – ROI

YEAR OF PROJECT	0	1	2	3	4	5	Total
Net economic benefit	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	
Discount rate (5%)	1,00 €	0,95 €	0,91 €	0,86 €	0,82 €	0,78 €	
PV of Benefits	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	
NPV of all BENEFITS	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
One-time COSTS	0,00 €						
Recurring Costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	
Discount rate (5%)	1,00 €	0,95 €	0,91 €	0,86 €	0,82 €	0,78 €	
PV of Costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	
NPV of all COSTS	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Cummulative Difference	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	
ROI							

Annex 3.2 Proof – of – concept A Cost-Benefit analysis

Input data

Tangible Benefits	
Category	**In €**
Cost reduction or avoidance	2.000,00 €
Error reduction	2.400,00 €
Increased flexibility to customize solutions	1.000,00 €
Savings for not having to travel to install the solution	1.400,00 €
Savings for not having to maintain several versions of an application for different environments	0,00 €
Improvement in management planning and control	1.800,00 €
Savings for reusing code	0,00 €
Total Tangible Benefits	**8.600,00 €**
Tangible One-Time Costs	
Category	**In €**
Development costs	15.500,00 €
Creation of the new IaaS (in the case of a private cloud)	3.500,00 €
New software licenses	0,00 €
User training	0,00 €
Adequation and institutionalisation of the organizational processes	0,00 €
Total Tangible One-Time Costs	**19.000,00 €**
Tangible Recurring Costs	
Category	**In €**

Application software maintenance and update	1.200,00 €
IaaS Maintenance (in the case of a private cloud)	300,00 €
Cloud provider (in case of a public cloud provider)	0,00
New application functionalities	0,00
Marketing	0,00
Helpdesk service	0,00
Customer service	0,00
Total Tangible Recurring Costs	**1.500,00 €**

Breakeven analysis

Break Even Analysis					
Costs of Existing System	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Development costs	7.000,00 €	8.000,00 €	9.000,00 €	9.000,00 €	10.000,00 €
Hardware	1.000,00 €	1.100,00 €	1.200,00 €	1.300,00 €	1.400,00 €
Operational costs	480,00 €	900,00 €	1.500,00 €	2.200,00 €	2.900,00 €
Maintenance costs	400,00 €	800,00 €	1.500,00 €	2.200,00 €	3.300,00 €
Total Cost of Existing System	**8.880,00 €**	**10.800,00 €**	**13.200,00 €**	**14.700,00 €**	**17.600,00 €**
Costs of Proposed Migrated System	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
One time-costs	**19.000,00 €**	**0,00 €**	**0,00 €**	**0,00 €**	**0,00 €**
Development costs	15.500,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Creation of the new IaaS (in the case of a private cloud)	3.500,00 €	0,00 €	0,00 €	0,00 €	0,00 €
New software licenses	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
User training	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Adequation and institutionalisation of the organizational processes	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Recurring costs	**1.500,00 €**	**6.500,00 €**	**1.100,00 €**	**1.100,00 €**	**1.100,00 €**
Application software maintenance and update	1.200,00 €	6.100,00 €	600,00 €	600,00 €	600,00 €
IaaS Maintenance (in the case of a private cloud)	300,00 €	400,00 €	500,00 €	500,00 €	500,00 €
Cloud provider (in case of a public cloud provider)	0,00 €				
New application functionalities	0,00 €				
Marketing	0,00 €				
Helpdesk service	0,00 €				
Customer service	0,00 €				
Total Cost of Proposed System	**20.500,00 €**	**6.500,00 €**	**1.100,00 €**	**1.100,00 €**	**1.100,00 €**

Payback analysis

Benefits of option	Year 1	Year 2	Year 3	Year 4	Year 5
Cost reduction or avoidance	2.000,00 €	2.200,00 €	2.400,00 €	2.600,00 €	2.800,00 €
Error reduction	2.400,00 €	2.640,00 €	2.880,00 €	3.120,00 €	3.360,00 €
Increased flexibility to customize solutions	1.000,00 €	1.100,00 €	1.200,00 €	1.300,00 €	1.400,00 €
Savings for not having to travel to install the solution	1.400,00 €	1.540,00 €	1.680,00 €	1.820,00 €	1.960,00 €
Savings for not having to maintain several versions of an application for different environments	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Improvement in management planning and control	1.800,00 €	1.980,00 €	2.160,00 €	2.340,00 €	2.520,00 €
Savings for reusing code	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Total Benefits	**8.600,00 €**	**9.460,00 €**	**10.320,00 €**	**11.180,00 €**	**12.040,00 €**
Costs of option	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
One time-costs	**19.000,00 €**	**0,00 €**	**0,00 €**	**0,00 €**	**0,00 €**
Development costs	15.500,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Creation of the new IaaS (in the case of a private cloud)	3.500,00 €	0,00 €	0,00 €	0,00 €	0,00 €
New software licenses	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
User training	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Adequation and institutionalisation of the organizational processes	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Recurring costs	**1.500,00 €**	**6.500,00 €**	**1.100,00 €**	**1.100,00 €**	**1.100,00 €**
Application software maintenance and update	1.200,00 €	6.100,00 €	600,00 €	600,00 €	600,00 €
IaaS Maintenance (in the case of a private cloud)	300,00 €	400,00 €	500,00 €	500,00 €	500,00 €
Cloud provider (in case of a public cloud provider)	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
New application functionalities	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Marketing	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Helpdesk service	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Customer service	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Total Costs	**22.000,00 €**	**13.000,00 €**	**2.200,00 €**	**2.200,00 €**	**2.200,00 €**
Net benefits/costs	-13.400,00 €	-3.540,00 €	8.120,00 €	8.980,00 €	9.840,00 €
Cumulative benefits/costs	-13.400,00 €	-16.940,00 €	-8.820,00 €	160,00 €	10.000,00 €
Payback	3,98	Years			

Present Value

Cost Benefit Analysis using Present Value (5%)					
Benefits of option	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Cost reduction or avoidance	2.000,00 €	2.200,00 €	2.400,00 €	2.600,00 €	2.800,00 €
Error reduction	2.400,00 €	2.640,00 €	2.880,00 €	3.120,00 €	3.360,00 €
Increased flexibility to customize solutions	1.000,00 €	1.100,00 €	1.200,00 €	1.300,00 €	1.400,00 €
Savings for not having to travel to install the solution	1.400,00 €	1.540,00 €	1.680,00 €	1.820,00 €	1.960,00 €
Savings for not having to maintain several versions of an application for different environments	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Improvement in management planning and control	1.800,00 €	1.980,00 €	2.160,00 €	2.340,00 €	2.520,00 €
Savings for reusing code	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
0	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
0	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Total Benefits	**8.600,00 €**	**9.460,00 €**	**10.320,00 €**	**11.180,00 €**	**12.040,00 €**
Costs of option	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
One time costs					
Development costs	15.500,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Creation of the new IaaS (in the case of a private cloud)	3.500,00 €	0,00 €	0,00 €	0,00 €	0,00 €
New software licenses	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
User training	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Adequation and institutionalisation of the organizational processes	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Recurring costs					
Application software maintenance and update	1.200,00 €	6.100,00 €	600,00 €	600,00 €	600,00 €
IaaS Maintenance (in the case of a private cloud)	300,00 €	400,00 €	500,00 €	500,00 €	500,00 €
Cloud provider (in case of a public cloud provider)	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
New application functionalities	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Marketing	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Helpdesk service	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Customer service	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Total Costs	**20.500,00 €**	**6.500,00 €**	**1.100,00 €**	**1.100,00 €**	**1.100,00 €**
Net benefits/costs	-11.900,00 €	2.960,00 €	9.220,00 €	10.080,00 €	10.940,00 €
Cumulative benefits/costs	-11.900,00 €	-8.940,00 €	280,00 €	10.360,00 €	21.300,00 €
Net benefits/cost (NPV @ 5%)	-11.333,33 €	2.684,81 €	7.964,58 €	8.292,84 €	8.571,78 €
Cumulative NPV	-11.333,33 €	-8.648,53 €	-683,94 €	7.608,90 €	16.180,67 €

Annex 3.3 Proof – of – concept B Cost-Benefit analysis

Input data

Tangible Benefits	
Category	**In €**
Cost reduction or avoidance	10.000,00 €
Error reduction	22.000,00 €
Increased flexibility to customize solutions	8.500,00 €
Savings for not having to travel to install the solution	10.000,00 €
Savings for not having to maintain several versions of an application for different environments	15.000,00 €
Improvement in management planning and control	0,00 €
Savings for reusing code	0,00 €
Total Tangible Benefits	**65.500,00 €**
Tangible One-Time Costs	
Category	**In €**
Development costs	45.000,00 €
Creation of the new IaaS (in the case of a private cloud)	5.000,00 €
New software licenses	0,00 €
User training	0,00 €
Adequation and institutionalisation of the organizational processes	20.000,00 €
Total Tangible One-Time Costs	**70.000,00 €**
Tangible Recurring Costs	
Category	**In €**
Application software maintenance and update	12.000,00 €
IaaS Maintenance (in the case of a private cloud)	22.000,00 €
Cloud provider (in case of a public cloud provider)	0,00 €
New application functionalities	4.000,00 €
Marketing	4.000,00 €
Helpdesk service	5.000,00 €
Customer service	0,00 €
Total Tangible Recurring Costs	**47.000,00 €**

Breakeven analysis

Break Even Analysis					
Costs of Existing System	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Development costs	65.000,00 €	45.000,00 €			
Hardware	5.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Operational costs	0,00 €	10.000,00 €	10.000,00 €	10.000,00 €	10.000,00 €
Maintenance costs	0,00 €	22.500,00 €	22.500,00 €	22.500,00 €	22.500,00 €
Total Cost of Existing System	**70.000,00 €**	**77.500,00 €**	**32.500,00 €**	**32.500,00 €**	**32.500,00 €**
Costs of Proposed Migrated System	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
One time-costs	**55.000,00 €**	**0,00 €**	**0,00 €**	**0,00 €**	**0,00 €**
Development costs	45.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €

Creation of the new IaaS (in the case of a private cloud)	5.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €
New software licenses	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
User training	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Adequation and institutionalisation of the organizational processes	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Hardware	5.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €
0,00 €		0,00 €	0,00 €	0,00 €	0,00 €
0,00 €		0,00 €	0,00 €	0,00 €	0,00 €
Recurring costs	**47.000,00 €**	**22.500,00 €**	**22.500,00 €**	**22.500,00 €**	**22.500,00 €**
Application software maintenance and update	12.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €
IaaS Maintenance (in the case of a private cloud)	22.000,00 €	5.000,00 €	5.000,00 €	5.000,00 €	5.000,00 €
Cloud provider (in case of a public cloud provider)	0,00 €				
New application functionalities	4.000,00 €	6.500,00 €	6.500,00 €	6.500,00 €	6.500,00 €
Marketing	4.000,00 €	5.000,00 €	5.000,00 €	5.000,00 €	5.000,00 €
Helpdesk service	5.000,00 €	4.000,00 €	4.000,00 €	4.000,00 €	4.000,00 €
Customer service	0,00 €				
Total Cost of Proposed System	**102.000,00 €**	**22.500,00 €**	**22.500,00 €**	**22.500,00 €**	**22.500,00 €**

Payback analysis

Benefits of option	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Cost reduction or avoidance	10.000,00 €	11.000,00 €	12.000,00 €	13.000,00 €	14.000,00 €
Error reduction	22.000,00 €	24.200,00 €	26.400,00 €	28.600,00 €	24.200,00 €
Increased flexibility to customize solutions	8.500,00 €	9.350,00 €	10.200,00 €	11.050,00 €	11.900,00 €
Savings for not having to travel to install the solution	10.000,00 €	11.000,00 €	12.000,00 €	13.000,00 €	15.000,00 €
Savings for not having to maintain several versions of an application for different environments	15.000,00 €	16.500,00 €	18.000,00 €	19.500,00 €	24.000,00 €
Improvement in management planning and control	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Savings for reusing code	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Total Benefits	**65.500,00 €**	**72.050,00 €**	**78.600,00 €**	**85.150,00 €**	**89.100,00 €**
Costs of option	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
One time-costs	**55.000,00 €**	**0,00 €**	**0,00 €**	**0,00 €**	**0,00 €**
Development costs	45.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €

Creation of the new IaaS (in the case of a private cloud)	5.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €
New software licenses	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
User training	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Adequation and institutionalisation of the organizational processes	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Hardware	5.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €
0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Recurring costs	**47.000,00 €**	**22.500,00 €**	**22.500,00 €**	**22.500,00 €**	**22.500,00 €**
Application software maintenance and update	12.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €
IaaS Maintenance (in the case of a private cloud)	22.000,00 €	5.000,00 €	5.000,00 €	5.000,00 €	5.000,00 €
Cloud provider (in case of a public cloud provider)	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
New application functionalities	4.000,00 €	6.500,00 €	6.500,00 €	6.500,00 €	6.500,00 €
Marketing	4.000,00 €	5.000,00 €	5.000,00 €	5.000,00 €	5.000,00 €
Helpdesk service	5.000,00 €	4.000,00 €	4.000,00 €	4.000,00 €	4.000,00 €
Customer service	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Total Costs	**149.000,00 €**	**45.000,00 €**	**45.000,00 €**	**45.000,00 €**	**45.000,00 €**
Net benefits/costs	-83.500,00 €	27.050,00 €	33.600,00 €	40.150,00 €	44.100,00 €
Cumulative benefits/costs	-83.500,00 €	-56.450,00 €	-22.850,00 €	17.300,00 €	61.400,00 €
Payback	3,57	Years			

Present Value

Cost Benefit Analysis using Present Value (5%)					
Benefits of option	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Cost reduction or avoidance	10.000,00 €	11.000,00 €	12.000,00 €	13.000,00 €	14.000,00 €
Error reduction	22.000,00 €	24.200,00 €	26.400,00 €	28.600,00 €	24.200,00 €
Increased flexibility to customize solutions	8.500,00 €	9.350,00 €	10.200,00 €	11.050,00 €	11.900,00 €
Savings for not having to travel to install the solution	10.000,00 €	11.000,00 €	12.000,00 €	13.000,00 €	15.000,00 €
Savings for not having to maintain several versions of an application for different environments	15.000,00 €	16.500,00 €	18.000,00 €	19.500,00 €	24.000,00 €
Improvement in	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €

management planning and control					
Savings for reusing code	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
0	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
0	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Total Benefits	**65.500,00 €**	**72.050,00 €**	**78.600,00 €**	**85.150,00 €**	**89.100,00 €**
Costs of option	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
One time costs					
Development costs	45.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Creation of the new IaaS (in the case of a private cloud)	5.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €
New software licenses	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
User training	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Adequation and institutionalisation of the organizational processes	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Hardware	5.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €
0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Recurring costs					
Application software maintenance and update	12.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €
IaaS Maintenance (in the case of a private cloud)	22.000,00 €	5.000,00 €	5.000,00 €	5.000,00 €	5.000,00 €
Cloud provider (in case of a public cloud provider)	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
New application functionalities	4.000,00 €	6.500,00 €	6.500,00 €	6.500,00 €	6.500,00 €
Marketing	4.000,00 €	5.000,00 €	5.000,00 €	5.000,00 €	5.000,00 €
Helpdesk service	5.000,00 €	4.000,00 €	4.000,00 €	4.000,00 €	4.000,00 €
Customer service	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Total Costs	**102.000,00 €**	**22.500,00 €**	**22.500,00 €**	**22.500,00 €**	**22.500,00 €**
Net benefits/costs	-36.500,00 €	49.550,00 €	56.100,00 €	62.650,00 €	66.600,00 €
Cumulative benefits/costs	-36.500,00 €	13.050,00 €	69.150,00 €	131.800,00 €	198.400,00 €
Net benefits/cost (NPV @ 5%)	-34.761,90 €	44.943,31 €	48.461,29 €	51.542,31 €	52.182,84 €
Cumulative NPV	-34.761,90 €	10.181,41 €	58.642,70 €	110.185,01 €	162.367,85 €

Annex 3.4 Proof – of – concept C Cost-Benefit analysis

Input data

Tangible Benefits	
Category	**In €**
Cost reduction or avoidance	6.000,00 €
Error reduction	10.000,00 €
Increased flexibility to customize solutions	3.000,00 €
Savings for not having to travel to install the solution	1.500,00 €
Savings for not having to maintain several versions of an application for different environments	3.000,00 €
Improvement in management planning and control	2.000,00 €
Savings for reusing code	3.000,00 €
Total Tangible Benefits	**28.500,00 €**
Tangible One-Time Costs	
Category	**In €**
Development costs	30.000,00 €
Creation of the new IaaS (in the case of a private cloud)	4.000,00 €
New software licenses	100,00 €
User training	1.000,00 €
Adequation and institutionalisation of the organizational processes	3.000,00 €
Total Tangible One-Time Costs	**38.100,00 €**
Tangible Recurring Costs	
Category	**In €**
Application software maintenance and update	0,00 €
IaaS Maintenance (in the case of a private cloud)	2.000,00 €
Cloud provider (in case of a public cloud provider)	0,00 €
New application functionalities	2.000,00 €
Marketing	1.000,00 €
Helpdesk service	3.000,00 €
Customer service	2.000,00 €
Total Tangible Recurring Costs	**10.000,00 €**

Breakeven Analysis

Break Even Analysis					
Costs of Existing System	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Development costs	15.000,00 €	18.000,00 €	18.000,00 €	18.000,00 €	18.000,00 €
Hardware	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Operational costs	10.000,00 €	12.000,00 €	15.000,00 €	18.000,00 €	21.000,00 €
Maintenance costs	50.000,00 €	51.000,00 €	53.000,00 €	56.000,00 €	59.000,00 €
Total Cost of Existing System	**75.000,00 €**	**81.000,00 €**	**86.000,00 €**	**92.000,00 €**	**98.000,00 €**
Costs of Proposed Migrated System	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
One time-costs	**38.100,00 €**	**0,00 €**	**0,00 €**	**0,00 €**	**0,00 €**

Development costs	30.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Creation of the new IaaS (in the case of a private cloud)	4.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €
New software licenses	100,00 €	0,00 €	0,00 €	0,00 €	0,00 €
User training	1.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Adequation and institutionalisation of the organizational processes	3.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Recurring costs	**10.000,00 €**	**12.000,00 €**	**12.000,00 €**	**12.000,00 €**	**12.000,00 €**
Application software maintenance and update	0,00 €	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €
IaaS Maintenance (in the case of a private cloud)	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €
Cloud provider (in case of a public cloud provider)	0,00 €				
New application functionalities	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €
Marketing	1.000,00 €	1.000,00 €	1.000,00 €	1.000,00 €	1.000,00 €
Helpdesk service	3.000,00 €	3.000,00 €	3.000,00 €	3.000,00 €	3.000,00 €
Customer service	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €
Total Cost of Proposed System	**48.100,00 €**	**12.000,00 €**	**12.000,00 €**	**12.000,00 €**	**12.000,00 €**

Payback Analysis

Benefits of option	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Cost reduction or avoidance	6.000,00 €	6.600,00 €	7.200,00 €	7.800,00 €	8.400,00 €
Error reduction	10.000,00 €	11.000,00 €	12.000,00 €	13.000,00 €	14.000,00 €
Increased flexibility to customize solutions	3.000,00 €	3.300,00 €	3.600,00 €	3.900,00 €	4.200,00 €
Savings for not having to travel to install the solution	1.500,00 €	1.500,00 €	1.800,00 €	1.950,00 €	2.100,00 €
Savings for not having to maintain several versions of an application for different environments	3.000,00 €	3.300,00 €	3.600,00 €	3.900,00 €	4.200,00 €
Improvement in management planning and control	2.000,00 €	2.200,00 €	2.400,00 €	2.600,00 €	2.800,00 €
Savings for reusing code	3.000,00 €	3.000,00 €	3.000,00 €	3.000,00 €	3.000,00 €
Total Benefits	**28.500,00 €**	**30.900,00 €**	**33.600,00 €**	**36.150,00 €**	**38.700,00 €**
Costs of option	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
One time-costs	**38.100,00 €**	**0,00 €**	**0,00 €**	**0,00 €**	**0,00 €**
Development costs	30.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Creation of the new IaaS (in the case of a private cloud)	4.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €
New software licenses	100,00 €	0,00 €	0,00 €	0,00 €	0,00 €
User training	1.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Adequation and institutionalisation of the	3.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €

organizational processes					
0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Recurring costs	**10.000,00 €**	**12.000,00 €**	**12.000,00 €**	**12.000,00 €**	**12.000,00 €**
Application software maintenance and update	0,00 €	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €
IaaS Maintenance (in the case of a private cloud)	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €
Cloud provider (in case of a public cloud provider)	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
New application functionalities	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €
Marketing	1.000,00 €	1.000,00 €	1.000,00 €	1.000,00 €	1.000,00 €
Helpdesk service	3.000,00 €	3.000,00 €	3.000,00 €	3.000,00 €	3.000,00 €
Customer service	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €
0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Total Costs	**58.100,00 €**	**24.000,00 €**	**24.000,00 €**	**24.000,00 €**	**24.000,00 €**
Net benefits/costs	-29.600,00 €	6.900,00 €	9.600,00 €	12.150,00 €	14.700,00 €
Cumulative benefits/costs	-29.600,00 €	-22.700,00 €	-13.100,00 €	-950,00 €	13.750,00 €
Payback	4,06	Years			

Present Value

Benefits of option	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Cost reduction or avoidance	6.000,00 €	6.600,00 €	7.200,00 €	7.800,00 €	8.400,00 €
Error reduction	10.000,00 €	11.000,00 €	12.000,00 €	13.000,00 €	14.000,00 €
Increased flexibility to customize solutions	3.000,00 €	3.300,00 €	3.600,00 €	3.900,00 €	4.200,00 €
Savings for not having to travel to install the solution	1.500,00 €	1.500,00 €	1.800,00 €	1.950,00 €	2.100,00 €
Savings for not having to maintain several versions of an application for different environments	3.000,00 €	3.300,00 €	3.600,00 €	3.900,00 €	4.200,00 €
Improvement in management planning and control	2.000,00 €	2.200,00 €	2.400,00 €	2.600,00 €	2.800,00 €
Savings for reusing code	3.000,00 €	3.000,00 €	3.000,00 €	3.000,00 €	3.000,00 €
0	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
0	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Total Benefits	**28.500,00 €**	**30.900,00 €**	**33.600,00 €**	**36.150,00 €**	**38.700,00 €**
Costs of option	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
One time costs					
Development costs	30.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Creation of the new IaaS (in the case of a private cloud)	4.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €

New software licenses	100,00 €	0,00 €	0,00 €	0,00 €	0,00 €
User training	1.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Adequation and institutionalisation of the organizational processes	3.000,00 €	0,00 €	0,00 €	0,00 €	0,00 €
0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Recurring costs					
Application software maintenance and update	0,00 €	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €
IaaS Maintenance (in the case of a private cloud)	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €
Cloud provider (in case of a public cloud provider)	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
New application functionalities	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €
Marketing	1.000,00 €	1.000,00 €	1.000,00 €	1.000,00 €	1.000,00 €
Helpdesk service	3.000,00 €	3.000,00 €	3.000,00 €	3.000,00 €	3.000,00 €
Customer service	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €	2.000,00 €
Total Costs	**48.100,00 €**	**12.000,00 €**	**12.000,00 €**	**12.000,00 €**	**12.000,00 €**
Net benefits/costs	-19.600,00 €	18.900,00 €	21.600,00 €	24.150,00 €	26.700,00 €
Cumulative benefits/costs	-19.600,00 €	-700,00 €	20.900,00 €	45.050,00 €	71.750,00 €
Net benefits/cost (NPV @ 5%)	-18.666,67 €	17.142,86 €	18.658,89 €	19.868,26 €	20.920,15 €
Cumulative NPV	-18.666,67 €	-1.523,81 €	17.135,08 €	37.003,35 €	57.923,50 €

Annex 4: Pricing Strategies decomposed

The data shown in Annex 4.1 through Annes 4.3 are fictional, and only for demonstrations purposes.

The data shown in Annex 4.4. is real.

As legend:

White cells	Insert text
Brown cells	Calculated automatically

Annex 4.1 Pricing Strategy: Pay-per-use

		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Cost structure			**6,912**	**4,712727 27**	**3,24**	**103,68**	**103,68**
Avg # of tenants (tenant = customer != user)	per year		15,00	22,00	32,00	47,00	72,00
Avg Instance Cost per tenant	(avg price per month)		0,60	0,60	0,60	0,60	0,60
Avg Instance Cost per tenant	(avg price per year)		7,20	7,20	7,20	7,20	7,20
Total Infrastructure Costs (all tenants in a year)	(price per year)		108	158,4	230,4	338,4	518,4
Margin							
%	(yearly margin per customer)		10,00%	10,00%	10,00%	10,00%	10,00%
Price (per year and subscription)			118,80	174,24	253,44	372,24	570,24
Periodicity of the contract		12					
Subscription		**Total**					
Pay Per Use		**Total**	**1782**	**3833,28**	**8110,08**	**17495,28**	**41057,28**
	Subscriptions (new custs)		1188,00	1036,80	1296,00	81216,00	186624,00
	Total Subscriptions		1782,00	3833,28	8110,08	17495,28	41057,28
	ARPA for new customers		130,68	191,66	278,78	409,46	627,26
	ARPA across the installed base		87,12	164,04	243,63	340,35	483,84
Annualized Run Rate (ARR)		**Total**	**1306,8**	**3608,968**	**7796,228**	**15996,508**	**34836,428**
Pay Per Use		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**

	New ARR		1306,80	2299,97	4181,76	8189,28	18817,92
negative values	Churned ARR		(5,5)	5,5)	(5,5)	(5,5)	(5,5)
	Growth ARR		5,5	7,7	11,0	16,5	27,5
	Net New ARR		1.306,8	2.302,2	4.187,3	8.200,3	18.839,9
	Starting ARR		-	1.306,8	3.609,0	7.796,2	15.996,5
	Ending ARR	-	1.306,8	3.609,0	7.796,2	15.996,5	34.836,4
Metrics related to Churn Rate of a customer base							
Pay Per Use		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	Total # of Customers (Total (Previous year) + net new (current year))	10,00	15,00	22,00	32,00	47,00	72,00
	# of new Customers		10,00	12,00	15,00	20,00	30,00
	# of churned Customers		(5,0)	(5,0)	(5,0)	(5,0)	(5,0)
	Net New Customers		5,0	7,0	10,0	15,0	25,0
% Customer Churn Rate of a customer base							
Pay Per Use		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	% Customer Churn		50,00%	33,33%	22,73%	15,63%	10,64%
	% ARR Churn		0,00%	0,00%	0,00%	0,00%	0,00%
	% ARR Growth		0,00%	0,00%	0,00%	0,00%	0,00%
	% Net ARR Churn		50,00%	33,33%	22,73%	15,63%	10,64%
New Customers		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Free							
	LTV		174,24	492,13	1071,98	2178,25	4548,09

	CAC		35,00	29,17	23,33	17,50	11,67
	LTV to CAC Ratio		5,0	16,9	45,9	124,5	389,8
	Months to Recover CAC		0,60	0,19	0,07	0,03	0,01

Summary Financial Metrics (P&L)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Sales		1782,00	7180,80	12364,80	207777,60	478137,60
Revenue		1306,80	3608,97	7796,23	15996,51	34836,43
Cost of Goods Solds		608,00	658,40	730,40	838,40	1018,40
Gross Margin		**698,80**	**2950,57**	**7065,83**	**15158,11**	**33818,03**
Gross Margin %		53,47%	81,76%	90,63%	94,76%	97,08%
Amortization and Depreciation		0,00	0,00	0,00	0,00	0,00
Operating Expenses		**640,00**	**650,00**	**660,00**	**670,00**	**680,00**
Sales and marketing		350,00	360,00	370,00	380,00	390,00
Development		180,00	180,00	180,00	180,00	180,00
General / Adminsitrative		110,00	110,00	110,00	110,00	110,00
EBITDA		**58,80**	**2300,57**	**6405,83**	**14488,11**	**33138,03**
EBIT		**58,80**	**2300,57**	**6405,83**	**14488,11**	**33138,03**
Financial expense		150,00	150,00	150,00	150,00	150,00
Financial income		75	75	75	75	75

Ordinary benefits	**-16,20**	**2225,57**	**6330,83**	**14413,11**	**33063,03**
Extraordinary expense	20	20	20	20	20
Extraordinary income	38	38	38	38	38
Earnings before income taxes (EBT)	**1,80**	**2243,57**	**6348,83**	**14431,11**	**33081,03**
Income taxes (20%)	0,36	471,15	1333,25	3030,53	6947,02
Net income	**1,44**	**1772,42**	**5015,57**	**11400,58**	**26134,01**

Annex 4.2 Pricing Strategy: Freemium

		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Pricing level							
Free	(price per month)	0,00	0,00	0,00	0,00	0,00	0,00
Premium	(price per month)	22,00	22,00	23,10	24,20	25,30	26,40
Margin							
Free	(monthly average margin per customer)	0,00	0,00	0,00	0,00	0,00	0,00
Premium	(monthly average margin per customer)	2,00	2,00	2,10	2,20	2,30	2,40
Free - Premium	Upgrade	2,00	2,00	2,10	2,20	2,30	2,40
Unit Price Premium		20	20	21	22	23	24
Periodicity of the contract		12					
Subscription	**Total**	**4752**	**8038,8**	**14229,6**	**23073,6**	**35798,4**	
Free	**Total**	**0**	**0**	**0**	**0**	**0**	
	Subscriptions Free (new custs)		0,00	0,00	0,00	0,00	0,00
	Total subscriptions Free		0,00	0,00	0,00	0,00	0,00
	ARPA for new customers		0,00	0,00	0,00	0,00	0,00
	ARPA across the installed base		0,00	0,00	0,00	0,00	0,00
Premium	**Total**	**4752**	**8038,8**	**14229,6**	**23073,6**	**35798,4**	
	Subscriptions Premium (new custs)		3696,00	3960,00	3696,00	3168,00	5544,00
	Total subscriptions Premium		4752,00	8038,80	14229,60	23073,60	35798,40

	ARPA for new customers		24,00	25,20	26,40	27,60	28,80
	ARPA across the installed base		29,78	39,34	42,68	46,40	50,58
Annualized Run Rate (ARR)		**Total**	**536**	**1140,8**	**2091,2**	**3526,4**	**5715,2**
Free		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	New ARR		0,00	0,00	0,00	0,00	0,00
negative values	Churned ARR		-	-	-	-	-
	Growth ARR		-	-	-	-	-
	Net New ARR		-	-	-	-	-
	Starting ARR		-	-	-	-	-
	Ending ARR	-	-	-	-	-	-
Premium		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	New ARR		240,00	378,00	528,00	828,00	1152,00
negative values	Churned ARR		(120,0)	(126,0)	(132,0)	(138,0)	(144,0)
	Growth ARR		216,0	352,8	554,4	745,2	1.180,8
	Net New ARR		336,0	604,8	950,4	1.435,2	2.188,8
	Starting ARR		200,0	536,0	1.140,8	2.091,2	3.526,4
	Ending ARR	200,0	536,0	1.140,8	2.091,2	3.526,4	5.715,2
	ARR Consolidated						
	New ARR		440,00	440,00	440,00	440,00	440,00
negative values	Churned ARR		(120,0)	(126,0)	(132,0)	(138,0)	(144,0)
	Growth ARR		216,0	352,8	554,4	745,2	1.180,8
	Net New ARR		336,0	604,8	950,4	1.435,2	2.188,8

	Starting ARR		200,0	536,0	1.140,8	2.091,2	3.526,4
	Ending ARR	200,0	536,0	1.140,8	2.091,2	3.526,4	5.715,2
Churn Metrics							
Free		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	Total # of Customers	10,00	12,00	15,00	17,00	20,00	18,00
	# of new Customers		10,00	10,00	10,00	10,00	10,00
	# of churned Customers		(5,0)	(5,0)	(5,0)	(5,0)	(5,0)
	Net New Customers		6,0	8,0	6,0	5,0	9,0
	# of Customers Premium-Free (downgrade)		1,00	3,00	1,00	0,00	4,00
Premium		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	Total # of Customers	10,00	18,00	29,00	49,00	76,00	113,00
	# of new Customers		10,00	15,00	20,00	30,00	40,00
	# of churned Customers		(5,0)	(6,0)	(3,0)	(5,0)	(10,0)
	Net New Customers		9,0	14,0	21,0	27,0	41,0
	# of Customers Free-Premium (Upgrade)		4,00	5,00	4,00	2,00	11,00
% Customer Churn							
Free		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	% Customer Churn		50,00%	41,67%	33,33%	29,41%	25,00%
	% ARR Churn		0,00%	0,00%	0,00%	0,00%	0,00%
	% ARR Growth		0,00%	0,00%	0,00%	0,00%	0,00%
	% Net ARR Churn		0,00%	0,00%	0,00%	0,00%	0,00%
Premium		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**

	% Customer Churn		50,00%	33,33%	10,34%	10,20%	13,16%
	% ARR Churn		-60,00%	-23,51%	-11,57%	-6,60%	-4,08%
	% ARR Growth		108,00%	65,82%	48,60%	35,64%	33,48%
	% Net ARR Churn		48,00%	42,31%	37,03%	29,04%	29,40%
Economics (new customers)		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Free							
	LTV		0,00	0,00	0,00	0,00	0,00
	CAC		0,00	0,00	0,00	0,00	0,00
	LTV to CAC Ratio		-	-	-	-	-
	Months to Recover CAC		-	-	-	-	-
Premium							
	LTV		99,2	240,5	665,5	610,4	464,5
	CAC		35,0	36,0	37,0	38,0	39,0
	LTV to CAC Ratio		2,8	6,7	18,0	16,1	11,9
	Months to Recover CAC		0,33	2,34	0,31	0,14	0,24

Summary Financial Metrics (P&L)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Sales		10.032,00	13.582,80	20.037,60	29.145,60	42.134,40
Revenue		1.256,00	1.860,80	2.811,20	4.246,40	6.435,20
Cost of Goods Solds		300,00	300,00	300,00	300,00	300,00
Gross Margin		**956,00**	**1.560,80**	**2.511,20**	**3.946,40**	**6.135,20**
Gross Margin %		76,11%	83,88%	89,33%	92,94%	95,34%
Amortization and Depreciation		0,00	0,00	0,00	0,00	0,00
Operating Expenses		**640,00**	**650,00**	**660,00**	**670,00**	**680,00**
Sales and marketing		350,00	360,00	370,00	380,00	390,00
Development		180,00	180,00	180,00	180,00	180,00
General / Adminsitrative		110,00	110,00	110,00	110,00	110,00
EBITDA		**316,00**	**910,80**	**1.851,20**	**3.276,40**	**5.455,20**
EBIT		**316,00**	**910,80**	**1.851,20**	**3.276,40**	**5.455,20**
Financial expense		150,00	150,00	150,00	150,00	150,00
Financial income		75,00	75,00	75,00	75,00	75,00
Ordinary benefits		**241,00**	**835,80**	**1.776,20**	**3.201,40**	**5.380,20**
Extraordinary expense		20,00	20,00	20,00	20,00	20,00
Extraordinary income		38,00	38,00	38,00	38,00	38,00
Earnings before income taxes (EBT)		**259,00**	**853,80**	**1.794,20**	**3.219,40**	**5.398,20**
Income taxes (20%)		51,80	179,30	376,78	676,07	1.133,62

Net income			**207,20**	**674,50**	**1.417,42**	**2.543,33**	**4.264,58**

Annex 4.3 Pricing Strategy: Tiered

		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Pricing tier							
Basic	(price per month)	0,00	0,00	0,00	0,00	0,00	0,00
Limited	(price per month)	22,00	22,00	23,10	24,20	25,30	26,40
Enterprise	(price per month)	33,00	33,00	34,10	35,20	36,30	37,40
Revenue							
Basic	(monthly margin per customer)	0,00	0,00	0,00	0,00	0,00	0,00
Limited	(monthly margin per customer)	2,00	2,00	2,10	2,20	2,30	2,40
Enterprise	(monthly margin per customer)	3,00	3,00	3,10	3,20	3,30	3,40
Basic-Limited	Upgrade	2,00	2,00	2,10	2,20	2,30	2,40
Basic-Enterprise	Upgrade	2,00	2,00	2,10	2,20	2,30	2,40
Limited-Basic	Downgrade	-2,00	-2,00	-2,10	-2,20	-2,30	-2,40
Limited Enterprise	Upgrade	1,00	1,00	1,00	1,00	1,00	1,00
Enterprise - Basic	Downgrade	-3,00	-3,00	-3,10	-3,20	-3,30	-3,40
Enterprise limited	Downgrade	-1,00	-1,00	-1,00	-1,00	-1,00	-1,00
Unit Price Basic		0,00	0,00	0,00	0,00	0,00	0,00
Unit Price Limited		20,00	20,00	21,00	22,00	23,00	24,00
Unit Price Enterprise		30,00	30,00	31,00	32,00	33,00	34,00
Margin		0,10					
Periodicity of the contract		12					
Subscription	**Total**	**10692**	**15787,2**	**19958,4**	**24393,6**	**29092,8**	

Basic		**Total**	**0**	**0**	**0**	**0**	**0**
	Subscriptions Basic (new custs)		0,00	0,00	0,00	0,00	0,00
	Total Subscriptions Basic		0,00	0,00	0,00	0,00	0,00
	ARPA for new customers		0,00	0,00	0,00	0,00	0,00
	ARPA across the installed base		16,67	14,29	10,53	8,33	6,90
Limited		**Total**	**4752**	**6375,6**	**8131,2**	**10018,8**	**12038,4**
	Subscriptions Limited (new custs)		3696,00	3049,20	3194,40	3339,60	3484,80
	Total Subscriptions Limited		4752	6375,6	8131,2	10018,8	12038,4
	ARPA for new customers		24,00	25,20	26,40	27,60	28,80
	ARPA across the installed base		28,44	33,22	36,71	39,52	41,89
Enterprise		**Total**	**5940**	**9411,6**	**11827,2**	**14374,8**	**17054,4**
	Subscriptions Enterprise (new custs)		4752,00	6138,00	5068,80	5227,20	5385,60
	Total Subscriptions Enterprise		5940	9411,6	11827,2	14374,8	17054,4
	ARPA for new customers		36,00	37,20	38,40	39,60	40,80
	ARPA across the installed base		37,33	45,37	50,99	55,26	58,73
Annualized Run Rate (ARR)		**Total**	**1272**	**2007,6**	**2655,6**	**3327,6**	**4023,6**
Basic		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	New ARR		0,00	0,00	0,00	0,00	0,00
negative values	Churned ARR		-	-	-	-	-
	Growth ARR		-	-	-	-	-
	Net New ARR		-	-	-	-	-
	Starting ARR		200,0	200,0	200,0	200,0	200,0
	Ending ARR	200,0	200,0	200,0	200,0	200,0	200,0

Limited		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
	New ARR		240,00	252,00	264,00	276,00	288,00
negative values	Churned ARR		(120,0)	(126,0)	(132,0)	(138,0)	(144,0)
	Growth ARR		192,0	126,0	132,0	138,0	144,0
	Net New ARR		312,0	252,0	264,0	276,0	288,0
	Starting ARR		200,0	512,0	764,0	1.028,0	1.304,0
	Ending ARR	200,0	512,0	764,0	1.028,0	1.304,0	1.592,0
Enterprise		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	New ARR		360,00	372,00	384,00	396,00	408,00
negative values	Churned ARR		(180,0)	(186,0)	(192,0)	(198,0)	(204,0)
	Growth ARR		180,0	297,6	192,0	198,0	204,0
	Net New ARR		360,0	483,6	384,0	396,0	408,0
	Starting ARR		200,0	560,0	1.043,6	1.427,6	1.823,6
	Ending ARR	200,0	560,0	1.043,6	1.427,6	1.823,6	2.231,6
	ARR Consolidated						
	New ARR		440,00	440,00	440,00	440,00	440,00
negative values	Churned ARR		(300,0)	(312,0)	(324,0)	(336,0)	(348,0)
	Growth ARR		372,0	423,6	324,0	336,0	348,0
	Net New ARR		672,0	735,6	648,0	672,0	696,0
Churn Metrics							
Basic		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	Total # of Customers	10,00	12,00	14,00	19,00	24,00	29,00
	# of new Customers		10,00	10,00	10,00	10,00	10,00
	# of churned Customers		(5,0)	(5,0)	(5,0)	(5,0)	(5,0)

	Net New Customers		2,0	2,0	5,0	5,0	5,0
	# of Customers Limited-Basic		1,00	1,00	1,00	1,00	1,00
	# of Customers Enterprise-Basic		1,00	1,00	1,00	1,00	1,00
Limited		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	Total # of Customers	10,00	18,00	23,00	28,00	33,00	38,00
	# of new Customers		10,00	10,00	10,00	10,00	10,00
	# of churned Customers		(5,0)	(5,0)	(5,0)	(5,0)	(5,0)
	Net New Customers		8,00	5,00	5,00	5,00	5,00
	# of Customers Basic-Limited		4,00	1,00	1,00	1,00	1,00
	# of Customers Enterprise-Limited		1,00	1,00	1,00	1,00	1,00
Enterprise		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	Total # of Customers	10,00	15,00	23,00	28,00	33,00	38,00
	# of new Customers		10,00	10,00	10,00	10,00	10,00
	# of churned Customers		(5,0)	(5,0)	(5,0)	(5,0)	(5,0)
	Net New Customers		5,0	8,0	5,0	5,0	5,0
	# of Customers Basic-Enterprise		1,00	4,00	1,00	1,00	1,00
	# of Customers Limited-Enterprise		1,00	1,00	1,00	1,00	1,00
% Customer Churn							
Basic		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	% Customer Churn		50,00%	41,67%	35,71%	26,32%	20,83%
	% ARR Churn		0,00%	0,00%	0,00%	0,00%	0,00%
	% ARR Growth		0,00%	0,00%	0,00%	0,00%	0,00%
	% Net ARR Churn		0,00%	0,00%	0,00%	0,00%	0,00%

Limited		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
	% Customer Churn		50,00%	27,78%	21,74%	17,86%	15,15%
	% ARR Churn		-60,00%	-24,61%	-17,28%	-13,42%	-11,04%
	% ARR Growth		96,00%	24,61%	17,28%	13,42%	11,04%
	% Net ARR Churn		36,00%	0,00%	0,00%	0,00%	0,00%
Enterprise		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	% Customer Churn		50,00%	33,33%	21,74%	17,86%	15,15%
	% ARR Churn		-90,00%	-33,21%	-18,40%	-13,87%	-11,19%
	% ARR Growth		90,00%	53,14%	18,40%	13,87%	11,19%
	% Net ARR Churn		0,00%	19,93%	0,00%	0,00%	0,00%
Economics (new customers)		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Basic							
	LTV		40,33	48,69	50,69	63,97	76,80
	CAC		35,00	36,00	37,00	38,00	39,00
	LTV to CAC Ratio		1,2	1,4	1,4	1,7	2,0
	Months to Recover CAC		13,0	12,0	8,3	8,3	8,4
Limited							
	LTV		56,9	119,6	168,9	221,3	276,5
	CAC		35,0	36,0	37,0	38,0	39,0
	LTV to CAC Ratio		1,6	3,3	4,6	5,8	7,1
	Months to Recover CAC		1,74	2,00	1,88	1,81	1,75
Enterprise							
	LTV		74,7	136,1	234,5	309,5	387,6
	CAC		35,0	36,0	37,0	38,0	39,0
	LTV to CAC Ratio		2,1	3,8	6,3	8,1	9,9
	Months to Recover CAC		1,51	1,04	1,30	1,26	1,23

Summary Financial Metrics (P&L)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Billings		11484,00	16711,20	21212,40	25977,60	31006,80
Revenue		1314,00	2091,60	2799,60	3531,60	4287,60
Cost of Goods Solds		300,00	300,00	300,00	300,00	300,00
Gross Margin		**1014,00**	**1791,60**	**2499,60**	**3231,60**	**3987,60**
Gross Margin %		77,17%	85,66%	89,28%	91,51%	93,00%
Amortization and Depreciation		0,00	0,00	0,00	0,00	0,00
Operating Expenses		**640,00**	**650,00**	**660,00**	**670,00**	**680,00**
Sales and marketing		350,00	360,00	370,00	380,00	390,00
Development		180,00	180,00	180,00	180,00	180,00
General / Adminsitrative		110,00	110,00	110,00	110,00	110,00
EBITDA		**374,00**	**1141,60**	**1839,60**	**2561,60**	**3307,60**
EBIT		**374,00**	**1141,60**	**1839,60**	**2561,60**	**3307,60**
Financial expense		150,00	150,00	150,00	150,00	150,00
Financial income		75	75	75	75	75
Ordinary benefits		**299,00**	**1066,60**	**1764,60**	**2486,60**	**3232,60**
Extraordinary expense		20	20	20	20	20
Extraordinary income		38	38	38	38	38
Earnings before income taxes (EBT)		**317,00**	**1084,60**	**1782,60**	**2504,60**	**3250,60**

	Income taxes (20%)		63,40	227,77	374,35	525,97	682,63
	Net income		**253,60**	**856,83**	**1408,25**	**1978,63**	**2567,97**

Annex 4.4 Proof-of-concept Company C Pricing Strategy

Tiered model

		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Pricing tier							
Basic	(price per month)	11,00	11,00	12,10	12,10	13,31	13,31
Limited	(price per month)	16,50	16,50	18,15	18,15	19,97	19,97
Enterprise	(price per month)	22,00	22,00	24,20	24,20	26,62	26,62
Platinum	(price per month)						
Basic	annual price	132,00	132,00	145,20	145,20	159,72	159,72
Limited	annual price	198,00	198,00	217,80	217,80	239,58	239,58
Enterprise	annual price	264,00	264,00	290,40	290,40	319,44	319,44
Platinum	annual price						
Discount Rate							
After 36 months	10%						
Revenue							
Basic	(monthly margin per customer)	1,00	1,00	1,10	1,10	1,21	1,21
Limited	(monthly margin per customer)	1,50	1,50	1,65	1,65	1,82	1,82
Enterprise	(monthly margin per customer)	2,00	2,00	2,20	2,20	2,42	2,42
Basic-Limited	Upgrade	0,50	0,50	0,55	0,55	0,61	0,61
Basic-Enterprise	Upgrade	1,00	1,00	1,20	1,20	1,42	1,42

Limited-Basic	Downgrade	-0,50	-0,50	-0,55	-0,55	-0,61	-0,61
Limited Enterprise	Upgrade	0,50	0,50	0,55	0,55	0,61	0,61
Enterprise - Basic	Downgrade	-1,00	-1,00	-1,10	-1,10	-1,21	-1,21
Enterprise limited	Downgrade	-0,50	-0,50	-0,55	-0,55	-0,61	-0,61
Unit Price Basic		10,00	10,00	11,00	11,00	12,10	12,10
Unit Price Limited		15,00	15,00	16,50	16,50	18,15	18,15
Unit Price Enterprise		20,00	20,00	22,00	22,00	24,20	24,20
Margin		0,10					
Periodicity of the contract		12					
Subscription		**Total**	**39600**	**51981,6**	**74923,2**	**118592,1**	**144786,18**
Basic		**Total**	**3960**	**4646,4**	**5227,2**	**5909,64**	**6069,36**
	Subscriptions Basic (new custs)		3960,00	580,80	871,20	319,44	319,44
	Total Subscriptions Basic		3960,00	4646,40	5227,20	5909,64	6069,36
	ARPA for new customers		12,00	13,20	13,20	14,52	14,52
	ARPA across the installed base		24,00	24,15	24,40	24,53	24,64
Limited		**Total**	**11880**	**16552,8**	**24393,6**	**39530,7**	**48634,74**
	Subscriptions Limited (new custs)		11880,00	3920,40	9583,20	13656,06	10062,36
	Total Subscriptions Limited		11880	16552,8	24393,6	39530,7	48634,74
	ARPA for new customers		18,00	19,80	19,80	21,78	21,78
	ARPA across the installed base		36,00	36,76	37,67	39,56	40,31
Enterprise		**Total**	**23760**	**30782,4**	**45302,4**	**73151,76**	**90082,08**
	Subscriptions Enterprise (new custs)		23760,00	5808,00	17424,00	26513,52	18527,52
	Total Subscriptions Enterprise		23760	30782,4	45302,4	73151,76	90082,08

	ARPA for new customers		24,00	26,40	26,40	29,04	29,04
	ARPA across the installed base		48,00	48,72	50,03	52,60	53,63
Annualized Run Rate (ARR)		**Total**	**7200**	**8731,2**	**12902,4**	**19479,96**	**24242,52**
Basic		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	New ARR		360,00	52,80	79,20	29,04	29,04
negative values	Churned ARR		-	(26,4)	(26,4)	(14,5)	(14,5)
	Growth ARR		360,0	26,4	52,8	14,5	14,5
	Net New ARR		720,0	52,8	105,6	29,0	29,0
	Starting ARR		-	720,0	772,8	878,4	907,4
	Ending ARR	-	720,0	772,8	878,4	907,4	936,5
Limited		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	New ARR		1080,00	356,40	871,20	1241,46	914,76
negative values	Churned ARR		-	(39,6)	(158,4)	(87,1)	(87,1)
	Growth ARR		1.080,0	316,8	712,8	1.154,3	827,6
	Net New ARR		2.160,0	633,6	1.425,6	2.308,7	1.655,3
	Starting ARR		-	2.160,0	2.793,6	4.219,2	6.527,9
	Ending ARR	-	2.160,0	2.793,6	4.219,2	6.527,9	8.183,2

Enterprise		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
	New ARR		2160,00	528,00	1584,00	2410,32	1684,32
negative values	Churned ARR		-	(105,6)	(264,0)	(290,4)	(145,2)
	Growth ARR		2.160,0	422,4	1.320,0	2.119,9	1.539,1
	Net New ARR		4.320,0	844,8	2.640,0	4.239,8	3.078,2
	Starting ARR		-	4.320,0	5.164,8	7.804,8	12.044,6
	Ending ARR	-	4.320,0	5.164,8	7.804,8	12.044,6	15.122,9
	ARR Consolidated						
	New ARR		1440,00	1440,00	1440,00	1440,00	1440,00
negative values	Churned ARR		-	(171,6)	(448,8)	(392,0)	(246,8)
	Growth ARR		3.600,0	765,6	2.085,6	3.288,8	2.381,3
	Net New ARR		7.200,0	1.531,2	4.171,2	6.577,6	4.762,6
Churn Metrics							
Basic		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	Total # of Customers	0,00	30,00	32,00	36,00	37,00	38,00
	# of new Customers		30,00	4,00	6,00	2,00	2,00
	# of churned Customers		0,00	-2,00	-2,00	-1,00	-1,00
	Net New Customers		30,0	2,0	4,0	1,0	1,0
	# of Customers Limited-Basic		0,00	0,00	0,00	0,00	0,00

	# of Customers Enterprise-Basic		0,00	0,00	0,00	0,00	0,00
Limited		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	Total # of Customers	0,00	60,00	76,00	112,00	165,00	203,00
	# of new Customers		60,00	18,00	44,00	57,00	42,00
	# of churned Customers		0,00	-2,00	-8,00	-4,00	-4,00
	Net New Customers		60,00	16,00	36,00	53,00	38,00
	# of Customers Basic-Limited		0,00	0,00	0,00	0,00	0,00
	# of Customers Enterprise-Limited		0,00	0,00	0,00	0,00	0,00
Enterprise		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	Total # of Customers	0,00	90,00	106,00	156,00	229,00	282,00
	# of new Customers		90,00	20,00	60,00	83,00	58,00
	# of churned Customers		0,00	-4,00	-10,00	-10,00	-5,00
	Net New Customers		90,0	16,0	50,0	73,0	53,0
	# of Customers Basic-Enterprise		0,00	0,00	0,00	0,00	0,00
	# of Customers Limited-Enterprise		0,00	0,00	0,00	0,00	0,00
% Customer Churn							
Basic		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	% Customer Churn		0,00	6,67%	6,25%	2,78%	2,70%
	% ARR Churn		0,00	-3,67%	-3,42%	-1,65%	-1,60%
	% ARR Growth		0,00	3,67%	6,83%	1,65%	1,60%
	% Net ARR Churn		0,00	0,00%	3,42%	0,00%	0,00%
Limited		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	% Customer Churn		0,00%	3,33%	10,53%	3,57%	2,42%

	% ARR Churn		0,00%	-1,83%	-5,67%	-2,06%	-1,33%
	% ARR Growth		0,00%	14,67%	25,52%	27,36%	12,68%
	% Net ARR Churn		0,00%	12,83%	19,85%	25,29%	11,34%
	Enterprise	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	% Customer Churn		0,00%	4,44%	9,43%	6,41%	2,18%
	% ARR Churn		0,00%	-2,44%	-5,11%	-3,72%	-1,21%
	% ARR Growth		0,00%	9,78%	25,56%	27,16%	12,78%
	% Net ARR Churn		0,00%	7,33%	20,45%	23,44%	11,57%
	Economics (new customers)	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	Basic						
	LTV		0,00	362,25	390,40	882,91	911,84
	CAC		333,33	2500,00	1666,67	5000,00	5000,00
	LTV to CAC Ratio		-	0,1	0,2	0,2	0,2
	Months to Recover CAC		6,3	641,7	210,6	2.302,5	2.357,9
	Limited						
	LTV		0,00	1.102,7	357,9	1.107,8	1.662,8
	CAC		166,7	555,6	227,3	175,4	238,1
	LTV to CAC Ratio		-	2,0	1,6	6,3	7,0
	Months to Recover CAC		1,04	11,88	2,13	1,02	1,97
	Enterprise						
	LTV		0,00	1.096,3	530,3	820,5	2.456,1
	CAC		111,1	500,0	166,7	120,5	172,4

	LTV to CAC Ratio		-	2,2	3,2	6,8	14,2
	Months to Recover CAC		0,35	8,02	0,84	0,38	0,77
Summary Financial Metrics (P&L)							
		Year 0	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	Billings		39.600,00	51.981,60	74.923,20	118.592,10	144.786,18
	Revenue		7.200,00	8.731,20	12.902,40	19.479,96	24.242,52
			0,11	0,11	0,10	0,10	0,12
	Cost of Goods Solds		800,00	1.000,00	1.300,00	2.000,00	3.000,00
	Gross Margin		**6.400,00**	**7.531,20**	**11.402,40**	**16.979,96**	**20.742,52**
	Gross Margin %		0,89	0,89	0,90	0,90	0,88
	Amortization and Depreciation		0,00	200,00	200,00	500,00	500,00
	Operating Expenses		**22.110,00**	**16.110,00**	**16.110,00**	**16.110,00**	**16.110,00**
	Sales and marketing		10.000,00	10.000,00	10.000,00	10.000,00	10.000,00
	Development		12.000,00	6.000,00	6.000,00	6.000,00	6.000,00
	General / Adminsitrative		110,00	110,00	110,00	110,00	110,00
	EBITDA		**-15.710,00**	**-8.578,80**	**-4.707,60**	**869,96**	**4.632,52**
	EBIT		**-15.710,00**	**-8.778,80**	**-4.907,60**	**369,96**	**4.132,52**

Freemium model

		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Pricing level							
Free	(price per month)	0,00	0,00	0,00	0,00	0,00	0,00
Premium	(price per month)	33,00	33,00	33,00	36,30	36,30	36,30
Margin							
Free	(monthly average margin per customer)	0,00	0,00	0,00	0,00	0,00	0,00
Premium	(monthly average margin per customer)	3,00	3,00	3,00	3,30	3,30	3,30
Free - Premium	Upgrade	3,00	3,00	3,00	3,30	3,30	3,30
Unit Price Premium		30	30	30	33	33	33
Periodicity of the contract		12					
Subscription	**Total**	**71280**	**84744**	**131551,2**	**187308**	**227383,2**	
Free	**Total**	**0**	**0**	**0**	**0**	**0**	
	Subscriptions Free (new custs)		0,00	0,00	0,00	0,00	0,00
	Total subscriptions Free		0,00	0,00	0,00	0,00	0,00
	ARPA for new customers		0,00	0,00	0,00	0,00	0,00
	ARPA across the installed base		0,00	0,00	0,00	0,00	0,00
Premium	**Total**	**71280**	**84744**	**131551,2**	**187308**	**227383,2**	
	Subscriptions Premium (new custs)		71.280,00	75.240,00	79.596,00	89.100,00	100.980,00

	Total subscriptions Premium		71.280,00	84.744,00	131.551,20	187.308,00	227.383,20
	ARPA for new customers		36,00	36,00	39,60	39,60	39,60
	ARPA across the installed base		72,00	69,14	71,68	74,38	72,95
Annualized Run Rate (ARR)		**Total**	**12960**	**14796**	**21646,8**	**31982,4**	**38080,8**
Free		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	New ARR		0,00	0,00	0,00	0,00	0,00
negative values	Churned ARR		-	-	-	-	-
	Growth ARR		-	-	-	-	-
	Net New ARR		-	-	-	-	-
	Starting ARR		-	-	-	-	-
	Ending ARR	-	-	-	-	-	-
Premium		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	New ARR		6480,00	1044,00	3168,00	4672,80	1861,20
negative values	Churned ARR		-	(180,0)	(198,0)	(198,0)	(198,0)
	Growth ARR		6.480,0	972,0	3.880,8	5.860,8	4.435,2
	Net New ARR		12.960,0	1.836,0	6.850,8	10.335,6	6.098,4
	Starting ARR		-	12.960,0	14.796,0	21.646,8	31.982,4
	Ending ARR						

		-	12.960,0	14.796,0	21.646,8	31.982,4	38.080,8
	ARR Consolidated						
	New ARR		6480,00	6480,00	6480,00	6480,00	6480,00
negative values	Churned ARR		-	(180,0)	(198,0)	(198,0)	(198,0)
	Growth ARR		6.480,0	972,0	3.880,8	5.860,8	4.435,2
	Net New ARR		12.960,0	1.836,0	6.850,8	10.335,6	6.098,4
	Starting ARR		-	12.960,0	14.796,0	21.646,8	31.982,4
	Ending ARR	-	12.960,0	14.796,0	21.646,8	31.982,4	38.080,8
Churn Metrics							
Free		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	Total # of Customers	0,00	30,00	48,00	92,00	152,00	182,00
	# of new Customers		30,00	30,00	60,00	90,00	90,00
	# of churned Customers		-	(5,0)	(5,0)	(5,0)	(5,0)
	Net New Customers		30,0	28,0	65,0	105,0	105,0
	# of Customers Premium-Free (downgrade)		0,00	3,00	10,00	20,00	20,00
Premium		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	Total # of Customers	0,00	180,00	214,00	302,00	430,00	522,00
	# of new Customers		180,00	29,00	80,00	118,00	47,00
	# of churned Customers		-	(12,0)	(3,0)	(15,0)	(10,0)

	Net New Customers		180,0	27,0	98,0	148,0	112,0
	# of Customers Free-Premium (Upgrade)		0,00	10,00	21,00	45,00	75,00
% Customer Churn							
Free		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	% Customer Churn		0,00%	16,67%	10,42%	5,43%	3,29%
	% ARR Churn		0,00%	0,00%	0,00%	0,00%	0,00%
	% ARR Growth		0,00%	0,00%	0,00%	0,00%	0,00%
	% Net ARR Churn		0,00%	0,00%	0,00%	0,00%	0,00%
Premium		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	% Customer Churn		0,00%	6,67%	1,40%	4,97%	2,33%
	% ARR Churn		0,00%	-1,39%	-1,34%	-0,91%	-0,62%
	% ARR Growth		0,00%	7,50%	26,23%	27,07%	13,87%
	% Net ARR Churn		0,00%	6,11%	24,89%	26,16%	13,25%
Economics (new customers)		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Free							
	LTV		0,00	0,00	0,00	0,00	0,00
	CAC		0,00	0,00	0,00	0,00	0,00
	LTV to CAC Ratio		-	-	-	-	-
	Months to Recover CAC		-	-	-	-	-
Premium							
	LTV		-	1.037,1	5.113,0	1.497,5	3.136,9

	CAC		333,3	333,3	166,7	111,1	111,1
	LTV to CAC Ratio		-	3,1	30,7	13,5	28,2
	Months to Recover CAC		0,00	0,00	0,00	0,00	0,00
Summary Financial Metrics (P&L)		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	Sales		71.280,00	84.744,00	131.551,20	187.308,00	227.383,20
	Revenue		12.960,00	14.796,00	21.646,80	31.982,40	38.080,80
	Cost of Goods Solds		800,00	1.000,00	1.300,00	2.000,00	3.000,00
	Gross Margin		**12.160,00**	**13.596,00**	**20.146,80**	**29.482,40**	**34.580,80**
	Gross Margin %		93,83%	93,24%	93,99%	93,75%	92,12%
	Amortization and Depreciation		0,00	200,00	200,00	500,00	500,00
	Operating Expenses		**22.110,00**	**16.110,00**	**16.110,00**	**22.110,00**	**22.110,00**
	Sales and marketing		10.000,00	10.000,00	10.000,00	10.000,00	10.000,00
	Development		12.000,00	6.000,00	6.000,00	12.000,00	12.000,00
	General / Adminsitrative		110,00	110,00	110,00	110,00	110,00
	EBITDA		**-9.950,00**	**-2.514,00**	**4.036,80**	**7.372,40**	**12.470,80**
	EBIT		**-9.950,00**	**-2.714,00**	**3.836,80**	**6.872,40**	**11.970,80**

Pay-per-use

		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Cost structure							
Avg # of tenants (tenant = customer != user)	per year		180,00	214,00	302,00	430,00	522,00
Avg Instance Cost	(avg price per month)		19,04	19,04	19,04	38,07	38,07
Avg Instance Cost	(avg price per year)		228,48	228,48	228,48	456,84	456,84
Total Infrastructure Costs (all tenants in a year)	(price per year)		41126,4	48894,72	69000,96	196441,2	238470,48
Margin							
%	(yearly margin per customer)		10,00%	10,00%	10,00%	10,00%	10,00%
Price (per year and subscription)			251,33	251,33	251,33	502,52	502,52
Periodicity of the contract		12					
Subscription		**Total**					
Pay Per Use		**Total**	**45239,04**	**53784,192**	**75901,056**	**216085,32**	**262317,528**
	Subscriptions (new custs)		45239,04	13069,06	23373,50	68845,79	53267,54
	Total Subscriptions		45239,04	53784,19	75901,06	216085,32	262317,53
	ARPA for new customers		276,46	276,46	276,46	552,78	552,78
	ARPA across the installed base		277,56	300,72	298,53	386,09	430,46
Annualized Run Rate (ARR)		**Total**	**49960,944**	**64354,5056**	**90156,66**	**166017,9268**	**224698,0252**
Pay Per Use		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**

	New ARR		49762,94	14375,96	25710,85	75730,37	58594,30
negative values	Churned ARR		-	(19,8)	(5,5)	(9,9)	(15,4)
	Growth ARR		198,0	37,4	96,8	140,8	101,2
	Net New ARR		49.960,9	14.393,6	25.802,2	75.861,3	58.680,1
	Starting ARR		-	49.960,9	64.354,5	90.156,7	166.017,9
	Ending ARR	-	49.960,9	64.354,5	90.156,7	166.017,9	224.698,0
Metrics related to Churn Rate of a customer base							
Pay Per Use		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	Total # of Customers (Total (Previous year) + net new (current year))	0,00	180,00	214,00	302,00	430,00	522,00
	# of new Customers		180,00	52,00	93,00	137,00	106,00
	# of churned Customers		-	(18,0)	(5,0)	(9,0)	(14,0)
	Net New Customers		180,0	34,0	88,0	128,0	92,0
% Customer Churn Rate of a customer base							
Pay Per Use		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	% Customer Churn			10,00%	2,34%	2,98%	3,26%
	% ARR Churn		0,00%	0,00%	0,00%	0,00%	0,00%
	% ARR Growth		0,00%	0,00%	0,00%	0,00%	0,00%
	% Net ARR Churn			10,00%	2,34%	2,98%	3,26%
New Customers		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Free							

	LTV		0,00	3007,22	12777,17	12955,40	13221,15
	CAC		55,56	192,31	107,53	72,99	94,34
	LTV to CAC Ratio		-	15,6	118,8	177,5	140,1
	Months to Recover CAC		0,01	0,16	0,05	0,01	0,02
Summary Financial Metrics (P&L)		**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	Sales		45.239,04	53.784,19	75.901,06	216.085,32	262.317,53
	Revenue		49.960,94	64.354,51	90.156,66	166.017,93	224.698,03
	Cost of Goods Solds		800,00	1.000,00	1.300,00	2.000,00	3.000,00
	Gross Margin		**49.160,94**	**63.154,51**	**88.656,66**	**163.517,93**	**221.198,03**
	Gross Margin %		0,98	0,98	0,99	0,99	0,99
	Amortization and Depreciation		0,00	200,00	200,00	500,00	500,00
	Operating Expenses		**22.110,00**	**16.110,00**	**16.110,00**	**16.110,00**	**16.110,00**
	Sales and marketing		10.000,00	10.000,00	10.000,00	10.000,00	10.000,00
	Development		12.000,00	6.000,00	6.000,00	6.000,00	6.000,00
	General / Adminsitrative		110,00	110,00	110,00	110,00	110,00
	EBITDA		**27.050,94**	**47.044,51**	**72.546,66**	**147.407,93**	**205.088,03**
	EBIT		**27.050,94**	**46.844,51**	**72.346,66**	**146.907,93**	**204.588,03**

Annex 5 Methodology Tasks

Value Proposition (ValPro)

- **Task Id**: VALPRO
- **Task Name**: Value Proposition
- **Task Objective**: This task is concerned with the definition of the value proposition of the application as a service. A value proposition is a statement that explains the relevance of a service (how it solves customers' needs), quantifies its value (that is, how it delivers benefits) and identifies the competitive advantage (it explains how this service differentiates from existing services so the customer does not have the temptation to go to the competitors).

  The value proposition may be unique for one SaaS application if it is addressed to one market. However, if the SaaS application is targeted to various market segments, they shall all receive a unique value proposition for the service.
- **Predecessor Task**: EDF
- **Successor task**: CUSTOMER
- **Related Activities**:
  - VALPRO.A1: Identify the features of the SaaS application and compare them to the features offered by the competitors
  - VALPRO.2: Identify and analyze the customers' needs as well as the problems that need to be solved
  - VALPRO.2: Define the features that need to be delivered to each customer segment in order to solve their needs and problems
  - VALPRO.3: Define the value delivered to each customer segment
  - VALPRO.4: Continuously monitor the value proposition

VALPRO.A1 - Identify the features of the SaaS application and compare them to the features offered by the competitors

- **Activity ID**: VALPRO.A1
- **Activity Name:** Identify the features of the SaaS application and compare them to the features offered by the competitors
- **depends** on Task ID: VALPRO
- **Activity Description**: Analyze which functionalities are offered in the SaaS application. Classify these functionalities in core functionalities, value-added functionalities and long-tail functionalities. Compare these functionalities to the ones offered by the most direct competitors in order to conclude what the

competitive advantage of this SaaS is with respect to the other SaaS' offered by the competition.

- **Activity taxonomy**: Business analysis task
- **Predecessor Activities**: EDF.A2, VALDEL.A12
- **Successor Activities**: VALPRO.A2
- **Input artefacts and classification:**
    - [Report] Market analysis
    - [Report] Functional analysis
    - [Report] Requirement analysis
    - [Report] Competitor's features analysis
- **Output artefacts and classification:**
    - [Report] Features analysis of the application
    - [Report] Comparison of the SaaS features with respect to its competitors
- **Roles**: Business Manager, Software Analyst, Software Architect
- **Supporting tools and material:**
    - [Report] Functional analysis
    - [Report] Requirements analysis
- **Migration project characteristic:** Business migration projects

VALPRO.A2 - Identify and analyze the customers' needs and motivation

- **Activity ID**: VALPRO.A2
- **Activity Name:** Identify and analyze the customers' needs
- **depends** on Task ID: VALPRO
- **Activity Description**: The value proposition for the SaaS application must be aligned with the needs of the customers, their motivation and perspectives when buying the application as a service. The identification of these needs can be done by interviews, surveys or observation. The same methods can be applied to the identification of the problems that need to be solved. The value proposition definition must explain what the added value of this SaaS application is with respect to its competitors, as it is a sales argument.
- **Activity taxonomy**: Business analysis task
- **Predecessor Activities**: EDF.A2
- **Successor Activities**: VALPRO.A3
- **Input artefacts and classification:**
    - Surveys, interviews or market observation (customer profiling)
    - [Report] Market analysis

    - [Report] Feature analysis of the application
    - [Report] Comparison of the SaaS features with respect to its competitors
- **Output artefacts and classification:**
    - [Report] Identification of the customers' needs and challenges and its coverage in the features of the application
- **Roles**: Business Manager
- **Supporting tools and material:**
    - Brainstorming sessions
    - Workshops
    - Interviews
    - Surveys
    - [Report] Market analysis and customer segment identification
    - [Report] Analysis of all the features provided in the SaaS and how these are different from the competitors
- **Migration project characteristic:** Business migration projects

VALPRO.A3 - Define the features that need to be delivered to each customer segment in order to solve their needs

- **Activity ID**: VALPRO.A3
- **Activity Name:** Define the features that need to be delivered to each customer segment in order to solve their needs.
- **depends** on Task ID: VALPRO
- **Activity Description**: Identify which features can potentially be offered in each SaaS offering. Classify which are core features, which are added value and which are long-tail, and also the customer segment addressed by each SaaS offering.
- **Activity taxonomy**: Business analysis task
- **Predecessor Activities**: VALPRO.A1, VALPRO.A2 FINANCIAL.A4
- **Successor Activities**: VALPRO.A4
- **Input artefacts and classification:**
    - [Report] Feature analysis of the application
    - [Report] Market analysis and customer segment identification
- **Output artefacts and classification:**
    - [Report] Inventory of which features are provided to each customer segment as well as the supporting services (e.g. customer support) – Product Catalogue
- **Roles**: Business Manager, Business Analyst, Software Analyst

- **Supporting tools and material:** None
- **Migration project characteristic:** Business migration projects

VALPRO.A4 - Define the value delivered to each customer segment

- **Activity ID**: VALPRO.A4
- **Activity Name:** Define the value delivered to each customer segment
- **depends** on Task ID: VALPRO
- **Activity Description**: Once the customers' needs for each market segment and the corresponding functionalities / features to be provided are identified, describe the value proposition specific for each of these segments. The value proposition must include what the SaaS application is aimed for and how it is different from the competitors in each of their tiers or offerings. In addition to that strategic definition of the value proposition, it is recommended to include for each service, the related technical information about the service offerings (capabilities, interface definitions including available service operations and pricing information). In the case of a pay-as-you-go or flat-rate models, where the customer segment is unique, describe the value proposition of the complete application, the competitive advantage with respect to its competitors, as well as the technical information of the offering.
- **Activity taxonomy**: Business analysis task
- **Predecessor Activities**: VALPRO.A3
- **Successor Activities**: VALPRO.A5
- **Input artefacts and classification:**
    - Functional specifications
    - Feature analysis
    - Customers' needs
    - [Report] Inventory of which features are provided to each customer segment as well as the supporting services (e.g. customer support) – Product Catalogue
- **Output artefacts and classification:**
    - [Report] (Updated) Product catalogue
- **Roles**: Business Manager, Business Analyst
- **Supporting tools and material:** None
- **Migration project characteristic:** Business migration projects

VALPRO.A5 - Continuously monitor the value proposition

- **Activity ID**: VALPRO.A5
- **Activity Name:** Continuously monitor the value proposition
- **depends** on Task ID: VALPRO
- **Activity Description**: This task is focused on establishing the means to monitor continuously the value proposition in order to provide the customer with the maximum added value. This added value shall be aligned to his expectations and needs at all times. Several approaches can be followed for this: interviews, surveys, satisfaction questionnaires, workshops, analysis of the competitors, observation of churned customer rate, etc.
- **Activity taxonomy**: Business analysis task
- **Predecessor Activities**: VALPRO.A4
- **Successor Activities**: VALDEL, if metrics, feedback, and so on are below thresholds, go to VALPRO.A6
- **Input artefacts and classification:**
    - [Report] Product catalogue
    - [Report] Marketing Strategy
    - Metrics of customer churn rate
- **Output artefacts and classification:**
    - [Report] (Updated) Value proposition
    - [Report] (Updated) Product catalogue
    - [Report] (Updated) Marketing strategy
- **Roles**: Business Manager, Business Analyst
- **Supporting tools and material:**
    - Metrics to calculate the customer churn rate
    - Surveys / Questionnaires
    - Interviews
- **Migration project characteristic:** Business migration projects

VALPRO.A6 – Apply Corrective Measures

- **Activity ID**: VALPRO.A6
- **Activity Name:** Apply Corrective Measures
- **depends** on Task ID: VALPRO
- **Activity Description**: This task is focused on applying the needed corrective measures in the value proposition of the SaaS offerings so as to remain sustainable and satisfy customers' needs.
- **Activity taxonomy**: Business analysis task

- **Predecessor Activities**: VALPRO.A5
- **Successor Activities**: VALPRO.A1
- **Input artefacts and classification:**
    - [Report] Product catalogue
    - [Report] Marketing Strategy
    - [Report] Market Analysis
    - [Report] Surveys / questionnaires
- **Output artefacts and classification:**
    - [Report] (Updated) Value proposition
    - [Report] (Updated) Product catalogue
    - [Report] (Updated) Marketing strategy
- **Roles**: Business Manager, Business Analyst
- **Supporting tools and material:**
    - Metrics to calculate the customer churn rate
    - Surveys / Questionnaires
    - Interviews
- **Migration project characteristic:** Business migration projects

External Driving Forces (EDF)

- **Task ID**: EDF
- **Task Name**: External Driving Forces
- **Task Objective:** The aim of this task is to know and understand the SaaS offering value chain and how the market that the SaaS offering is targeting, behaves.
- **Predecessor Task:** None
- **Successor task**: CUSTOMER and VALPRO
- **Related activities:**
    - EDF.A1 - Analyze the value chain of the SaaS offering
    - EDF.A2 – Analyze the market where the SaaS offering will compete
    - EDF.A3 - Identify the Marketing objectives
    - EDF.A4 - Identify the marketing strategy
    - EDF.A5 - Start implementing the market strategy
    - EDF.A6 - Monitor the market plan
    - EDF.A7 - Monitor the market
- Sequential

EDF.A1 - Analyze the value chain of the SaaS offering

- **Activity ID**: EDF.A1
- **Activity Name**: Analyze the value chain of the SaaS offering
- **depends** on EDF
- **Activity Description**: The objective of this activity is to analyze the value chain of the SaaS offering: primary activities as well as secondary activities must be identified. This will help to identify also who are the suppliers of the SaaS offering (if any), or if it is needed to have any at all (e.g. a public cloud service provider).
- **Activity taxonomy**: Business analysis task
- **Predecessor Activities**: None
- **Successor Activities**: EDF.A2
- **Input artefacts and classification**: None
- **Output artefacts and classification**
    - [Report] Value chain for the SaaS offering
- **Roles:** Marketing Manager, Business Manager and Business Analyst
- **Supporting tools and material**: Porter's value chain
- **Migration project characteristic**: Business migration projects

EDF.A2 - Analyze the market where the SaaS offering will compete

- **Activity ID**: EDF.A2
- **Activity Name**: Analyze the market where the SaaS offering will compete
- **depends** on EDF
- **Activity Description**: The objective of this activity is 1) to analyze the market where the SaaS application aims to enter, 2) analyze the features and pricing strategies that the competitors have, 3) perform a SWOT analysis, PESTLE analysis.
- **Activity taxonomy**: Business analysis task
- **Predecessor Activities**: None
- **Successor Activities**: EDF.A3, CUSTOMER.A1, and VALPRO.A1
- **Input artefacts and classification**: None
- **Output artefacts and classification**
    - [Report] Market analysis
    - [Report] Competitor's features analysis
- **Roles:** Marketing Manager, Business Manager and Business Analyst
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

EDF.A3 - Identify the Marketing objectives

- **Activity ID**: EDF.A3
- **Activity Name**: Identify the Marketing objectives
- **depends** on EDF
- **Activity Description**: During the realization of this activity and based on the analyses carried out in the previous activity, the marketing objectives will be established and the strategic alternatives to reach these objectives will be evaluated.
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities**: EDF.A2
- **Successor Activities**: EDF.A4
- **Input artefacts and classification**:
    - [Report] Business objectives
    - [Report] Market analysis
    - [Report] Identification of the customers' needs and challenges
- **Output artefacts and classification**
    - [Report] Marketing Objectives
- **Roles:** Marketing Manager
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

EDF.A4 - Identify the marketing strategy

- **Activity ID**: EDF.A4
- **Activity Name**: Identify the marketing strategy
- **depends** on EDF
- **Activity Description**: The objective of this task is to tailor the marketing strategy in order to offer value to customers, to communicate the SaaS offering and to make it accessible and convenient
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities**: EDF.A3
- **Successor Activities**: EDF.A5
- **Input artefacts and classification**:
    - [Report] Market analysis
    - [Report] Marketing Objectives
    - [Report] Product Catalogue
- **Output artefacts and classification**
    - [Report] Marketing Strategy
- **Roles:** Marketing Manager

- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

EDF.A5 - Implement the market strategy

- **Activity ID**: EDF.A5
- **Activity Name**: Implement the market strategy
- **depends** on EDF
- **Activity Description**: This activity has the objective to ensure that the marketing strategy defined in the previous activity is implemented. For doing this, this activity will define appropriate actions such as: define a clear schedule, designate clear areas of responsibility and finally plan and assign an appropriate budget for carrying out the actions for marketing purposes.
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities**: EDF.A4
- **Successor Activities**: EDF.A6
- **Input artefacts and classification**:
    - [Report] Market analysis
    - [Report] Marketing Objectives
    - [Report] Marketing Strategy
- **Output artefacts and classification**
    - [Report] Marketing Plan
- **Roles:** Marketing Manager
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

EDF.A6 - Monitor the market plan

- **Activity ID**: EDF.A6
- **Activity Name**: Monitor the market plan
- **depends** on EDF
- **Activity Description**: This activity sets in place control techniques for monitoring the performance of the established marketing plan. Usually this entails a systematic review of all aspects of the plan against the set targets, usually on a monthly or quarterly basis. The review must be carried out regularly to ensure prompt attention and action in areas when the results lag behind the established targets. Managers and others actors responsible for the successful implementation of all these elements should be involved in this activity. If during this activity it is discovered that

the marketing objectives are not the most appropriate ones, the process should be repeated from activity EDF.A3.

- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities**: EDF.A5
- **Successor Activities**: EDF.A7 and if the marketing objectives are not appropriate EDF.A3
- **Input artefacts and classification**:
    - [Report] Market analysis
    - [Report] Marketing Objectives
    - [Report] Marketing Strategy
    - [Report] Marketing Plan
- **Output artefacts and classification**
    - [Report] Marketing Objectives
    - [Report] Marketing Strategy
    - [Report] Marketing Plan
- **Roles:** Marketing Manager, Business Manager
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

EDF.A7 - Monitor the market

- **Activity ID**: EDF.A7
- **Activity Name**: Monitor the market
- **depends** on EDF
- **Activity Description**: The realization of this activity implies to continuously analyze the market competitors, to analyze costs of cloud providers' services (so as to port the application to another cloud service provider) in order to be able to pivot the SaaS offering and pricing strategy when needed. This activity also feeds into the design of the SaaS offering and marketing mix as customer needs and the competitive environment changes.
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities**: EDF.A6 and VALPRO.A4
- **Successor Activities**: If some changes are detected in the market, the process should start with the activity EDF.A2, if changes are detected in the cloud offerings, proceed to VALDEL.A23.
- **Input artefacts and classification**:
    - [Report] Market analysis

    - [Report] value proposition
    - [Report] Product catalogue
    - [Report] Marketing strategy
- **Output artefacts and classification**
- **Roles:** Marketing Manager, Business Manager
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

Customer Interaction (Customer)

- **Task Id**: CUSTOMER
- **Task Name**: Customer Interaction
- **Task Objective**: This task is focused on the set-up of customer relationships and interaction means, that is, how customers will be supported in the delivery of the SaaS. This support will vary depending on the services associated with each SaaS offering and its value proposition.
- **Predecessor Task**: VALPRO, EDF and VALDEL
- **Successor task**: VALDEL
- **Related Activities**:
    - CUSTOMER.A1: Analyze the expected customer relationships for each SaaS offering type
    - CUSTOMER.A2: Perform a gap analysis
    - CUSTOMER.A3: Implement the generic customer relationships mechanisms for each SaaS offering
    - CUSTOMER.A4: Instantiate these generic mechanisms for strategic customers customer and SaaS offering
    - CUSTOMER.A5: Register communications with customers
    - CUSTOMER.A6: Perform an Initial diagnosis to classify the communication
    - CUSTOMER.A7: Incidence identification
    - CUSTOMER.A8: Incidence logging
    - CUSTOMER.A9: Incidence categorization
    - CUSTOMER.A10: Detailed diagnosis
    - CUSTOMER.A11: Incidence prioritization
    - CUSTOMER.A12: Incidence escalation
    - CUSTOMER.A13: Final diagnosis
    - CUSTOMER.A14: Resolution and Recovery
    - CUSTOMER.A15: Follow-up of the incidence

- CUSTOMER.A16: Inform the user
- CUSTOMER.A17: Close the incidence
- CUSTOMER.A18: Measure and analyze customer's feedback
- CUSTOMER.A19: Implement corrective measures with respect to the relationship with the customers

- A1 – A2 – A3 – A4-A5-A6-A7 (that go back to A2)

CUSTOMER.A1 - Analyze the expected customer relationships for each SaaS offering type

- **Activity ID**: CUSTOMER.A1
- **Activity Name:** Analyze the expected customer relationships for each SaaS offering type
- **depends** on Task ID: CUSTOMER
- **Activity Description**: Determine how the customers will be able to interact with the SaaS application provider, depending on the SaaS offering, value proposition and pricing strategy. In the case of flat-rate and pay-as-you-go models the relationship with the customers will be in principle, common for all of them. Exceptions can occur when a loyalty strategy is launched to keep an strategic customer.

  In the case of pricing strategies with different tiers such as the freemium model or the tiered one, each layer will need to have a distinct definition of how each customer belonging to each pricing plan can interact with the SaaS provider.
  The following issues must be considered:
  - Means: e.g. phone, email, fora, social networks, direct contact with the sales person, and so on.
  - Contacting period: e.g. workdays in working hours, 24x7, …
  - Time needed to provide an answer: e.g. 4h, a day, …
  - Classification of communication messages: incidence reporting, consultation, claim, and so on.
  - Billable or not?
- **Activity taxonomy**: Business analysis task
- **Predecessor Activities**: EDF.A2, VALPRO.A4
- **Successor Activities**: CUSTOMER.A2
- **Input artefacts and classification:**
  - [Report] Market analysis
  - [Report] Marketing Strategy

    - [Report] Product Catalogue
- **Output artefacts and classification:**
    - [Report] Inventory of possible relationships and acceptance by each customer segment, as part of the (updated) Marketing strategy
    - [Report] (Updated) Product Catalogue
- **Roles**: Business Manager, Business Analyst
- **Supporting tools and material:**
- **Migration project characteristic:** Business migration projects

CUSTOMER.A2 - Gap Analysis

- **Activity ID**: CUSTOMER.A2
- **Activity Name:** Perform a Gap Analysis
- **depends** on Task ID: CUSTOMER
- **Activity Description**: The previous activity identified the potential relationship types that each SaaS offering will have taking into consideration the customer segment the offer is addressed to. However, some of these relationships may be up and running in the company, especially when the SaaS offering is the result of the migration and customers already used the SaaP offering. An evaluation of what the company offered to previous customers and what it aims to provide with the new SaaS offering needs to be performed. The goal is to know what can remain as it is, what needs to be readapted, and what needs to be defined from scratch.
- **Activity taxonomy**: Business analysis task
- **Predecessor Activities**: CUSTOMER.A1, EDF.A2
- **Successor Activities**: CUSTOMER.A3
- **Input artefacts and classification:**
    - Inventory of possible relationships and acceptance by SaaS offering, as part of the Marketing strategy
    - Current relationships
    - [Report] Product Catalogue
- **Output artefacts and classification:**
    - [Report] (Updated) Marketing strategy
    - [Report] (Updated) Product Catalogue
- **Roles**: Business Manager, Business Analyst
- **Supporting tools and material:** None
- **Migration project characteristic:** Business migration projects

CUSTOMER.A3 – Define generic customer relationship mechanisms

- **Activity ID**: CUSTOMER.A3
- **Activity Name:** Define generic customer relationship mechanisms
- **depends** on Task ID: CUSTOMER
- **Activity Description**: Both old and new relationships with the customers must be integrated in the new business model and in the updated definition of organizational processes of the company. This task focuses on the generic definition of how the relationships with the customers will be per SaaS offering. This definition shall include at least:
    - The communication means (e.g. email, phone, …) through which the customer can contact the SaaS provider;
    - The appropriate physical and logical structure to implement the communication mechanisms;
    - A satisfaction questionnaire, a categorization of customers to which this questionnaire will be sent, a target threshold below which improvement measures will have to be put in place
- **Activity taxonomy**: Business analysis task
- **Predecessor Activities**: CUSTOMER.A2
- **Successor Activities**: CUSTOMER.A4, VALDEL
- **Input artefacts and classification:**
    - [Report] Marketing strategy
    - [Process] Monitor customer requests
    - [Process] Incidence Management
    - [Report] Product Catalogue
    - [Report] Business plan
- **Output artefacts and classification:**
    - [Report] Marketing strategy
    - [Process] (Updated) Monitor customer requests
    - [Process] (Updated) Incidence Management
    - [Report] (Updated) Product Catalogue
    - [Report] (Updated) Business plan
- **Roles**: Business Manager, Business Analyst
- **Supporting tools and material:** None
- **Migration project characteristic:** Business migration projects

[Optional] CUSTOMER.A4 – Instantiate and customize these generic mechanisms for strategic customers and SaaS offerings

- **Activity ID**: CUSTOMER.A4
- **Activity Name:** Instantiate and customize these generic mechanisms for strategic customers and SaaS offering
- **depends** on Task ID: CUSTOMER
- **Activity Description**: For customers classified as strategic (e.g. due to business volume, potential big customer, etc.), the generic mechanisms defined in the previous task may be customized with special conditions in pricing, billable hours in case of incidences, response times, and so on.
- **Activity taxonomy**: Business analysis task
- **Predecessor Activities**: CUSTOMER.A3
- **Successor Activities**: VALDEL
- **Input artefacts and classification:**
    - [Process] Monitor customer requests
    - [Process] Incidence Management
    - [Report] Product Catalogue
    - [Report] Marketing Strategy
- **Output artefacts and classification:**
    - [Report] (Updated) Marketing Strategy
    - [Process] (Updated) Monitor customer requests
    - [Process] (Updated) Incidence Management
- **Roles**: Business Manager, Business Analyst
- **Supporting tools and material:** None
- **Migration project characteristic:** Business migration projects

CUSTOMER.A5- Register communications with customers

- **Activity ID**: CUSTOMER.A5
- **Activity Name**: Register communications with customers
- **depends** on CUSTOMER
- **Activity Description**: This activity is responsible to collect each of the communications that occur with a customer and a SaaS offering. Each communication will be assigned a reference number to be able to follow it and check the status of this communication at any time.
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities**: CUSTOMER.A3, [optional] CUSTOMER.A4
- **Successor Activities**: CUSTOMER.A6
- **Input artefacts and classification**:

    - [Report] SLA
    - [Report] Communication mechanism
    - [Process] Monitor customer requests
    - [Process] Incidence Management
- **Output artefacts and classification**
    - [Report] Incidence log
- **Roles:** Business Manager; Business Analyst
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

CUSTOMER.A6 – Perform an Initial diagnosis to classify the communication

- **Activity ID**: CUSTOMER.A6
- **Activity Name**: Perform an Initial diagnosis to classify the communication
- **depends** on CUSTOMER
- **Activity Description**: The objective of this activity is to investigate the cause of the communication with the information provided in the previous activity and based on this investigation, to provide first initial solution, if possible, inform the user and close the incidence (CUSTOMER.A16 and CUSTOMER.A17). However, if this initial solution cannot be provided or it does not work, classify this communication as incidence reporting and proceed to CUSTOMER.A7.
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities** CUSTOMER.A5
- **Successor Activities**:
    - If the cause of communication is solved, CUSTOMER.A16
    - If the cause of communication is not solved, CUSTOMER.A7
- **Input artefacts and classification**:
    - [Report] SLA
    - [Report] Incidence log
    - [Process] Incidence Management
    - [Process] Monitor Customer Requests
- **Output artefacts and classification**
    - [Report] (Updated) Incidence log
- **Roles:** Software Analyst
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

CUSTOMER.A7 - Incidence identification

- **Activity ID**: CUSTOMER.A7
- **Activity Name**: Incidence identification
- **depends** on
- **Activity Description**: This activity will initiate the log of each incidence. This incidence could be detected from the Technical team or from the communication mechanisms established with the customer.
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities**: CUSTOMER.A6, if the incidence has been communicated by the user.
- **Successor Activities**: CUSTOMER.A8
- **Input artefacts and classification**:
    - [Report] Incidence Model. An Incidence Model is a way of pre-defining the steps that should be taken to handle a process dealing with a particular type of incidence in an agreed way. The incidence model should include at least:
        - The types of the incidence
        - The steps that should be taken to handle the incidence
        - The chronological order these steps should be taken in, with any dependences or co-processing defined
        - Responsibilities; who should do what
        - Timescales and thresholds for completion of the actions
        - Escalation procedures; who should be contacted and when
- **Output artefacts and classification**
    - [Report] Incidence log. This output should record at least the following information:
        - Unique reference number
        - Incidence categorization (often broken down into between two and four levels of sub-categories)
        - Incidence urgency
        - Incidence impact
        - Incidence prioritization
        - Date/time recorded
        - Name/ID of the person and/or group recording the incidence
        - Method of notification (telephone, automatic, e-mail, in person, etc.)
        - Name/department/phone/location of user
        - Call-back method (telephone, mail, etc.)

        - Description of symptoms
        - Incidence status (active, waiting, closed, etc.)
        - Support group/person to which the incidence is allocated
        - Related problem/Known Error
        - Activities undertaken to resolve the incidence
        - Resolution date and time
- **Roles:** Software Analyst
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

CUSTOMER.A8 - Incidence logging

- **Activity ID**: CUSTOMER.A8
- **Activity Name**: Incidence logging
- **depends** on CUSTOMER
- **Activity Description**: This activity will start completing the log of the incidence, namely data such as: date/time, Name/ID of the person and/or group recording the incidence, Method of notification (telephone, automatic, e-mail, in person, etc.), Name/department/phone/location of user and call-back method.
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities**: CUSTOMER.A7
- **Successor Activities**: CUSTOMER.A9
- **Input artefacts and classification**:
    - [Report] Incidence Model
    - [Report] Incidence log.
- **Output artefacts and classification**
    - [Report] Incidence log.
- **Roles:** Software Analyst
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

CUSTOMER.A9 - Incidence categorization

- **Activity ID**: CUSTOMER.A9
- **Activity Name**: Incidence categorization
- **depends** on CUSTOMER

- **Activity Description**: The objective of this activity is to classify the incidence according to the incidence model. This classification will indicate if the problem is functional, infrastructural, misuse and so on.
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities**: CUSTOMER.A8
- **Successor Activities**: CUSTOMER.A10
- **Input artefacts and classification**:
    - [Report] Incidence Model
    - [Report] Incidence log.
- **Output artefacts and classification**
    - [Report] Incidence log.
- **Roles:** Software Analyst
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

CUSTOMER.A10 - Detailed diagnosis

- **Activity ID**: CUSTOMER.A10
- **Activity Name**: Detailed diagnosis
- **depends** on CUSTOMER
- **Activity Description**: The objective of this activity is to investigate the cause of the incidence with the information provided by the previous activities and define who should solve the incidence.
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities**: CUSTOMER.A9
- **Successor Activities**: CUSTOMER.A10
- **Input artefacts and classification**:
    - [Report] Incidence Model
    - [Report] SLA
    - [Report] Incidence log.
- **Output artefacts and classification**
    - [Report] Incidence log.
- **Roles:** Software Analyst
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

CUSTOMER.A11- Incidence prioritization

- **Activity ID**: CUSTOMER.A11
- **Activity Name**: Incidence prioritization
- **depends** on CUSTOMER
- **Activity Description**: In order to prioritize the incidences that are occurring, it is required to take into account both the urgency of the incidence (how quickly the business needs a resolution) and the level of impact it is causing, as well as in which SaaS offering is the incidence occur, in the case of tiered models. Factors that should take into account for determining the impact:
    - The tier of the SaaS offering where the problem has been reported
    - The number of services affected – may be multiple services
    - Number of customers affected and the business volume
    - The level of financial losses
    - Effect on business reputation
    - Regulatory or legislative breaches.

  It should be noted that the determination of the priorities for the incidences is dynamic - if circumstances change, or if an incidence is not resolved within SLA target times, then the priority must be altered to reflect the new situation.
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities**: CUSTOMER.A10
- **Successor Activities**: if it is required to escalate the incidence based on the SLA and the prioritization of the incidence the successor activity is CUSTOMER.A12, if not it is CUSTOMER.A16.
- **Input artefacts and classification**:
    - [Report] Incidence Model
    - [Report] SLA
    - [Report] Incidence log.
- **Output artefacts and classification**
    - [Report] Incidence log.
- **Roles:** Software Analyst
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

CUSTOMER.A12 - Incidence escalation

- **Activity ID**: CUSTOMER.A12
- **Activity Name**: Incidence escalation
- **depends** on CUSTOMER

- **Activity Description**: if according to the SLA and the prioritization, an escalation is appropriate, then escalate the incidence. The escalation of the incidence could be of two types:
    - Functional escalation: If the incidence will need deeper technical knowledge, the incidence must be immediately escalated to the appropriate level support group in order to solve the incidence as soon as possible.
    - Hierarchic escalation: If incidence is of a serious nature (for example urgent and with great impact) the appropriate Software Analyst must be notified, for informational purposes at least. This type of escalation is required when the SLA fulfilment is in danger. Hierarchic escalation is also used if the activities CUSTOMER.A12- Investigation and Diagnosis and CUSTOMER.A14- Resolution and Recovery are taking too long or proving too difficult.
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities**: CUSTOMER.A11
- **Successor Activities**: CUSTOMER.A13, VALDEL.A12
- **Input artefacts and classification**:
    - [Report] Incidence Model
    - [Report] SLA
    - [Report] Incidence log.
- **Output artefacts and classification**
    - [Report] Incidence log.
- **Roles:** Software Analyst
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

CUSTOMER.A13- Final diagnosis

- **Activity ID**: CUSTOMER.A13
- **Activity Name**: Final diagnosis
- **depends** on CUSTOMER
- **Activity Description**: This activity consists of the following of actions:
    - Establish exactly what has gone wrong (e.g. reproducing the error) or is being sought by the user
    - Understand the chronological order of events
    - Confirm the full impact of the incident, including the number and range of users affected
    - Identify any events that could have triggered the incident

    - Look for previous occurrences by searching previous Incidence logs
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities**: CUSTOMER.A12
- **Successor Activities**: CUSTOMER.A14
- **Input artefacts and classification**:
    - [Report] Incidence Model
    - [Report] SLA
    - [Report] Incidence log.
- **Output artefacts and classification**
    - [Report] Incidence log.
- **Roles:** Software Analyst, Software Analyst
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

CUSTOMER.A14 - Resolution and Recovery

- **Activity ID**: CUSTOMER.A14
- **Activity Name**: Resolution and Recovery
- **depends** on CUSTOMER
- **Activity Description**: The objective of this activity is to implement the solution to the incidence. If a potential solution has been identified, this should be applied and tested. Even when a solution has been found, sufficient testing must be performed to ensure that the recovery action is complete and that the service has been fully restored to the user(s). Regressing testing is very important here as the deployment of a corrected application can also affect the operations of the application and other users that are using the application in the time the corrected application is deployed. To solve this issue, SaaS providers are recommended to use a DevOps approach.
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities**: CUSTOMER.A13, VALDEL.A15
- **Successor Activities**: CUSTOMER.A15
- **Input artefacts and classification**:
    - [Report] Incidence Model
    - [Report] SLA
    - [Report] Incidence log.
- **Output artefacts and classification**
    - [Report] Incidence log.
- **Roles:** Software Analyst, Software Analyst, Developer, Tester.

- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

CUSTOMER.A15 – Follow-up of the incidence

- **Activity ID**: CUSTOMER.A15
- **Activity Name**: Follow-up of the incidence
- **depends** on CUSTOMER
- **Activity Description**: The objective of this activity is to be able to know at all times the status of a particular incidence. For doing this, the actions that need to be carried out are:
    - to check the progress of the actions defined to solve the incidence
    - to collect information of the incidence management process
    - to communicate if some problems on the resolution to the part affected
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities**: CUSTOMER.A14
- **Successor Activities**: CUSTOMER.A16.
- **Input artefacts and classification**:
    - [Report] SLA
    - [Report] Incidence log.
- **Output artefacts and classification**
    - [Report] Incidence log.
- **Roles:** Quality manager, Software Analyst, Software Analyst
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

CUSTOMER.A16 – Inform the user

- **Activity ID**: CUSTOMER.A16
- **Activity Name**: Inform the user
- **depends** on CUSTOMER
- **Activity Description**: The objective of this activity is to communicate the user about the progress of the incidence
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities:** CUSTOMER.A15
- **Successor Activities**: CUSTOMER.A17
- **Input artefacts and classification**:
    - [Report] SLA

    - [Report] Incidence log
    - [Process] Incidence Management
    - [Process] Monitor Customer Requests
- **Output artefacts and classification**
    - [Report] (Updated) Incidence log.
- **Roles:** Software Analyst; Business Manager
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

CUSTOMER.A17 – Close the incidence

- **Activity ID**: CUSTOMER.A17
- **Activity Name**: Incidence closure
- **depends** on CUSTOMER
- **Activity Description**: The objective of this activity is to close the incidence and ensure that all the information related to it is correctly collected in the incidence log. There are three main actions recommended to close an incidence:
    - Closure categorization: Check and confirm that the initial incidence categorization was correct or, where the categorization subsequently turned out to be incorrect, update the record so that a correct closure categorization is recorded for the incidence;
    - User satisfaction survey: Carry out a user satisfaction survey for the agreed percentage of incidences;
    - Incidence documentation: Chase any outstanding details and ensure that the Incidence log is fully documented so that a full historic record at a sufficient level of detail is complete.
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities:** CUSTOMER.A16
- **Successor Activities**: CUSTOMER.A18
- **Input artefacts and classification**:
    - [Report] Incidence log.
- **Output artefacts and classification**
    - [Report] (Updated) Incidence log.
- **Roles:** Software Analyst; Business Manager
- **Supporting tools and material**: None
- **Migration project characteristic**: Process migration project.

CUSTOMER.A18 - Measure and analyze customer's feedback

- **Activity ID**: CUSTOMER.A18
- **Activity Name**: Measure and analyze customer's feedback
- **depends** on CUSTOMER
- **Activity Description**: In order to improve the customer's satisfaction, it is important to collect their feedback. To achieve this, three main actions need to be carried out:
    - Collect the feedback of the users according to the process defined on the customer relationships mechanisms (CUSTOMER.A3).
    - Analyze the received feedback.
    - Provide solutions or improvement to cover the problems detected by the satisfaction measures.
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities:** CUSTOMER.A3, CUSTOMER.A17
- **Successor Activities**: CUSTOMER.A19
- **Input artefacts and classification**:
    - [Report] Incidence log.
    - [Report] Business strategy
    - [Report] Marketing strategy
    - [Process] Monitor Customer Requests
- **Output artefacts and classification**
    - [Report] Customer's feedback and satisfaction metrics. This report will collect the feedback as well as the customer's satisfaction degree. These results will be analysed, and proper correction measures will be taken (CUSTOMER.A10) the analysis of these comments and the solution provided if required
- **Roles:** Marketing manager; Business Manager
- **Supporting tools and material**: None
- **Migration project characteristic**: Process migration project.

CUSTOMER.A19 – Implement corrective measures with respect to the relationship with the customers

- **Activity ID**: CUSTOMER.A19
- **Activity Name:** Implement corrective measures with respect to the relationship with the customers
- **depends** on Task ID: CUSTOMER
- **Activity Description**: This activity focuses on the definition and the implementation of corrective measures that will have to be put in place to

increase the satisfaction degree of customers. The main goal to implement these corrective measures is to avoid an increase of the customer churn rate.

- **Activity taxonomy**: Business analysis task
- **Predecessor Activities:** CUSTOMER.A18
- **Successor Activities**: CUSTOMER.A1
- **Input artefacts and classification:**
    - Marketing strategy
    - [Process] Monitor Customer Requests
    - [Report] Business Plan
    - [Report] Business Strategy
    - [Report] Product Catalogue
- **Output artefacts and classification:**
    - Marketing plan
    - [Process] (Updated) Monitor Customer Requests
    - [Report] (Updated) Business Plan
    - [Report] (Updated) Business Strategy
    - [Report] (Updated) Product Catalogue
- **Roles**: Business Manager, Business Analyst
- **Supporting tools and material:** None
- **Migration project characteristic:** Business migration projects

Value Delivery (ValDel)

- **Task Id**: VALDEL
- **Task Name**: Value Delivery
- **Task Objective**: This task is concerned with the implementation to successfully deliver the value proposition of the SaaS offering(s).
- **Predecessor Task**: VALPRO, CUSTOMER
- **Successor task**: FINANCIAL
- **Related Activities**:
    - VALDEL.A1: Determine SLA Framework
    - VALDEL.A2: Document and establish which SLA terms and SLOs will be covered in each of the different SaaS offerings
    - VALDEL.A3: Review underpinning agreements
    - VALDEL.A4: Monitor service performance against SLA
    - VALDEL.A5: Produce service reports
    - VALDEL.A6: Review SLAs and underpinning agreements
    - VALDEL.A7: Define the new roles

    - VALDEL.A8: Modify the existing roles
    - VALDEL.A9: Train people on their new roles
    - VALDEL.A10: Communicate the affected people their new roles and responsibilities
    - VALDEL.A11: Communicate the entire organization the new and modified roles
    - VALDEL.A12: Requirements elicitation
    - VALDEL.A13: Select the requirements to be developed in the sprint
    - VALDEL.A14: Analysis and modelling
    - VALDEL.A15: Development, continuous integration and continuous testing
    - VALDEL.A16: Testing of functional and non-functional requirements
    - VALDEL.A17: Review and add the requirements
    - VALDEL.A18: Continuous delivery and deploying of the final application
    - VALDEL.A19: Plan the releases
    - VALDEL.A20: Build and test the release
    - VALDEL.A21: Release testing
    - VALDEL.A22: Define the main features to be fulfilled by the cloud infrastructure provider
    - VALDEL.A23: Match and rank the best cloud environments
    - VALDEL.A24: Select the Target Cloud Infrastructure
    - VALDEL.A25: Establish the agreements with the cloud infrastructure
    - VALDEL.A26: Monitor the fulfilment of the conditions
    - VALDEL.A27: Report and control the SLA violations by the cloud provider
    - VALDEL.A28: Set up sales channels
    - VALDEL.A29: Monitor the performance of the sales team
    - VALDEL.A30: Implement corrective measures in the sales team
- All in parallel

VALDEL.A1 – Determine the SLA Framework

- **Activity ID**: VALDEL.A1
- **Activity Name**: Design the SLA Framework
- **Depends on** VALDEL
- **Activity Description**: This activity aims to design the SLA structure to ensure that all SaaS offerings and associated services as well as all customers are covered in a manner that it suits best the needs of the organization. The SLA structure shall

include SLA concerns (e.g. availability, response time, mean time between failures, and so on), as well as Service Level Objectives (e.g. availability = 99%).

- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: None
- **Successor Activities**: VALDEL.A2
- **Input artefacts and classification**:
    - [Report] Business Impact Analysis [optional]
    - [Report] Financial plans [optional]
    - [Report] Organizational Strategy pla n[optional]
- **Output artefacts and classification**
    - [Report] Service level agreement structure
- **Roles:** Business Analyst
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

VALDEL.A2 - Document and establish which SLA terms and SLOs will be covered in each of the different SaaS offerings

- **Activity ID**: VALDEL.A2
- **Activity Name**: Document and establish which SLA terms and SLOs will be covered in each of the different SaaS offerings
- **Depends on** VALDEL
- **Activity Description**: This activity has as main goal the documentation of the SLA terms and SLOs that will have to be fulfilled in each of the SaaS offerings. This is especially relevant in tiered and freemium pricing strategies, where SLA coverage will vary depending on the tier.
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A1
- **Successor Activities**: VALDEL.A3, EMREQ.A3
- **Input artefacts and classification**:
    - [Report] Service level agreement structure
- **Output artefacts and classification**
    - [Report] SLA. The SLA should contain issues such as:
        - Conditions under which the service is considered to be unavailable (e.g. if the service is offered at several locations)
        - Availability targets for each tier of the SaaS offering (exact definition of how the agreed availability levels will be calculated, based on agreed service time and downtime)

        - Reliability targets
        - Maintainability targets
        - Down times for maintenance
        - Restrictions on maintenance, e.g. allowed maintenance windows, seasonal restrictions on maintenance, and procedures to announce planned service interruptions
        - Definitions of Major Incidents
        - Requirements regarding availability reporting
        - Required capacity (lower/upper limit) for the service, e.g. Numbers and types of transactions, Numbers and types of users, Business cycles (daily, weekly) and seasonal variations.
        - Response times from applications
        - Requirements for scalability (assumptions for the medium and long-term increase in workload and service utilization)
        - Requirements regarding capacity and performance reporting
        - Time within which a defined level of service must be re-established
        - Time within which normal service levels must be restored
        - Responsibilities: Duties of the service provider, of the customer and of service users (e.g. with respect to IT security)
        - IT Security aspects to be observed when using the service (if applicable, references to relevant IT Security Policies)
        - Pricing model: Cost for the service provisioning, Rules for penalties/ charge backs, additional support, etc.
- **Roles:** Business Manager, Software Analyst
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

VALDEL.A3 - Review underpinning agreements

- **Activity ID**: VALDEL.A3
- **Activity Name**: Review underpinning agreements
- **Depends on** VALDEL
- **Activity Description**: If service providers are dependent to some extent on external partners or suppliers (e.g. deployment of the application on public clouds, usage of cloud service brokers), the SaaS provider may not be able to commit to meeting SLO target unless the supplier´s performances underpin these targets. Contracts with external suppliers are mandatory. These contracts have to ensure that all the

targets defined by the suppliers are aligned with the ones defined in the SaaS offering SLA.

- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A2.
- **Successor Activities**: VALDEL.A4 and VALDEL.A6
- **Input artefacts and classification**
    - [Report] SLA
- **Output artefacts and classification**
    - [Report] SLA
- **Roles:** Business Manager. Additionally, Business Analyst, Software Analyst and Software Architect could be involved.
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

VALDEL.A4 - Monitor the service performance against the SLA

- **Activity ID**: VALDEL.A4
- **Activity Name**: Monitor service performance against SLA
- **Depends on** VALDEL
- **Activity Description**: This activity will monitor the SaaS offerings against the agreed parameters of the SLA defined in the activity VALDEL.A2. Mechanisms to control potential deviations will be put in place. This activity is repeated with the periodicity in which it is defined in the SLA. The goal of this task is to be prepared in case a customer accuses the SaaS provider with a violation of any of the terms defined in the SLA.
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A2.
- **Successor Activities**: VALDEL.A5, EMREQ.A3 and CUSTOMER.A7
- **Input artefacts and classification**:
    - [Report] SLA
- **Output artefacts and classification**
    - [Report] Service Report. This report provides details of the service levels achieved in relation to the targets contained within SLAs. This report should include details of all the aspects of the service and its delivery
- **Roles:** Business Manager. Additionally, Business Analyst, Software Analyst and Software Analyst could be involved.
- **Supporting tools and material**: None

- **Migration project characteristic**: Business migration projects

VALDEL.A5 – Produce service reports

- **Activity ID**: VALDEL.A5
- **Activity Name**: - Produce service reports
- **Depends on** VALDEL
- **Activity Description**: The SLA reporting mechanism must be defined and agreed with the customer. The periodic reports have to incorporate details of performance against all SLA targets. To elaborate this report, it is important to collect accurate information from all the services and processes and that these are measured against the agreed SLOs. During this activity, reports on the performance of the services will be produced, this performance of the services will be checked against the SLOs and in case of any non-conformance, an information report will be produced and propagated to the affected parts. Compensation mechanisms to the customer of the SaaS offering will be launched.
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A4
- **Successor Activities**: VADEL.A6
- **Input artefacts and classification**:
    - [Report] SLA
- **Output artefacts and classification**
    - [Report] Service Report. This report provides details of the service levels achieved in relation to the targets contained within SLAs. This report should include details of all the aspects of the service and its delivery.
- **Roles:** Software Analyst and Software Analyst.
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

VALDEL.A6 - Review SLAs and underpinning agreements

- **Activity ID**: VALDEL.A6
- **Activity Name**: Review SLAs and underpinning agreements
- **Depends on** VALDEL
- **Activity Description**: All SLAs and their underpinning agreements must be kept updated. These reviews will ensure that the services covered and the defined SLOs for each SLA term in each SaaS offering are still relevant, and that nothing

significant has changed which invalidates the agreement in any way. This activity should be carried out at least every time that major changes or incidence are found.

- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**:
  - VALDEL.A2
  - VALDEL.A3
  - VALDEL.A4
  - VALDEL.A5
- **Successor Activities**: If changes in the agreements are required:
  - VALDEL.A2
  - VALDEL.A3
  - VALDEL.A4
  - VALDEL.A5
- **Input artefacts and classification**:
  - [Report] SLA
  - [Report] Service Report.
- **Output artefacts and classification**
  - [Report] SLA Review Report.
- **Roles:** Business Manager, Quality manager, Software Analyst.
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

VALDEL.A7 - Define the new roles

- **Activity ID**: VALDEL.A7
- **Activity Name**: Define the new roles
- **depends** on VALDEL
- **Activity Description**: This activity is focused on the identification, adaptation and creation of the new roles needed in the organization to successfully deliver the SaaS offering according to the new business model. These new roles need to cover all processes and activities needed to carry out the successful SaaS offering provisioning. In addition to the identification of the new roles, the required skills needed in each particular role need to be defined.
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: This activity runs in parallel in parallel with VALDEL.A8
- **Successor Activities**: VALDEL.A9
- **Input artefacts and classification**:

    - [Report] Description of roles
    - [Report] Organizational chart
- **Output artefacts and classification**
    - [Report] Description of roles
    - [Report] Organization chart
- **Roles** Human Resources Manager
- **Supporting tools and material**: None
- **Migration project characteristic**: Process migration project

VALDEL.A8 - Modify the existing roles

- **Activity ID**: VALDEL.A8
- **Activity Name**: Modify the existing roles
- **depends** on VALDEL
- **Activity Description**: The objective of this activity is to change / update the existing roles with the required changes in order to be aligned with the new business model.
- **Activity taxonomy**: Business Analysis task; Support task
- **Predecessor Activities**: this activity takes place in parallel with VALDEL.A1
- **Successor Activities**: VALDEL.A9
- **Input artefacts and classification**:
    - [Report] Description of roles
    - [Report] Organizational chart
- **Output artefacts and classification**
    - [Report] Description of roles
    - [Report] Organizational chart
- **Roles** Human Resources Manager
- **Supporting tools and material**: None
- **Migration project characteristic**: Process migration project

VALDEL.A9 – Train the people on their new roles

- **Activity ID**: VALDEL.A9
- **Activity Name**: Train people
- **depends** on VALDEL
- **Activity Description**: During this activity, requirements for new skills need to be collected. The new skills will be initially sought within the organization. If there is a match, these roles will be filled in with those people. In the case there is not a

match, a training plan will be prepared so as to train to those people who are going to be assigned to the new or modified roles.

- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A7 and VALDEL.A8
- **Successor Activities**: VALDEL.A10
- **Input artefacts and classification**:
    - [Report] Description of roles
    - [Report] Organizational chart
- **Output artefacts and classification**
    - [Report] Description of roles
    - [Report] Training plan
- **Roles** Human Resources Manager
- **Supporting tools and material**: None
- **Migration project characteristic**: Process migration project

VALDEL.A10 - Communicate the affected people their new activities and responsibilities

- **Activity ID**: VALDEL.A10
- **Activity Name**: Communicate the affected people their new roles and responsibilities
- **depends** on VALDEL
- **Activity Description**: The objective of this activity is to ensure that all people affected by the business model and organizational changes have the enough information to carry out their new responsibilities in an appropriate way in order to ensure the successful delivery of the SaaS offering.
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A9
- **Successor Activities**: VALDEL.A11
- **Input artefacts and classification**:
    - [Report] Description of roles
    - [Report] Organizational chart
- **Output artefacts and classification**
    - Communication to the staff
- **Roles** Human Resources Manager and Business manager
- **Supporting tools and material**: None
- **Migration project characteristic**: Process migration project

VALDEL.A11 - Communicate the entire organization the new and modified roles

- **Activity ID**: VALDEL.A11
- **Activity Name** Communicate the entire organization the new and modified roles
- **depends** on VALDEL
- **Activity Description**: The objective of this activity is to ensure that all the people in the organization are aware of the changes in the organizational chart
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A10
- **Successor Activities**: NONE
- **Input artefacts and classification**:
    - [Report] Description of roles
    - [Report] Organizational chart
- **Output artefacts and classification**
    - Communication to the entire organization
- **Roles** Human Resources Manager and Business manager
- **Supporting tools and material**: None
- **Migration project characteristic**: Process migration project
    - Requirements elicitation.
    - Select the requirements to be developed in the sprint
    - Analysis and modelling
    - Development, continuous integration and continuous testing
    - Testing of functional and non-functional requirements
    - Review and add the requirements
    - Continuous Testing, continuous delivery and deploying of the final application

VALDEL.A12 - Requirements elicitation

- **Activity ID**: VALDEL.A12
- **Activity Name**: Requirements elicitation
- **depends** on VALDEL
- **Activity Description**: The objective of this activity is to elicit the requirements from multiple stakeholders or by what the market is demanding. These requirements are to be ordered and prioritized, in accordance to best practices of software engineering and also in order to facilitate the assignment to the sprints. The following actions for the requirements elicitation are to be carried out: 1.- Collect the

requirements from the customers or other stakeholders, 2.- Analyze and define the functional and non-functional requirements and finally, 3.- Prioritize the requirements. These requirements can also come from an incidence reported by a customer in CUSTOMER.A7. in this case, this requirement shall have the highest priority. All SaaS applications must fulfil, at least, the following non-functional requirements:

  - Support multitenancy: It should be designed to support concurrent accesses by multiple tenants and handle their sessions in isolation
  - High reusability: Services providers develop and deploy cloud services and expect that the services would be reused by a large number of consumers.
  - High availability: Cloud services are not just for specific users; rather they are for any potential unknown consumers who may wish to use the services anytime and anywhere.
  - High scalability: could services should be highly scalable even in the situation that an extremely high number of services invocations and so their associated resource requests are requested

- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: Select target cloud
- **Successor Activities**: VALDEL.A13 - Select the requirements to be developed in the sprint
- **Input artefacts and classification**:
  - [Report] User Requirements
  - [Market Analysis[
- **Output artefacts and classification**
  - [Report] Prioritized requirements
- **Roles:** Software Analyst; Application owner; Software Analyst
- **Supporting tools and material**:
  - Brainstorming
  - Market analysis
- **Migration project characteristic**: Business migration projects

VALDEL.A13 - Select the requirements to be developed in the sprint

- **Activity ID**: VALDEL.A13
- **Activity Name**: Select the requirements to be developed in the sprint
- **depends** on VALDEL

- **Activity Description**: To develop SaaS applications, an agile and iterative approach is recommended. In this activity, the team selects those requirements that need to be completed during each sprint (usually the duration of each sprint is 3 weeks). These requirements are selected from the list of prioritized requirements, adding to them those requirements from the previous sprint that have not been successfully implemented.
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A12 - Requirements elicitation
- **Successor Activities**: VALDEL.A14 - Analysis and modelling
- **Input artefacts and classification**:
    - [Report] Prioritized requirements
    - [Report] User Requirements
- **Output artefacts and classification**
    - [Report] List of requirements for each sprint. This report is composed by those requirements that will be developed in a concrete sprint
- **Roles:** Software Analyst;
- **Supporting tools and material**: Requirements analysis tools; Use Case Diagrams; UML activity diagrams
- **Migration project characteristic**: Business migration projects

VALDEL.A14 - Analysis and modelling

- **Activity ID**: VALDEL.A14
- **Activity Name**: Analysis and modelling
- **depends** on VALDEL
- **Activity Description**: The objective of this activity is to analyze the requirements assigned to each sprint and model them in order to facilitate the development.
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A13, VALDEL.A24
- **Successor Activities**: VALDEL.A15
- **Input artefacts and classification**:
    - [Report] User Requirements
    - [Report] List of requirements for each sprint
- **Output artefacts and classification**
    - [Report] Technical design document, updated in each sprint
- **Roles:** Software Analyst; Software Architect; Modeller

- **Supporting tools and material**: UML modelling tools: UML component diagram, UML sequence diagram, UML class diagram
- **Migration project characteristic**: Business migration projects

VALDEL.A15 - Development, continuous integration and continuous testing

- **Activity ID**: VALDEL.A15
- **Activity Name**: Development, continuous integration and continuous testing
- **depends** on VALDEL
- **Activity Description**: During this activity the prototype of each sprint will be developed, continuously tested and integrated according to the design done in activity VALDEL.A14 and the requirements elicited in VALDEL.A12. In SaaS applications, it is recommended to follow a DevOps approach.
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A14 - Analysis and modelling
- **Successor Activities**: VALDEL.A16 - Testing of functional and non-functional requirement
- **Input artefacts and classification**:
    - [Report] List of requirements for each sprint
    - [Report] Design of each sprint. This output collects the design of the work planned for each sprint.
- **Output artefacts and classification**
    - [Software] Prototype of each sprint
    - [Software] Unit and integration tests
    - [Report] Integration Test Plan
    - [Report] Integration Test case specification
    - [Report] Test report
- **Roles:** Developer, Tester
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

VALDEL.A16 - Testing of functional and non-functional requirements

- **Activity ID**: VALDEL.A16
- **Activity Name**: Testing of functional and non-functional requirements
- **depends** on VALDEL
- **Activity Description**: The objective of this activity is to test if the prototype covers all the requirements assigned to each sprint, functionally and non-functionally.

- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A15 - Development
- **Successor Activities**:
    - If all the requirements are covered and implemented in a correct way, the successor activity is VALDEL.A17 - Review and add the requirements
    - If any requirement is pending of being implemented the successor activity is VALDEL.A13 - Select the requirements to be developed in the sprint.
- **Input artefacts and classification**:
    - [Report] List of requirements for each sprint
    - [Software] Prototype of each sprint.
- **Output artefacts and classification**
    - [Software] Tested SaaS application of each sprint.
    - [Report] Test Plan, Test Case specification and Test Report
- **Roles:** Developer and tester
- **Supporting tools and material**: None
- **Migration project characteristic**: Business migration projects

VALDEL.A17 - Review and add necessary requirements

- **Activity ID**: VALDEL.A17
- **Activity Name**: Review and add the requirements
- **depends** on VALDEL
- **Activity Description**: Once all sprints have finished, the application owner needs to validate that all the requirements have been covered. This User Acceptance Test checks that the application has implemented all the expected and detailed functionalities, as listed in the requirements. In the event this is not true, new requirements need to be added.
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A16 - Testing of functional and non-functional requirements
- **Successor Activities**:
    - If there are not any more requirements to be implemented the successor activity is VALDEL.A18 - Test and deploy the final application
    - If there are additional requirements the successor activity is VALDEL.A12 – Requirements elicitation.
- **Input artefacts and classification**:
    - [Report] User Requirements

    - [Report] List of requirements for each sprint
    - [Software] Tested SaaS incremental application of each sprint.
    - [Report] User Acceptance Test
- **Output artefacts and classification**
    - [Report] User Requirements
- **Roles:** Application owner; Technical Manager and Software Analyst.
- **Supporting tools and material**:
- **Migration project characteristic**: Business migration projects

VALDEL.A18 - Continuous delivery and deploying of the final application

- **Activity ID**: VALDEL.A18
- **Activity Name**: Continuous Testing, continuous delivery and deploying of the final application
- **depends** on VALDEL
- **Activity Description**: Once all the requirements are implemented in the different sprints, the prototype is to be deployed in the selected target platform. In the case of SaaS applications, full time availability is expected and therefore, a DevOps approach is recommended. DevOps allow to continuously integrate, test and deliver a SaaS offering.
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A17 - Review and add the requirements, Select target platform
- **Successor Activities**: VALDEL.A19
- **Input artefacts and classification**:
    - [Report] List of requirements for each sprint
    - [Software] Tested SaaS application
    - [Report]User Requirements
- **Output artefacts and classification**
    - [Software] Tested Application
    - [Software] Deployed application.
- **Roles:** Software Analyst, Software Analyst; Application Owner and Tester
- **Supporting tools and material**:
    - Configuration Management
    - Testing Tools
    - DevOps environment
- **Migration project characteristic:** Business migration projects

VALDEL.A19 - Plan the releases

- **Activity ID**: VALDEL.A19
- **Activity Name**: Planning the releases
- **depends** on VALDEL
- **Activity Description**: Develop release and deployment plans in order to avoid problems or uncontrolled impacts. The actions to be carried out in this activity are to analyze the situation and to define the release strategy to build, test and operate the application.
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A18
- **Successor Activities**: VALDEL.A20 - Build and test the release
- **Input artefacts and classification**:
    - [Software] Deployed SaaS application
- **Output artefacts and classification**:
    - [Report] Release Strategy.
- **Roles:** Business Manager and Software Analyst
- **Supporting tools and material:** DevOps environment
- **Migration project characteristic**: Business migration projects

VALDEL.A20 - Build and test the release

- **Activity ID**: VALDEL.A20
- **Activity Name**: Build and test the release
- **depends** on VALDEL
- **Activity Description**: This activity is composed of the following actions:
    - Use of build and test environments such as the ones provided by DevOps approaches
    - Take into account standardization and integration aspects
    - Record the complete steps of the build so that the SaaS application can be rebuilt if required
    - Maintain evidence of testing
    - Check that security requirements are met
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A19 - Planning the releases
- **Successor Activities**: VALDEL.A21 - Release testing and pilot
- **Input artefacts and classification**:
    - [Report] Build Model

    - [Report] Release Strategy
- **Output artefacts and classification**
    - [Software] Release Package
- **Roles:** Software Analyst; Software Analyst, Tester, Software Architect
- **Supporting tools and material**: DevOps environment
- **Migration project characteristic**: Business migration projects

VALDEL.A21 - Release testing

- **Activity ID**: VALDEL.A21
- **Activity Name**: Release testing
- **depends** on VALDEL
- **Activity Description**: This activity is composed of the following actions:
    - Evaluate whether a service and its underlying service assets can be released into the production environment.
    - Ensure that business processes, customer, user and service provider interfaces are capable of using the services properly
    - Ensure that service teams are capable of operating the service
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A20 - Build and test the release
- **Successor Activities**: If testing Ok, the successor activity is VALDEL.A18, if not The successor activity is VALDEL.A20 - Build and test the release
- **Input artefacts and classification**:
    - [Report] Build Model
    - [Report] Release Strategy
- **Output artefacts and classification**
    - [Software] Release Package
- **Roles:** Tester, **Business** Analyst and Software Analyst
- **Supporting tools and material**: DevOps environment
- **Migration project characteristic:** Business migration projects

VALDEL.A22 - Define the main features to be fulfilled by the cloud infrastructure provider

- **Activity ID**: VALDEL.A22
- **Activity Name**: Define the main features to be fulfilled by the cloud provider
- **depends** on VALDEL

- **Activity Description**: This activity aims to define the technical requirements needed regarding to technical aspects such as type of Data base, programming language, availability, scalability metrics and to business aspects such us pricing model, standards compliance etc., that the cloud provider should provide.
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A12
- **Successor Activities**: VALDEL.A23
- **Input artefacts and classification**:
    - [Report] List of cloud providers and information of their features
    - [Report] SaaS application provider own SLA
- **Output artefacts and classification**
    - [Report] Required features for the cloud provider
- **Roles:** Application owner, Software Architect, Software Analyst, Business Manager
- **Supporting tools and material**: None
- **Migration project characteristic**: Process migration project

VALDEL.A23– Match and rank the best cloud environments

- **Activity ID**: VALDEL.A23
- **Activity Name**: Search for matching Cloud environments (matchmaking, ranking)
- **Depends** on Task Id: VALDEL
- **Activity Description**: The goal of this activity is to study the different offerings by public cloud providers and also by private ones. Based on the non-functional requirements, as well as business requirements, the cloud infrastructure offerings need to be classified. Then, a matchmaking and ranking process (requirement-service-feature-pricing-changes in the organization) is carried out and the results will drive the final decision on the selected cloud target.
- **Activity taxonomy**: Matchmaking; Support task
- **Predecessor Activities**: VALDEL.A22
- **Successor Activities**: VALDEL.A24
- **Input artefacts and classification**:
    - [Report] User requirements
- **Output artefacts and classification**:
    - [Report] Ranked list of matching Cloud infrastructure offerings (technical and business considerations)

- **Roles**: Application owner, Software Architect, Software Analyst, Business Manager
- **Supporting tools and material**: None
- **Migration project characteristic**: Technical migration projects, Business Migration projects

VALDEL.A24 – Select the Target Cloud Infrastructure

- **Activity ID**: VALDEL.A24
- **Activity Name**: Select target Cloud environment
- **depends** on Task ID: VALDEL
- **Activity Description**: Based on the ranked list of matching cloud infrastructure providers, the target cloud provider where to deploy the SaaS application is selected
- **Activity taxonomy**: Support task
- **Predecessor Activities**: VALDEL.A23
- **Successor Activities**: VALDEL.A25
- **Input artefacts and classification**:
    - [Report] Ranked list of matching Cloud Infrastructure providers
- **Output artefacts and classification**:
    - [Report] Selected Cloud Infrastructure
- **Roles**: Application owner, Software Architect, Software Analyst, Business Manager
- **Supporting tools and material**: None
- **Migration project characteristic**: Technical migration projects, Business Migration projects

VALDEL.A25 - Establish the agreements with the cloud infrastructure provider

- **Activity ID**: VALDEL.A25
- **Activity Name**: Establish the agreements with the cloud infrastructure provider
- **depends** on VALDEL
- **Activity Description**: This activity aims to reflect the agreements reached with the selected cloud infrastructure provider if it is a public cloud provider. This agreement can be a contract, license, service level agreement, or memorandum of agreement. The most common way to do this agreement is through an SLA with the cloud provider
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A24

- **Successor Activities**: VALDEL.A26
- **Input artefacts and classification**:
    - [Report] Required features for the cloud provider
- **Output artefacts and classification**
    - [Report] Cloud provider SLA
- **Roles:** Business Manager
- **Supporting tools and material**: None
- **Migration project characteristic**: Process migration project

VALDEL.A26 - Monitor the fulfilment of the SLA conditions

- **Activity ID**: VALDEL.A26
- **Activity Name**: Monitor the fulfilment of the SLA conditions
- **depends** on VALDEL
- **Activity Description** This activity aims to monitor, as defined in the agreement, the fulfilment of the SLA terms and SLOs defined by the cloud provider's SLA.
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A25
- **Successor Activities**: VALDEL.A26
- **Input artefacts and classification**:
    - [Report] Cloud provider SLA
- **Output artefacts and classification**
    - [Report] Report on the monitoring of the cloud provider
- **Roles:** Business Manager; Software Analyst
- **Supporting tools and material**:
    - Monitoring tools such as an Availability Audit Lib
- **Migration project characteristic**: Process migration project

VALDEL.A27 - Report and control the SLA violations by the cloud provider

- **Activity ID**: VALDEL.A27
- **Activity Name**: Report and control the SLA violations by the cloud provider
- **depends** on VALDEL
- **Activity Description**: The Cloud provider monitoring and reporting mechanisms must be defined and agreed with the cloud provider. The periodic reports should incorporate details of performance against all cloud provider SLA targets. It is important for elaborating these reports to collect accurate information from all the areas and other processes and measured against the agreed business targets.

During this activity, reports on non-fulfilment situations are to be produced and propagated to the affected parts to request, for instance, a compensation to the cloud infrastructure provider. In case of repetitive non-fulfilments and SLA violations, it may be necessary to select another cloud infrastructure provider.

- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A26
- **Successor Activities**: If non fulfilments occur repetitively, VALDEL.A22
- **Input artefacts and classification**:
    - [Report] Cloud provider SLA
- **Output artefacts and classification**
    - [Report] Report on the monitoring of the cloud provider
- **Roles:** Business Manager; Software Analyst and Quality manager
- **Supporting tools and material**: None
- **Migration project characteristic**: Process migration project

VALDEL.A28 – Set up sales channels

- **Activity ID**: VALDEL.A28
- **Activity Name**: Report and control the SLA violations by the cloud provider
- **depends** on VALDEL
- **Activity Description**: This activity entails the set up and practical implementation of the sales channels per SaaS offering.
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALPRO.A4
- **Successor Activities**: VALDEL.A29
- **Input artefacts and classification**:
    - [Report] Product catalogue
    - [Report] Business Plan
    - [Report] Marketing strategy
- **Output artefacts and classification**
    - [Report] (Updated) Marketing Strategy
- **Roles:** Business Manager
- **Supporting tools and material**: None
- **Migration project characteristic**: Process migration project

VALDEL.A29 – Monitor the performance of the sales team

- **Activity ID**: VALDEL.A29

- **Activity Name**: Monitor the performance of the sales team
- **depends** on VALDEL
- **Activity Description**: This activity aims to continuously monitor metrics such as funnel metrics (efficiency of the different sales channels), customer churn rate trends, and so on. In this activity it is also important to analyze why customers are stopping from using the SaaS application.
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A28
- **Successor Activities**: VALDEL.A30
- **Input artefacts and classification**:
    - [Report] Marketing Strategy
    - [Report] Business Plan
- **Output artefacts and classification**
    - [Report] Analysis of the performance of the sales team and users' feedback on why they are leaving
- **Roles:** Business Manager
- **Supporting tools and material**: None
- **Migration project characteristic**: Process migration project

VALDEL.A30 – Implement corrective measures in the sales team

- **Activity ID**: VALDEL.A30
- **Activity Name**: Implement corrective measures in the sales team
- **depends** on VALDEL
- **Activity Description**: This activity aims to apply corrective measures in the sales team, such as a reorganization of the team, a pivoting on the customer segments, and so on.
- **Activity taxonomy**: Business Analysis Task; Support task
- **Predecessor Activities**: VALDEL.A29
- **Successor Activities**: None
- **Input artefacts and classification**:
    - [Report] Marketing Strategy
    - [Report] Business Plan
- **Output artefacts and classification**
    - [Report] (Updated) Marketing Strategy
    - [Report](Updated) Business Plan
- **Roles:** Business Manager

- **Supporting tools and material**: None
- **Migration project characteristic**: Process migration project

Financial Management (Financial)

- **Task Id**: VALDEL
- **Task Name**: Financial Management
- **Task Objective**: The goal of this task is to determine how the SaaS provider is going to charge for the application and thus obtain the optimal revenues to ensure the sustainability of the organization, needing to do so a strict analysis of the cost structure. **Predecessor Task**: VALPRO, VALDEL.
- **Successor task**: BUSTECHVAL, VALPRO
- **Related Activities**:
    - FINANCIAL.A1: Determine the Costs Structure
    - FINANCIAL.A2: Determine the Revenue means
    - FINANCIAL.A3: Simulate different pricing strategies
    - FINANCIAL.A4: Decide on the pricing strategy
    - FINANCIAL.A5: Monitor continuously the costs and revenues, as well as other financial metrics and implement corrective measures

FINANCIAL.A1 – Determine the Costs Structure

- **Activity Id**: FINANCIAL.A1
- **Activity Name**: Determine the costs structure
- **Depends on Task ID**: FINANCIAL
- **Activity Description**: This activity focuses on determining the structure of costs for the SaaS offering provided. This structure must include fix and variable costs. Some aspects that need to be considered:
    - Costs coming from the cloud infrastructure provider, if the selected provider is a public cloud service provider
    - Operational costs, that is, the costs incurred when running the service
    - Marketing and Sales costs

  If these costs are not completely known, estimations can be initially written.
- **Activity taxonomy**: Business analysis task
- **Predecessor Activities**: VALDEL.A25
- **Successor Activities**: FINANCIAL.A2
- **Input artefacts and classification:**
    - Costs

- **Output artefacts and classification:**
    - Cost structure
- **Roles**: Business Manager, Business Analyst
- **Supporting tools and material:**
    - spreadsheet
- **Migration project characteristic:** Business migration projects

FINANCIAL.A2 – Determine Revenue means

- **Activity ID**: FINANCIAL.A2
- **Activity Name:** Determine Revenue Streams
- **depends** on Task ID: FINANCIAL
- **Activity Description**: The goal of this activity is to determine the revenues streams to ensure the sustainability of the organization and the offering. Revenues in SaaS come mostly from the number of subscriptions (total number of customers that have bought the offering) but also from additional services charged to the users. These services need to be identified and priced. Establish the margin that the SaaS offering will make whenever a subscription occurs for each group of features identified in the VALPRO activities.
- **Activity taxonomy**: Business analysis task
- **Predecessor Activities**: VALPRO.A3, FINANCIAL.A1
- **Successor Activities**: FINANCIAL.A3
- **Input artefacts and classification:**
    - List of potential revenue means
- **Output artefacts and classification:**
    - Revenues analysis
- **Roles**: Business Manager, Business Analyst
- **Supporting tools and material:**
    - Spreadsheet
- **Migration project characteristic:** Business migration projects

FINANCIAL.A3 – Simulate different pricing strategies

- **Activity ID**: FINANCIAL.A3
- **Activity Name:** Simulate different pricing strategies
- **depends** on Task ID: FINANCIAL
- **Activity Description**: Taking the features identified by each customer segment, the revenue streams and the cost structure identified in previous tasks, simulate

how the different pricing strategies behave and impact the profit and loss account. There are different pricing strategies in the SaaS world, for instance:

  - By use: Pay-as-you-go
  - By transaction, e.g.; sessions (number of accesses to the service), requests (clicks on a certain functionality / feature)
  - By volume: The volume of the used service: GB, MB/s, CPU cycles, etc.
  - By value, such as the freemium models or the tiered models
  - By time: the time that the client uses the service measured in hours, seconds or microseconds.
  - By users: number of simultaneous users that can access the system
  - Flat rate
  - Hybrid

- **Activity taxonomy**: Business analysis task
- **Predecessor Activities**: FINANCIAL.A2, FINANCIAL.A1
- **Successor Activities**:
  - If managers agree with the obtained results: FINANCIAL.A4
  - If managers do not agree with the obtained results: FINANCIAL.A1, FINANCIAL.A2
- **Input artefacts and classification:**
  - [Report] Product Catalogue
  - [Report] Marketing Strategy
  - [Report] Business Plan
- **Output artefacts and classification:**
  - [Report] Pricing strategies simulated
- **Roles**: Business Manager, Business Analyst
- **Supporting tools and material:**
  - Spreadsheet, such as the one presented in this PhD thesis
- **Migration project characteristic:** Pricing model simulation task

FINANCIAL.A4 – Decide on the pricing strategy

- **Activity ID**: FINANCIAL.A4
- **Activity Name:** Decide on the pricing strategy
- **depends** on Task ID: FINANCIAL
- **Activity Description**: Based on the results obtained in the simulation task, decide which pricing strategy provides better results in the mid and long term.

The final decision on the pricing strategy will also affect the value proposition of the SaaS offering, that will have to be updated accordingly.

- **Activity taxonomy**: Business analysis task
- **Predecessor Activities**: FINANCIAL.A3
- **Successor Activities**: VALPRO.A4, FINANCIAL.A5, FINANCIAL.A6, FINANCIAL.A7
- **Input artefacts and classification:**
  - [Report] Product Catalogue
- **Output artefacts and classification:**
  - Pricing policy
  - [Report] (Updated) Product Catalogue
- **Roles**: Business Manager, Business Analyst
- **Supporting tools and material:**
  - Spreadsheet
- **Migration project characteristic:** Business migration projects

FINANCIAL.A5 – Monitor continuously the costs and revenues, as well as other financial metrics and implement corrective measures

- **Activity ID**: FINANCIAL.A5
- **Activity Name:** Monitor continuously the costs and revenues, as well as other financial metrics
- **depends** on Task ID: FINANCIAL
- **Activity Description**: This activity entails first the definition and frequency of the metrics that will be monitored to be able to pivot the pricing strategy and associated business model and secondly the collection, monitoring and analysis of such metrics.

  Common metrics studied in the SaaS world include, but are not limited to:
  - MRR or monthly recurring revenue
  - Subscriptions
  - Customer growth
  - Customer churn rate
  - CAC: customer acquisition cost
  - LTV: lifetime value of a customer
  - CAC:LTV ratio
  - Funnel: efficiency of the sales teams

If any of these metrics are below the defined thresholds, corrective measures will have to be taken, and the pricing strategy will have to be pivoted again.

- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities**: FINANCIAL.A4
- **Successor Activities**:
    - If all metrics are OK: FINANCIAL.A5 (activity to be done continuously)
    - If any metric is not OK: [optional] FINANCIAL.A1, [optional] FINANCIAL.A2, FINANCIAL.A3
- **Input artefacts and classification:**
    - Pricing strategy
- **Output artefacts and classification:**
    - [Report] Scoreboard / Dahsboard
- **Roles**: Business Manager, Business Analyst
- **Supporting tools and material:**
    - Spreadsheets
- **Migration project characteristic:** Business migration projects

FINANCIAL.A6 – Implement the monitoring component in the application

- **Activity ID**: FINANCIAL.A6
- **Activity Name:** Implement the monitoring component in the application
- **depends** on Task ID: FINANCIAL
- **Activity Description**: This activity entails the implementation from scratch or the customization of a monitoring component that will monitor the necessary parameters to implement the selected pricing strategy. For instance, if the pricing strategy establishes that it is pay per concurrent users, the monitoring component will count on how many concurrent users are using the application. In the case of the freemium model or the tiered model, this will be done through different authorization levels. In the case a user wants to use a module that belongs to a superior version, the user will be offered the possibility to upgrade and will be billed accordingly.
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities**: FINANCIAL.A4, VALPRO.A4
- **Successor Activities**: Running in parallel with VALDEL.A15 and FINANCIAL.A6
- **Input artefacts and classification:**
    - Monitoring component

    - Generic billing component
    - Cost structure
    - Pricing strategy
- **Output artefacts and classification:**
    - Customized billing component
- **Roles**: Business Manager, Business Analyst
- **Supporting tools and material:**
    - Monitoring component
    - Billing component
    - Pricing strategy
- **Migration project characteristic:** Business migration projects

FINANCIAL.A7 – Implement the billing component in the application

- **Activity ID**: FINANCIAL.A7
- **Activity Name:** Implement the billing component in the application
- **depends** on Task ID: FINANCIAL
- **Activity Description**: This activity entails the implementation from scratch or the customization of a billing component, that will bill the SaaS user according to the pricing strategy defined. The billing component must offer also the possibility to decide on the frequency the user wants to receive its bill. Most commonly, the frequency in which the user will be billed is monthly, although the first year in most SaaS offerings the customer may be offered to pay the first year upfront.
- **Activity taxonomy**: Business Analysis Task
- **Predecessor Activities**: FINANCIAL.A4
- **Successor Activities**: NA
- **Input artefacts and classification:**
    - Monitoring component
    - Generic billing component
    - Pricing strategy
- **Output artefacts and classification:**
    - Customized billing component
- **Roles**: Business Manager, Business Analyst
- **Supporting tools and material:**
    - Monitoring component
    - Billing component
    - Pricing strategy

- **Migration project characteristic:** Business migration projects

Activities timeline at a glance

Table 33. Timeline of VALPRO activities

Activity Id	Activity Name	Predecessor	Successor
VALPRO.1	Identify the features of the SaaS application and compare them to the features offered by the competitors	EDF.A2, VALDEL.A12	**VALDEL**
VALPRO.2	Identify and analyze the customers' needs as well as the problems that need to be solved	EDF.A2	VALPRO.A3
VALPRO.3	Define the features that need to be delivered to each customer segment in order to solve their needs and problems	VALPRO.A1, VALPRO.A2	VALPRO.A4
VALPRO.4	Define the value delivered to each customer segment	VALPRO.A3	VALPRO.A5
VALPRO.5	Continuously monitor the value proposition	VALPRO.A4	VALDEL
VALPRO.6	Apply Corrective Measures	VALPRO.A5	VALPRO.A1

Table 34. Timeline of Customer Interaction activities

Activity Id	Activity Name	Predecessor	Successor
CUSTOMER.A1	Analyze the expected customer relationships for each SaaS offering type	VALPRO.A4, EDF.A2	CUSTOMER.A2, OPERATIONAL.A2
CUSTOMER.A2	Perform a gap analysis	CUSTOMER.A1, EDF.A2	CUSTOMER.A3
CUSTOMER.A3	Implement the generic customer relationships mechanisms for each SaaS offering type	CUSTOMER.A2	CUSTOMER.A4, VALDEL
CUSTOMER.A4	Instantiate these generic mechanisms for strategic customers customer and SaaS offering	CUSTOMER.A3	VALDEL
CUSTOMER.A5	Register communications with customers	CUSTOMER.A3, CUSTOMER.A4	CUSTOMER.A6
CUSTOMER.A6	Perform an Initial diagnosis to classify the communication	CUSTOMER.A5	[if incidence not solved] CUSTOMER.A7, [if incidence solved] CUSTOMER.A17
CUSTOMER.A7	Incidence identification	CUSTOMER.A6	CUSTOMER.A8
CUSTOMER.A8	Incidence logging	CUSTOMER.A7	CUSTOMER.A9
CUSTOMER.A9	Incidence categorization	CUSTOMER.A8	CUSTOMER.A10
CUSTOMER.A10	Detailed diagnosis	CUSTOMER.A9	CUSTOMER.A11

Activity Id	Activity Name	Predecessor	Successor
CUSTOMER.A11	Incidence prioritization	CUSTOMER.A10	CUSTOMER.A12
CUSTOMER.A12	Incidence escalation	CUSTOMER.A11	CUSTOMER.A13, VALDEL.12
CUSTOMER.A13	Final diagnosis	CUSTOMER.A12	CUSTOMER.A14
CUSTOMER.A14	Resolution and Recovery	CUSTOMER.A13, VALDEL.A15	CUSTOMER.A15
CUSTOMER.A15	Follow-up of the incidence	CUSTOMER.A14	CUSTOMER.A16
CUSTOMER.A16	Inform the user	CUSTOMER.A15	CUSTOMER.A17
CUSTOMER.A17	Close the incidence	CUSTOMER.A16	CUSTOMER.A18
CUSTOMER.A18	Measure and analyze customer's feedback	CUSTOMER.A3, CUSTOMER.A17	CUSTOMER.A18
CUSTOMER.A19	Implement corrective measures with respect to the relationship with the customers	CUSTOMER.A18	CUSTOMER.A1

Table 35. Timeline of External Driving Forces activities

Activity Id	Activity Name	Predecessor	Successor
EDF.A1	Analyze the value chain of the SaaS offering	None	EDF.A2
EDF.A2	Analyze the market where the SaaS offering will compete	EDF.A1	EDF.A3, CUSTOMER.A1, VALPRO.A1
EDF.A3	Identify the Marketing objectives	EDF.A2	EDF.A4
EDF.A4	Identify the marketing strategy	EDF.A3	EDF.A5
EDF.A5	Start implementing the market strategy	EDF.A4	EDF.A6
EDF.A6	Monitor the market plan	EDF.A5	[if marketing objectives OK] EDF.A7; [if marketing objectives NOK] EDF.A3
EDF.A7	Monitor the market	EDF.A6, VALPRO.A4	[if changes in the market] EDF.A4, [if changes in CSP] VALDEL.A23,

Table 36. Timeline of Value Delivery activities

Activity Id	Activity Name	Predecessor	Successor
VALDEL.A1	Determine SLA Framework	None	VALDEL.A2
VALDEL.A2	Document and establish which SLA terms and SLOs will be covered in each of the different SaaS offerings	VALDEL.A1	VALDEL.A3
VALDEL.A3	Review underpinning agreements	VALDEL.A2	VALDEL.A4, VALDEL.A6

Activity Id	Activity Name	Predecessor	Successor
VALDEL.A4	Monitor service performance against SLA	VALDEL.A3	VALDEL.A5, VALDEL.A7
VALDEL.A5	Produce service reports	VALDEL.A4	VALDEL.A6
VALDEL.A6	Review SLAs and underpinning agreements	VALDEL.A2, VALDEL.A3, VALDEL.A4, VALDEL.A5	if changes: VALDEL.A2, VALDEL.A3, VALDEL.A4, VALDEL.A5
VALDEL.A7	Define the new roles	None	VALDEL.A8
VALDEL.A8	Modify the existing roles	None	VALDEL.A9
VALDEL.A9	Train people on their new roles	VALDEL.A7, VALDEL.A8	VALDEL.A10
VALDEL.A10	Communicate the affected people their new roles and responsibilities	VALDEL.A9	VALDEL.A11
VALDEL.A11	Communicate the entire organization the new and modified roles	VALDEL.A10	None
VALDEL.A12	Requirements elicitation		VALDEL.A13
VALDEL.A13	Select the requirements to be developed in the sprint	VALDELA.12	VALDEL.A14
VALDEL.A14	Analysis and modelling	VALDELA.13, VALDEL.A23	VALDEL.A15
VALDEL.A15	Development, continuous integration and continuous testing	VALDELA.14	VALDEL.A16
VALDEL.A16	Testing of functional and non-functional requirements	VALDELA.15	[if all reqs implemented] VALDEL.A17, [if all reqs not implemented] VALDEL.A13
VALDEL.A17	Review and add the requirements	VALDELA.16	VALDEL.A18 (all reqs), VALDEL.A12 not all reqs
VALDEL.A18	Continuous delivery and deploying of the final application	VALDE.LA17; VALDEL.A22	VALDE.A19
VALDEL.A19	Plan the releases	VALDEL.A18	VALDEL.A20
VALDEL.A20	Build and test the release	VALDEL.A19	VALDEL.A21
VALDEL.A21	Release testing	VALDEL.A20	[Testing OK] VALDEL.A18, [Testing NOK] VALDEL.A20
VALDEL.A22	Define the main features to be fulfilled by the cloud infrastructure provider	VALDEL.A12	VALDEL.A23
VALDEL.A23	Match and rank the best cloud environments	VALDEL.A22	VALDEL.A24
VALDEL.A24	Select the Target Cloud Infrastructure	VALDEL.A23	VALDEL.A25

Activity Id	Activity Name	Predecessor	Successor
VALDEL.A25	Establish the agreements with the cloud infrastructure	VALDEL.A24	VALDEL.A26
VALDEL.A26	Monitor the fulfilment of the conditions	VALDEL.A25	VALDEL.A27
VALDEL.A27	Report and control the SLA violations by the cloud provider	VALDEL.A26	[if non-fulfillments,] VALDEL.A22
VALDEL.A28	Set up sales channels	VALPRO.A4	VALPRO.A29
VALDEL.A29	Monitor the performance of the sales team	VALPRO.A28	VALPRO.A30
VALDEL.A30	Implement corrective measures in the sales team	VALPRO.A29	

Table 37. Timeline of Financial activities

Activity Id	Activity Name	Predecessor	Successor
FINANCIAL.A1	Determine the Costs Structure	VALDEL.A25	FINANCIAL.A2
FINANCIAL.A2	Determine the Revenue means	FINANCIAL.A1, VALPRO.A3	FINANCIAL.A3
FINANCIAL.A3	Simulate different pricing strategies	FINANCIAL.A1, VALPRO.A4	[if managers ok] FINANCIAL.A4, [if managers NOK] FINANCIAL.A1
FINANCIAL.A4	Decide on the pricing strategy	FINANCIAL.A3	FINANCIAL.A5, VALPRO.A4
FINANCIAL.A5	Monitor continuously the costs and revenues, as well as other financial metrics and implement corrective measures	FINANCIAL.A4	[if metrics ok] FINANCIAL.A5, [if metrics NOK], FINANCIAL.A1
FINANCIAL.A6	Implement the billing component in the application	FINANCIAL.A4, VALPRO.A4	in parallel with VALDEL.A15, FINANCIAL.A7
FINANCIAL.A7	Implement the monitoring component in the application	FINANCIAL.A4, VALPRO.A4	in parallel with VALDEL.A15, FINANCIAL.A7

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GLOSSARY

Cloud Computing: Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. According to the National Institute of Standards and Technology of U.S. Department of Commerce, the cloud computing model promotes availability and presents five essential characteristics: On-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service

Software as a service: Software as a Service (SaaS) is a software distribution model in which applications are hosted by a vendor or service provider and made available to customers over a network, typically the Internet. SaaS is commonly licensed on a subscription basis.

Legacy Software: Legacy software is an existing software product developed compliant to the specifications of the source framework, while the target software system is a software product, compliant to the specifications of the target framework and resulted as outcome of a migration process. For this thesis, legacy software is: software not developed for the cloud, non-cloud, applications / software in traditional architectural paradigms is that software developed for a client-server architecture, two or three tiers but that cannot scale, cannot be measured and does not share resources beyond infrastructure (e.g. database, memory) as Software-as-a-service does. It often is on-premise software installed at the company's own infrastructure.

The perpetual licensing model has been the most common business model before the cloud delivery model started to be popular. In the perpetual model, the cost to own an application is calculated up-front and charged to the buyer (licensee) in return to a perpetual (forever) right to use the software. Moreover, in this model, the upgrading costs are not covered, although often the bug-fixes are. Cloud computing is allowing new business models to grow, mostly based on subscription or on use basis.

Software migration implies that the source (legacy) and target frameworks are different in some essential aspects, which impede the legacy system to be executed on the target framework without accomplishing important changes on the legacy software system.

Therefore, this framework mismatching requires applying transformations on the legacy software.

Software modernization: A particular case of software migration is software modernization (or evolutionary software), where the target software framework was specified (and created) time after the source software framework was, whereby target specification can be consider much more modern that source specification. In the way around, source software framework can be considered obsolete.

Cloudified: Cloudification is the action of moving a software to the cloud (software migration and modernization), considering the architectural and business constraints that such actitity implies.

Service Level Agreement (SLA): A service-level agreement (SLA) is a contract between a network service provider and a customer that specifies, usually in measurable terms, what services the network service provider will furnish. The values of the different terms of an SLA are named SLOs or Service Level Objectives.

SOA: A service-oriented architecture (SOA) is the underlying structure supporting communications between services. SOA defines how two computing entities, such as programs, interact in such a way as to enable one entity to perform a unit of work on behalf of another entity. Service interactions are defined using a description language. Each interaction is self-contained and loosely coupled, so that each interaction is independent of any other interaction.

QoS: On the Internet and in other networks, QoS (Quality of Service) is the idea that transmission rates, error rates, performance and other characteristics can be measured, improved, and, to some extent, guaranteed in advance.

Reverse Engineering: The process of examining an already implemented software system (i.e. a legacy system) in order to represent it in different forms or formalisms and at higher abstraction levels (e.g. using different types of models).

Forward Engineering; The traditional process of moving from high level abstractions & logical or implementation independent designs (e.g. models) to the physical implementation of a system (e.g. source code).

Multi tenancy: multitenancy refers to a principle in software architecture where a single instance of the software runs on a single infrastructure, serving multiple client organizations (tenants) and supporting a high consolidation of the resources. Multitenancy is contrasted with a multi-instance architecture where separate software instances (or hardware systems) are set up for different client organizations.

There are 3 different levels for creating a multi-tenant environment depending on the types of resources shared among the different tenants:

- Hardware consolidation level
- Application consolidation level
- Database consolidation level

Scalability: Scalability is the ability of a system, application or database to continue performing well in terms of efficiency under an increased workload or demand and its ability to be enlarged to accommodate that growth. In order to design a scalable application separate layers with static and dynamic data need to be defined. The static data scale easily, while dynamic data require some specific mechanisms. If the stateless nodes are separated from the transactional ones the problem is simpler. The best manner to scale an application is to maintain it stateless, in this way, several instances from the database can be created without synchronizing the state among them. The scalability could be dealt from two different points of view: application layer scalability and storage layer scalability.

Monitoring: When an application is offered as SaaS, other relevant issue is to monitor the application usage and all the used resources. This monitoring is used to establish for example the fee policy. Several aspects could be monitoring. These aspects could be classified as: physical resources (CPU, storage) where the monitoring is useful for monitoring the use of the infrastructure by each tenant and application usage (access), concurrent users in order to be able to bill according to the real usage of the application.

Business Model: Software off-the-shelf business model cannot be applied directly without adjustments to the SaaS business model. Changes are required in the business model in order to ensure some degree of success in the service provision. SaaS business model may involve the automation of some processes in order to meet the customer expectations over some de-facto standard in the interaction with SaaS. For example, online subscriptions, message based support or configurable mail notifications.

Business / Organizational Process: A business process or organizational process is an activity or set of activities that will accomplish a specific organizational goal and contributing to the delivery of a product or a service.