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Master Program in Information Management

Cloud Technology Selection

A structured framework for decision making

Tiago Miguel Rodrigues Pereira de Araújo

Dissertation presented as partial requirement for obtaining the master's degree in Information Management, with a specialization in Information Systems and Technology Management

Advisor: Vítor Duarte dos Santos, PhD.

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ABSTRACT

This study aims to get organizations to improve their decision making during the selection of cloud technology process. As the technology evolves alongside an ever-increasing abundance in market offer, it may be challenging to choose the desirable service that encompasses several business approaches.

For the purpose of this study to be attained, the reader must first comprehend the definition of Cloud Technology: it is the delivery of IT resources over the Internet, being applications, software, storage, among other services. Furthermore, understanding the current main technologies/architectures and their capabilities/limitations will play an important role in designing and developing the prospected solution. A thoroughly research will be produced to better define the criteria used in the process.

Despite the fact that technology is able to be tailored up to a certain level for the organization needs, a higher level of participation will encourage vendors and architecture designers to develop a better knowledge on the companies' desires, thus delivering more appropriate features to their unique needs.

KEYWORDS

Cloud Technology; Information Management; Decision Support; Multi-Criteria Decision Making

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LIST OF ABBREVIATIONS AND ACRONYMNS

AHP	Analytic Hierarchy Process
CTS	Cloud Technology Selection
DK	Design Knowledge
DSR	Design Science Research
ERP	Enterprise Resource Planning
HCM	Human Capital Management
i.e.	id est
IS	Information Systems
IT	Information Technology
MTBF	Mean Time Between Failures
PM	Project Manager
QoS	Quality of Service
SLA	Service Level Agreements
SLM	Service Level Management
SME	Small/Medium Enterprises
TOE	Technological-Organizational-Environmental

1. INTRODUCTION

1.1. BACKGROUND

Big companies face major challenges. Amongst them is the clear capability to run a company effectively and efficiently. For instance, if the reader could analyze a unique worker, you would have found yourself immersed in the great number of variables that define every single aspect of the worker's life (de Bruin & Floridi, 2017). To capture them and to make use of that data by turning that into valuable information, thus providing meaningful insights requires a paramount management system (Garg et al., 2013).

Enterprise resource planning commonly known as ERP is the management of essential business processes that are often in real-time and are handled by software and technology. ERP is commonly cited as a division of business-management software, ordinarily a suite of integrated applications that a company may make use in order to collect, store, manage and interpret data from various business activities.

While the majority of the market is populated with all sorts of rudimentary manually managed systems on-premise, cloud brings a whole new opportunity for businesses which need that information in the palm of their hands (Godse & Mulik, 2009). While bureaucracy and inefficiency could potently damage the organizations overall operational performance, the lack of profound audits may impede them from ever reaching the desired maximum productivity (Rehman et al., 2011).

Taking a look at the current situation of the Covid-19 pandemic, society is, for instance, witnessing how ERP systems are being able to maintain the whole industry in operation with its capability to bolster business operations through remote access, automated reporting, computerized data exchange and real-time factory controls (Y. C. Lee, 2019).

As an efficient information management system is crucial to effectively maintain the day to day business operations, companies need to maintain their processes running smoothly and efficiently while at the same time keeping a profound control over their information (Zeng et al., 2009). As a result, companies with faster response times to the businesses' risen challenges are able to sustain the hard-gained leverage against their competitors. Data driven decision-making has, without a doubt, verified a huge surge in demand (P. yu Chen & Wu, 2013).

Furthermore, the search for automatized processes which aims at reducing overall costs and eliminate unnecessary bureaucracies has also represented a powerful tendency in the most recent years (C.-W. Chen et al., 2011). Companies nowadays have established automation strategies designed to optimize resource usage consequently enabling cost cutting and better work conditions.

The advantages presented by a use of an ERP are not solely unique to this type of cloud deployment as all sorts of cloud technologies are created everyday with the aim to enlarge a companies' access to data, on whichever form this may be provided into.

Thankfully, the customer has at its disposal a vast majority of cloud technology offers in the market. But to choose which one is the most suitable for its needs is a hard process. Many factors come into play on economic, social and technical sides (Choi et al., 2018). While having already established a

cloud migration strategy, it is truly necessary to understand which cloud providers may offer the best conjunction of features and resources that meet each and every process need of the business.

From human capital management to logistics, from financial to education, the market offer covers numerous economic sectors as well as the different aspects of the business (Vouk, 2008). At the moment of decision-making, some areas may have a higher priority over others, whether it is the economic impact such system could provide or the digital transformation that could revolutionize any business process.

Again, talking about ERPs, the global ERP market was valued in 2018 at $35.81 billion as seen in Figure 1.1. As this is the currently the latest data available in terms of a concrete number that represents the ERP market size, 2020 is expected to exceed $49 billion. Bearing in mind the COVID-19 pandemic's harsh effects on the economy and the society, which may lead to a downturn, this value stills represents an overall solid trend especially in cloud technology adoption at a global scale (Dove et al., 2015; Sharma et al., 2020).

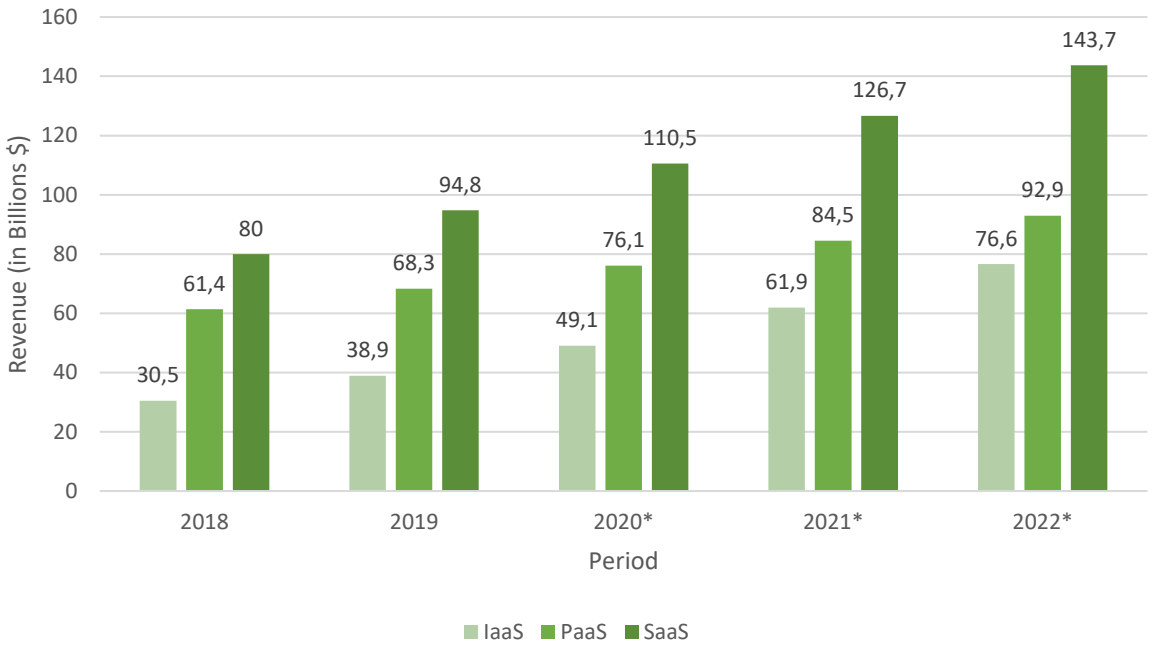

Figure 1.1 – Deployment models revenues – Source: (Contu et al., 2019)

While the reader may at a first glance assume that the ERP ecosystem is something new, the fact of the matter is that it has coexisted with us for over 40 years, involving step by step. For that matter, vendors will keep innovation as the driving force for their strategy (L. S. L. Chen & Chen, 2018).

Now, assessing cloud technology as a whole the values greatly skyrocket as it is no longer solely of SaaS but almost every sort of cloud technology available. In 2020, the global cloud technology market was worth a whopping 371 billion USD. It is expected that this value greatly increases to up to a 832 billion USD by 2025, reflecting not only an interest in this sort of technologies but actually a major step in technology and society in (*Cloud Computing Market - Global Forecast to 2025 | TC 1228*, 2020).

Looking back at when any sort of developing platform would be executed locally in a computer, nowadays any client is faced with a wide sort of solutions that allow any website to be built from day

to night, using for instance Wordpress, or any application to be developed in an easy drag and drop procedure, for instance Outsystems. And what's the common thing between all of them? They can all be developed collaboratively in the cloud.

Technologies come and go, but the ones which can keep up with the ever changing business and technological environment seem to propel a greater level of confidence on the client. You may find aerospace, retail, financial services amongst other industries opting for what the user may assume at the first sight the same technology, but which actually translate into various intricacies and adaptations that make each system unique (Mokhtar et al., 2017; Oliveira et al., 2014).

The reader could also verify the adaptation level which vendors and their cloud software and infrastructure improve constantly as businesses change. A solution which can be optimized today, may also lag behind tomorrow (Wittern et al., 2012). At the same level, transparency in the business processes seems to be present in today's everyday approach, as easy understanding on how the system works allows for continuous improvement.

This adaptation and innovation have recently been visible with many vendors investing heavily on machine learning and blockchain technologies to drive their future lead (Casino et al., 2019; Goldfeder et al., 2017), thus lastly impacting the way companies are managed and furthermost providing indirect society's changes over time.

1.2. STUDY JUSTIFICATION

While searching for the right cloud technology, an organization may encounter different vendors with many different products that may cover some or all of their needs. As the market's offer grows bigger and bigger each year, companies are often overwhelmed by the lack of support for a structured decision making (T L Saaty, 1994). The need for a selection framework dedicated to cloud technology selection has never been so substantial as it currently is (Büyüközkan et al., 2018).

The selection process itself of cloud technology selection can prove to be a tedious task, with many variables coming into play, along with different criteria as well as different stakeholders' inputs (Rehman et al., 2011), especially if the migration occurs from traditional models into cloud ones. In this case, a lack of transparency and oversight can result in down-right failures, with the delivered product not being up to standards according to the client's expectations (L. Sun et al., 2014).

Nonetheless, it is within this context of uncertainty that a framework can be used as a white board for any future endeavors. A wide business analysis is truly necessary in order to target the specific areas that would make a better use of such technology. But in order to prioritize, there is a necessity to make use multi-layered criteria models (Ramacher & Mönch, 2014; Triantaphyllou, 2000) which would enable the organization to evaluate those areas according to an equative benchmark (Morrisey, 1976).

With that said, organizations will often feel that with only a criterion modeled system they would not reach the intended purpose. In fact, they could make use of different frameworks that could overlap while maintaining an equivalent basis. To understand the common principle which statement builds on there is need to acknowledge that a framework would never be able to account for all the different aspects of the business (Turskis et al., 2009).

In the very sense, the reader may find for instance frameworks that mostly cover the financial sides of the business with greater detail than other frameworks that look into administration and business process efficiency. As organizations shift gears through time and according to both internal and external factors, a framework with easy application on today's business standards may not be suitable for tomorrow ones.

To build a framework that could account for the majority of the business aspects as well as their embedded intricacies proves a challenge from the start, as the framework would also to prove to be time proof (Rahi et al., 2017). Bearing in mind that this is also addressing an area of pure innovation which has been asserted by years and years of exponential growth and with no stoppage in sight, the framework has to be easily adaptable for the world of tomorrow (J. Yang et al., 2013). If it does not, it may become outdated quite easy. Therefore, it must quickly adapt to the end-user usability challenges as well.

As lucrative enterprises have a tendency to grow in number, the usage of such systems increases as business grows. But as business grows, the different fields of the business may be addressed not just by one but by multiple vendors and software enterprises, thus enabling a certain level of inefficiency. To choose not just right but also the most compatible ERP, infrastructure, platform, etc…., takes considerable system knowledge.

Taking part in companies that do develop and implement cloud technology systems, to help companies adopt the right technology suiting all of their needs thus enabling them to evolve has always been the

aim, which is mostly translated not only in value creation perceived by the customer but also customer satisfaction (Garrison et al., 2015; Karim et al., 2013).

Ensuring that the framework is adapted requires continuous monitorization (Ghezzi et al., 2014). The client must at all times have a range of qualified and well structures KPI's, as they provide the client with the correct tools to measure the application of the model as well as the level of success.

This study finds its relevance as it enables effective decision making. The reader may understand that the customer satisfactions levels are encompassed by three key objectives:

- A multi-layered criteria model will aid critical decision making granting a higher level of success as well as customer satisfaction. By establishing a path in which each level would represent a sort of needs, requirements, resources as well as timelines for the project among other significant details, it would provide a framework in order to obtain clear insights for the support of a decision
- The framework will not only focus on the selection with a keen pursuit of a successful implementation stage accounting for the client satisfaction level during the entire process (Retana et al., 2018). Therefore, customer satisfaction will be measured not only on the client delivery but also on a continuous basis beforehand (Garrison et al., 2012). For that, the framework will make use of existing as well as establish key performance indicators that need to be verified at all times (Zant & Gagnaire, 2015)
- As a selection process is always unique, the framework will aim at encompassing the external and internal variables that, when translated into specific events, may change the customer satisfaction level. In a sense, the framework will have a huge focus on risk analysis (Cavalcante et al., 2011; Schmidt et al., 2001), with strategies that will help to identify, evaluate, control and handle that specific risk category by building a risk management framework applied only to the cloud technology selection process (Cayirci et al., 2016; Razaque et al., 2020)

Even though it might be tricky, with a structured framework, the organization has a fully instructed path to aid their decision. This will certainly prove itself useful as it might contribute to save time and reduce costs. The results of the framework will also help vendors and designers to create solutions that will better suit the client's needs.

As it aims at improving this particular business process which has such a massive impact during the operation of an enterprise, the model aims at improving the Information Technology environment in a broader sense. Lastly, with implementation of this framework, the organizations will achieve significant cost reductions as well as shorter decision timespans, thus contributing for the maximization of the efficiency on the economic layer of society.

1.3. SPECIFIC OBJECTIVES

The research goal is to propose an optimized model to serve as a guided path for Cloud Technology Selection.

In order to achieve this goal, the following intermediate objectives were established:

1. Study of the conceptual processes of cloud technology selection and decision-making models
2. Study of the most important current cloud technology architectures and implementations processes
3. Construction of the framework and the decision-making model
4. Validation of the framework and model

2. LITERATURE REVIEW

2.1. CLOUD TECHNOLOGY

2.1.1. Concepts

Cloud Computing is a denomination which has surged in popularity both a business and academic levels but specially in society in general translating into many endeavors to clearly explain it. In order for us to characterize this term, the following definitions were gathered.

The U.S. National Institute of Standards and Technology (NIST) by (Mell & Grance, 2011) has established a definition for Cloud Computing: "*cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (for instance: networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."*

This description establishes the vital components of cloud technology setting. One example can be the on-demand self-service, reachable via a wide network which in turn can be swiftly expanded or diminished based on instantaneous demand.

(Armbrust et al., 2009) defines cloud computing as the applications distributed as services over the internet as well as the hardware/systems software in datacenters that grant those exact services. Therefore, it can establish that both software and hardware embody the cloud definition.

In (Foster et al., 2008), cloud computing is established as being a sizable and widely available computer model that is guided by economies of scale. Here, a group of virtual, dynamically expandable, controlled computing storage, platform, infrastructure as well as service that are conveyed instantaneously to extraneous clients through the internet. The previous study clearly aims to differentiate cloud computing and against other computer paradigms.

2.1.1.1. History

Cloud Technology is not a new technology. In fact, it combines distinct business models that reflect upon different technologies. Each stage can be identifiable by its development across time encompassing virtualization, public utility computing, among others. Looking as far back as the 60's, computing resources started to be delivered as websites.

Yet, the first record of the definition of Cloud Technology was given by the Professor Ramnath Chellappa in 1997 (Mishra, 2014) and in 1999 Salesforce launched the well-known enterprise application through a website (*The History of Salesforce - Salesforce News*, 2021), marking this as the first cloud service delivered straight to businesses.

Amazon Web Services launch is also considered by many as a game changer. Launched in 2002 (Fernandes, 2017), it massively led the development of cloud computing until today. Table 2.1 represents the calendarization and its different phases (Cheng, 2017).

Phase	Period	Description
1st	1960s	The first step that significantly start this long path into cloud technology development was given by the scientist John McCarthy (1971 Turing award winner). His proposal identified timesharing of mainframe notions as well as a prediction that computing would be structured as a public utility (Waggener & Wheeler, 2009).
2nd	Late 1690s - 1970s	Virtualization has verified its appearance during the 1970s. It gave the possibility execute a virtual machine within a distinct operating system and run more than one operating system at the same time.
3rd	1997	First definition of cloud computing: "A computing paradigm where the boundaries of computing will be determined by economic rationale rather than technical limits alone." Prof. Ramnath Chellappa, Dallas, Texas.
4th	1999	Salesforce arrives in 1999, delivering enterprise applications through a website for businesses.
5th	2002	Amazon Web Services was launched in 2002. In comprises a suit of cloud-based services that have led the cloud technology development for years and on.
6th	2006	In 2006 Amazon launches Elastic Compute Cloud (EC2) and Simple Storage Service (S3). This marks a significant milestone for small enterprises grating them accesses to run their apps on the cloud (*About AWS*, 2021).

Table 2.1 – Different phases of the evolution of cloud technology – Source: (Cheng, 2017)

2.1.2. Main Characteristics

2.1.2.1. Resource Pool

More than a single user can access the system a use the applications, memory, and storage at the same time. As the resources offered by the cloud service providers can be retrieved from a shared pool, they are ready to be utilized by multiple users (Khowfa & Silasai, 2017).

2.1.2.2. Measured Service

Being a pay per use service, the cloud service providers charge the usage of every service. Therefore, businesses are able to thoroughly monitor and manage their service usage (Serrano et al., 2016).

2.1.2.3. On-Demand Self–Service

Businesses are able to manage the requirements on the computing technology such as application, infrastructure, and storage via the application of the service provider (Trapero et al., 2017).

2.1.2.4. Broad Network Access

Businesses can access the cloud services over the internet, enabling to easily connect to the network with any platform such as mobile phones or laptops (Serrano et al., 2016).

2.1.2.5. Rapid Elasticity

Any computing resources that are in use or can be in use can swiftly be allocated and de-allocated on-demand. This facilitates the process of scaling up or down according to the business's needs. Finally, if the resources are not utilized, the businesses can immediately send them back to the resource pool.

2.1.3. Service Models

(Attiya & Zhang, 2017) splits the cloud technology platforms into three groups correlated with the deployment model of cloud supplier and the abstraction level of the capability provided as presented in Figure 2.1.

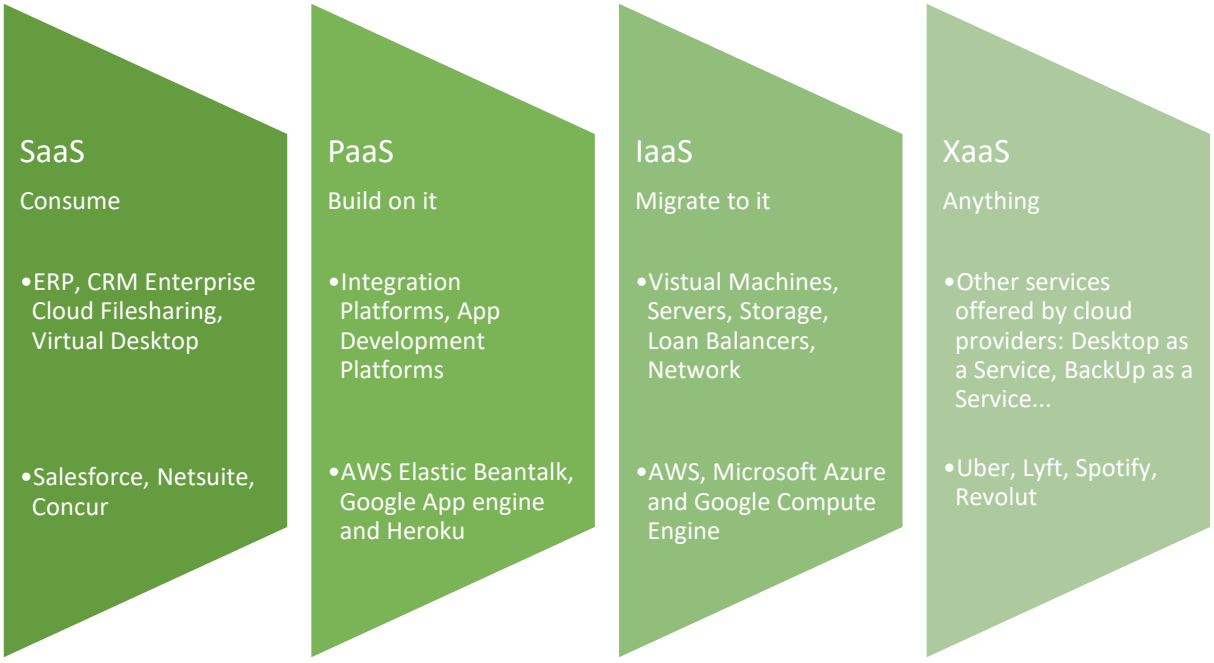

Figure 2.1 – Service models – Source: (Attiya & Zhang, 2017)

2.1.3.1. Infrastructure as a Service (IaaS)

Infrastructure as a Service (IaaS) provides storage, processing power, network resources and other crucial computing assets to the clients. Whatever sort of discretionary application, software or operating systems, they can be implemented by the client on the infrastructure, which can in turn be able to quickly scale up and down (W. Huang et al., 2015).

2.1.3.2. Platform as a Service (PaaS)

Platform as a Service (PaaS) provides a high-level unified environment to develop, test, deploy and host client-built or purchased applications. Nonetheless, the clients don't have any authority on the rooted cloud infrastructure including servers/data centers, network, storage, and operating systems (Yasrab, 2018).

2.1.3.3. Software as a Service (SaaS)

Software as a Service (SaaS) is a software delivery model. The "*applications are hosted by a provider and are made accessible through a simple interface such as a web browser over the internet*" (Bandulet, 2017). With this model, the client does not have to install the software locally and have the supportive structure providing the client with more mobility and flexibility. However, clients will not have any sort of authority over the software system they are using.

2.1.3.4. Anything as a Service (XaaS)

More recently, a new terminology has been used specifying a fourth type of service model: Anything as a Service (XaaS) (Duan et al., 2015). According to (Duan et al., 2015) this type of system aims towards aggregating a multitude of categories as X as a service.

With this sort of combination, the cloud system is able to support from a sizeable to a more particular, clear-cut, and granular requirement. Some examples are Communication as a Service (CaaS), Security as a Service (SecaaS), Routing as a Service (RaaS), Data as a Service (DaaS) or Monitor as a Service (MaaS). Figure 2.2 depicts a quick comparison across all models.

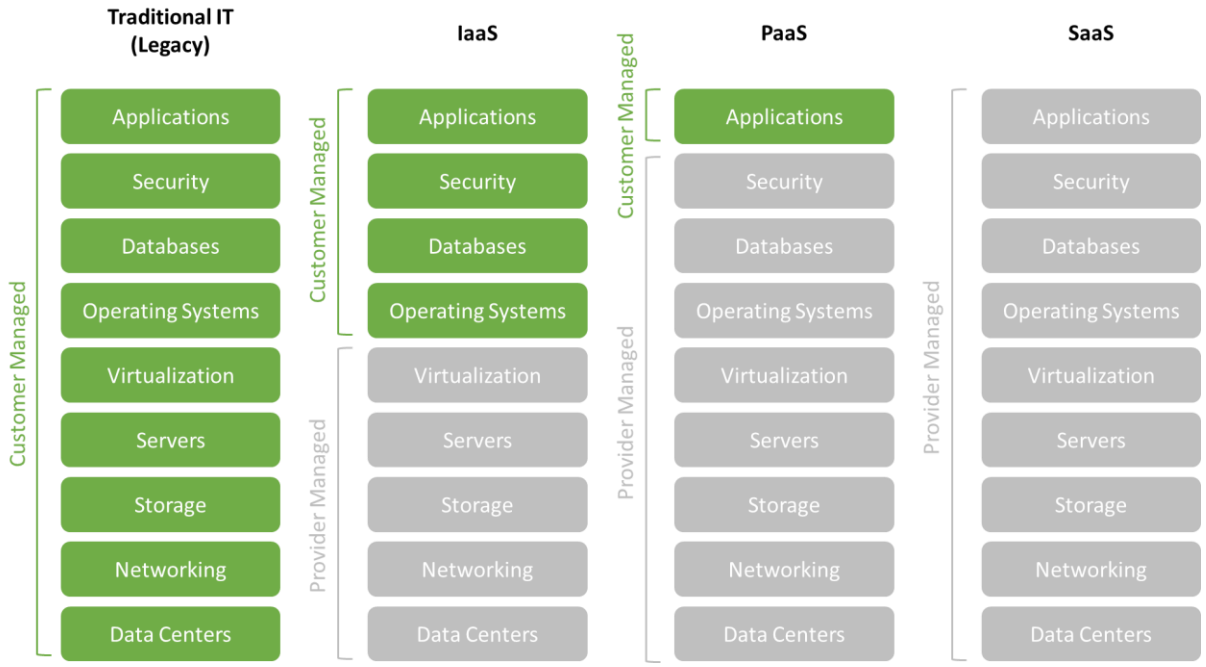

Figure 2.2 – Service models and their applications – Source: (Duan et al., 2015)

2.1.4. Deployment Models

Cloud technology can be divided into five deployed models as established by the NIST, each with their own advantages and disadvantages clearly depicted in Figure 2.3.

2.1.4.1. Public Cloud

Being the most popular deployment model, in this configuration a service provider makes resources available to the clients over internet. This model allows for greater scalability, as it can quickly be adapted for an increase or decrease of user demand (Franklin & Chee, 2019). However, as their presence is undetermined, there is a higher difficulty to protect in case of an attack.

Advantages

- Higher-level of scalability – Ability to keep up with demand
- Pay-as-you-go pricing model
- Hardware's maintenance and updates does not fall under the client's responsibilities
- The required technical knowledge is minimal in order to set up and use the public cloud resources
- Services are available for anyone over the internet

Disadvantages

- Specific security requirements may constrain the use of public cloud
- There may be government policies, industry standards, or legal requirements which public cloud platforms cannot meet

- Restrictions of usage
- Occasionally particular business requirements cannot be satisfied

2.1.4.2. Private Cloud

Also referred as single-tenant environment, the cloud environment is developed in a specific client's datacenter and provides self-service access to compute resources for a single organization. This differs from the public cloud, which its resources can be used by a multitude of organizations (*11th IEEE International Conference on Cloud Computing, CLOUD 2018, San Francisco, CA, USA, July 2-7, 2018*, 2018). Therefore, the resources under this deployment cannot be shared. This may be the preferred deployment configuration if the data could face deep constrains.

Advantages

- Legacy application or scenario support
- Higher degree of security control
- Strict security, compliance, or legal requirements are surely met with this deployment configuration

Disadvantages

- Initial investment may be required for maintenance of hardware
- Private Cloud requires greater technical knowledge
- There are limitations to salability as the client needs to acquire and implement the new hardware

2.1.4.3. Hybrid Cloud

A mix between Public and Private cloud, aggregating benefits from both categories (Talaat et al., 2020). Certain scenarios can gain form this option such as legal-related (which legal reasons may impede data cloud storage) or old hardware/software that is needs to be used to execute legacy applications and cannot be updated.

Advantages

- Higher scalability and flexibility in comparison with the on-premises systems
- Ability to keep systems functioning and available that use out-of-date hardware/operating system
- Benefits from economy of scale of public clouds
- For security purposes, the client is able to utilize his own equipment thus meeting security, legacy, and compliance requirements

Disadvantages

- Higher difficulty and complexity to set up and manage/maintain
- Higher cost

2.1.4.4. Community Cloud

It is a hybrid combination of a private cloud with the same ability to use set levels of privacy and security. According to (Marinos & Briscoe, 2009) this type of platform that lets multiple organizations work on a shared platform. The main objective is to allow multiple customers to work on collective projects and applications that belong to the community. This type of environment is generally used by governments, healthcare companies, or large manufacturing enterprises.

Advantages

- Scalable and flexible
- Reduced costs against Private Clouds
- Reduced security risks against Public Clouds, offering a greater level of convenience and control

Disadvantages

- There is a finite level of data storage and bandwidth which is shared by all community members. Prioritizing all can be challenging
- It is not a one-size-fits-all, meaning that he may not be a fit for many organizations
- As data is accessible between organizations and stored in a specific location, one organization may have to adhere to the location's organization rules and regulation

2.1.4.5. Virtual Private Cloud

Virtual Private Cloud presents a high level of elasticity, and it is set up for the most delicate data workloads. Virtual Private Cloud provides customers with flexibility and mobility, without commercial licensing expenses (Moghaddam et al., 2011). In a sense, it can be classified as a sub-model of the hybrid model.

Advantages

- Higher degree of security control
- No need for technical knowledge staff
- Strict security, compliance, or legal requirements are surely met with this deployment configuration

Disadvantages

- Higher difficulty and complexity to set up and manage/maintain
- Higher cost linked to the deployment setting
- Initial investment may be required for maintenance of hardware

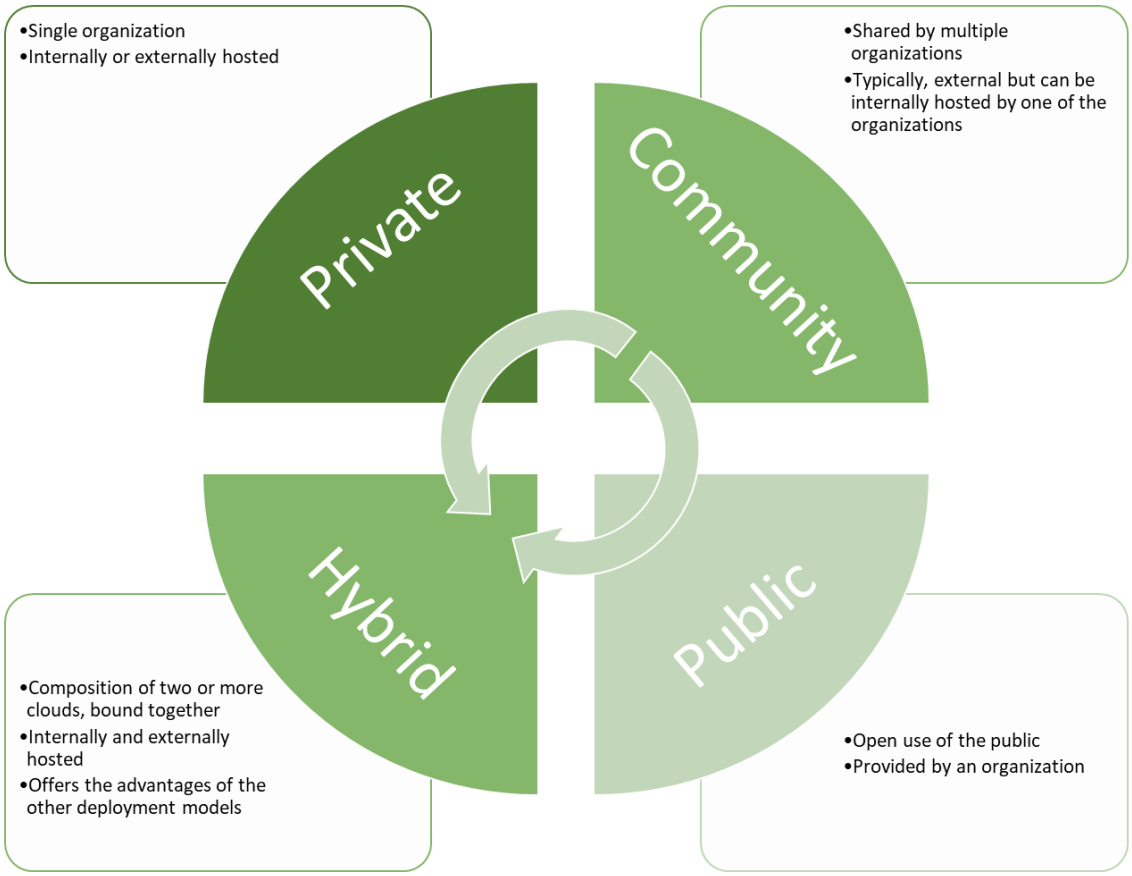

Figure 2.3 – Deployment models – Source: (Moghaddam et al., 2011)

2.1.5. Risk

As the market grows year by year, so do the risks. During the selection phase, the client must acknowledge that some risks may rise up not only during the implementation stage but also during the post go-live stage (Serrano et al., 2016). A risk assessment becomes necessary and helps to define the requirements that the cloud technology service providers should align with.

The business can mitigate several of the below risks through meticulous planning with regard to details in the contracts with service providers. Here are some of the risks that are mostly impacting CT services nowadays as seen in Figure 2.4.

Figure 2.4 – Business risks factors – Source: (Serrano et al., 2016)

2.1.5.1. Return of Investment

Although at a first sight cloud migration should sound like a massive cost gain, businesses should still compare the costs of owning the infrastructure and software with the cost of "renting" IT technologies. As stated in (Misra & Mondal, 2011), the needs of a company tend to change considerably throughout time and factors like usage, speed, security among other need to swiftly adapt for the growing needs.

2.1.5.2. Trust

As one service provider is not equal to next one, cloud technology services may be interrupted by unexpected events. For that reason, service providers are unable to guarantee an availability of 24/7.

There are risks associated with trusting the entire business operation to an external party and which strategies are to be implemented in case an interruption of the service occurs. Therefore, a careful assessment of the cloud service provider is necessary, focused on the guarantees that a cloud service provider offers if a failure occurs (C. Huang et al., 2021).

2.1.5.3. Compliance

The non-compliance risks involving contractual obligations and policies associated with business operations or data handling may cause legal implications. The legal implications of utilizing an external

IT provider should be assessed and a constant monitor throughout all the stages of the project should prevent them (Singh & Sidhu, 2017).

2.1.5.4. Confidentiality

One of the core concerns for any business is data confidentiality. This often poses has a major obstacle for companies not willing to go into the cloud. Therefore, the protection of this data becomes a top priority while at the same time a concern (Sulochana & Dubey, 2015). As analyzed before on the Technology Platforms, distinct platforms offer different levels of protection. Handling that data could result in a data breach and as it happens between two distinct parties (business and CT system) it turns out to be tenuous process to find any accountability.

2.1.5.5. Performance Control

The assurances from the service provider related to system performance and how promptly it takes corrective action given a service disruption should be evident as there is always the risk that the cloud service provider might not be able to provide quality services all the time or that the system quality may end up being inadequate. In the end, the business has to solely rely on the service provider prompt action as it does not have direct access to the infrastructure (Mansouri et al., 2020).

2.1.5.6. Compatibility

Cloud migration can impose issues of combability with the already existing IT software/infrastructure as well as organizational policies or business security requirements. Hence, it is crucial to assess all these factors before committing to this change (Lin & Chen, 2012).

2.1.5.7. Security

An entire structure review should be performed as many variables can generate security risks (Duncan, 2020). Storage location of the data, information granted accesses, encryption for the transmission of data and the specific security and protection measures offered by the cloud service provider to name a few (Song, 2020).

2.1.5.8. Quality Control

Or better yet, the lack of quality control systems may impede a business of accurately assessing the quality standards agreed on the SLAs with the service provider (Alshazly et al., 2020). And this leads to another question: will it be easy to switch service providers if the quality does in fact degrade?

2.1.6. Business Models

A few years ago, few would have pictured that the employees could work completely remotely or that a whole business framework could exist on the internet. With the embracement of cloud computing, a service that allows enterprises to access data storage and processing power over the internet, these business models are becoming a reality (see Figure 2.5).

Nowadays, small businesses can attain substantial advantage of the same computing power that big enterprises use without paying for the entire infrastructure. Different business models can be verified. For instance, cloud computing companies, such as Microsoft Azure or Amazon Web Services, sell increments of computing power (Microsoft Azure, 2021) (Amazon Web Services (AWS), 2021). Companies are quickly incorporating cloud solutions. And just a few weeks ago, Microsoft announced the launch of Windows 365 Cloud PC directly, well, in the cloud (*Windows 365 Cloud PC | Microsoft*, 2021).

In 2020, Amazon Web Services made over $13.5 billion in profits (Statista, 2021). But these profits are dispersed among an enormous number of enterprises. A small business is able to only take what it needs to operate their trade. Technology startups, like Modern Tribe, have established a fully remote workforce while at the same time enabling new business processes (Modern Tribe, 2021).

In order to establish a deep discussion on the cloud technology value chains and associated business models a framework will be need, provided by an analysis from an innovative IT service delivery model. The following main features affect the progress on the service and vender procurer perspectives:

- Cloud technology transfers users' expenses out from capital expense toward operating expense and accommodates a general cost-cutting capability. Investment in IT infrastructure is practically solely required by the service provider
- The software landscape's complexity is boosted by cloud technology. Additional partners must be integrated with the on-premises solutions – at the organizational, technical, and business process stages
- Cloud technology is dynamically growing over time: there will be major implications on integrations and migrations because it is anticipated that the solutions will evolve in rapid succession into Software as a Service (SaaS) applications enablement, platforms for on-demand infrastructure services as well as cloud-based development systems

2.1.6.1. Powerful Processing

Many small-scale tech businesses are researching the improvements attained from cloud computing to boost their simulations' speed. By linking to the cloud, simulations can be processed by several computers at once. This substantially diminishes the processing time.

Project that would take 4 weeks can now conclude in a 3/4 days simulation (bearing in mind that the business makes use of cloud computing services to acquire 20x more computing power) (Aldmour et al., 2021). Whether the business is small or large in size, both are able to convey solutions swiftly.

2.1.6.2. Workforce in the Cloud

All the employees come collectively to work digitally. Modern Tribe's employees can answer questions about the business's software over a cloud program. Employees can meet via Microsoft Teams, email, or any other platform. 99% of the time, Modern Tribe employees engage with each other on the cloud (Grimm, 2021).

Remote work presents as a great advantage for employees as well as for clients. Clients are distributed throughout many time zones. This way, clients can query at any time to request a response to their dire software questions. The business can have an employee available to aid at any time.

The business can verify significant cost saving a fully distributed workforce. Modern Tribe provides a workstation for each employee, yet the company does not have to provide office space (Modern Tribe, 2021). With an ever-increasing workforce, instead of searching for a bigger office, they solely approach their cloud hosting provider and upgrade their services.

2.1.6.3. Better Management of IT Resources

In the past few years, the focus of the IT staff has been to renovate computers at a specific time, in order to maximize performance as well as costs. With cloud computing, that need decreases severely. As the processing power is moved to the cloud, employees can extend the usage of their computers which would already be labelled as obsolete.

This tedious task no longer holds back the IT staff time, thus freeing them for other projects. Ric Telford, an IBM executive clarifies *"…it is taking the previous dollars you spent on having IT staff and making sure you get those folks working on the things that are most differentiating to your company*" (Nishanth, 2010).

2.1.6.4. Integrated SaaS, PaaS, etc...

All software can be hosted on the cloud and accessed from anywhere. The client can have accounting linked to Customer Relationship Management (CRM) software through APIs which by turn is linked to Human Capital Management (HCM). Cloud solutions like Workday can be integrated with a CRM, such as Salesforce.

Employees can access these services anytime, anywhere (H. Fan et al., 2015). Modern Tribe might not have a designated accounting computer. Rather, any employee that uses the accounting software can connect from distinct equipment in distinct locations. This access enables a new level of Collaboration reaches a whole new level as everyone has access to the same cloud services (Modern Tribe, 2021).

2.1.6.5. Process Automation

As cloud services are integrating more and more with each other over the cloud, the possibilities for automation increase every day. Different divisions of the business are no longer isolated. The

employee payroll election from Cloud Pay can swiftly be sent to HCM software to record the pay slips and track a departments budget. Tedious tasks which once were perform by human hands are now completely executed by the cloud software by a seamless process (Pau et al., 2018).

Cloud computing produces a simple solution – access to more data storage and processing power. Nonetheless, businesses take advantage of this access in different ways. The cloud conceives a central hub for SaaS. Businesses can integrate their software and automate processes. Cloud technology and hosting allows for a whole new business landscape which businesses are now just starting to explore.

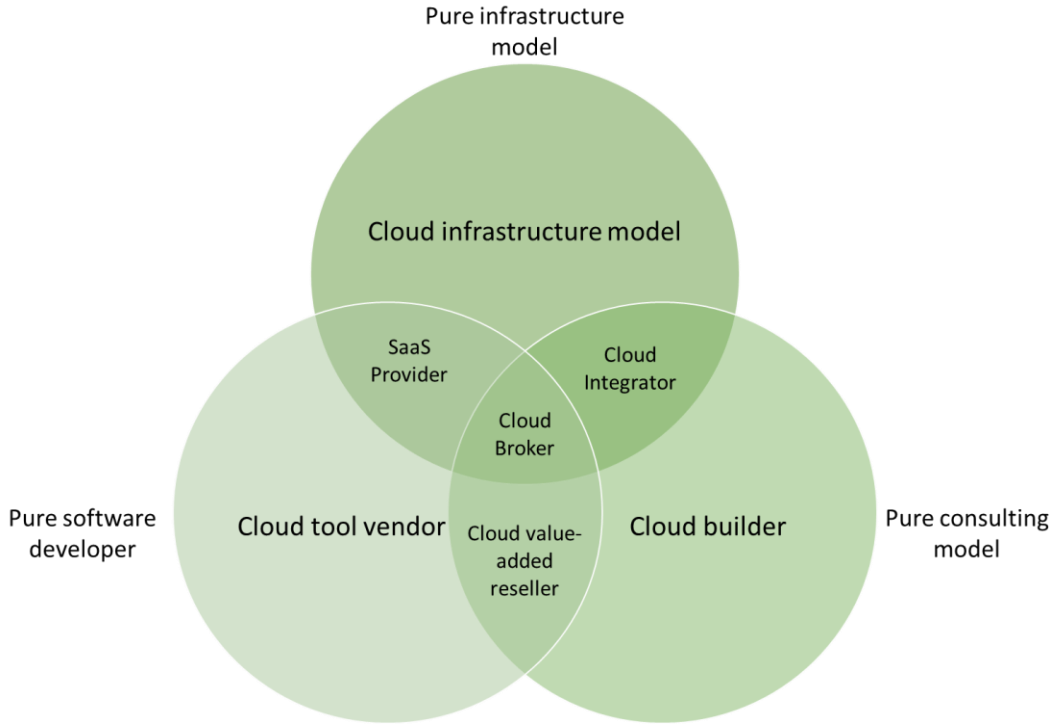

Figure 2.5 – Cloud business model – Source: (Pau et al., 2018)

Currently, the cloud computing providers' business model is essentially supported on service automation and economies of scale. Partnership relationships founded on trust and security in networks is the footing for successful cloud computing's business models. Further along, as segments of cloud services can be provided and solicited from distinct clouds (public, private, hybrid, community, virtual private clouds) this translates into growing requirements given the ability to manage and coordinate a broad sphere of distinct infrastructure and applications segments.

From a technical perspective, thanks to a standardization in the Web, integration is effortless. Contrary to this, complexity rises when it comes to process integration and service administration. IT consulting organizations and traditional system integrators still face difficulties, even if no longer for all types of IT service and to the same scope. Customers will request SaaS subscription services with business SLAs.

2.1.7. Value Chain

Classical IT value chain usually adhere to the following stages: consulting, design, implementation, and operation of the IT infrastructure to administration of the application. As a result of cloud computing

concepts, the IT is always changing (Dehmer & Niemann, 2018). The client is continuously facing a decrease in transaction expenses during certain stages of the value chain as this is an outcome of the new service and price models in cloud computing. This may reflect in a break of the value chain. For instance, independent monitoring of SLA's or managing IT infrastructures (Schneckenberg et al., 2021).

As there are lower entry expenses for the utilization of cloud IT infrastructure this has led to the rise of a considerable amount of small yet innovative businesses offering IT services with lower capital commitment as well as higher flexibility on operating costs (see Figure 2.6).

There is currently a higher differentiation on the success factors for the cloud service providers (Bello et al., 2021). Where once, factors such as flexible contractual models and low prices were the norm, these are increasingly being surpassed by other factors which depend on a particular link on the value chain.

To give a few examples, major factors in SaaS are best-of-breed support (software purchased from different enterprises) for the business processes that are mapped, the provider's economic reliability, migration and integration interfaces, references, and flexible pricing models (C. Wu et al., 2019).

When it comes to Platform as a Service (PaaS) providers, the main features are the community's size which is entrusted to develop the system, architecture frameworks that back automatic scaling and easiness of service deployment.

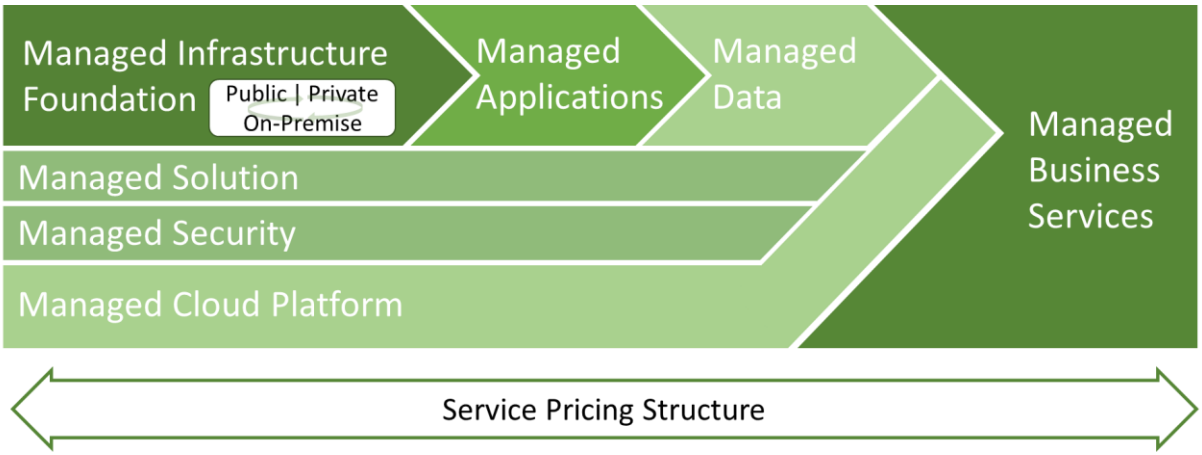

Figure 2.6 – Cloud technology value chain – Source: (C. Wu et al., 2019)

2.2. PROJECT MANAGEMENT

2.2.1. Concepts

According to the English-language dictionaries (Oxford Reference, 2021), project is the word used to define planning: the drafting of new laws, putting an intention into practice, opening a company, or building construction documentation (Jha, 2011). Thus, this opens up a very wide space for the application of the term that is used in the most varied occasions (S. K. Lee & Yu, 2012).

Therefore, in the corporate environment, the definition of a project is more interesting and specific. The Project Management Body of Knowledge (PMBOK) Guide (Institute, 2013) helps to answer this question, as it was built by the Project Management Institute (PMI). The manual records that the meaning of the term is related to the temporary efforts that are undertaken to create unique results.

In addition, according to (Publishers, 2017) projects are used to generate unique solutions, services or products that meet the needs of individuals or companies. In other words, a project is temporary, has a beginning, middle and end, which makes it different from operations that are continuous. In this way, it can be used to build homes, develop an application, or create furniture, for instance.

Though this thesis focusses solely on an IT perspective, project management also serves to write books, travel, implement new production lines in industries and much more. (Davidson, 2000) identifies that its main aspects are the limitation of resources, the involvement of a team, the elaboration of stages with planned evolution, the planning, execution and control by a specialized professional and the definition of deadlines (Romme, 2003).

2.2.2. Lifecyle

In this section, this literature review will delve into the phases that a project goes through, from conception to completion. Project management is mapped into process groups and knowledge areas by the Project Management Institute. The five main process groups are initiating, planning, executing, monitoring & controlling, and closing and depicted in Figure 2.7. According to (Epstein et al., 2013), the majority of the processes that the reader can think of will fall under these five basic processes and cloud technology selection is not an exception. According to (Epstein et al., 2013), there is a reason for the assumptions in Figure 2.7 as a cycle, as overall it may translate into a continuous project of digital transformation.

Figure 2.7 – Project lifecycle – Source: (Epstein et al., 2013)

2.2.2.1. Initiating Phase

Initially, leaders must collect all indispensable data (Epstein et al., 2013). The manager and the team need to have access to information about costs, time, quality, and restrictions that can interfere in the completion of the other steps. In the initiation phase, the responsible professional registers the identified limitations and premises.

At this point, it is necessary to obtain a macro understanding so that the manager knows all the possible interferences and influences that may arise and prevent the project from being successful. (Frigenti & Comninos, 2005) suggests the usage of a charter to record all pertinent information and obtain the consent of company leaders regarding the actions that will be taken to generate results.

2.2.2.2. Planning Phase

After the directors or partners have agreed to the project, start planning the activities. In this step, it will be necessary to do a breakdown from the overview that was elaborated in the initiation phase (Cadle & Yeates, 2008). The time has come to think about the details for structuring the plan, so that it becomes consistent.

The program presented by the manager must be guaranteed success. For this to become a reality, the manager must use some documents that are included in the Project Analytical Structure (WBS). They are:

- Risk management plan
- Proposal schedule

- Communications planning
- Quality strategies
- Others

2.2.2.3. Executing Phase

According to (Nicholas & Steyn, 2008), the manager needs to have his attention and his efforts focused on carrying out everything that was planned in the execution phase. The activities must be carried out with agility, safety, and effectiveness, according to the estimates released in the schedule during the planning phase. However, there may be changes and requests for changes made by customers or managers.

In this phase, the manager's focus will be to meet the pre-established standards and promote continuous improvements, in addition to following the procedures. It is necessary to deliver excellent results, with the desired and planned quality in the previous stage of the lifecycle (Healey, 2010).

2.2.2.4. Monitoring and Controlling Phase

As stated in (Mahaney & Lederer, 2010), monitoring encompasses the control of tasks and happens concurrently with the execution process. This is the safest way for the manager to have the guarantee that the activities are carried out according to the initial planning. In this phase, the advances are validated according to the progress of the services and the deviations can undergo interventions (Healey, 2010).

In accordance with (León et al., 2008), the control starts from the premise that the goals were set during the planning stage and that the indicators were predefined in advance. Thus, this phase is concerned only with the progress of activities compared to the plan and with monitoring the performance of employees.

2.2.2.5. Closing Phase

This is the finalization phase of the project, in which there are steps that are taken with the purpose of making official the conclusion of the project, with the aggregation of important data for the next projects. This means that this stage of the project lifecycle still requires efforts on behalf of the manager (Yeates & Wakefield, 2004) (Olson, 2014).

On that occasion, the final actions are carried out, such as the recording of learning, through documentation that exposes the experience of employees and managers, as well as the signing of the acceptance term, which closes the proposal and exempts entrepreneurs from future responsibilities.

2.2.3. RACI Matrix

The RACI definition stands for Responsible, Accountable, Consulted, and Informed. Therefore, it demonstrates the result of the combination of the numerous activities meaning the achievement of a specific activity or project deliverable. The RACI Matrix (see Table 2.2) may also be known as the Responsibility Assignment Matrix (RAM) or the Linear Responsibility Chart (LRC). This methodology was designed and published by (Andersen Kristoffer V Grude Tor Haug, 1984).

Bearing in mind that the number of tasks may turn out to be significant, if they are not properly assigned and handled, it may lead towards a higher level of uncertainty throughout the stakeholders. This makes it important to assign each task to a different team member. A RACI chart is a clear matrix chart used to attribute responsibilities and duties per each job or decision in a project by all of the team members. A simple yet clear map on the diverse tasks assigned to all members at each stage and level of a project erases disorientation and produces a response to the question: “Who's doing what?”.

Activity (or Project Deliverable)	i.e. Team Member #1	i.e. Team Member #2	i.e. Team Member #3	i.e. Team Member #4
Activity 1	C	A	R	I
Activity 2	A	R	I	C
Activity 3	A	R	C	I

Table 2.2 – RACI Matrix example – Source: (Andersen Kristoffer V Grude Tor Haug, 1984)

2.2.3.1. Definition

The RACI matrix is a duty assignment chart which putting into frame simple and coherent picture about every task or key decision towards the completion of the project and appoint tasks and responsibilities to distinct team members. A team subsists of members who are bounded to each action, responsible for each deliverable, while a few members are required to be informed and/or consulted. At the main stage, the RACI matrix enables the assessment of the expectations about project responsibilities and roles. It also motivates team members to be accountable for their appointed tasks or to delegate to someone else if needed. RACI stands for:

- **Responsible** – With this assignment, the team member has the goal of completing the appointed task as well as each appointed task needs a responsible party who would seek to complete the job. The task may be assigned to one or more members
- **Accountable** – In charge of reviewing the deliverables before its completion. During some tasks, the member assigned with Responsible figure can also serve as the Accountable one. There can only be one Accountable person assigned per each job or deliverable

- **Consulted** – These team members are usually the ones who would cater suggestions either on how it will influence their future endeavors or their domain of prowess on the deliverable itself. Nonetheless, it is a fact that every deliverable bolster itself with a review and consultation process from more than one team member
- **Informed** – These team members are informed about the project's progress rather than being pushed into every deliverable's details

2.3. Decision Making and Selection

2.3.1. Concepts

2.3.1.1. Decision Making

Decision-making is one of the most important components in modern management. It is established as a core function of the management, whether it is rational or sound decision-making. The decision maker takes a multitude of conscious and subconscious decisions which may have a significant impact on both management and organizational activities (Sanchez et al., 2017). These decisions are established to sustain the activities of all organizational functions and business processes. Therefore, the definition of a single decision translates into a delineate course of action deliberately picked out of an assortment of alternatives in order to accomplish managerial and organizational goals.

Every level of management makes decisions in order to guarantee that both business and organizational goals are attained. Moreover, they are one of the main functional values adopted and implemented by any origination to guarantee maximum growth for its delivered products and services. The Cambridge Dictionary (Cambridge English Dictionary, 2021) defines decision making as the process of establishing something crucial, especially in an organization. According to (Trewatha & Newport, 1982): "Decision-making involves the selection of a course of action from among two or more possible alternatives in order to arrive at a solution for a given problem".

From the previous statements the reader is able to establish that the decision-making process is an advisory task performed by a team of professionals to improve the operation of a company. It is a truly dynamic and on-going process that penetrates all the other activities of the business. And as it is a continuous activity, it plays a crucial part in the operation of a business (J. Fan et al., 2019). Experts in the field are fully involved in the decision-making process as this process requires strong academic knowledge aggregated with years of experience as well as skills.

Therefore, to keep the growth of a business, decision making is established as a check and balance system making it goal oriented. According to (Sohaib et al., 2019), they are pre-set company missions, objectives, and its vision. There are, however, many challenges on operational, administrative, etc. domains when aiming to attain these goals whose issues can only be solved through far-reaching decision-making processes. A single decision may translate into a multitude of outcomes and new issues to be sorted. Therefore, as one issue is sorted, others may rise up thus making decision making, as it was previously stated, a dynamic and continuous process.

This process ends up consuming resources on multiple levels, being time the most important of them all. Time spent to make the decision can in the end prove to affect the opportunity cost as this opportunity cost can be influenced by capability to make a specific decision at the correct timing. Even though this process is time consuming, its impact will result on either a bigger or smaller impact on business organization (Alabool et al., 2018).

2.3.1.2. Service Selection

By providing access to a large pool of resources available to end-users, cloud services end up playing an important role. The resources made available over the internet made possible the by the increasing number of services provides the businesses greater difficulty on the movement of decision on which services meet their needs and which ones to use (Z. Yang & Wang, 2020).

Factors such as pricing, cloud processing or performance aligned with distinct marketing strategies increases the complexity of the decision. Thus, the business finds it hard to choose the service that best fits its needs. A technique to select cloud services with a strong emphasis on multiple criteria is crucial and it is for this precise reason that the cloud selection process is essential to help the decision maker chose the service that best fits their needs (Liu et al., 2016).

2.3.1.3. Quality of Service (QoS)

Quality of Service (QoS) is an assortment of attributes that exist in every service. They compute, weight, and rank the priority of the services (Eisa et al., 2020). Although this study will research on a greater assortment that the attributes presented, the top 5 most used to rank and analyze a cloud service can be found in Table 2.3.

Availability	Measures the accessibility of the cloud service to the end-user
Reliability	Measures the fulfillment of the established SLA criteria, resulting in trust and security.
Cost	Pay as you go pricing model to use the cloud infrastructure
Response Time	Time between a sent and received request by a user
Throughput	A network metric, the rate at which is successfully transferred between two endpoints

Table 2.3 – Top rated attributed for QoS analysis – Source: (Eisa et al., 2020)

An assortment of QoS attributes was proposed by (Burkon, 2013) that are used in cloud service selection process, with special attention for the for SaaS model.

2.3.1.4. Service Level Agreement (SLA)

The Service Level Agreement (SLA is essential for any service provision contract in IT. It refers to the specification, in measurable and clear terms, of all the services that the contractor can expect from

the supplier in the negotiation. In addition, it presents service level goals, terms of commitment, contract terms, technical support, among others. In other words, it is a technical clarification of the contract.

It is important to note that the SLA is a required document in any IT contractual relationship. It must be revised periodically in order to be more effective. Only with continual review will the contractor be assured that the IT company will provide support at all stages of the process. After all, each of them requires differentiated care and services (Trapero et al., 2017).

With the establishment of the SLA, not only the contracting company, but also the service provider itself, can have several guarantees that the link will be transparent and productive. Therefore, there must be a mention to the impact of the SLA on the credibility of the entire sector. For the contractor, for example, it is possible to foresee fines in case of non-compliance with any established services or goals, which can reassure the manager regarding the signed contract (Serrano et al., 2016) (Emeakaroha et al., 2012).

On the other hand, the service provider company also protects itself against any abuse or undue charges by the contracting company. This is possible because the contractor will work based on a pre-established script.

For example, hiring specialized staff in the right measure or preparing contingency action plans to be able to meet the defined service goals. These measures even favor internal planning itself. It is important to make it clear that the SLA must be managed, giving rise to the so called SLM (Service Level Management). For this task to be effective, it is necessary to have a series of indicators that enable a transparent relationship between the IT company and its customers, such as the availability indicators (Service Availability) and the response time between failures (MTBF).

2.3.2. Approach

There is a multitude of requirements that will solicit a decision-making process turning the establishment of a universal structure truly complex (Rehman et al., 2011). Therefore, the following structure is laid as a foundation for the structure design from which others can be drawn from Figure 2.8.

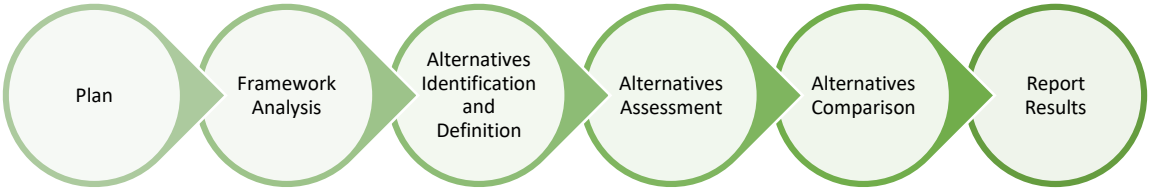

Figure 2.8 – Project planning stages – Source: (Rehman et al., 2011)

2.3.2.1. Plan

The business specifies objectives/requirements/preferences supported while also identifies stakeholders. The business also specifies the effort/schedule/costs and determines the study team. Lastly, it designs the study plan.

2.3.2.2. Foundation/Framework Analysis

Specify the analysis problem context, statement, framework, and scope for alternative comparison, along with the criteria to be utilized. Determine the base rules and assumptions that shape the analysis. Focus on business requirements, collection, and data sources before and during the study.

2.3.2.3. Alternatives Identification and Definition

Specify multiple alternatives (to maintain the "status quo" can in fact be one of them) that focus on the presented requirement within the scope and context defined. The final range of alternatives evaluated should be the result of thorough investigation, inspection, and filtering.

2.3.2.4. Alternatives Assessment

Assess each alternative in contrast to the ingrained criteria (for instance risk, cost, benefit) and conduct the analysis of sensitivity.

2.3.2.5. Alternatives Comparison

Specify the related advantages of the alternatives as disclosed by the analysis.

2.3.2.6. Report Results

In the end, the decision-maker/stakeholder is presented with a result report highlighting the most supported alternative.

2.3.3. Technique

Techniques of decision-making could be grouped into two categories:

- Qualitative techniques
- Quantitative or mathematical techniques

2.3.3.1. Qualitative Techniques:

Also known as traditional decision-making techniques, these techniques are called qualitative because in these techniques the nature of decision depends on the qualities (i.e., skills, know ledge, competence etc.) of the decision-maker. The higher the expertise level of the decision maker, the better will be the decision's quality determined by him (Gireesha et al., 2020). The following techniques are also classified as traditional techniques of decision-making. Some examples are:

- Experience
- Facts
- Considered opinions (or mutual consultations)
- Delphi technique

Further along is a brief explanation of various qualitative techniques of decision-making that shall significantly impact the cloud technology selection:

Experience

Experience as a of technique of decision making involves that a decision-maker with a greater experience level makes use of his past experiences' feedback on deciding the soundness of present alternatives (Devi & Shanmugalakshmi, 2020). In this technique, the decision-maker may also take advantage of the other people's experiences, from the similar fields of activities and confronted with comparable decision-making situations.

There is absolutely no replacement of experience as a technique of decision-making. However, this technique must be utilized with discretion bearing in mind changing environmental conditions. In many situations, experience as a technique of decision-making is greatly unscientific leading to ambiguous or imprecise decisions when the decision-maker is himself deluded by his own experience.

Facts

Solid decision-making requires data or facts as the background information for developing and analyzing alternatives. However, as facts by themselves do not translate into anything and as figures do not speak there is a need for systematically process and interpret data, rendering these appropriate for decision-making purposes.

Facts are not an independent technique of decision-making. These should be used as a support for decision-making, by a decision-maker who prefers to take decisions on a stable basis. Facts are if fact like crutches on which the decision maker, confronted by the complexities of decision making, walks on to reach up to the goal of rational decision-making.

Considered opinions (or mutual consultations)

As a technique of decision-making, considered opinions requests for:

- Mutual consultations among a group of decision-makers and stakeholders done at meetings
- Searching for suggestions, opinions, and ideas of other stakeholders, to get their viewpoints on decision-making problem thus broadening the initial viewpoint approach
- Inviting experts, to get advantage of their specialized knowledge on technical issues

The benefit of the considered opinion technique of decision-making is that it aids in developing varied and innovative ideas from a number of stakeholders, which facilitate the process of solid decision-making.

Delphi Technique

A panel of experts related to a specific business area is prepared. The experts are separated while their identity is kept hidden from each another. A questionnaire is meticulously crafted and sent to each expert in order to obtain a response to the questions within that questionnaire. The answers are thoroughly analyzed and on those answers on which experts have differences of opinion, feedback is provided to those experts (Devi & Shanmugalakshmi, 2020).

The experts are asked to disclose the reasons for their divergence and provide more opinions in which feedback is also sent to them. This process of giving feedback will recur until a confluence of opinions starts to materialize (Lang et al., 2018). The decision established is when a convergence of opinions has been verified.

2.3.3.2. Quantitative or Mathematical Techniques:

Some popular quantitative techniques examples of decision-making that significantly impact the cloud technology selection process are:

- Cost-benefit Analysis
- Operations Research

Further along is a brief account of the above quantitative techniques of decision-making:

Cost-benefit Analysis

It is a technique of evaluating alternatives, in relation to their benefits and costs, so that an alternative where benefits are maximum against costs involved may be preferred (Marešová & Půžová, 2014). Cost models may be refined to present cost estimates for each alternative and benefit models to present the connection between each alternative and its effectiveness (McLaren et al., 2011).

Incorporating both models may be developed to present the connections between costs and benefits of each alternative (Maurer et al., 2012). However, this technique of decision-making is used when goals are less specific.

Operations Research

Operations research involves the application of the methods of the physical scientist and the engineer to economic and commercial requirements, made possible by the development of rapid computing machines (Yu et al., 2018). It is essentially the application of specific methods, tools, and techniques to operations of system with optimum solution to the problem, quantitative common sense for obtaining optimum solutions to business problems. The crucial aspects as applied to decision-making are as follows:

- It highlights the mathematical models – bearing the logical presentation of an alternative
- It assimilates in the model those variables in an issue/requirement/preference that appear to be most important to its solution
- It quantifies variables to the extent possible as only quantifiable data can be inputted into the model to yield perceptible results
- It highlights goals in a business area and refines the measures of effectiveness in determining whether a given solution presents assurance of attaining those goals

2.3.4. Models

2.3.4.1. Multi-Criteria Decision-Making (MCDM)

The method of Multi-Criteria Decision-Making (MCDM) helps the decision-maker to effectively make a decision by comparing alternatives and choosing the best option out of a set of fairly similar things. To put it mildly, the decision maker has a tendency to make an option based on subjective criteria (preferences), thus turning the decision-making process into a rather difficult and complex process (Alabool et al., 2018).

Due to an ever-increasing variety of cloud services available to the public, the decision maker also faces an extraordinary challenge. Consequently, there is a need to use multiple MCDM methods in order to aid on the selection of the cloud service provider enabling the support for determining the weight of QoS criteria. This process enhances the cloud service selection process by weighting each QoS attribute accordingly to the decision-maker's preferences (Rehman et al., 2015) (Liu et al., 2016).

2.3.4.2. Analytic Hierarchy Process (AHP)

Presentation

Analytical Hierarchy Process (AHP) is an effective method utilized to clarify a broad assortment of Multi-criteria decision-making issues. (Thomas L. Saaty, 1984) introduced AHP with the intention of organizing the simple rationality by breaking down the issue into minor pieces as seen in Figure 2.9. By decomposing the decision problem, AHP empowers the decision-maker to concentrate on a finite figure of criteria at a given time.

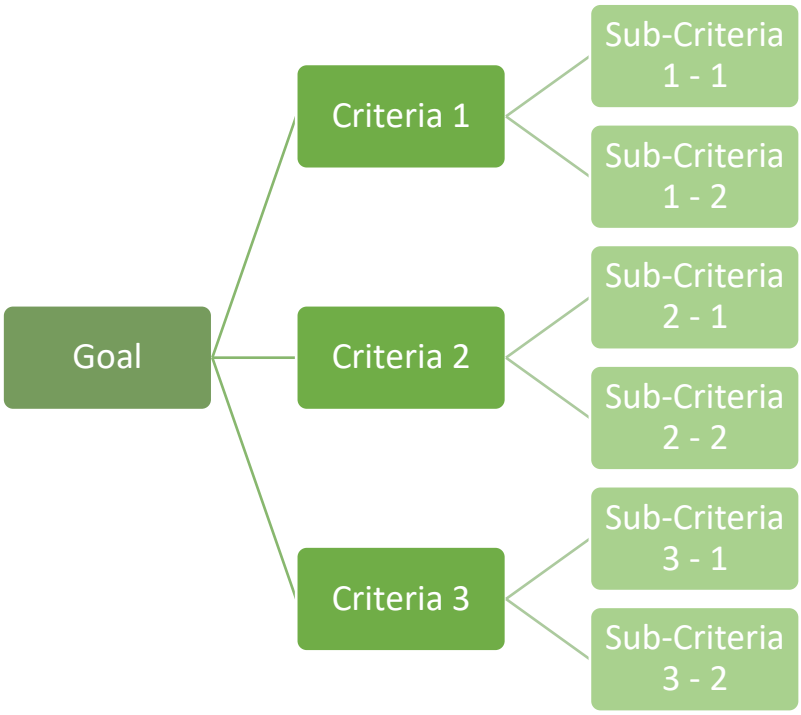

Figure 2.9 – Decomposition of the criteria to attain a goal in AHP – Source: (Thomas L. Saaty, 1984)

AHP empowers decision-maker to correlate quantitative and qualitative criteria. AHP can be broken down into three stages: characterizing the decision issue, constitution of the hierarchy and constituent in the hierarchy's evaluations (Arbel & Vargas, 1993). AHP, a multi-level hierarchical model, has the alternatives in the bottom of the hierarchy, criteria as well as sub-criteria in the middle and the goal of the system in the top.

The evaluation of the hierarchy constituents comprises criteria's pairwise comparison. On this sort of comparison, the decision-maker compares a single criterion opposed to another criterion for a particular alternative (Khowfa & Silasai, 2017). Utilizing a scale of numbers between 1 and 9, this will indicate the proportionate relevance and can be seen in Table 2.4.

Rating Scale	Definition	Description
1	Equal Importance	Two criteria are of equal importance
2	Equally to Moderately	Whenever a compromise is needed
3	Moderate Importance	Experience strongly favors one's criteria over another
4	Moderately to Strong	Whenever a compromise is needed

5	Strong Importance	Experience and judgement strongly favor one activity over another
6	Strongly to Very Strong	Whenever a compromise is needed
7	Very Strong Importance	Criteria is strongly favored, and its dominance is demonstrated in practice
8	Very Strong to Extremely	Whenever a compromise is needed
9	Extreme Importance	The evidence favoring one's criteria over another is of highest possible order of affirmation

Table 2.4 – AHP criteria's pairwise comparison – Source: (Khowfa & Silasai, 2017)

Related Work

The selection of cloud technology has seen many works published based on AHP. (M. Sun et al., 2013) based on AHP to demonstrate a consumer-focused cloud technology selection. Five criteria were adopted: availability, response time, throughput, cost, and reliability. Their importance in the decision-making process was made evident by the weight assignment on each of the criteria.

Tests on three types of cloud technologies were performed to verify their proposal. The demonstration in (Nie et al., 2011) aims to greatly reduce the cost of using the software by establishing an AHP-based methodology in order to select the preferred business's cloud technology.

The major improvement of this work is the definition of other costs (Nie et al., 2011) besides the financial one such as costs related to risk as well as scalability. This is performed by assessing the improvement of scalability, and this by the gain on agility captured through cloud technologies.

(Martens & Teuteberg, 2012) proposed a mathematical decision model to select cloud technologies utilizing Linear Optimization and AHP. (Khaddaj, 2012) presented a framework for QoS assurance, recurring to AHP, to provide cloud technologies that meets application and customer requirements in relation with Service Level Agreements. Meanwhile, (Godse & Mulik, 2009) suggested an AHP-based approach for the selection of SaaS Cloud Services. (Nie et al., 2011) proposed an AHP cloud technology evaluation index system by only utilizing four evaluation criteria: security, cost, QoS, and reputation.

To conclude, the reader may now be able to establish that AHP in a useful in a wide assortment of fields, especially regarding cloud technology selection. The method's success is a result of its robustness and clearness. Despite all the work cited below based on AHP, there is a lack of correlation with other models from which AHP could minimize its disadvantages.

2.3.4.3. Fuzzy Logic

The main goal of Fuzzy logic is to model logical reasoning with broad or inaccurate statements. Fuzzy logic has its roots from the theory of fuzzy sets. It was firstly introduced by (Zadeh, 1965). A fuzzy set assigns a level of association, generally a real number between 0 and 1. Fuzzy logic arises by assigning levels of truth to propositions. The accepted set of values (degrees) is [0,1], meaning that 0 will translate into "totally false" and 1 into "totally true". As for the other numbers, they will refer to partial truth (Jiang & Liao, 2020).

The notions of union, inclusion, intersection, etc., are expanded to such sets, and numerous properties of these concepts in the background of fuzzy sets are settled, especially a disengagement theorem for convex fuzzy sets is demonstrated without soliciting that the fuzzy sets be divided (Hao et al., 2021).

2.3.4.4. TOE Framework

Technological-Organizational-Environmental is a unique framework introducing a broad sort of variables that elucidate and anticipate the possibility of technology as well as innovation adoption (Tornatzky et al., 1990). The framework indicates three parts of enterprise backgrounds that impact the implementation of innovations. The backgrounds are:

- Technology progress (Kauffman & Walden, 2001)
- Organizational circumstances, business, and organizational reshaping (Chatterjee et al., 2002)
- Industry environment (Rao Kowtha & Whai Ip Choon, 2001)

According to (Jeyaraj et al., 2006)(Sabherwal et al., 2006)(Tornatzky et al., 1990)(Zhu et al., 2003), technology characterizes the adoption in means of the range of technologies both external and internal to the organization as well as their perceived practicality, organizational and technical affinity, intricacy and learning curve, pilot test and experimentation, and imagination.

The organization obtains descriptive measures such as organization's business outlook, top management assistance, organizational culture, intricacies of managerial organization evaluated by centralization and formalization, and lastly the quality of human capital.

Technology-Organization-Environment presents a broad sort of factors explaining and anticipating the probability of technology as well as innovation adoption. This framework can be divided into three elements of enterprise context, influencing the implementation of all sorts of innovation. These contexts are:

- **T**echnological development
- **O**rganizational conditions
- Industry **E**nvironment

The technology adoption is therefore assessed in terms of the variety of technologies, both internally and externally to the business, as well as their perceived practicality, compatibility, visibility, experimentation, and the learning curve.

The environmental background is related to the operational promoters. Among them, the most compelling are trading partners' keenness, socio-cultural problems, competitive strain, government backing, as well as technology support infrastructures like the connection to technical consultants. There is however a major issue with the TOE framework.

Some of the constructs in the adoption predictors are presumed to be better applied in big organizations, where customers have a higher level of continuity guarantee and less of complaints, in comparison to SMEs (Awa et al., 2011). Nonetheless, the TOE hypothesize is identical to the Actor Network Theory (ANT) as it asserts the dynamic means and collective interplay of social and technical schemes.

Besides (Thong, 1999), TOE is about the sole IS framework that better accentuates on behavioral and social constructivism. Meanwhile, it perceives the continuous combination of technology evolution and organization's circumstances carved by environmental problems (Hossain & Quaddus, 2011)(Ramdani et al., 2009).

The TOE framework presents itself as a boundless theoretical viewpoint unique to the information systems domain. Hence, its variables were thoroughly tested on the adoption of numerous other technologies such as e-procurement, e-commerce, or enterprise systems (J. H. Wu & Wang, 2007)(Zhu et al., 2003).

Even though they are not unique in technology adoption, the IDT's variables are compatible with those of TOE's technology and organization (Oliveira & Martins, 2011) therefore by combining the variables of environment, the TOE framework produces a higher level of theoretical analysis than IDT upon analyzing technology adoption, utilization, and the creation of value (Gangwar et al., 2014)(Hossain & Quaddus, 2011)(Oliveira et al., 2011).

Contradictory to the majority of other frameworks, (Salwani et al., 2009)(J. H. Wu & Wang, 2007), conclude that TOE presents a more comprehensive observation (disregarding size and industry restrictions) into adoption factors and challenges, value-chain actions, adoption procedures and implementation, post-adoption, as well as the improvement of competences using the technology.

3. METHODOLOGY

The expected result of this study is the creation of a model that helps an organization in the analysis and selection of a cloud technology service and provider. Therefore, for the best quality data, a Design Science Research (DSR) methodology seemed the utmost choice to be applied. The DSR refers to a research activity that invents or builds new, innovative theories, models, and artefacts for solving problems or achieving improvements (Weinhardt et al., 2009).

For instance, DSR creates new means for achieving some general goal, as its major research contributions. Such new and innovative artifacts create a new reality, rather than explaining the existing reality or helping to make sense of it". DSR "creates and evaluates IT artifacts intended to solve identified organizational problems" (Venable, 2010). Further explanation about DSR and how it will be applied to this model can be found below.

3.1. DESIGN SCIENCE RESEARCH

3.1.1. Introduction

The Design Science Research model verifies its early beginning in the sciences of the artificial and engineering (Simon, 1996). It is in its essence a problem-solving paradigm. DSR aims to perfect human knowledge with the generation of ingenious artifacts and the creation of design knowledge (DK) by utilizing original solutions to real-world issues (Hevner et al., 2004).

Because of that, this research model has developed a growth of curiosity in the past two decades, mainly due to its capacity to assist on fostering the modernization aptitudes of organizations while also contributing to the much-desired sustainable revolution of society (Watson et al., 2010)(Vom Brocke et al., 2013).

3.1.2. Concept

The objective of a DSR research project is to expand the limits of organizational and human aptitudes by designing unique and ingenious artifacts characterized by models, constructs, and methods (Hevner et al., 2004)(Gregor & Hevner, 2013). DSR seeks to develop knowledge on how objects can and should be established (i.e., designed), commonly by human action, to accomplish a craved sort of objectives, referred to as design knowledge (DK).

The DSR outcomes in IS have been shown to generate compelling societal and economic repercussion (Gregor & Hevner, 2013)(Krumeich et al., 2014). Apart from the IS sphere of influence, DSR presents itself as a central research paradigm in many other fields being architecture, business, engineering, economics, and other information technology associated subjects for the generation of innovative solutions to meaningful design problems. Above, the reader may find some essential frameworks and processes that are deemed crucial in order to present the basis on how to conduct and prepare the DSR paradigm to scholarly standards.

3.1.3. Framework

In order to make use of the Design Research Methodology throughout this research process, the quadrant that is most applicable to this study must first acknowledge, by analyzing Figure 3.1.

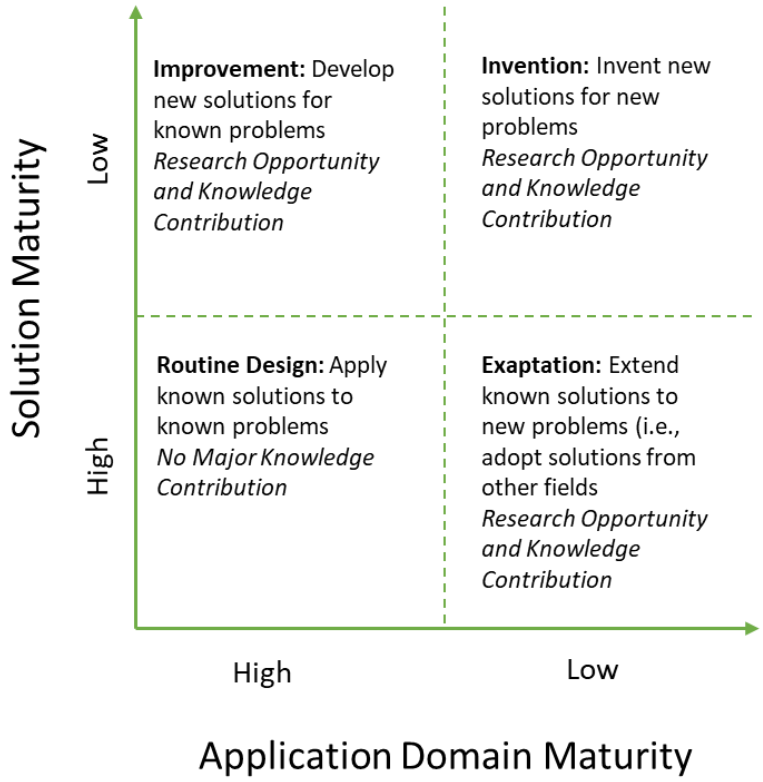

Figure 3.1 – DSR Knowledge Contribution Framework – Source: (Gregor & Hevner, 2013)

The statement "nothing is really new" (Gregor & Hevner, 2013) comes to mind in order to understand that in the very end, everything was created out of something else already in existence or lays its foundation on a previous idea. For the purpose of this master thesis, this thesis will consider Exaptation and Improvement as the main quadrants.

The following thesis seeks make use of already existing knowledge from other subjects with a high or lower relating level and it will aim to apply the knowledge into CTS design. Therefore, the reader will witness an adaptation of already existing solutions, more specifically the purpose, into a new subject with a different context as well as different variables/characteristics.

In the Figure 3.2, the reader can find a conceptual framework for recognition, execution, and evaluation of a DSR (Hevner et al., 2004). The background characterizes the problem amplitude in which the phenomena of interest dwell. It is comprised of organizations, people as well as the extant or planned technologies. In it are the objectives, assignments, issues, and opportunities that characterize the needs as they are grasped by stakeholders within that organization (Pacheco Lacerda et al., 2013).

Necessities are determined and evaluated within the situation of organizational structure, strategies, culture, and existing work processes. They are considered relative to the extant technology applications, architectures, communication, development, infrastructure capabilities. Collectively, these specify the "research problem" as recognized by the researcher.

Devising research activities to focus on real stakeholder requirements grants research significance. The knowledge foundation produces the raw materials from and through which DSR is concluded. The knowledge basis is constituted of foundations and methodologies (Freitas Junior et al., 2017).

Previous research and results from reference subjects sustain the foundational constructs, frameworks, instruments, models, methods, and theories utilized in the assemble stage of a research project (see Figure 3.2). Methodologies grant guidelines used in the evaluate stage. Precision is attained by accordingly implementing existing foundations and methodologies.

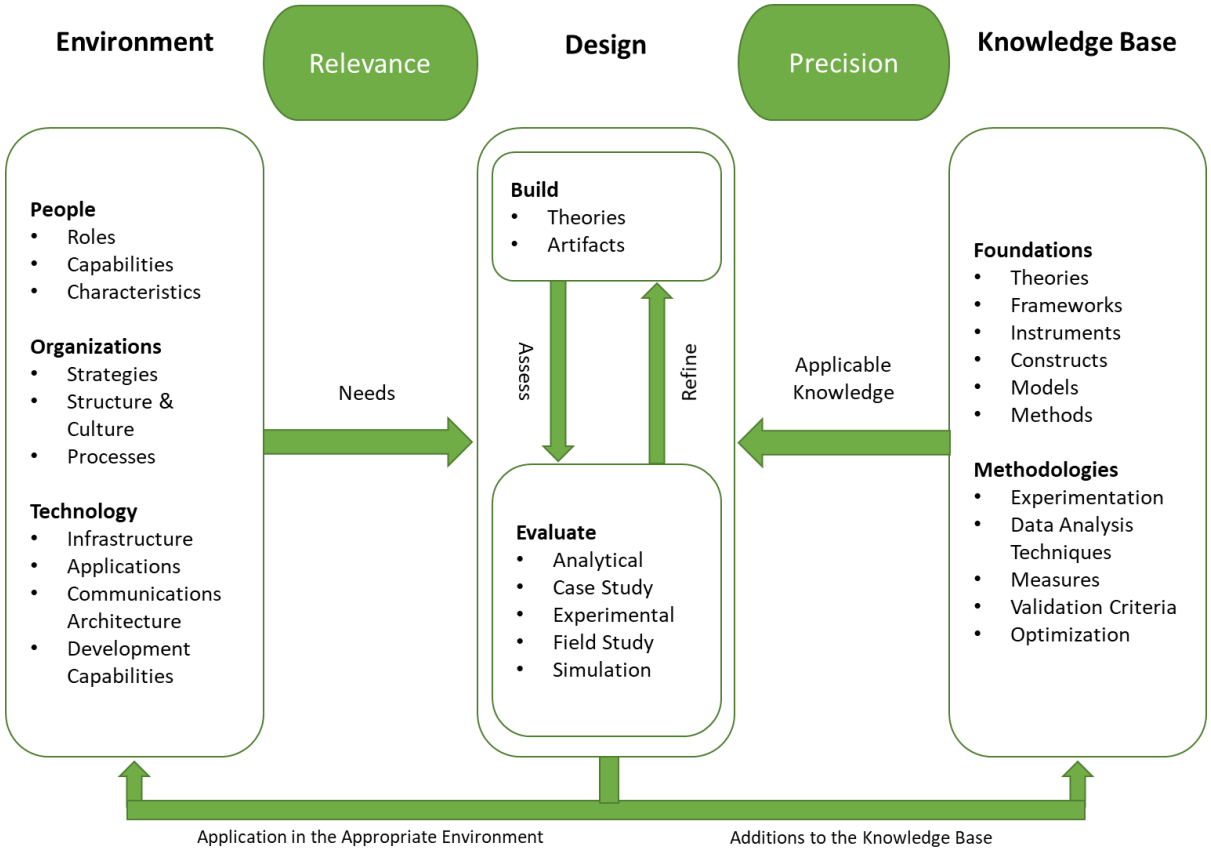

Figure 3.2 – Design Science Research Framework – Source: (Hevner et al., 2004)

DSR tackles meaningful issues in the real-world environment with distinct application fields. Research commonly results in the intent of a solution to be empirically inspected and scrutinized with people in organizations using distinct technology. Generally, the analysis of the business situation and the source of precise needs to be solved construct the initial point of a DSR project.

Nevertheless, there is also the possibility to encounter situations where the needs have already been studied and can be taken from the existing research. DSR inquires the knowledge foundation in that it researches to which degree design knowledge is already conveyed to solve an issue of interest.

That knowledge can present in the form of theories, frameworks, instruments, or design artifacts, such as constructs, models, or methods. In the event that knowledge is already usable to resolve an issue identified, this knowledge can be implemented according to "routine design", which does not embody the DSR. Otherwise, the DSR initiates creation of an ingenious solution to the issue, which, in most instances, constructs on already existing bits of a solution and aggregates, revises, and expands the existing design knowledge (Pacheco Lacerda et al., 2013).

The design activities constitute of "build" and "evaluate" activities, consistently succeeding numerous iterations. When it comes to a DSR study, various research methodologies are enforced, including those well-established in social science research: i.e., literature reviews, surveys, focus groups, and interviews.

3.1.4. Process

The model will try to solve the already mentioned problem using the DSR as this method focuses on the development of solutions for the technology world. This methodology presents an assortment of proposed sequence of stages and steps to present new solutions for verified issues and provide a better perception of the world (vom Brocke et al., 2017).

The stages will be structured under the following order: Problem Identification and Motivation; Objective Definition of the Solution; Design and Development; Demonstration; Evaluation; Communication (Pimentel & Filippo, 2020) and can be found in Figure 3.3.

Figure 3.3 – Methodology proposal – Based on the DSR Methodology (Source: Own Model / Adapted from: (Pimentel & Filippo, 2020)

This methodology is planned in a nominally sequential structure. Yet, a researcher does not need to proceed in a sequential order beginning in the 1st activity through the 6th activity. Alternatively, they are able to actually initiative at practically any activity and move outward. A problem-focused concept is the foundation of the nominal progression, initiating with the 1st activity, researchers shall progress in this sequence assuming that the concept for the research culminated either from observation of the problem or from recommended future research in a paper from a previous project (see Figure 3.4).

A design and development focused procedure would begin the 3rd activity. It would be the outcome of the presence of an artifact that has not yet been properly considered as a solution for the specific problem domain in which it will be employed. Said artifact could have materialized from another research domain, it could have already been utilized to solve a distinct problem, or it could even have presented as an analogical idea.

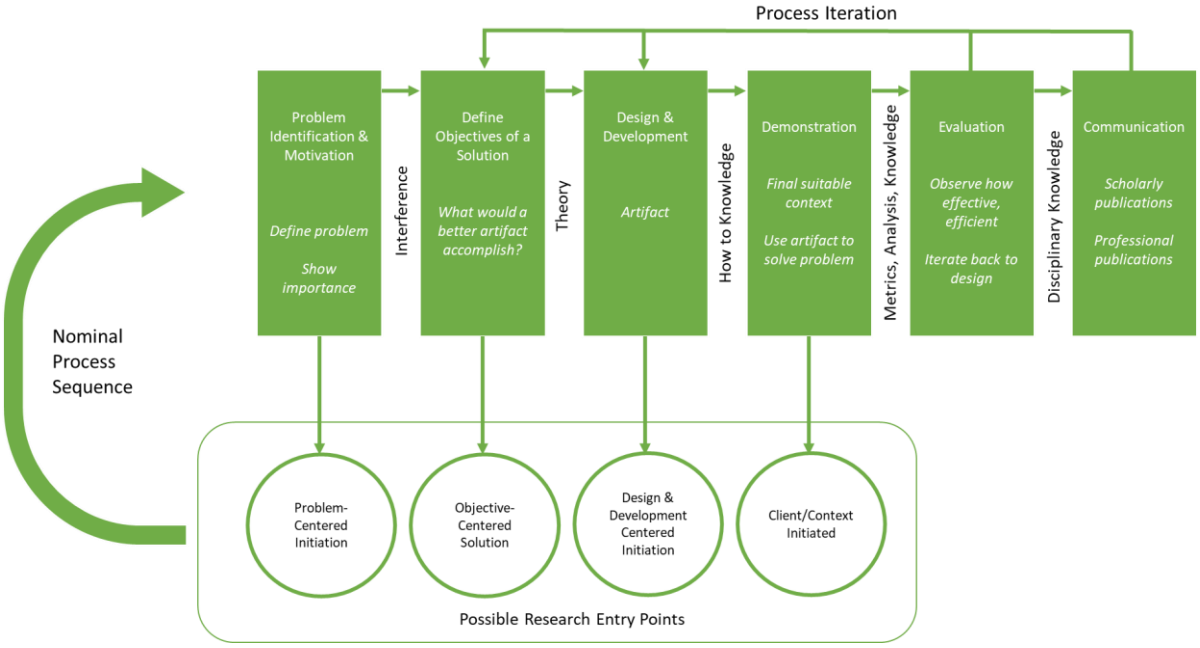

Figure 3.4 – DSR methodology process model – Source: (vom Brocke et al., 2017)

An objective focused solution, starting on the 2nd activity, could be the side product of consulting experiences, in which, for instance, the outcomes of the system improvement activities which fell short of the expectation and clients wished that the executant could perform a better job of setting up offshore programming. Lastly, watching a practical solution that functioned, initiating in the 4th activity, the outcome can present itself as a DSR solution if the researchers strive in reverse in order to apply rigor to the process retroactively (Goes, 2014).

3.1.4.1. Step 1 – Problem Identification and Motivation

This step determines the distinct research problem and supports the value of a possible solution. Explaining the value of a solution produces two results: it inspires the researcher and the target audience of the research to seek the solution and it aids the audience to acknowledge the researcher's comprehension of the problem (Goes, 2014). The resources required for this step include knowledge of the state of the problem and the significance of its solution.

3.1.4.2. Step 2 – Objective Definition of the Solution

The objectives of a solution can be implied from the problem definition. The reader may conclude on what is possible and feasible (March & Smith, 1995). The objectives can be:

- Qualitative: i.e., a description of how a generated artifact has a likelihood to assist the solutions to issues not addressed.
- Quantitative: i.e., conditions in which a craved solution would be better than the current ones. The objectives should be implied logically from the problem specification.

3.1.4.3. Step 3 – Design and Development

During this step, an artifact is generated. It is split between the sub steps "artefact design" and assisting "literature research". Subsequently to identifying a problem and performing a pre-evaluation about its relevance, a solution has to be refined in the style of an artefact. Theoretically, a DSR artifact can be any sort of designed object from which a research input is ingrained in the design (Geerts, 2011).

This activity encompasses the determination of the artifact's craved functionality and its architecture and then generating the artifact itself. It is within this step that research rigor/precision has to be ensured by making use of all related work available.

In a sense, artefact design is a creative scientific process and there is a lack of literature review specifically about this subject. Existing solutions and state-of-the-art must be taken into account. Throughout artefact design, the problem can be renewed. In that case, the activities originated from "identify problem" are iterated while design decisions should be documented (March & Smith, 1995).

3.1.4.4. Step 4 – Demonstration

This activity presents the utilization of the artifact to resolve one or more instances of the issue. This could relate to its use in experimentation, simulation, case study, proof, or other adequate action.

3.1.4.5. Step 5 – Evaluation

The Evaluation can be triggered once the solution reaches a specific state. The evaluation step assesses how well the artifact provides assistance to a solution to the issue. This step requires to compare the goals of a solution to actual observed results occurred from the utilization of the artifact. Depending on the nature of the problem venue and the artifact, evaluation could take many forms.

Evaluation is to be attained by utilizing an action research or case study (thus presenting the applicability in practice), by preparing a wide expert survey (in order to present broad interest) and by utilizing simulations or laboratory experiments (in order to equate distinct approaches). The business requirements should be aligned with the solution (McLaren et al., 2011). It is, in fact, greatly important as most of the claims on final solution are associated with its performance issues (Hevner et al., 2004).

In order to effectively measure the solution output, one of the actions that can be undertaken to verify how the solution fits in the initial problem is to perform a comparison between the starting point of the research, being the thesis in this case, and what can be observed in the practical application (Peffers, 2006). This means that in the end of this step, researchers can determine whether to iterate

back to the third step in order to seek to perfect the effectiveness of the artifact or to simply proceed on to communication step and leave further improvements to ensuing projects (Peffers, 2006).

The evaluation of artifacts serves as a fundamental aspect of DSR. Nonetheless, with the exception of a few present-day works, there is still the urgency for more assistance on how to design the evaluation segment of DSR. A review was performed by (Peffers, 2006) on 148 DSR articles to study the "artifact/evaluation method" combination in pursuance of providing assistance to researchers in the evaluation process selection.

A four-step methodology was established by (Venable, 2010) in which it delineated an important comparison amongst "ex-ante vs. ex-post" evaluation as well as "artificial vs. naturalistic" evaluation which resulted in a broad framework for the evaluation process in DSR. (Prat et al., 2014) composed a comprehensive glimpse into the artifact evaluation in information systems, producing a high-level abstraction approach of evaluation processes and in some instantiations of this approach over a range of broad evaluation processes (Geerts, 2011).

3.1.4.6. Step 6 – Communication

The communication of all the aspects of the issue and the designed artifact takes place in this step, thus notifying the relevant stakeholders. There are suitable means of communication that may be emplaced depending on the research goals as well as the target audience (McLaren et al., 2011).

3.2. RESEARCH STRATEGY

A complete literature review is base ground for this project as it will help to understand the cloud selection process and its subprocesses. Study cases regarding the usage of similar models will also be analyzed alongside the intricacies, difficulties, and advantages of each utilized process. Market evaluation as well as vendor scrutiny will also be performed to better compliment the retrieved information on the Problem Identification & Motivation stage (Pacheco Lacerda et al., 2013).

The second stage will focus on the Objective Definition of the Solution where the model's main requirements will be established. By doing this the third stage: Design and Development will have all the necessary information to construct the model. The Demonstration stage will see the model being implemented in a real case scenario (Figure 3.5 below).

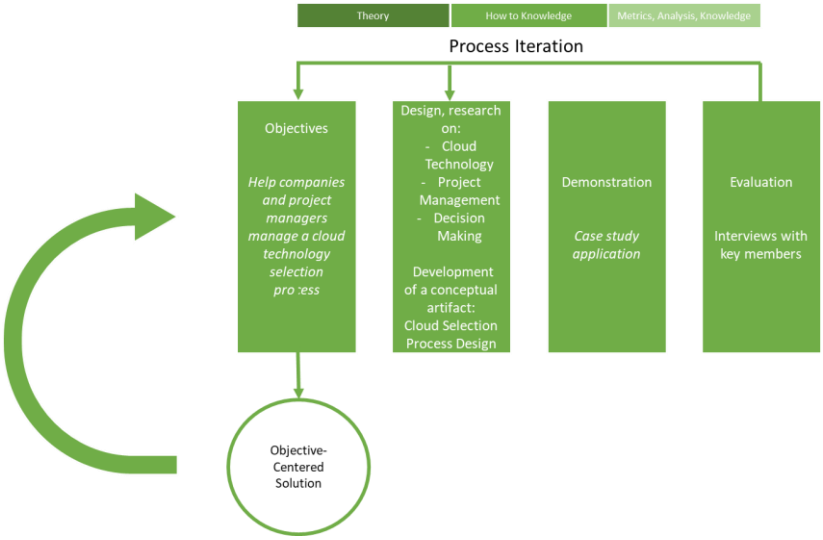

Figure 3.5 – DSR Implementation Strategy – Source: Own Illustration / Adapted from (vom Brocke et al., 2017)

The validation and consequent Evaluation stage will take place at a later period by implementing this specific framework into a real process and collecting the results from that experiment (Baskerville et al., 2015). The gathered data will help us obtain some insights. Below, the reader will find each stage in further detail:

3.2.1. Problem Identification and Motivation

The first step was to execute a Systematic Literature Review (SLR), as it would enable the analysis of the scientific relevance of the research. The problem scope was defined as well as the motivation of this study. This structure of research synthesis is widely common in information technology studies (Baskerville et al., 2018). Ergo, the SLR was performed to investigate how information, collaboration, and knowledge in cloud technology selection, as well as to acknowledge the state-of-the-art of concepts to tackle these questions. The main discoveries obtained with this SLR were:

- There is not any comprehensive systematic assessment on the specific matter and scope of the mandatory information for making fair decisions in cloud technology
- There is a lack of all-inclusive and systematic research focused on how cloud technology processes should be performed
- There is no evidence on which decision-making processes applied to cloud technology selection have resulted in a higher level of satisfaction by the client

In order to certify the practical relevance of the presented research, thus improving the definition of the problem as well as the motivation of the research, interviews with project managers along with clients were staged. The primary objective of these interviews was to contribute to an in-depth assessment on the affiliation and the impact of project managers strategies in cloud technology selections (Vom Brocke et al., 2013).

Therefore, this segment of the research is already accomplished. The following segment is to use the outcomes from both the preliminary research and the SLR to develop a conceptual framework, alongside some design hypothesis (ex-ante design hypothesis).

The resulting framework, not to mention the design hypothesis, will then undergo further testing in the later stage of the research, presenting the background knowledge for the design of the Case Study Research (CSR) and of the artifact to be improved and developed, which produce the next planned segments of the current research.

3.2.2. Objective Definition of the Solution

In order to assist in the definition of the wished objectives for the solutions to be developed, a more concentrated research will be executed by applying a CSR. As previously stated, in DSR, case studies are only identified to be employed at the ex-post evaluation stage of a precise artifact. Thus, a qualitative design of a various ingrained case study will be utilized to describe the existing cloud technology selections process notions.

The principal objective will be to define the requirements for an effective conversion of information towards knowledge on cloud technology selection, discussed through collaborative processes and mechanisms (Baskerville et al., 2018). This CSR will be developed and improved in accordance with the suggestions for effectively designing CSR.

These results will also be utilized to experiment and clarify the design hypothesis developed in the preceding research stage (ex-ante design hypothesis). With this CSR it will be possible to provide the definition of the objectives for the solution that is to be developed, as well as to execute a hard-boiled ex-ante evaluation of the artifact. Therefore, the artifacts will be designed and matured alongside the CSR.

3.2.3. Design and Development

During this stage of the research, this thesis will follow the design period of the DSR paradigm, which will be performed alongside with the CSR, resulting in an iteration between the evaluation and the

design of the artifact. Accordingly, throughout time, data will be gathered from the project managers who will be interested in reviewing and providing feedback on intermediate notions of the artifact.

The anticipated outcome is the design of two artifacts intended to be utilized as fundamental components for the development of decision-making support systems in a cloud technology selection background. This outcome will be an amalgamation of theoretical artifacts, for instance methods and models. In (Peffers, 2006), this is stated as a method that illustrate actionable directives that are theoretical (not algorithmic).

A model is a clear depiction of reality documented through a formal notation or language. The clear-cut objectives of this research stage are:

- To execute a requirements collection procedure for designing the artifacts
- To design a versatile cloud technology selection framework which could be applied to any sort of process in a global scale (1st artifact)
- To design a precise yet highly comprehensive decision-making model to aid businesses to support their choice (2nd artifact)

With a pursuit to contribute to DSR knowledge, the final artifact shall encompass two dimensions:

- Improvement (new solutions for known problems), by cloud technology selection plan
- Exaptation (known solutions extended to new problems), by the decision-making support system

3.2.4. Demonstration

To complete the demonstration as well as the ex-post evaluation of the artifacts, Case Study Research will be utilized. The procedures to execute this CSR will be the same exercised in the ex-ante evaluation, regarding the validity assurance. There is however a distinction: project managers will be interviewed, with adjustments and improvements being made in consonance to the received feedback.

The ex-post evaluation of the artifact shall also include interviews with project managers distinct sectors. This will enable to solidify the validation process of the artifact, while turning the findings universal.

3.2.5. Evaluation

The evaluation process will result in the approval of the artifacts for the current proposal. The procedure will still make use to the case studies that will enable a real-case validation of the artifacts. As the timetable proves short on time, this will be performed with minimum time consumption while still remaining highly accurate given the current circumstances .

3.2.6. Communication

The scientific and practical contributions of this master thesis will be reported to the supervisor, the evaluators as well as the NOVA IMS University and its interesting individuals. These results will encompass the final theoretical framework and model, as well as the ultimate design hypothesis (ex-post design hypothesis). Furthermore, there is the intention for the improvement and viability of the artifact which will also be disseminated.

3.3. VALIDATION AND EVALUATION PROCEDURES

3.3.1. Case Study

The case studies, in essence, seem to inherit the characteristics of the qualitative investigation. This seems to be the dominant position of authors who approach the methodology of the case studies. In this sense, the case study is governed by the logic that guides the successive stages of collection, analysis, and interpretation of information from the qualitative methods, with the particularity that the purpose of the investigation is intensive study of one or a few cases.

Researchers from various disciplines use the study investigation method of case to develop theory, to produce new theory, to contest or to challenge theory, to explain a situation, to establish a basis for applying solutions to situations, to explore, or to describe an object or phenomenon (Cloutier & Renard, 2018). Despite some differentiation, sometimes conceptual, according to the epistemological framework of the authors, there is, however an assortment of characteristics that help to shape the methodology of case studies, such as the nature of the investigation in the case study, its holistic character, the context and its relationship with the study, the possibility of being able to make generalizations, the importance of a previous theory and its constant interpretative character (Zainal, 2007).

The development of research projects is a complex component when carrying out case studies, as, unlike other research strategies, case study projects have not yet been systematized (Yin, 2005). Given that in this situation, the case study strategy, being a poorly systematized and comprehensive strategy, determines that the characteristics of the case studies are not completely coincident and may suffer some variation according to the approaches, methodological design, and aspects to which each researcher attaches more importance (March & Smith, 1995). There is also the use of a different language for similar aspects of the case study. This difference may result from the way each author interprets the case study methodology.

About the holistic character of case studies, the case studies can be holistic, because they inherit this characteristic of qualitative research. In this perspective, the case studies aim at a greater concentration on the whole, in order to understand the phenomenon as a whole and not some particularity or differentiation from other cases (Pries-Heje et al., 2008).

One of the characteristics of case studies is the possibility to obtain information from multiple data sources. The researcher must take into account the format in which he will collect the data, the structure, and the technological means he intends to use (David et al., 1999). The case study makes use of a variety of ways of gathering information, depending on the nature of the case and with the purpose of enabling the crossing of study or analysis angles. Among the instruments for collecting information are the diary, the questionnaire, document sources, individual and group interviews, and other records that modern information and communication technologies allow us to obtain (Zainal, 2007).

The current work's validation will take place using documentary sources. The use of documentary sources related to the subject is a basic strategy in a case study. These sources can be diverse: reports, proposals, plans, internal institutional records, press releases, files, etc. The information collected can

serve to contextualize the case, add information or to validate evidence from other sources. This will be aligned with the interviews that will be explained after (Cloutier & Renard, 2018).

To sum up, the case study is often referred to as allowing the study of the object (case) in its real context, using multiple sources of evidence (qualitative and quantitative) and fits into a logic of knowledge construction, incorporating the researcher's subjectivity. It can be a powerful strategy when the context is complex and when it intersects with a complex set of variables.

It is a strategy that requires the researcher to reflect carefully on aspects (cross-cutting works on this theme), such as its qualitative/quantitative nature, the lack of systematization as a research method, its more or less holistic character, its greater or lesser importance context, participant/non-participant research, the possibility of generalizing the results, the need for a prior theory and the constant interpretative character (Crowe et al., 2011).

The case study makes sense to be based on a rigorous methodological design, starting from a problem starting with a “why” or “how” and where the objectives and theoretical framework of the investigation are clear. The problem may be broken down into propositions and these, in turn, into guiding questions (Crowe et al., 2011). The units of analysis will have to be identified and the instruments for collecting the information to be designed. In this case, this thesis will look into a real case scenario from a global organization which will be referred as organization X.

The necessary recording and classification of information from multiple sources of evidence will also be carried out, proceeded by the triangulation of information to answer the guiding questions and, finally, critically filtered the problem studied with the theoretical conceptual elements that underpinned the study.

3.3.2. Individual Interviews

In order to evaluate and verify the conceptual framework proposed as well as the study assumptions, individual interviews were conducted, through Microsoft Teams or presential meetings, with field experts of cloud technology selection and project management. These experts hold different professional and academic backgrounds. The research had the main goal of understanding the point of view of each of the interviewees about the challenges that a cloud technology project may face (Carolyn Boyce, 2006).

It is necessary to say, in the first place, even though it seems like redundant, that interviews aren't the only way to do qualitative research – there is no mandatory link between qualitative research and the performance of interviews (Fox & Midlands, 2009). Therefore, it is not because a researcher chooses to adopt a qualitative method that he necessarily has to resort to interviews (whatever they are). The researcher can:

- Make field observations and take our records as a source
- Use documents (written, recorded in audio or video, pictorial etc.)
- Take pictures or video recordings of significant situations
- Work with check lists, focus groups, questionnaires, among other possibilities

What provides the qualitative factor is not necessarily the resource that is used, but the referential theoretical/methodological chosen for the construction of the research object and for the analysis of the material collected in the field work (Roulston, 2014). It should also be noted that interviews are not suitable for everyone research situations – there are circumstances where they just don't work or even can be performed.

Interviews are essential when the researcher needs to map practices, beliefs, values, and knowledge in s specific topic (Dicicco-Bloom & Crabtree, 2006), more or less well delimited, in which conflicts and contradictions are not clearly explained. In this case, if done well, they will allow the researcher to make a kind of deep dive, collecting evidence of the ways in which each of those subjects perceives and signifies their reality and raising consistent information that allows them to describe and understand the logic that governs the relationships that are established within that group, which, in general, is more difficult to obtain with other data collection instruments.

Research interviews can be divided into three types of frameworks: structured, semi-structured and unstructured (Gill et al., 2008). A semi-structured interview is based on several elemental questions aiming at identifying the fields of expertise to be explored. It also enables the interviewer or interviewee to diverge to pursue an idea or response with a greater level of detail. (Dicicco-Bloom & Crabtree, 2006) refers that the semi-structured interviews are structured around an assortment of predetermined and open-ended questions. Other questions might rise up from the dialogue between the interviewer and the interviewee.

With regard to the interpretation of open or semi-structured interviews (DeJonckheere & Vaughn, 2019), thematic analysis can be a resource that “shorts the path” of the researcher, especially when it comes to beginning researchers. In this case, the researcher can take the set of information collected from the interviewees and organize them, first, in three or four main axes thematic, articulated to the central objectives of the research.

Therefore, the data from a survey of this type will always result from the ordering of the empirical material collected/constructed in the field work, which involves the interpretation of fragments of the interviewees' discourses, organized around categories or thematic axes, and the intersection of this material with the theoretical/conceptual references that guide the gaze of that researcher.

This implies the construction of a new text, which articulates the speeches of different informants, promoting a kind of "artificial dialogue" between them, bringing similar, complementary responses or divergent in order to identify recurrences, agreements, contradictions, divergences, etc. This procedure helps to understand the nature and logic of the relations established in that context and the way in which the different interlocutors perceive the problem he is dealing with.

The interviews followed a structured script aimed at meeting both the validation requirements as well as the specifications. They followed a precise sequence so they could obtain the best quality of information relevant to this study. It was introduced by a general explanation cloud technology nowadays as well as project management, then moving to more specific questions to validate the proposed conceptual model. The questions were open-ended questions meaning that the experts were able to fully express their personal point-of-views and experiences while at the same time allowing them to ask their own questions about the conceptual strategy and framework (Rabionet, 2011). The study case was shared with them to provide an extra foundation for their answers.

As stated before, individual interviews enable the interviewer to take a deep dive into both social and personal matters, leveraging information that would otherwise not be possible to access using other techniques (i.e., surveys). Still, the data resulting from the interviews can be recorded and reviewed at different times, raising the accuracy level of the results (Alshenqeeti, 2014). Individual interviews were conducted with three experts on the matter and three questions were asked:

- Q1: Did the proposed framework clearly define the stages of the entire process?
- Q2: What improvements as well as criticism would you suggest?
- Q3: Would you be open implement the proposed framework?

Researchers often feel discomfort when they conduct interviews because they imagine themselves taking something very precious from the other without giving them anything in return. There is not any reason to feel that way as the interview is always an exchange and, at the same time collects information. The researcher offers his interlocutor the opportunity to reflect on himself, to retrace his biographical journey, to think about its organization, values, history, and ethics that constitute the project he has taken part in, the processes of its organization and its previous endeavors (Valenzuela & Shrivastava, 2008).

When the researcher conducts an interview, he acts as mediators for the subject to apprehend his own situation from another angle, leading the other to focus on himself. The researcher should look for relationships and organize them. By providing raw material for the research, the informants are also reflecting on their own lives and giving new meaning to them. Assessing his social environment, he will be self-evaluating, asserting himself before his project and before his organization/society, legitimizing itself as an interlocutor and reflecting on issues around which perhaps it would not dwell on other circumstances.

4. PROPOSAL

4.1. ASSUMPTIONS

4.1.1. Cloud Technology

Based on what was studied in the literature review, about cloud technologies deployment and service model, it was defined that a cloud technology section project, in order to be effective and correctly deployed should:

- Understand the evolution of cloud technology throughout the ages, bearing in mind the major improvements that helped shaped the evolution direction (Mishra, 2014)
- Understand the current situation both on a technological as well as an economical perspective and understand the mutual relations between the two. As the two are massively interlinked they are able to greatly influence the immediate as well as the long run outcome (Cheng, 2017)
- Verify the major trends in cloud technology for companies which already have partially adopted cloud technology services and companies that are right now starting on this journey (*The History of Salesforce - Salesforce News*, 2021) (Modern Tribe, 2021)
- Address the characteristics that help to define a cloud technology service, thus enabling a multi-dimension analysis of the service (Khowfa & Silasai, 2017) (Serrano et al., 2016) (Trapero et al., 2017)
- Bear in mind the biggest challenges of that adoption and how they can affect the entire scope of the project. Upon addressing the challenges, the project manager/team will be able to delineate strategies that will help to tackle them (Misra & Mondal, 2011) (C. Huang et al., 2021) (Singh & Sidhu, 2017)
- Acknowledge the risk of an adoption and the severe impacts that may occur if the risk is not well assessed as well as not to have a mitigation strategy. This strategy will also contribute to minimize the impact on customer satisfaction in case of a negatively impacting event (Singh & Sidhu, 2017) (Alshazly et al., 2020)
- Determine the major advantages to gain from pushing their infrastructure into the cloud and transmit those changes to all the stakeholders, motivating them to take an active part in the project (Aldmour et al., 2021) (Grimm, 2021) (H. Fan et al., 2015)
- Establish the deployment models on how the cloud technologies can be implemented and how are the intricacies of that implementation, while at the same time looking at the advantages and disadvantages for each type (Franklin & Chee, 2019) (*11th IEEE International Conference on Cloud Computing, CLOUD 2018, San Francisco, CA, USA, July 2-7, 2018*, 2018) (Talaat et al., 2020) (Marinos & Briscoe, 2009) (Moghaddam et al., 2011)
- Verify which service model to be implemented as well as the structure needed to plan out that deployment. A full set of resources on various grounds (financial, human, etc.) are to be estimated (W. Huang et al., 2015) (Yasrab, 2018) (Bandulet, 2017) (Duan et al., 2015)
- The business models of cloud technology and how it influences which vendor would better suit the needs. On a broader perspective, the business model of cloud technology has to be intrinsically clear to the client, the major benefiter of this project (Pau et al., 2018) (H. Fan et al., 2015)

- Promote digital inclusion throughout the company, as some employees may have a higher level of digital literacy thus are more prepared when exposed to new systems, especially if they are to be used by a common employee. Training sessions as well as Q&A's sessions have to be prepared especially for this audience. As the strength of a chain is only as strong as it is weakest link, the project team should grant that no one is left behind in the digital transition (Grimm, 2021)

4.1.2. Project Management

As the whole process can be organized as a small to mid-size project, the concept of project management was also studied with a high-level overview. The main goal of this literature approach was to provide a perspective on the different stages of the well-studied project management science and how our Cloud technology process can clearly be identified as one:

- Prepare the project schedule for the entire project and adapt it as they fit and according to the client's expectations (Epstein et al., 2013)
- Prepare the kickoff meetings, providing a plan and helping to address the core challenges that may be raised at that stage (Frigenti & Comninos, 2005)
- Execute a RACI matrix analysis, helping to distribute the activities amongst key stakeholders (J. Mike Jacka, 2009)

4.1.3. Decision-Making

The decision-making process was also analyzed in detail. As this sort of process can be applied to not just cloud technology but literally everything there is a fair amount of literature that helped structure the trial of thought. Therefore, decision making as a process that enables fair, well studied and with a strong fundamental basis can be asserted by the following elements that defined it:

- How decision-making theories have evolved throughout time (Alabool et al., 2018)
- Perform a full environmental review, thus reaching out to more vendors and being exposed to all sorts of alternatives (Nie et al., 2011)
- Assert both quantitative and qualitative techniques in which decision-making processes can make use of in order to be structure (Lang et al., 2018)
- The decision-making process well-structured with each stage clearly explained (Rehman et al., 2011)
- Perform a companywide analysis thus targeting the fundamental areas in which the cloud technology system to be implemented should focus on (Z. Yang & Wang, 2020)
- Promote companywide participation via surveys that could facilitate information sharing if anonymously
- Promote core members participation making use of brainstorming sessions and reaching out directly to those core members via Q&A sessions
- Prepare a feedback system so users can continuously provide information on how the implemented service is functioning or prepare an already used issue raising tool for the new service

- Provide feedback to the vendor, getting evolved beyond the simple implementation of the project and actually contributing to the evolution of the system

4.1.4. Theoretical Models for Decision Making

The models used to structure decision making with a huge focus on cloud technology:

- TOE framework – enables technology adoption in organizations and characterizes how the procedure of adopting and implementing technological innovations are influenced by the technological, organizational, and environmental context
- QoS parameters – used to evaluate the quality of serve (Eisa et al., 2020) (Burkon, 2013)
- SLA – how SLAs maintain the agreed conditions of service providing a sort of benchmark for the functioning of the service (Trapero et al., 2017) (Serrano et al., 2016) (Emeakaroha et al., 2012)
- AHP – a model that helps to structure and prioritize the criteria (Thomas L. Saaty, 1984).
- Fuzzy Logic – a model to map logical reasoning with broad or inaccurate statements (Zadeh, 1965)

4.2. A STRUCTURED FRAMEWORK FOR DECISION-MAKING ON CLOUD COMPUTING

4.2.1. Overview

The presented framework has its basis in real-life scenarios where some bits or even the entire framework have been applied with the intention of either working as a whole process or simply assuming as an aid to decision making. As it has a broad usage capability, the framework can in fact be applied and used to capture almost any sector which will engage in a change in cloud technology.

At a first stance, I aimed to describe the process a whole, providing with the path to assess the complexity of the selection process. As the current thesis is not solely focus on the decision making, there was a feeling that only by addressing the entirety of process this thesis would be able attain all the variables that build up to the model.

By utilizing this strategy, the reader is not directly thrown into the decision-making model but rather guided, understanding all the processes and sub-processes that surround it while at the same time helping him to effectively structure the entirety of the project.

Starting off by the initial stage where the activities with are not specifically applied to this project but basically every project that may exist, let us move forward into the more distinct ones. The coming of age of this initial stage will happen in the framework definition. We will then proceed with both longlist and shortlist vendor generation. These sub-processes enable the PM and the client to exhaustively assess the organization as well as its intricacies and reflect that study on what is in market.

We will then be guided into the decision-making model. A model that can produce accurate results in reflection of a wide variety of theories that add up and are structured to present a strong answer on what the choice of CT shall be. Lastly, the results shall be reported to all the stakeholders. You may find the above figures with greater detail in the Annexes.

4.2.2. Initiation Phase

The first stage of any project, the current framework wraps up the essential steps to start the project within this stage which plan can be found in the Figure 4.1.

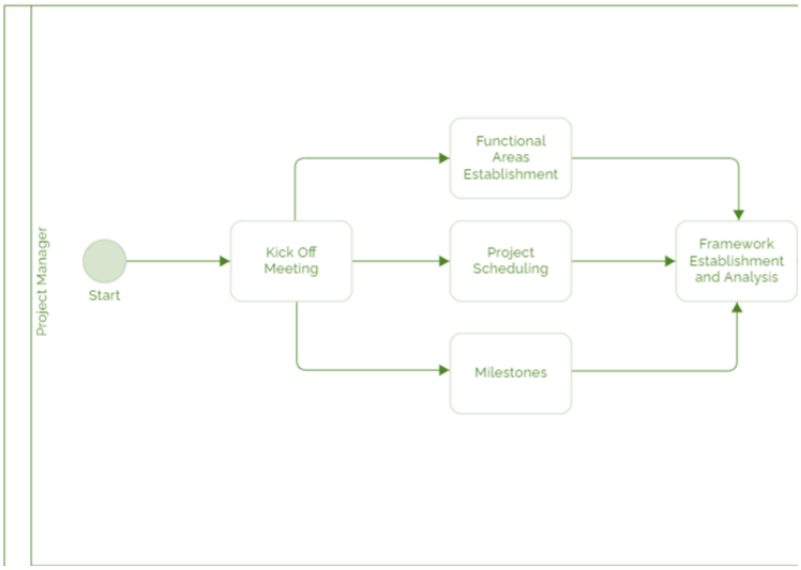

Figure 4.1 – Initiation Phase Sub-Plan – Source: (Own Illustration)

4.2.2.1. Kick-Off Meeting

Definition

The first step in the CTS process and any project in general should be the kick-off meeting. But what is exactly a project kick-off meeting?

The kickoff is part of the CTS initiation phase of the entire project lifecycle. It is a crucial project management activity that requires team members and the client preparation on the communication, expectations, and participation for the project.

This meeting gives the opportunity to inform about the project planning phase of the project. It also allows the harmonization and agreement on different details such as project management methodology, project timeline, success tracking, etc. The majority of kickoffs requires a series of meetings, both internal and client-side.

If the PM was to start a project without a kick-off meeting it would be like setting sail without any concrete destination. He is most likely able to see some things throughout our journey, but he will probably end his vacation with major unexpected events. A good project kick-off meeting sets the course for a successful and smooth project collaboration.

Main Purposes

- **Formally meet between team and the client** – This is the best opportunity to understand the client's objectives and expectations. It is important to listen to what they say and do not
- **Establishing what needs to be executed** – After the kick-off meeting, everyone present should have a complete understanding of what needs to be accomplished in order to achieve success

- **Agree on the methodology of working together effectively** – Effective means of collaboration have to be established in order to remove any potential barriers to success
- **Set the expectations** – Delineate the realistic measures of success to be foreseen along the way
- **Diminish the probability of potential surprises** – Predict any problems or unexpected delays that may happen, acknowledge them, and set a contingency plan for each one of them
- **Understand each other weaknesses and strengths** – Understand the best and worst assets and skills of each stakeholder. Plan appropriately and determine means of utilizing each individual's best skills
- **Generate enthusiasm and inspire confidence in the client/project team** – Ensuring that the client/project team leaves the meeting feeling invigorated by the level of commitment and enthusiasm

Format

In Figure 4.1, you will verify three steps that proceed the kick-off meeting. These are the main steps to start conducting the project. Nonetheless, they should be included in the initial meetings alongside the following:

- **Welcoming everyone** – Thank everyone for being present and ask them to provide short introductions to improve familiarity among the team/client
- **Agenda discussion** – Discuss the wished order of business for the kick-off meeting. In order to save some time, it is recommended to print agendas that you can distribute at the beginning of the meeting or simply shared them digitally
- **Ice breaking** – As both the project team and client are certain to come from an unfamiliar background, it might be advised to include a small icebreaker game to develop a team mentality. This however should be applied according to the level of relationship with the client
- **Project background** – Explain why this project is worthy of the business's resources while also providing context on how the project came to fruition
- **Project charter analysis** – Discuss the objectives, scope, and participants of the project. The project charter serves as a benchmark of authority for the forthcoming project
- **Responsibilities and roles discussion** – The project manager may use the RACI Index (Responsible, Accountable, Consulted, and Informed). This index states the collaboration of the various roles in each task of the projects
- **Timelines (see Figure 4.1)** – Review the schedule for the project. The plan should contain several milestones and phases of the project all laid out. Everyone should be aligned with the schedule and identify any events that may impact it. For instance: indecisiveness, delays in approvals, legal issues, etc...
- **Risks' assessment** – Prepare a list of likely risks prior to your kick-off meeting. Run through this list as part of your discussion and identify ways of minimizing them
- **Establish rules for any further communication and meetings** – Discuss the means for any future communication with the client. Book project meetings periodically according to the project's schedule and establish the basis for requesting any non-prescribed meetings

4.2.2.2. Framework

A project management framework is a set of tools, tasks and processes that enable structure and guidance for the implementation of a project. Since the beginning up to completion, the framework helps the project team/client to map out the advancement of the individual project steps. The framework includes all the variables of the project, from specific processes and tasks to required resources and tools.

The project management framework can be divided into three core components:

- **Project lifecycle** – Determines a timeline with goals and milestones for five different stages
- **Project control cycle** – Provides functions for monitoring and management
- **Tools and templates** – Provide organizations with ready-made frameworks that can be applied to project implementations

The reason for the step occurs mainly because the thesis framework may still be adapted to capture specific details from that company. As previously stated, the aim of the framework is to provide a broad tool so that any sort of organization can easily apply to their own case, adapting it if necessary.

4.2.3. Requirements Gathering

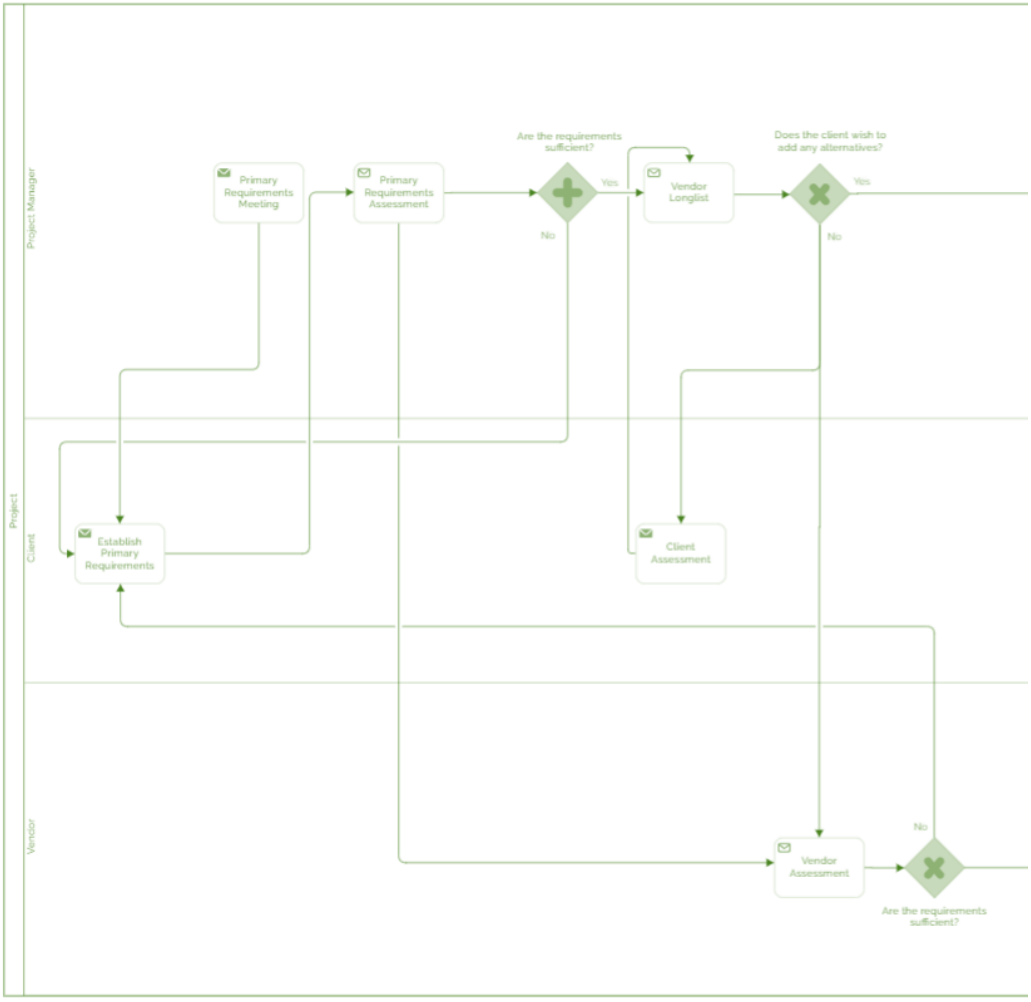

Figure 4.2 – Requirements Gathering and Longlist Assessment Sub-Plans – Source: (Own Illustration)

4.2.3.1. Concept

Requirement gathering (see Figure 4.2) or more commonly known as the Discovery Phase is a process in which the project manager understands and identifies a business's project technical requirements and proceed with a clearly defined plan. Though the discovery phase is a required phase in any crucial project plan, it is quite often neglected with the absence of sufficient groundwork.

Some of the project managers/consultants might argue that if a client's requirements are accurately identified in the early stages, then completing a full phase of requirements gathering is simply not required. The discovery phase tens to have its importance minimized. If the requirement gathering is not performed accordingly, it can lead into project deliverables not meeting the business requirements which in turn could result in a waste of money and time.

This stage is crucial as the collected information can be used, for instance, as a support for the System Requirements Specifications (SRS) document (by combining a mission or simply a vision statement from the client company defining the overall objectives and business plans). So basically, the

requirements gathering stage enables both parties to diminish risks and stabilize the task management within the required frame of time. The process of discovery phase must definitely include stakeholders and key executives.

Throughout both stages, there will be two sessions of requirements gathering in which the primary one is the crucial ones, or in other words, the ones the business cannot operate without, and the secondary ones are requirements that though not crucial, still play an important part in encompassing the entire organizational relationship structure.

4.2.3.2. Techniques

An ideal project manager should make use of certain techniques for the requirements gathering process. Some of them can be found below:

Interview

This is one of the most effective techniques for requirement gathering. With this method, the project manager can talk to the client who is unable to give out extensive information as they are not aware of the system development and similar functionalities. It is the responsibility of the project manager to acquire proper information from them which can be accomplished by interview.

Survey

This is truly an effective method on collecting requirements as well as all sorts of information within a brief timeframe. It is suggested to first determine the goal of the survey and thereafter draft the questionnaire. Once the questions list is ready, it should be conveyed to the client as well as any stakeholder for the answers. The answers will then be studied and documented.

Brainstorming

Brainstorming sessions enable the discussion which proves to be useful to find out solutions to complex problems.

Observation

Under this method, the project manager/project team observes the team in the working environment and retrieves ideas about the technology and while at the same time documenting the observation. Observation can be invisible, as the person simply observes the working and does not interact or makes himself visible. This is however a time taking process and it is not suitable for all types of cloud technology selection processes.

Focus Group

The project manager supports the requirement gathering process by cooperating with the representatives on behalf of the client. The representatives here have a vague idea pertaining to the requirements. Under the focus group, the idea is to gather information from representatives to acknowledge the technology idea clearly.

Interface Analysis

Specialized technique where certain requirements correlated to application development are established and their interaction with other SaaS components is monitored and measured.

Prototyping

With this technique, according to the client's requirements, the project manager may build a model of the service (especially for SaaS). The output can be sketching formats of the service or vague mockups.

Use Case Diagram

Technique that displays how people interact with the service (especially for SaaS) and also shows what a system does.

Problem Reports and Suggestion Analysis

Requirement's analysis can also be performed from user issues as well as change suggestions. A direct method to look for requirements is to check for suggestions and issues that are characterized in the document. If the client's business has a method of reporting and recording system problems, the project manager is able to look into such report and sort the issues into unique key areas that are troubling the client. When you want to select which technique to employ, there are some factors that require to be considered:

- Location and availability of the stakeholders
- Project team and client's knowledge on the problem
- Project team and client's knowledge of the development process and methodology to solve it

4.2.3.3. Mitigate Risk

Collecting and managing requirements is a challenge in project management. It can be a matter of failure or success for projects assuming that this can occur even if the project is midcourse and the requirement gathering is ineffective. IT projects have a criterion that is continuously evolving throughout the project's timetable and needs careful management.

The project team requires to duly assess and understand the novelty value of the requirement collecting process of individual project. Requirement risks are one of the most duplicitous risks that threaten any sort of IT project and their effectual management. Lack of client involvement in the requirement gathering process, ambiguous requirements or inadequate requirements can all result on the major perpetrators in the projects likely to going awry.

4.2.3.4. Overcoming Challenges

Requesting and gathering business requirements is a crucial step for any sort of project. Designing a complete set of requirements at an initial phase can facilitates in accurate cost estimates, better planning, enhanced client satisfaction, shorter delivery timeline and better feedback to the end-product.

The project manager has the responsibility of erasing the gap between technical and business requirements as they are required to acknowledge the business needs in the full context and synchronize the same with the business goals while communicating the same to the development team as well as other company stakeholders. For the stated purpose, they are required to guarantee that the requirements are elaborated in a form that is clearly understandable by both the parties.

The project manager also needs to stir between vague and sometimes colluding views of the stakeholders in order to concur on what needs to be accomplished. There are times when the requirements collection efforts are hindered by several sorts of pitfalls. Therefore, we shall discuss about the various challenges that can grip the requirements collecting process while also discussing the potential approaches on how to deal with them. A list of challenges follows:

Lack of Clarity in Defining Criteria for Success

Stakeholders and usually clients have a translucid idea about the issues that they are exposed to when exploring a unique opportunity. Nonetheless, often they are extremely lost about what exactly is that they are looking to accomplish. To address this concern, it is advisable to split the project into small parts and start from the part where the client has mostly understood.

The client can make use of collaborative modelling tools which allow them to have a high-level overview of the result making feedback retrieval early in the process purely simple. It is also desirable to ask questions from the client and identify current business practices and identify the pain points which can be improvised. Being it as it may, the best approach to have is to make the requirements quantifiable and testable to achieve a solid basis against which the outcomes can be later measured.

Clients are Always Changing Their Minds

If the requirements are not clearly stated or understood during the project, modifications are bound to occur. The best approach to tackle it is to adapt the project and accept the modifications. Though, it is important that the modifications are prioritized and estimated, new time and budget allocations

should be discussed and communicated as well as confirmed with the client before modifications are applied.

Lack of or Over Communication by Clients

Active communication and participation by all stakeholders are crucial to the success of the requirement collection process. Establishing a rapport of trust is required if the intention is to get the stakeholders to provide open and honest inputs. It is also important to listen, absorb and speak the client/stakeholders' lingo for the project. The same is applicable if the project manager is interested and if he understands the client's business difficulties and are here to focus on resolving the issues.

Certain Solutions May Clog the Client's Trail of Thought

Clients may unnecessarily lean towards a specific technology or software which happens to be the one that they had them in the past or have been already exposed to. The best approach is to try and alter the client's consideration towards the main central area.

Priorities May Conflict for the Stakeholders

The requirements collection process must have a tough approach which includes querying open ended questions which require the stakeholder to provide a reply. All stakeholders involved must express their perspectives and ideas within a specific timeframe. Rushing through process may lead to proposed terms that are contemplated as out of scope. This may also lead to promoting individual agendas rather than the organization's vision.

It is advisable to have several interactive sessions with the client. They should have some time in between them to digest the collected inputs, granting that the requirements collection process delivers the results accordingly.

4.2.4. Vendor Longlist

Once the systems requirements have been assessed and documented, the next phase in the selection process is to identify potential vendors, by creating a long list of significantly relevant solutions. The project manager can find many vendors which websites have detailed information. Though, your main objectives are:

1. To create a list of potentially suitable vendors
2. To identify which are relevant to the business' needs

4.2.4.1. Searching Procedure

Useful sources and tips to create a long list of potential service solutions include:

Search Engines

Search engines provide great amounts of information. Therefore, the vendors that meet the business meets must be selected with care. Some advantages of using search engines include:

- Popularity – First place to look
- High number of results
- Free and especially anonymous to use
- Significantly quick to use

Disadvantages may include:

- The results may be too many possibly leading towards confusion
- Greater chance of results not being relevant
- In order to achieve relevance of results, there might be a need to constantly refine the search

Vendor Directories

Vendor directories vary greatly. They may amount to only paid listings, free listings, or a mix of both. Some may solely list vendors, whilst others provide considerable detail. Most categorize the vendors and have an enabled search to aid the users. Some require registration and may even charge whilst others are free to use (anonymously). The more reliable vendor directories tend to be well known names or, part of a reputable organization.

Expos, Exhibitions and Conferences

Traditional exhibitions, expos, conferences, in other words, events in which you can physically visit, meet vendors, and discuss the requirements. On the websites of such events, there will be the list of vendors along with details of their services and as well as links to their websites. Some websites are free to use and easily accessible, others require the event registration. The same goes for attendance: some events are free, others are chargeable.

Online Vendor Listings Resources

Other website resources also list cloud technology service vendors. There is a wide variation in both detail and quality. The lists may be quite comprehensive as well as clearly simple yet, not all vendors may be included. The majority is free to use, but some may solicit a sign up. Reasonable results may still be achieved. However, lower rated websites may undermine the results, as the project manager will have to avoid listings without relevance and a large number of adverts.

Websites with Published Directories

Offline or printed directories are the first approach to publicize any sort of vendors. In a matter of fact, they are quite rare these days. They may be published at a regular timeframe or simply annual and a

cost may be presented to the user. The results are high quality as they are verified and validated each year. Yet, being an offline publication, the results have a tendency to date a little after publishing, especially if the publication is annual. There may also be published vendor listings that are free, but they fall into a basic listing category, while the remainder are chargeable.

4.2.5. Vendor Shortlist

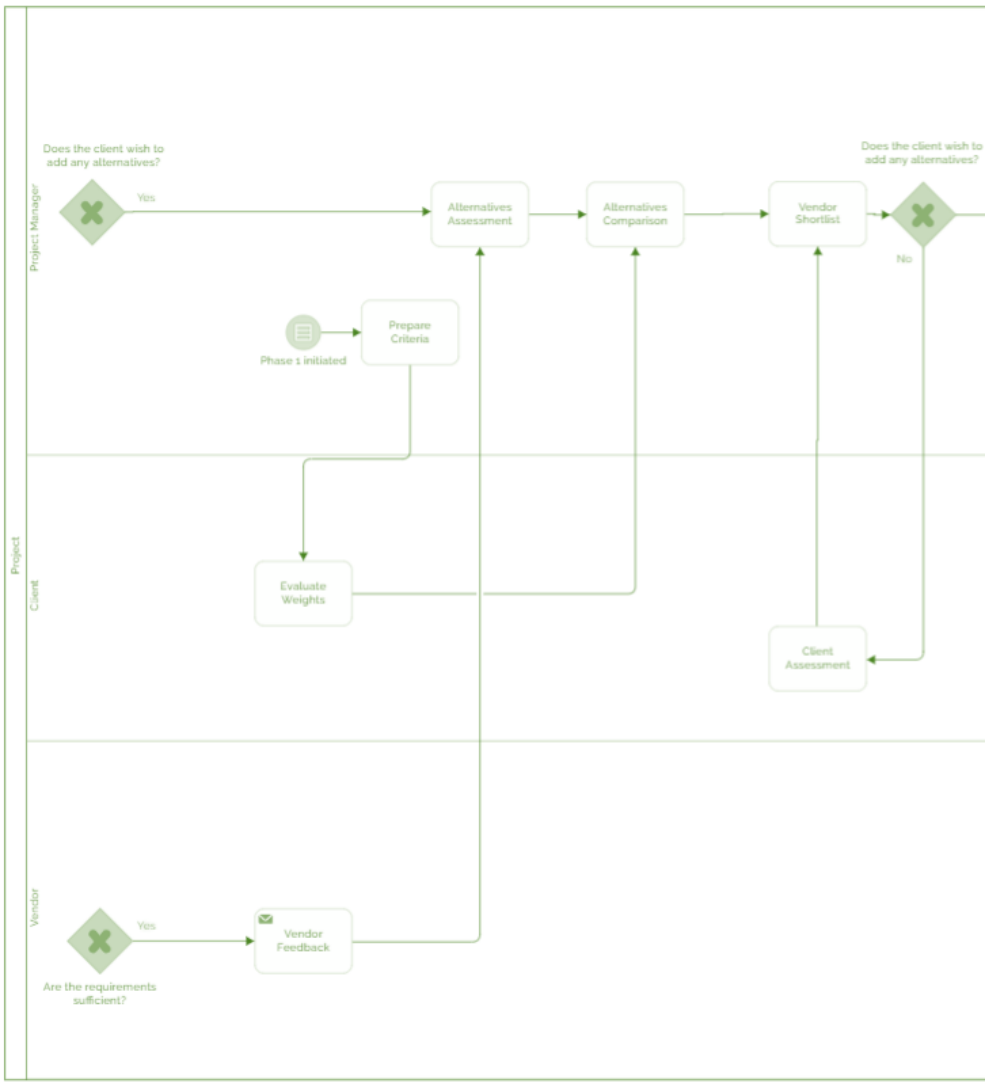

Figure 4.3 – Shortlist Assessment Sub-Plan – Source: (Own Illustration)

4.2.5.1. Vendor Assessment

At this stage (see Figure 4.3), the vendor assessment takes part is a simple manner. Bearing the fact that the collected requirements may still be insufficient, they would still raise prominent questions that only the vendors would be able to answer. Calls maybe schedule between the client/CTS team and some vendors but most likely simple e-mail exchange shall be sufficient at this point.

The meetings have to be heavily documented as the amount of information exchanged between all the stakeholders shall be significant. The requirements gathering process may extend until this stage.

4.2.5.2. Alternatives Assessment

According to the results from the vendor assessment, the project manager in coordination with the client will be able to generate a small list. The small list of vendors will at a higher regard account for the majority of the criteria defined by the client and will feature vendors closely match that same criterion.

Nonetheless, the vendor feedback may be required specially in this stage, as the crucial requirements are already sorted and encompassed by every alternative, there might be a need to resort back to some of the teams and collect non-crucial requirements that may result in meaningful criteria upon the alternatives comparison sub-process.

Cost related questions shall be at this stage asked to the vendors as it deeply impacts the selection of a cloud technology. A cost-benefit analysis assessment as well as other assessments related to costs may be performed on the organizations side and are covered in the literature review section.

4.2.5.1. Alternatives Comparison

The assessment is not yet final and requires an alternatives comparison to better grasp the advantages and disadvantages of each solution. It may turn out to be the lengthiest subprocess of the project as it

The shortlist creation process bears a higher level of participation on behalf of the organization. In this case, the organization will actively aid in generating the criteria as well as evaluate them by weights. The whole process of supporting criteria assessment is the first phase of this types of sub-processes throughout the project.

In this stage, the organization will again have the last say, meaning that if it feels that another vendor should accounted for or not, the project manager has to take that into account before moving on to the next stage. The reasons may differ on why the stakeholders in charge of the project on the organization side may take any option, yet they are the main target of the project bearing a powerful opinion towards the outcome.

4.2.6. Decision Making Model

The project now enters the decision-making stage in which the model shall be applied. The stage is the last main stage, and it will provide the result for the entire project.

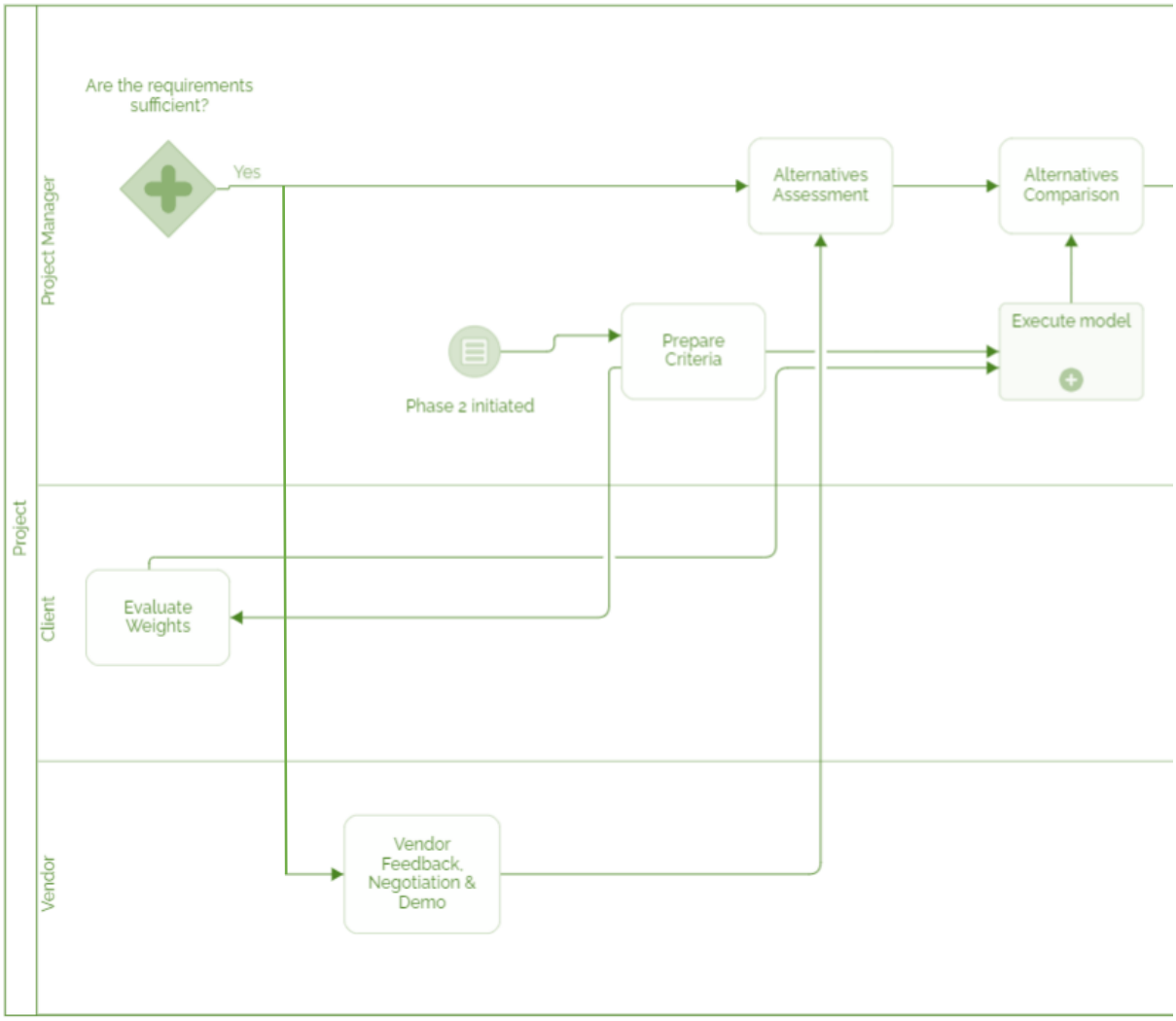

Figure 4.4 – Decision Making Sub Plan – Source: (Own Illustration)

4.2.6.1. Vendor Assessment

This stage (see Figure 4.4) though optional may present itself to be useful if two great contenders match each other almost identically, although highly unlikely. The subprocess is the same as the one described on the shortlist assessment, with the only difference being that when performed at this stage the level of granularity is much higher as the criteria is already clearly defined. This is the stage where the decision-making model will be applied.

4.2.6.2. Alternatives Comparison – Model

In order to define the model, the process will be split into three stages of analysis. These three stages will provide the necessary information to implement the structured model.

Stage 1 – TOE Assessment

The initial stage will make use of the TOE model. With this model, the project manager is able to assess and account the entirety of areas that are influenced by both internal and external factors from the organization. The TOE will provide a high-level overview of the entire organization and the interactions with the environment. It will also look in the technological capabilities present in the organization.

During this moment, the PM will already be able to make use of the structure provided by this framework as he will be able to class all the criterion into types: Technological, Environmental and Organizational. All sets of criteria are guaranteed to fall into one of the three specified types as it is in its core a project related to information technology.

At the very end, the TOE framework is still a qualitative analysis tool and will only serve as a support for the model (Figure 4.5 below).

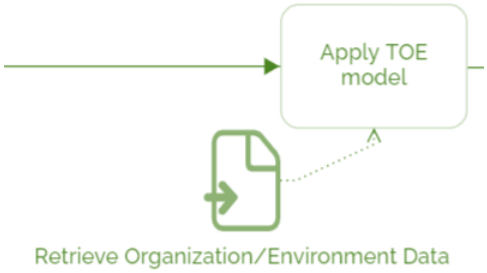

Figure 4.5 – TOE Assessment – Source: (Own Illustration)

Stage 1 – SLA Assessment

The second stage of the analysis will focus on the SLAs, and it is at this stage where the PM will look into the shortlist of vendors and address the capabilities covered in the SLA. A vendor may make its own SLA document publicly available. Otherwise, a request to the vendor is a possible action.

This is still a qualitative assessment, yet it will highly support the calculated model (see Figure 4.6).

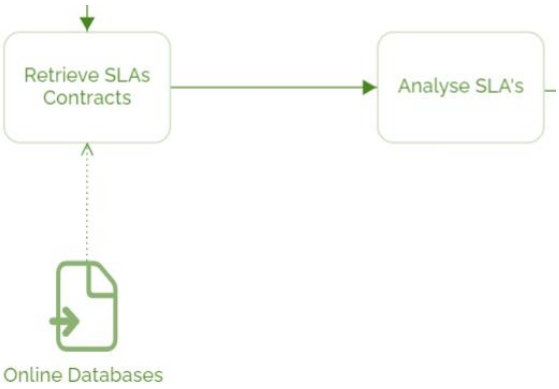

Figure 4.6 – SLAs Assessment – Source: (Own Illustration)

Stage 1 – QoS Assessment

The last stage will look not QoS and more specifically the metrics that surround them. QoS rankings are available throughout multiple sources over the internet (while some may present themselves with a lower accuracy level), some paid while others directly provided by the vendor. These QoS metrics also provide the last layer of qualitative analysis and at a certain stance may be overlooked if the provided information is not sufficient for a further analysis. This third stage is in fact, the most complex to acquire information. Therefore, if the QoS metrics are not obtained for all the vendors, this would prove to be an inadequate assessment level (see Figure 4.7) and may be overlooked (although not recommended).

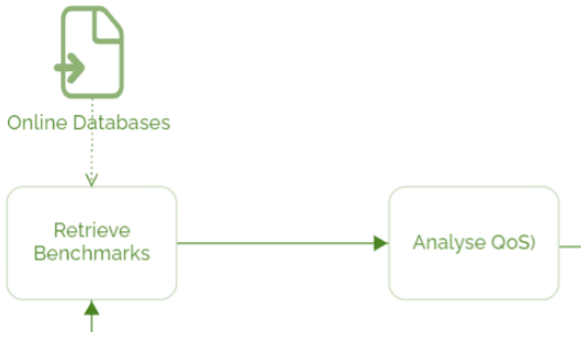

Figure 4.7 – QoS Assessment – Source: (Own Illustration)

All of these assessments will contribute to the main PM's assessment.

Stage 2 – AHP Application

Looking now at the model, several works have verified the application of either AHP or Fuzzy. The conjunction of the two has yet to verify significant work especially on an Information Systems subject. Hence the ultimate realization of this study as it focuses on applying an already existing model into a new environment, being in this case the cloud technology selection process.

To the criteria that was previously established, either by the project manager or by the client organization, we can easily apply the principles of both formulas. We will start by applying the AHP and for that, the criteria that is closely related with each other will be marked at sub-criteria and merged together as solely one criterion.

By using this methodology, it will reduce the impact that several criteria closely related would have in the end result. Using a scale from 1 to 9, previously presented in the literature review (although an adjustment to this scale is possible, while affecting the accuracy in the result), the PM will classify each set of criteria among all vendors.

Averages will be measured on all levels: sub-criteria, criteria, and goal. In that sense, and with the agglutination of similar (perhaps even identical) sub-criteria, the average will present a highly equitable level.

As we will be speaking of different criterion form distinct functional areas, services, technologies, etc. with different desired impacts, the classification influence may have to be more significant in some cases then others. Therefore, a weighted system may be used, bringing more granularity in between the steps (see Figure 4.8).

Stage 3 – Fuzzy Sets Application

The PM will lastly recur to the fuzzy sets. This method will help us address the uncertainty around the outcome. This is massively important to equate the level of accuracy of all the predispositions assessed during the assessment stages. Some of the criteria may in the end, at eyes of the PM or the client organization, appear to not display an accurate reflection of an organization parameter. To counter this, all the criteria is classified between a 0 to 1 scale, where 1 represents "Totally true" and 0 "Totally false". All the values in between are measured as partially true, as stated in the literature review.

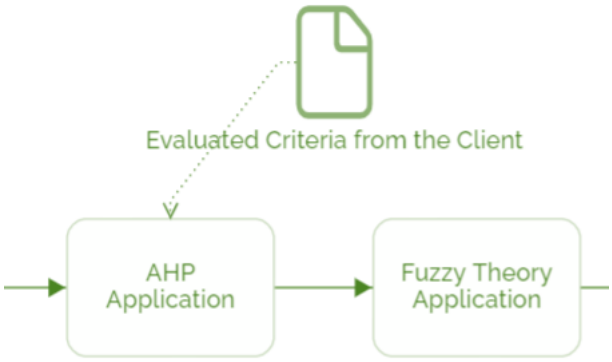

Figure 4.8 – AHP and Fuzzy Sets Assessment – Source: (Own Illustration)

In the end (see Figure 4.9), the PM will be faced with a classification for all the vendors aiding in the assessment of which one would better suit the client organization needs. The value for each vendor represents the outcome of several of assessments throughout the project stage and it drastically supports the decision on behalf of all the stakeholders.

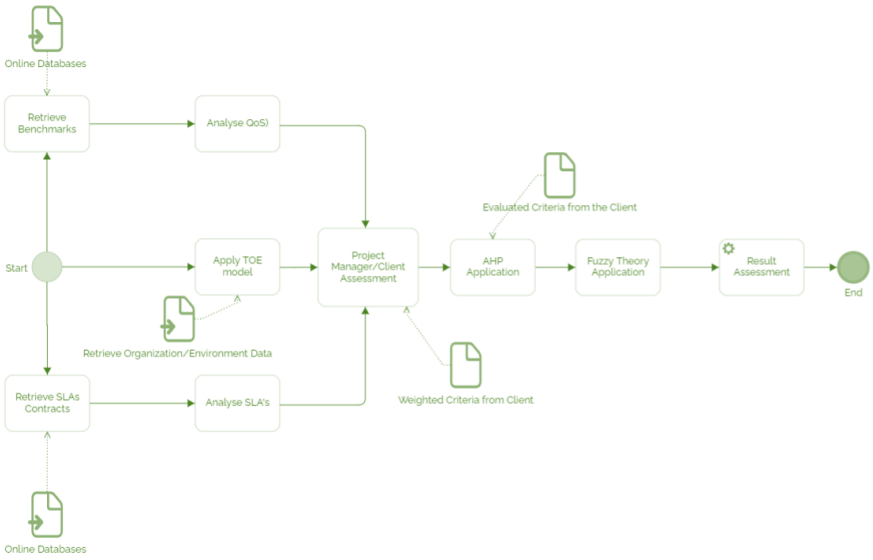

Figure 4.9 – Decision-Making Model – Source: (Own Illustration)

4.2.7. Report Results

Figure 4.10 – Report Results Sub-Plan – Source: (Own Illustration)

The objective of this phase (see Figure 4.10) is the delivery of the final product to the customer, with the consolidation of project documentation and demobilization of the work team. In the closing phase of the project, the "autopsy" of the entire process and the relevant events recorded during the development of the project must be carried out.

The project manager must analyze, together with the team, everything that went well and everything that could be improved, in order to repeat the successes and correct the mistakes during the next project, whether they sit as external consultants or on the organization's side. The end of the project is accompanied by the generation of the "Lessons Learned Document", which will be the basis for improving the processes of the team, the project manager, and the organization.

Many project managers tend to go straight through this final step. However, the closure of the project is as important as the initiation, after all, without taking care of the final delivery and closing of the contracts (i.e., if the PM works as an external consultant for the project), simple mistakes can happen and end up wasting the work undertaken in the execution.

Therefore, it is recommended that in the closing stage, a formal delivery of the solution/decision to the customer is included, the termination of contracts (such as equipment leasing and professional outsourcing, for instance for external consultants), the holding of post-project meetings to give feedbacks and analyze the positive and negative aspects, as well as the sum of lessons learned in the knowledge base for future projects.

If a project template has been tested and approved, it can be stored by the project manager to be applied to a future project, or at least to serve as a basis for it. This practice favors the optimization of time and makes planning more practical, in addition to reducing the risk of something going wrong.

Project Performance Analysis

Before decreeing the end of the project, the project manager must evaluate the list of project objectives and map those that, perhaps, have not been met. If these exist, it will be necessary to promote alignment with the stakeholders, presenting the reasons that made it unfeasible the achievement of these goals.

In addition, the project manager should be responsible for developing the global comparative analysis between what was planned and what was done, in terms of scope, deadline, costs and quality, generating as a product the mapping of all aspects that culminated in the detachment of these curves.

Feedback

Conduct the closing and process feedback meeting. At this stage, the project manager will be able to map all the positive and negative aspects behind the development of the project, promoting personal and professional aggrandizement for the improvement of the next works.

Project Closure

In the project closing stage, the team demobilization plan must be executed. After the project closure, project may have its resources reassigned, as well as team assessments drawn up. It is a particular tradition for project managers to hold an official closing meeting.

Documentation

The last stage of a project's life cycle foresees that all documents generated during development will be archived and the project is concluded with the release of the “Lessons Learned Document”. This last document presents a mapping of the main events, positive and negative, registered throughout the process and serves as a basis for the continuous improvement of the organization and all those involved in the process.

4.3. USE CASE

Due to the lack of time, the use case would present itself as a theoretical case study scenario. It is based on a real case scenario of a cloud technology selection process, yet the application of the present framework would require an enormous timeframe which is not attainable for the current's project schedule.

4.3.1. Background

The Organization X — a highly diversified healthcare services and listed organization — is to this date a very successful organization in its sector. In the early 2000's, they implemented an expansion plan aimed at acquiring participations worldwide and grow the company beyond its national borders. The company was founded in the 1960's in Australia and to this date, they have revenues of around 9 billion USD.

For this case study, the focus will be on an ERP implementation, more specifically a HCM focused ERP, for an organization that operates worldwide in 12 countries. The organization X is what the reader may consider a large firm, with around 23 thousand workers spread around their global dependencies, with a fast pace of growth, having double the headcount in just 8 years of operation.

4.3.2. Challenges

Organization X also makes use of different HCM systems which nowadays are considered mostly as legacy (on premise, lack of integrations, etc..) and to which the lack of maintenance has resulted in many processes simply not being mapped in the system but rather being processed manually with resorts to e-mail or Excel.

The usage of different HCM systems across their countries of operation also proves to be extremely inefficient, has data has to be processed with an unreasonable number of steps for a common day business operation. This makes it hard for them to obtain meaningful analytics and the insights that it may translate into.

In the end, the lack of supported integrations with other services turns this change into a crucial one, as to maintain the system alive, the organization relies mainly on a diverse set of teams of outsourced experts while the intention is to create an in-house team which would deal with this sort of issues.

4.3.3. Process

A project of this sides will definitely require a high-quality software provider and as the selection may get trickier due to the intricacies of the system, the company has decided to contract a PM in order to aid and guide the process throughout the many selection stages.

As the initiation phase begins, so does all the planning for the entire project. Meetings are scheduled between the PM and the team which will operate this process on behalf of the organization. The

current team is situated in the headquarters, and it will be the link between not only the other technology teams spread around the countries in operation but also the other stakeholders which will be impacted by this change.

The initiation phase is remarkably important. It is the framework defining stage meaning that it will provide the foundations for a well performed project. Just as Sun Tzu says “Every battle is won before it’s ever fought” so are the preparations that lead towards the start of the battle, or in this case, the selection process.

Though this thesis does not reference a specified criteria for time scheduling other than acknowledging its need, it still bears a significant importance as resources such as human, financial, and especially time (which may reflect financially) are scarce and have a huge impact on the project outcome.

As the initiation stage progresses and leads on the last step of framework definition, all the details are settled and adjusted to the current organization’s profile. The requirements collection stage is a step of steps that aim to attain most of the requirements from the current organization environment. The PM starts off by solely obtaining the most significant ones. With this approach, it saves time as few meetings are for now required.

In this case, the team assigned by the organization to deal with the process on their assigned has already envisioned and capture the main requirements. As the level of complexity faced in the Vendor Longlist stage is still low, these few requirements may turn out to be sufficient to remove any ERP vendor’s software that do not closely match them. Where the goals were once blurred, they start to appear clearer now.

The client will always have the final word regarding the advancement of the process to the next stage. Only if organization X is satisfied with all the alternatives as well as the answers provided by the vendors, will the project manager be allowed to proceed. The next stage is the Vendor Shortlist which picks up on some traits from its preceding longlist assessment stage while carrying way more the amount of work required.

At his stage, the organization X, the team in charge of the selection and the other stakeholders will actively participate in this sort of filtering process. Many more meetings may be scheduled, as the need to entirely capture all the organization areas of operations becomes required. A single requirement may be sufficient to eliminate the options of at least 40% of the proposed longlist.

Therefore, the requirements stage will extend itself up to this stage. Organization X must have by now mapped 99% of the requirements. The remaining 1% are requirements that might rise up in the following stages but may present to be insignificant and simply impossible or rather unnecessary to leverage at this point.

The PM is also keen at this point to work out with the organization’s team which are the main requirements which have a higher impact on the daily operations and which ones are simply niche, grading them adequately. In the real-life scenario, the company did in fact prologue the Requirements Gathering stage up to the decision-making stage. This however should be avoided as a lengthy Requirements Gathering process may result to be counterproductive.

The process has now attained a small list of vendors as the outcome of the Vendor Shortlist stage. The small list, no greater than 3/4 alternatives must already have capture all the requirements by now and due to start the decision-making process with the application of the subsequent model. Alongside the application of this model, vendor demonstration may and should be scheduled so that the client can experience hands on whether this ultimately would be the best solution for them.

Nonetheless, the decision-making model is applied with some support from the organization, while at the same time it is configurated and adjusted by the project manager. The outcome of this model will rank the solutions according to the feedback provided by the organization and the known theoretical solutions. At this stage, organization X has all the tools to take a decision, meaning that just because there is a best ranked solution from the model, this may ultimately not be the one to be used by the organization. The decision-making model translates into a support for decision making rather than the decision itself.

Lastly, and upon a decision, the project closure kicks in. This is of extreme importance to the project manager has it helps on assessing what went wrong and right as well it allowed him to prepare any sorts of document and tools that can be used in different projects of the same sort. With the decision now made, the organization can start with the talks on the implementation perspective of the desired vendor offer.

4.4. Evaluation and Discussion

4.4.1. Evaluation

The evaluation will constitute on an interview process with the participation of three members who have closely worked on cloud technology selection projects. The individuals that were interviewed can be found in Table 4.1.

#	Field of Employment	Area of Expertise	Domain	Interview Date
I1	Implementing a HCM system in a global healthcare organization	Manager @ Accenture	Industry	09/06/2021
I2	Implementing a HCM system in a global transport organization	Partner @ CloudRock Partners	Industry	15/06/2021
I3	Implementing a financials system in a banking organization	IT Consultant @ Oracle	Industry	26/05/2021

Table 4.1 – Interviewees for the subsequent evaluation and discussion stages

The organizations to whom this framework and the subsequent model were applied, were in fact applied in a side-by-side process, meaning that it would actually try to emulate an actual scenario. Yet, as its direct application did not occur, the level of accuracy can only be assessed, as stated before, in a theoretical format. The three posted questions were:

- Q1: Did the proposed framework clearly define the stages of the entire process?
- Q2: What improvements as well as criticism would you suggest?
- Q3: Would you be open implement the proposed framework?

The interviews were conducted in order to provide the required validation of the previously suggested selection framework. This qualitative methodology aims at filling the research gaps on this subject, which scientific research has yet to address due to the intricacies of said type of process. The reader must consider that the proposed approach is still classified as being in an early stage of development. Therefore, there is some ambiguity in the literature regarding profound guidelines that can be applied for selection of cloud technologies for organizations, translating in the reduced number of studies performed on this subject. The case study was also shared previously to the interviews.

The interviews were conducted with each listed expert on an individual basis. All agreed on being recorded providing a platform for transcription. The interviews were conducted between May and June 2021.

Q1: Did the proposed framework clearly define the stages of the entire process?

I1: By taking part on several projects throughout my professional career, I was faced with an enormous set of challenges, which differed from project to project. Nonetheless, an underlying structure was

applied to all of them which led me through the many stages of this type of process. Although, there was a pre-established sequence, said sequence would significantly differ from an organization to another one.

The framework that you have presented proves to be very useful. There's a core sequence of steps that should be taken in order to effectively assess the businesses environment which, in its essence, doesn't really differ from any other sort of project. The stages establishment clearly defines from an over-the-top view of what we usually encounter.

I2: This sort of projects, while from an outside view, it may seem as rather linear, the reality of the matter is that they prove to be rather complex. The bigger the business, the bigger the complexity. Other than that, there are several variables that I have to verify when analyzing a business and the application of those variables might not follow a specific sequence. I have witnessed how a project tends to deviate from its originally course in a matter of days.

While having a well-thought structured is indeed welcomed, in reality, a framework cannot be too specific as it may end up being solely applied to a niche. The goal is to encompass a broader number of types of organizations, as well as technologies, environments, etc. Your proposal does take in account a broad approach not going much into detail. I can reflect on my previous projects that several of them did in fact follow a similar structure, minus one step or two.

Indeed, I understand that this is hard to capture, yet your framework does provide some sort of path that, though similar frameworks are applied every day throughout mine and any other projects, they follow the notions of project management and expertise rather than an already well-defined plan for this sort of processes.

I3: These types of processes and the knowledge that go around them tend to stick as a consultancy firm's secret. That is why I would agree that you won't that much information online. I haven't gone through any papers or expert publishments on the matter, yet the knowledge that I have comes from years and years of performing the same process and achieving a great customer satisfaction value.

I would say that if you look into this type of process with a broad view you are able to capture everything. With that said, don't go in too deep as these selection processes greatly differ on from another. Currently, I can tell that you have defined the stages as I mostly would, with some changes here and there, but with a good sequence in place.

I do find it useful, yet I have some suggestions to make. As long as you have these three main stages in scope: requirements collection, assessment, and decision making, it encompasses everything. In fact, if this knowledge can easily be accessible to the client, it would make my life a lot easier.

Q2: What improvements as well as criticism would you suggest?

I1: A minor criticism I could perceive was that the framework tends to be a bit too broad. So, I would really break it down a bit more. For instance, the requirement gathering should further be detailed. It is such a big part of the process and also one of the most, if not the most, important.

This case study does capture a theoretical application of the process. Still, you need to apply it in some sort to a real case scenario otherwise you won't be able to fully test it. I would also look towards the capture of uncertainty. What I mean by that, is that sometimes the client, after reviewing the presented requirement, might not feel too confident on the established criteria.

Your decision-making model should take that into account thus allowing them to perceive some criteria as well defined and some other as a lack of some or even full dept as well as assurance.

I2: Though timeframes are hard to assess, as they vary from client to client, a sort of percentages spent on each stage could serve the purpose. The tendency is to spend a lot of time on the requirements gathering process, especially if we are having meetings with almost every single entity within a firm in comparison with the longlist or shortlist.

The case study that you've sent me fully implements this framework. I think it has detailed how each stage of the process impacts the end result. Nonetheless, you will need to implement this in reality in order to perceive which parts are well adjusted and which ones might need some improvements.

Though I have mentioned that this sort of frameworks cannot be to specialize, you may want to prepare a subset of processes specific to selects fields, say for instance, the selection of a procurement ERP vs HCM. This may, however, pursued later on in the future, as there is not any relevant information available online.

I3: At a first glance, you're making use of models that have existed for some time now. Though they are not of easy application, they turn out to be from an eventual use of a specific sort of software, mainly during the decision-making process. In regard to the project management part, I'm sure you are well aware of the different tools we have at our disposal to assess and measure any project.

A small critic is that, given that we are looking into a surprisingly changing world especially in cloud technology itself, this model may indeed end up having to be reviewed from time to time to adjust to a possible new reality. A good example is that for the past 2 years I worked on several projects of this nature. Two of them were applied to organizations with similar characteristics. For instance, similar size, same sector, same environment. Nonetheless, the offers that we have faced from vendors and the technology that they presented has significantly changed in those two years.

What might have seemed like the rightful choice for the first client, did not even make into the short list of the second client, not because it didn't encompass similar business areas within the second client's organization but mostly because the vendors faced such a major shift on their offers, and by shift, I mean improvement, that the previous option was no longer the best one by far.

Only by implementing this project, you would be able to understand the nature of an organization and if this model/framework does in fact perform as intended.

Q3: Would you be open implement the proposed framework?

I1: As your focus is not solely on us (project managers) but also the client, I think that this is a welcoming project. If it enables any client to easily understand each stage of the project beforehand,

it will turn out to be a great deal for us. It will save a lot of effort and time, which we usually tend to lack.

I would not only implement this as I would also send it to my clients in case, they had some doubts. Make sure to implement the suggestions that I've given you as I feel that a few tweaks here and there and this can be useful. As long as you can capture the process in a broaden sense, this can even be adjusted and applied for other types of non-cloud technologies.

I2: I would apply this framework. Client wise, I would still have to make some adaptations for a specific client, but overall, it does cover the entire selection process and I do like you model for decision making. The solution for any cloud technology will always face enormous challenges, especially if the company is moving on from a legacy system into a cloud one.

But the same can also be applied from a cloud to a cloud system. Look at Workday's failure to implement its ERP in Amazon and how it has impacted its reputation. This is a cooperative task not only between me and the client but also between the vendors because, in the end, if something does not work out, the vendors reputation may be tarnished. The word to mouth is strong within our business.

I3: I would definitely consider implementing the outlined proposed framework for the selection of a cloud technology provider. Yet I would extend it, as said, with the mentioned dimensions and additional suggestions. With the intention of verifying said framework, at least some of the stages can indeed be implemented with relative ease.

The decision-making model that you have presented does seem concise although it may also prove to be complex. Hence, the creation of a software tool would mostly be welcomed, even if it solely tackled the decision-making stage.

Nonetheless, looking into a customer centric perspective, the goal is to always have a structure that would work for every client, regardless of which requirements, beliefs, or organization structure it may present. Nowadays, though technologies change fast, the process to select stays the same, with some minor improvements here and there, but nothing that would translate into a revolution in a way of thinking.

While it is a framework that I would wish to apply, the final say regarding a full implementation of such will always remain within the client. The plans are always fitted with the client's expectations in mind.

4.4.2. Discussion

All interviewees have contributed to the further development and analysis of the precedent framework. With an extensive knowledge of projects of this sort, their contribution was highly valuable. The purpose of the interviews is to understand the true level of use of cloud selection framework, in relation to what was investigated during the literature review and assumptions. The interview was focused on three areas:

- Utility of the framework
- Improvements and criticism to the framework

- Application of the framework

During this stage, three analyses were performed, regarding utility, viability of implementation and improvements based on the answers from evaluation stage. They are all based on the appliance of the given framework on a case study scenario and the interviewees own professional experience. In the end, a general evaluation to the proposed framework was performed based on the previous performed analysis.

Thus, with respect to the proposed conceptual framework and with regard to the utility of it, the three participants of the interviews agreed that the proposed model is, indeed, very useful. It was considered by all participants as a structured mean to analyze the entire selection process, providing the necessary guidance for each stage of the project. The idea that one size fits all came as an over-the-top view, yet the model helped to analyze in a more minacious way, adjusting each stage to a specific criterion.

Also, and still regarding the utility of the proposed model it was a shared idea that this could be amazing, specially, as a way to provide knowledge, as well as transparency for the client (the organization in this case) on the entire process. This knowledge shall result in a higher level of participation from all the stakeholders throughout the course of the project, as each one of them may now get a clearer idea on the different courses that the project may take on.

The path itself was presented in a meaningful manner and adapted to the reality of most selection processes. The same may be stated about the decision-making model which was detailed yet clear enough for companies to easily understand and implement in their selection models or simply in their means of analysis. The current model does, in fact, make use of well-known and tested models and combines them, thus resulting in a model that captures the best of all models, while at the same time presenting them in a clear-cut display.

Upon reviewing the observations on what was, in reality, proposed and an evaluation of the viability level of this endeavor, the major focused of the discussion was on adaptability of this process to an ever-expanding sort of organization backgrounds. In other terms, how easily can this path/model be adapted to account for the multitude of organizations (and its adjacent criteria, background, environment, etc.). The proposed framework tries to capture with detail the current process, yet in a fast-pacing world where the organizations change so fast there is a need to continuously capture the current organization in study and itself may undergo significant changes throughout the process.

This gap should be accounted for throughout the course of the process as minimizing its influence may results in a significant impact on the decision. Nonetheless, another observation that was addressed was that there is a multitude of decision-making models that can also be applied in a specific situation, ones with greater accuracy than others.

Yet, the application of two or more models may contribute to increase the accuracy of the final decision as a decision relies on every assessment on all levels. This gap must indeed be evaluated and improved even before the starting of the implementation of the framework, as a later appliance may influence the success of the decision.

Another positive point lays on the fact that the model can be applied to a massive set of cloud technologies. This way, whether the organization is looking to deploy an infrastructure or a software, the model can be applied to all deployment models related with cloud technologies. To conclude, it

was considered viable the proposed framework as it would contribute to define a step-by-step definition for each stage and the means to execute it.

As criticism and suggestions for improvement, all participants agreed that it would only be possible to evaluate the framework with a practical application of the proposed framework and tests around it. Therefore, in a broaden overview, the proposed framework fulfills the needs of the project manager when addressing a process of this magnitude.

As it details every step for each stage, it enables an easy structure for the project. It is, however, understood that there is a need to study the practicality in a real-life scenario, thus testing the adaptability of the given framework.

Lastly, given the broad range of scenarios that the model might face the challenge of assessing a time fixed project time schedule is not feasible. The sole purpose of providing of defining timeframes for each stage would result to be unfruitful as the current model aims to tackle different sets of organizations. It was stated that an organization the size of a small coffee shop would not endure the same length in the requirement gatherings stage as a national utility company.

4.4.3. Revised Framework for Implementation

The basis for the revised model is provided by the previously conducted expert interviews. As the composition of the interviewees proved to be heterogenous enough and due to the generic first version of the model (draft), a great number of diverse points of criticism could be attained. Despite the discrepancies in expertise, the constructive discussion above culminated in successive improvements being performed within the framework that was originally proposed.

Looking into the first stage (Initiation Stage), further detail was requested by the interviewees as the previously presented information did not capture the complexity of the process at this stage. This change responds to the criticism of the experts and addresses the importance of the business requirements and their influence on the precise framework definition.

Furthermore, adjustments were performed with regards to the importance of the requirement gathering matter. A further detailed explanation was presented, which looks into particular methods of requirements gathering and the quality of data of those methods. Lastly, a secondary decision-making method was established to look for uncertainties in business requirements (Fuzzy-set method).

5. CONCLUSION

In order to effectively conclude this work, it is crucial to begin by mentioning that the previously defined objectives were attained. By the implementation and utilization of the proposed model and according to what was the feedback gathered at the validation stage, organizations tend to greatly benefit from the implementation of this steps as well as the underlined decision-making model.

5.1. SYNTHESIS OF THE DEVELOPMENT WORK

Throughout this work subjects like decision making, cloud technology selection and project management were analyzed as a starting point to be able to construct a framework that was afterwards validated by a case study scenario based on an organization that was pursuing a decision on a cloud technology service (SaaS).

5.2. LIMITATIONS

Unfortunately, it is important to state that the main limitation of this endeavor was the fact that the validation of the proposed framework only involved a single CTS process for a specific organization. As time was a scarce resource there was a need to further implement this framework on another project of another organization which could not be accomplished on time.

Another limitation of this work was the fact that the communication phase, which was scheduled recurring to the DSR methodology, could not be carried out in the scope of this master's thesis given the short period of time spent to execute this master's thesis. Because of this fact, it was not possible, by all means, to incorporate a practical application of this framework in the scope of this master's thesis.

5.3. FUTURE WORK

Unfortunately, as it was detailed in the previous section it was not feasible to encompass all the subjects considered relevant to this master's thesis in appropriate time to be included in the proposed framework. Stating this and in line with what was concluded after the validation process, it is considered crucial to study distinct stakeholders and how this knowledge could be used to enhance the communication phase of the proposed framework, as it was considered crucial to enhance the means of communication considered in the proposed framework.

Likewise, it was deliberated as fundamental, after validating the framework, that further applicability testing on distinct organization's settings is needed. As one of the limitations was the fact that it was not possible to validate this framework by practical application, it was considered that it should be done in the future in order to improve it based on a practical application in a real-life scenario.

Lastly, a consideration for future work on this subject of cloud technology selection, it is considered important to evaluate the option to improve the proposed framework by implemented some sort of

automated software, thus relinquished the need for a drain of resources, both human and financial on tasks that can be performed by a single piece of software. Therefore, not only can the entire process be easily captured as well as it could aid consultancy firms to clearly apply the same standards on any other projects of the same sort. Such software is at this point non-existing.

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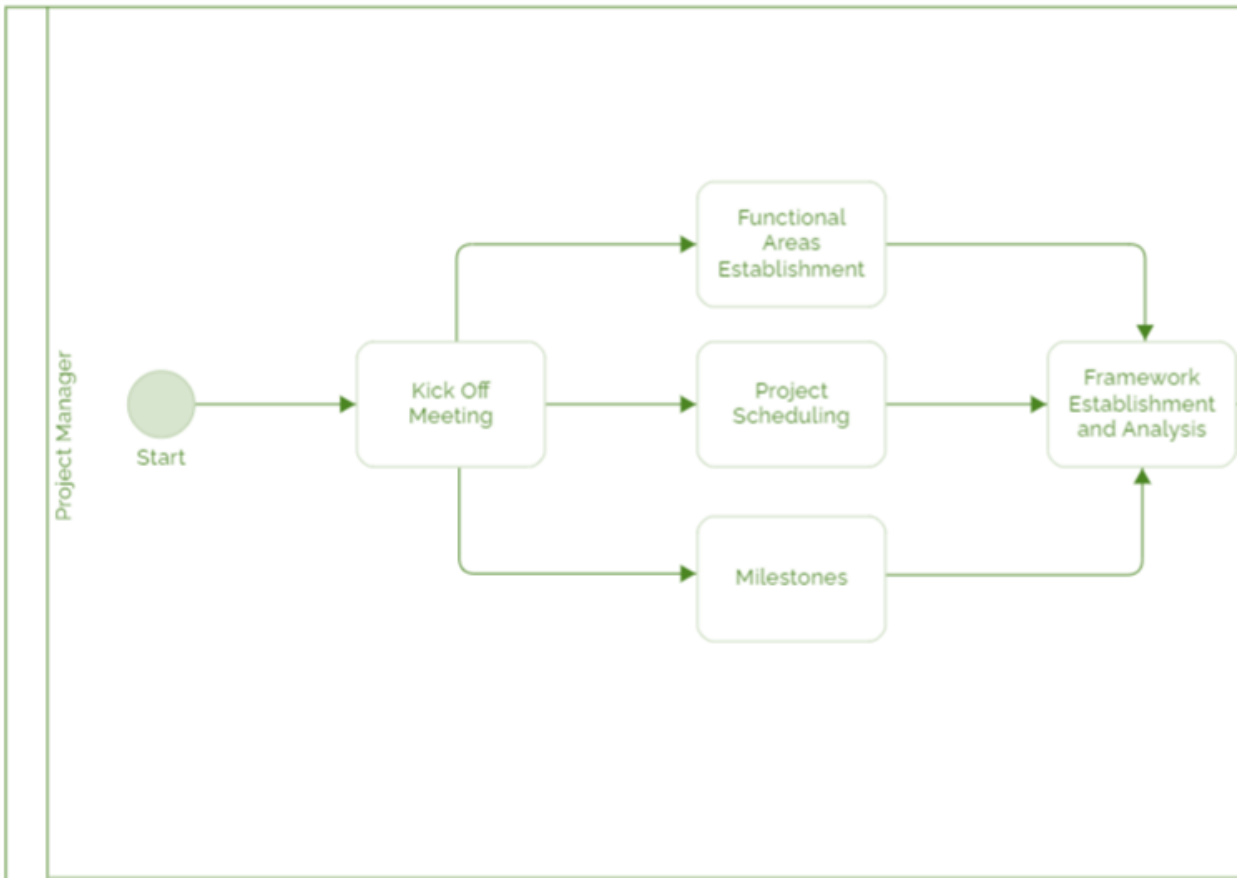
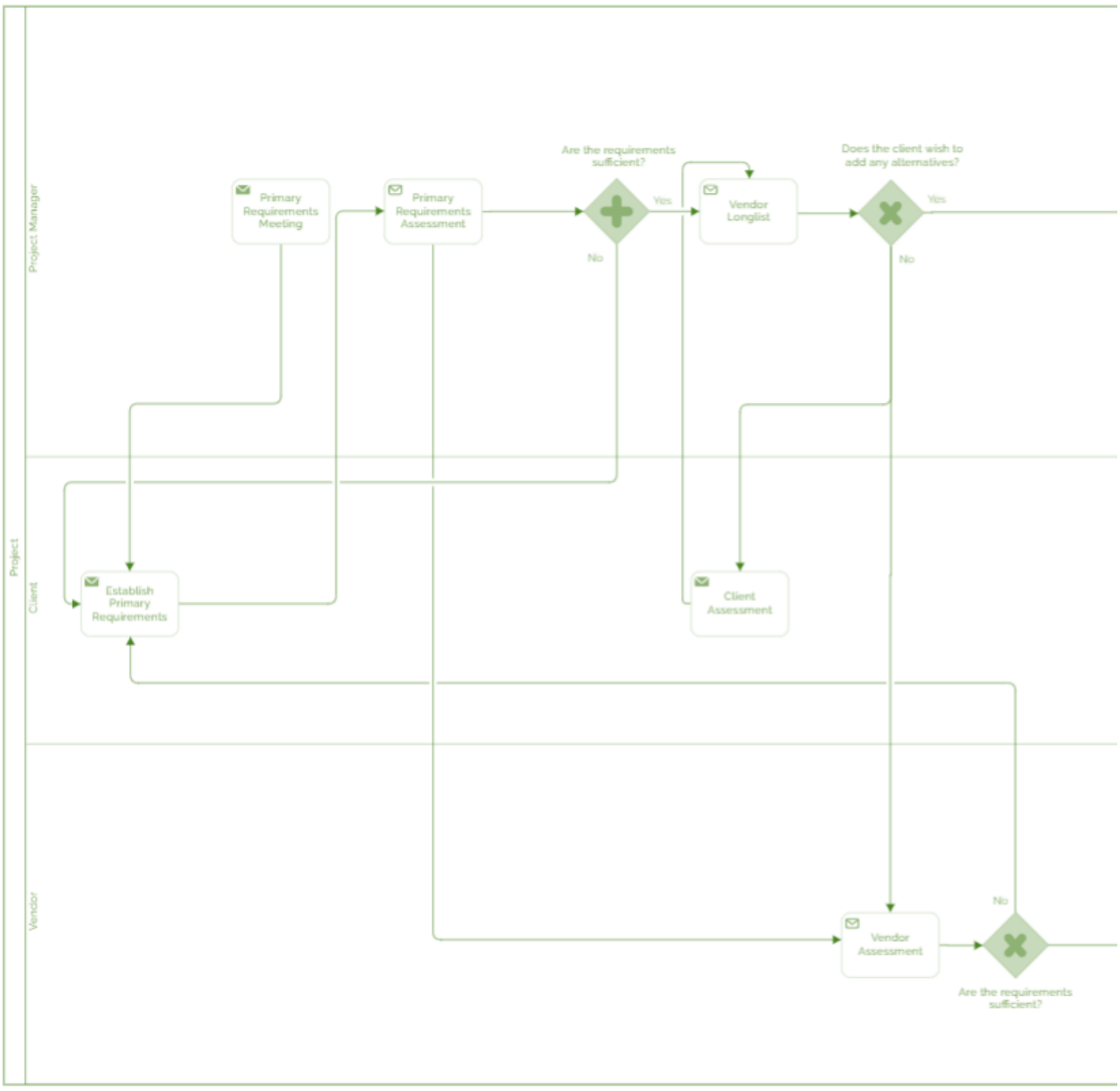
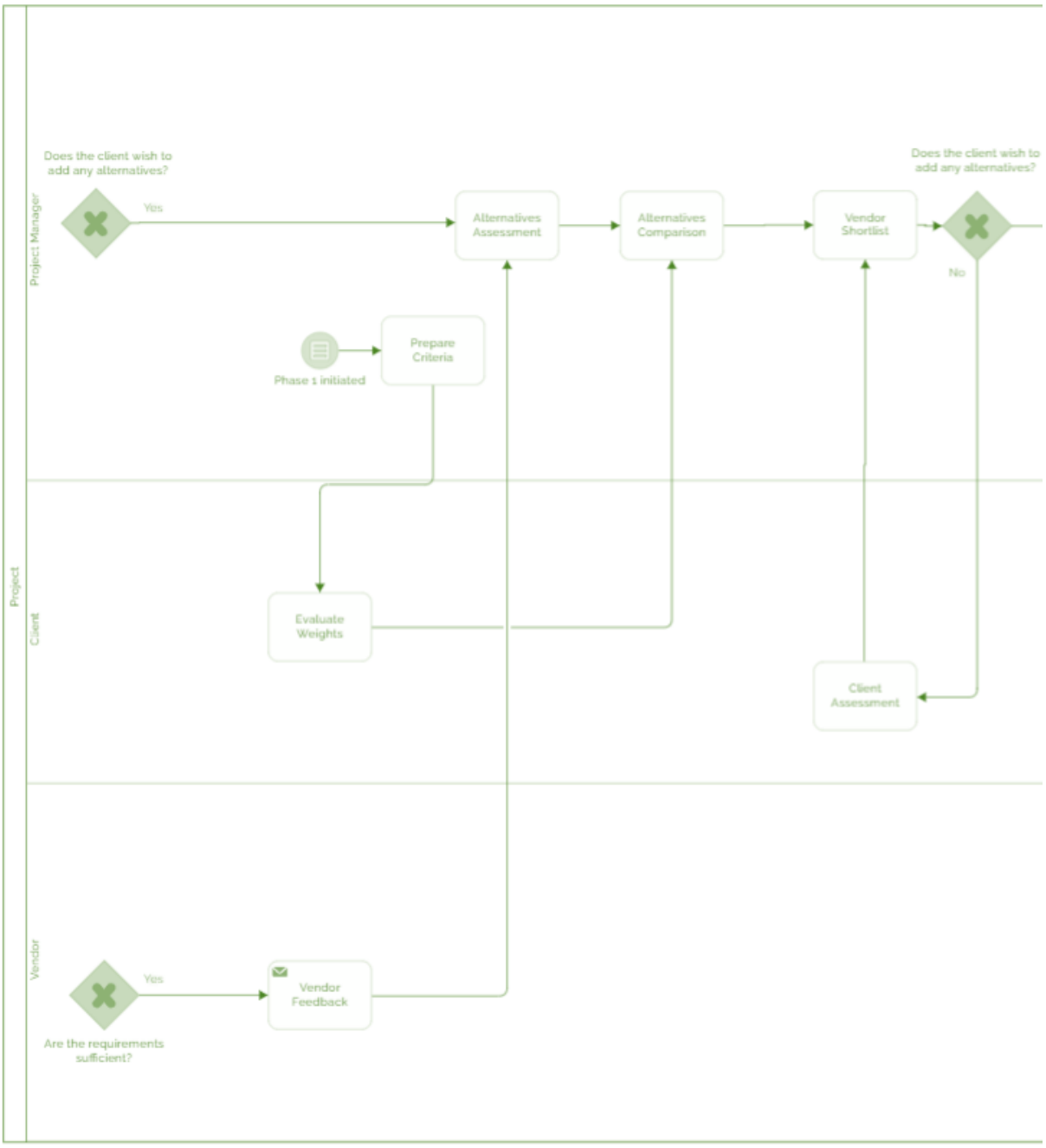
ANNEXES



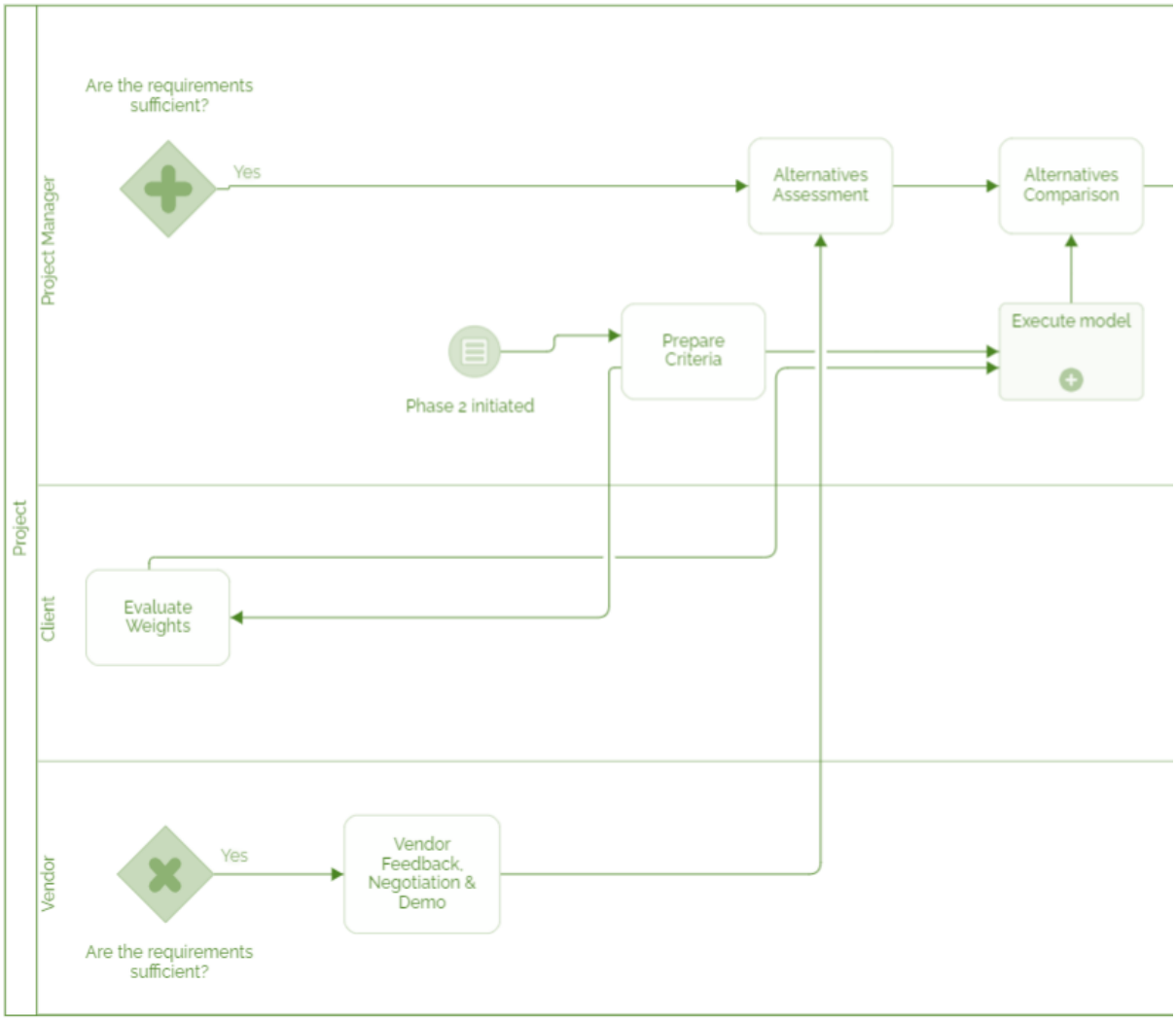
Annex 1 - Initiation Phase Sub-Plan – Source: (Own Illustration)



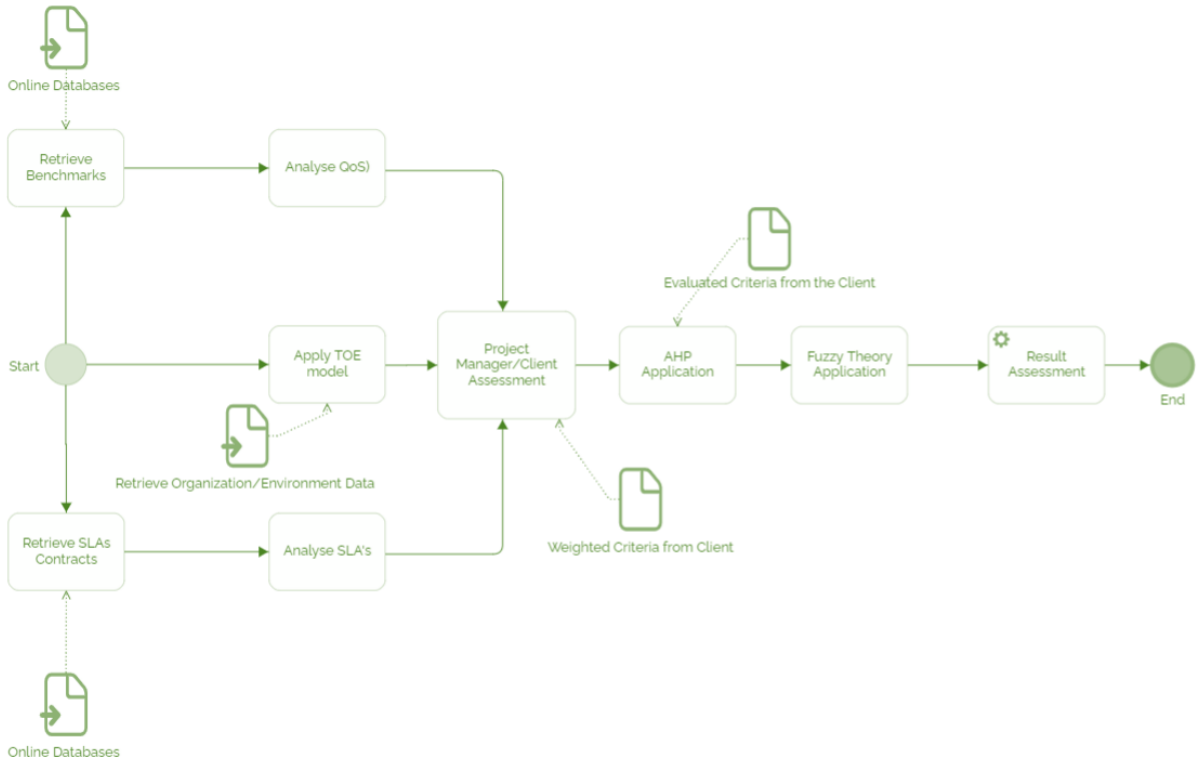
Annex 2 - Requirements Gathering and Longlist Assessment Sub-Plans – Source: (Own Illustration)



Annex 3 – Shortlist Assessment Sub-Plan – Source: (Own Illustration)



Annex 4 – Decision Making Sub Plan – Source: (Own Illustration)



Annex 5 – Decision Making Model – Source: (Own Illustration)