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An improved Architecture for a Telecommunications Organization Information Systems

As is – To be

Lizeth Geraldina Nakulua Bastos

Project Work

presented as partial requirement for obtaining the Master's Degree Program in Information Management

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

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AN IMPROVED ARCHITECTURE FOR A TELECOMMUNICATIONS ORGANIZATION INFORMATION SYSTEM

By

Lizeth Bastos

Project Work presented as partial requirement for obtaining the master's degree in information management, with a specialization in Information Systems and Technologies Management.

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11 2023

STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledge the Rules of Conduct and Code of Honor from the NOVA Information Management School.

Lizeth Bastos

Lisbon, November 23rd, 2023

DEDICATION

This thesis is dedicated to my mother Verónica Nakulua and sister Luzolo Ricardo, whose unwavering belief in my abilities has been a constant source of strength and motivation throughout this academic year. Your encouragement, support, and sacrifices have been the cornerstone of my success.

I also dedicate this work to dearest friend Virgínia Dias, whose inspiration, guidance, and presence have played a significant role in shaping my academic journey. Your influence has been invaluable, and I am profoundly grateful for your impact on my life.

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I am indebted to the company I work, for the trust and for allowing me to dig into their internal information systems infrastructure to develop this project. Their camaraderie and acceptance were indispensable for me to be able to elaborate this project.

My deepest gratitude goes to my family for their unwavering love, understanding, and continuous encouragement. Their unwavering support has been the pillar upon which I built this academic pursuit.

Finally, I extend my sincere thanks to all individuals who, directly or indirectly, contributed to the completion of this project. Your contributions, whether big or small, have been immensely valuable.

ABSTRACT

This project endeavors to overhaul and modernize the information systems architecture of “The Organization” to address existing limitations and capitalize on emerging technological advancements. In an era of rapid digital transformation, the current architecture of “The Organization” faces challenges in scalability, integration, and adaptability to dynamic business needs.

The project methodology involves a comprehensive assessment of the existing information systems, including business, process, information, application and technology architectures. This assessment phase aims to identify bottlenecks, inefficiencies, and areas where the current architecture falls short of meeting organizational objectives.

Following the assessment, a strategic, transformation plan is formulated to redesign the information systems architecture. This plan incorporates cutting-edge technologies, such as cloud computing, middleware and API-driven integration. The proposed redesigned architecture aims to foster a more agile, scalable, integrated and secure IT environment capable of accommodating future growth and technological advancements.

In the transformation plan a careful attention is paid to minimize disruptions to ongoing operations due to the lack of centralized information by proposing a new integrated information systems architecture. A phased roadmap approach with all the information system opportunities including the priorities that need to be taken into account during the execution is adopted to ensure a smooth transition from the legacy systems to the new architecture. Rigorous testing, training programs, and change management strategies must be implemented within the company to ensure a successful adoption by all stakeholders.

The anticipated outcomes of this project include company’s efficiency, collaboration, agility, and data-driven decision making by enabling “The Organization” to optimize its processes, drive innovation, and gain a competitive edge in the market.

By addressing the inherent challenges of the current information systems architecture, this project contributes to the advancement of technological infrastructure, paving the way for more agile, secure, and efficient systems that are primed to support the evolving needs of contemporary enterprises.

KEYWORDS

Information Systems Architecture, Digital Transformation, Scalability, Security, Cloud Computing, Organizational Efficiency, Information Centralization

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LIST OF ABBREVIATIONS AND ACRONYMS

AS	Applicational System
EA	Enterprise Architecture
ERP	Enterprise Resource Planning
BPMN	Business Process Management Notation
CTO	Chief Technical Officer
CRM	Customer Relationship Management
ISA	Information System Architecture
ISO	Information Systems Opportunities
IPTV	Internet Protocol Television
IT	Information Technology
MS	Microsoft
SI	Systems Information
RQ	Research Question
RO	Research Objectives
PTO	Public Telecom Operator

1. INTRODUCTION

1.1. BACKGROUND PROBLEM IDENTIFICATION

Organizations since the latest 1983 until today have recognized information as an asset once it represents a strategic value for the company itself (Inmon et al., 1997).

However, the way information and knowledge are created through and from existing systems is a subject that has been suffering transformation and evolving at a record time. Therefore, organizations must follow the pace and digitally transform themselves to create value and become more competitive.

Processes and business process management are, in particular, parts of a larger development that has been affecting the design of information systems since its beginning, thus representing the evolution of enterprise systems architectures which are mainly composed of information systems (Weske, 2019). Enterprise architecture captures the essential of the business, IT and its evolution (Lankhorst, 2017, p. 3), and it is the holistic expression for the main strategies of an enterprise in terms of business, applications and technologies, and the impact they have on its processes and functions (Gomes, sem data).

The Information Systems Architecture cannot by any means be separated from the Enterprise Architecture considering that when holistically integrated, the specific information systems that support operations, management, and knowledge work constitute the system architecture of the organization. Hence, to avoid business disintegration, it is extremely crucial to have within organizations an optimal, efficient, and integrated system architecture (Santos, 2022). This Enterprise Integration is key to systems interoperability that recommends that the IT architecture and infrastructure be aligned with business process organization and control to support synchronous and asynchronous operations both at the business level and at the application level (Vernadat, 2006).

Nevertheless, not everything works as it should for organizations struggle to have this interoperability amongst the various systems. Regarding Enterprise Architectures, there is the lack of any theoretically-based concept of gap analysis or detailed as-is and to-be architecture (Kotusev, 2019, p. 14). On the other hand, according to the scientific article "*INTEROPERABLE ENTERPRISE SYSTEMS: ARCHITECTURES AND METHODS*", there are immediate questions, gaps that are found once the business services and processes have been defined and modeled, activities specified, and applications encapsulated. These questions are centered on how services can be interconnected? How can their execution be orchestrated in an orderly fashion? How will processes be synchronized? How to control security? How to share data and services with partners? (Vernadat, 2006, p. 17).

"The organization" as a multinational telecommunication company of fiber-optic cables that offers a wider range of products based on IP circuits it is not an exception to the rule for it has a lack, gap in information centralization due to some processes, systems, applications that aren't integrated. This ends up affecting the performance levels of operations and their response time. Thus, the gap between the as-is systems information architecture and the to-be architecture must be filled in.

The way to approach this gap is connected to the methodology that is going to be used to answer the following research question:

RQ: How can the current information system architecture of “The organization” get improved to guarantee information centralization, better alignment between people and processes, increased performance, and increased levels of customer satisfaction?

1.2. OBJECTIVES

The present project has the objective to propose an artifact on the Information Systems architecture of “The organization” to allow in the end increased performance, and consequently increased levels of customer satisfaction.

To attend the main objective, the research question will be addressed by fulfilling the following objectives:

1. Take the current picture, status of the company in terms of their information system architecture;
2. Find the gaps in the existing SI architecture;
3. Based on all the outputs of the As-Is status, propose an innovative and flexible systems architecture approach;
4. Validate the proposed architecture.

1.3. EXPECTED RESULTS

The expected result is a new proposed Information Systems architecture of “The organization” to guarantee information centralization, better alignment between people and processes, and increased performance on the execution of these processes.

This new architecture will additionally allow the company to become more efficient in its activity, reduce costs, and be aligned with the latest tendencies of the market regarding systems’ architectures.

All these altogether will surely contribute for increased performance, and consequently increased levels of customer satisfaction.

1.4. IMPORTANCE AND RELEVANCE

Enterprise architecture is connected to the organization strategic plans and is a main base for investing decisions (Babb et al., 2019). Such decisions are significant for the success of the company once according to (RMIT University & Kotusev, 2018) companies spend significant amounts of money investing in IT. Therefore, to entirely realize the full potential value of IT investments, both the strategy and infrastructure of a company should be aligned with its business strategy and processes. EA helps organizations with this alignment and along with that it brings lots of benefits to the company itself.

Information systems architecture, on the other hand, it is seen as a vehicle for assisting managers in the task of dealing with the need for integrations in a complex technological environment, and coming to grips with issues concerning the role of information systems in supporting the organization’s business needs (Wardle, sem data). By interrelating the two, Enterprise and Information systems architecture, it is noticed a common denominator that leads us to the business strategy of the company. Thus, every company that aims to become strategically more competitive must invest on an integrated information systems architecture.

One of the assumptions of EA, for example, includes the current state, future state and roadmap describing the transition from the current state to the future state (Kotusev et al., 2020), which is the scope of this project work. Furthermore, the essence of this project is on proposing the development of an improved artifact on the information systems architecture of "The organization" by finding the gaps in the current IS architecture of the company, propose the future state and model the roadmap to transition from the current state to the future one. This intentional approach will provide "The organization" with a descriptive document that will illustrate according to (Kotusev, 2019), a specific view of the organization from the perspective of its business and IT.

As the company is gaining visibility in the Telecom field worldwide, it has the need to grow geographically and along this growth it comes a huge responsibility to have the information centralized that can be rapidly accessed from anywhere at any time. Therefore, the key factor of the proposed artifact is to guarantee integration amongst the various core systems within the organization. This integration means that is necessary to create a coherent information system architecture in which the various administrative and business processes, information, and systems are integrated so that they appear seamless from the point of view of the individual user (Vernadat, 2006).

This unified point of view of information it is of great importance and relevance, as Vernadat (2006) in other words stated, it is an IT systems interoperability platform and will allow the company to improve efficiency and effectiveness of internal process and system operations, not to mention that according to (Kotusev & Kurnia, sem data, p. 1) it will support corporate strategic planning, it will help coordinate organizational transformations, it will facilitate communication between different stakeholders, it will enable informed decision-making and will provide actionable guidance for implementing IT systems.

On the other hand, this project work will allow me to deepen my knowledge in the field of SI architectures that will be beneficial not for me only but for the improvement on the processes of the department of Information Systems which I'm currently part of.

2. WORK PLAN

Besides being a practical project, the foundation of its implementation lies in some aspects of the cycles of design science research.

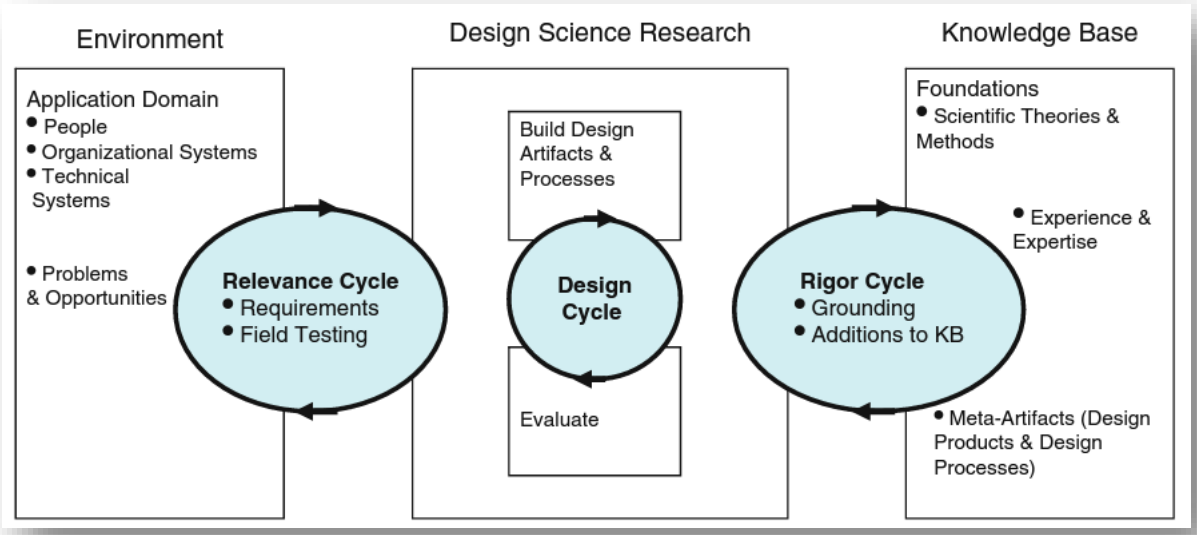


Figure 2-1 – Design science research cycles

The above figure illustrates the IS research framework found in (A. Hevner & Chatterjee, 2010), which overlays a focus on three inherent research cycles.

The Relevance Cycle bridges the contextual environment of the research project with the design science activities. The Rigor Cycle connects the design science activities with the knowledge base of scientific foundations, experience, and expertise that informs the research project. The central Design Cycle iterates between the core activities of building and evaluating the design artifacts and processes of the research (A. Hevner & Chatterjee, 2010). The interrelation of these cycles addresses research trough the building and evaluation of artifacts to meet the identified business need. The goal of design science research is utility (A. R. Hevner et al., sem data). Therefore, this practical project tends to propose a new Information System architecture for "The Organization" to meet the company's business needs. The work plan for this project will be, therefore, divided into 3 phases:

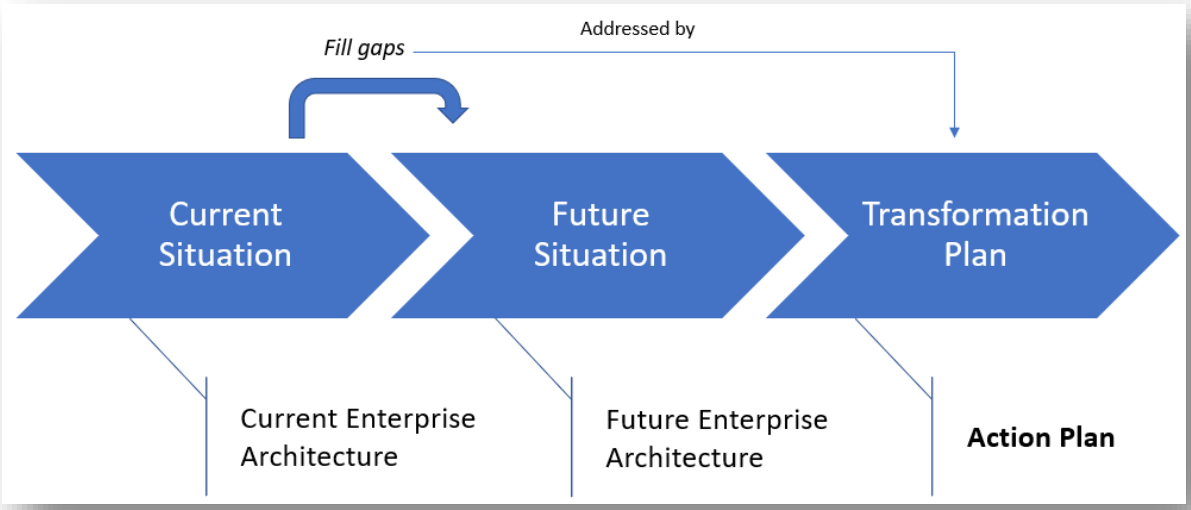


Figure 2-2 – Steps of Information System Plan

Basically, the project plan to complement the mentioned methodology will follow the parts of the steps to build a new Enterprise Architecture, which will be represented by the below framework:

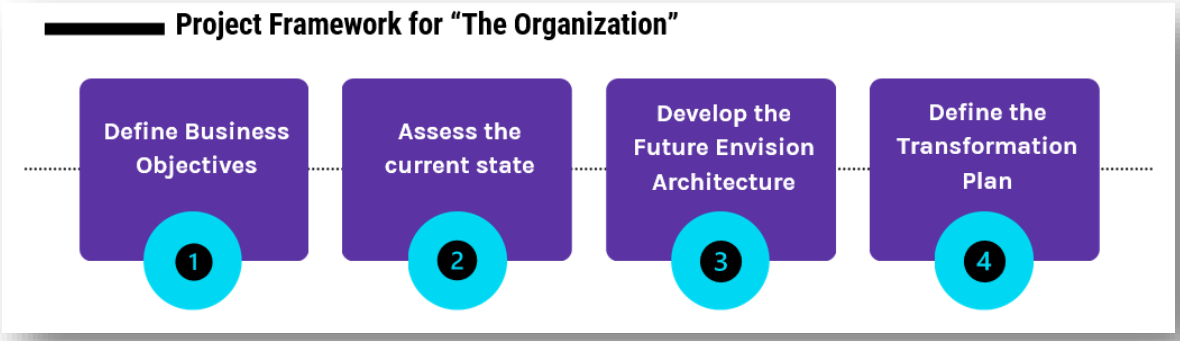


Figure 2-3 – Project Framework

1. **Define Business Objectives**: Clarify the business goals and objectives that the new architecture must support. This will serve as a foundation for the rest of the architecture development process.
2. **Assess the current state**: Evaluate the current AS-IS enterprise architecture, including hardware, software, data, and processes, to identify areas for improvement and areas of alignment with business goals.
3. **Develop the Future Envision Architecture**: Based on the assessment of the current state, develop a vision for the future architecture, including technology solutions, data, and processes.
4. **Define the Transformation Plan**: Create a roadmap for transitioning from the current state to the future envision architecture, including a timeline.

2.1. PROJECT PHASES

Based on the work plan, the project is divided into 3 phases, namely:

2.1.1. Current Situation – As Is

The focus of this phase is to take an X-Ray of the company by firstly understanding the organization such as its purpose, environment, activities, business model and organs.

- Purpose, presents the mission and industry, Legal status and property, Dimension, Performance of the company;
- Environment, is related to the main entities outside the organization that interacts with it;
- Activities, are the main activities (macro-activities) implemented in the organization;
- Business model is the description of the main flows of goods/services and cash flows;
- Organs are the processors, mainly people and machines, including computers.

Following that, this phase needs to focus on understanding the organization EA, which translates into building an AS IS Enterprise architecture that is formed by:

- Business Architecture that is the bridge between the business model and "The Organization's" strategy;
- Processes Architecture that is the portfolio of the company macro processes;
- Informational Architecture is the representation of the entities that are necessary for the pursuit of company's business;
- Applicational Architecture is the current demonstration of the applications used to support the business and the relationship between them;
- Technological Architecture is the current demonstration of the organization technological architecture.

2.1.2. Future Situation – To Be

The second phase is the ideal state the company intends to be regarding its ISA. It infers the determination of ISO (IS needs) such as:

- Survey of information needs which results on the Corporate Governance Strategy;
- Deviation analysis between Required information and the Available Information;
- ISO identification
    - GAP analysis - based on target ISA;
    - Process improvement;
    - Innovation;
    - ISO Forms;
    - ISO Grouping;
- Definition of acting priority areas, priority ISO, and Opportunities.

2.1.3. Transformation Plan

The third phase is the designing of the future Information System and involves both the Information and Application Strategy as the Technology Strategy.

- Information Systems and Application Strategy
    - Definition of Applicational Target Systems;
    - McFarlan matrix with Applicational Target Systems;
    - Definition of applicational development priorities.
- Technology Strategy
    - Definition of the Technology Architecture;
    - Organizational Strategy.

2.2. TOOLS & TECHNOLOGIES

2.2.1. Bizagi Modeler

This tool creates, interprets, and optimize workflow diagrams using BPMN. It also enables organizations to create and document business processes in a central cloud repository to gain better understanding of each step and identify process improvement opportunities to increase organizational efficiency (Bizagi, 2022).

Bizagi modeler navigates from the value chain diagrams to any end-to-end or child process. Therefore, to build the As-Is core processes' structure of "The organization" it is the perfect tool to serve the need.

2.2.2. Microsoft Visio

MS Visio is a collaborative tool to create and coauthor professional-looking diagrams for effective decision making, data visualization, and process execution to help increase productivity across the business (Microsoft, 2022).

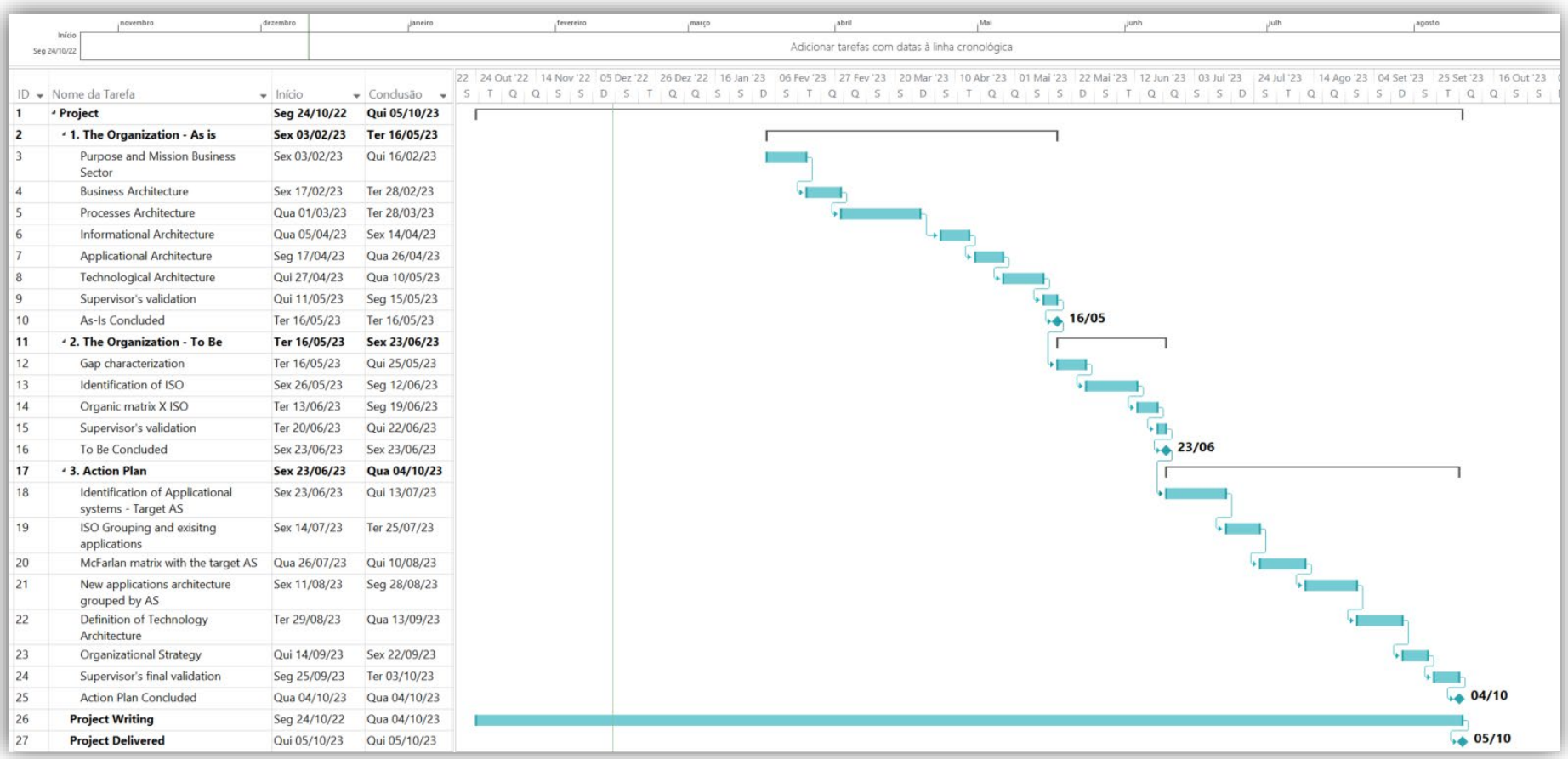
The tool will be used interchangeably with Archi to model the informational, applicational and technological architecture of "The organization".

2.2.3. Archi 4.9.2

Archi software is a free and open-source visual-modelling and design tool for creating ArchiMate models and modelling sketches (Wikipedia, 2021).

This software, as MS Visio will be used to model the informational, applicational and technological architecture of "The organization".

2.3. CHRONOGRAM



ID	Nome da Tarefa	Início	Conclusão
1	**Project**	**Seg 24/10/22**	**Qui 05/10/23**
2	**1. The Organization - As is**	**Sex 03/02/23**	**Ter 16/05/23**
3	Purpose and Mission Business Sector	Sex 03/02/23	Qui 16/02/23
4	Business Architecture	Sex 17/02/23	Ter 28/02/23
5	Processes Architecture	Qua 01/03/23	Ter 28/03/23
6	Informational Architecture	Qua 05/04/23	Sex 14/04/23
7	Applicational Architecture	Seg 17/04/23	Qua 26/04/23
8	Technological Architecture	Qui 27/04/23	Qua 10/05/23
9	Supervisor's validation	Qui 11/05/23	Seg 15/05/23
10	As-Is Concluded	Ter 16/05/23	Ter 16/05/23
11	**2. The Organization - To Be**	**Ter 16/05/23**	**Sex 23/06/23**
12	Gap characterization	Ter 16/05/23	Qui 25/05/23
13	Identification of ISO	Sex 26/05/23	Seg 12/06/23
14	Organic matrix X ISO	Ter 13/06/23	Seg 19/06/23
15	Supervisor's validation	Ter 20/06/23	Qui 22/06/23
16	To Be Concluded	Sex 23/06/23	Sex 23/06/23
17	**3. Action Plan**	**Sex 23/06/23**	**Qua 04/10/23**
18	Identification of Applicational systems - Target AS	Sex 23/06/23	Qui 13/07/23
19	ISO Grouping and exisitng applications	Sex 14/07/23	Ter 25/07/23
20	McFarlan matrix with the target AS	Qua 26/07/23	Qui 10/08/23
21	New applications architecture grouped by AS	Sex 11/08/23	Seg 28/08/23
22	Definition of Technology Architecture	Ter 29/08/23	Qua 13/09/23
23	Organizational Strategy	Qui 14/09/23	Sex 22/09/23
24	Supervisor's final validation	Seg 25/09/23	Ter 03/10/23
25	Action Plan Concluded	Qua 04/10/23	Qua 04/10/23
26	**Project Writing**	Seg 24/10/22	Qua 04/10/23
27	**Project Delivered**	Qui 05/10/23	Qui 05/10/23

Figure 2-4 – Schedule Estimation

3. THEORECTICAL FRAMEWORK

3.1. THE TELECOMMUNICATION SECTOR

3.1.1. Overview

The telecommunication industry has proven over the last thirty years to be a key factor in the development of national economies as an accelerator of the availability of technology, a replacement for travelling and by creating completely new types of virtual products and the related emergence of totally new sectors of the Internet economy (Možný, 2017).

The telecommunication industry has specific attributes linked to its network:

- Significant economy of scale in production;
- Network externalities and externalities in consumption;
- Complementarities, compatibility, standards;
- Costs associated with changing of product/service provider for customer.

Due to the strong economy of scale these markets often have an oligopolistic structure with just a few strong players or a structure with one dominant player with a group of smaller challengers (Možný, 2017).

This market is also often characterized by a high level of regulation. Market regulators oversee compliance with standards, compatibility, and safety. Regulators also manage the use of scarce natural resources and are often involved in the relationship between service providers and customers. Historically the telecommunication sector was a natural monopoly. This led in principle to granting the state a monopoly on operating telecommunication services (Možný, 2017).

In the early stages of telecom reform, the role and significance of regulation has been somewhat ambiguous. One school of thought was that the PTOs should be privatized, the doors of competition opened, and the industry placed under the anti-monopoly laws. Thus, there would be no need for industry specific regulation at all. New Zealand tried to implement this approach. A second school of thought has argued that regulation is needed only for the short-term to manage the transition from monopoly to competition. Regulation should be light-handed and have a sunset provision for expiration after a few years. This was the predominant view in the UK during the early years of reform (but not now), Australia, the World Bank, and others. A third school of thought has perceived regulation as a necessary permanent part of the reformed institutional structure, arguing that the reform objectives of efficient competition and universal service cannot be achieved and maintained without strong, independent regulation (Melody, 1999).

A close examination of the essential characteristics of the network facilities infrastructure sector makes it immediately apparent that these markets will remain highly imperfect for the foreseeable future. Regulation is necessary to provide a foundation upon which markets can function more effectively than they could otherwise. Access to public resources, including the radio spectrum, numbering, and rights of way, is essential for facilities-based entry. None of these essential resources can be acquired in unregulated competitive markets. Operators must be licensed. There must be a high degree of cooperation in technical standards development. Interconnection with dominant PTOs

on reasonable terms, is essential and will occur only if regulation enforces it. Consumers of basic public services who have no competitive options will need regulatory protection for both prices and quality of service. Universal service regulation will be necessary both to capture the network externality benefits that competitive markets cannot achieve and to implement important economic and social policy objectives. With network service developments on the internet and electronic commerce coming over the horizon, new concerns relating to privacy and security are requiring policy and regulator attention (Melody, 1999).

In the last decade the telecommunications industry has been turned topsy-turvy by the confluence of two revolutions that have fed upon one another. The first is technological change, which led to the explosion of cellular telephony, digital wireless telephony, digital satellite service, fiber optic technology, and so forth These technical advances accelerated the changes brought on by earlier innovations, such as digital exchanges, microwave communications, and the fusion of the computer and communications technologies. But a second, equally important, revolution has occurred in the last decade whose importance is not as widely recognized. This is the unprecedented change in the institutional and regulatory arrangements within the sector, resulting from the privatization of state owned telephone companies and widespread deregulation of the sector (Ramamurti, 2000).

The privatization trend was inspired by the U.K. experience with British Telecom and the deregulation trend by the U.S. experience with the break-up of the incumbent monopoly (AT&T). Although both events occurred in the mid-1980s, it wasn't until the 1990s that other countries embraced one or both policies in their own markets. Business historians are likely to regard the 1990s as a watershed in the evolution of the global telecommunications industry. To be sure, the technological and institutional revolutions have fed upon one another. The institutional changes were no doubt influenced by the technological changes, which undermined the natural monopoly assumption on which prior regulations were based and which exposed the weaknesses of state-owned enterprises in keeping up with the needs of consumers (Ramamurti, 2000).

In turn, the institutional changes spurred the creation and adoption of new technologies. Privatization and deregulation not only allowed local private capital into telecommunications, but they generated a wave of foreign investment by the Baby Bells and the national telephone companies of OECD countries (Sarkar, Cavusgil, & Aulakh, 1999). Consequently, the telecommunications industry gradually began to globalize (Witte, 1994). National strategies and firm strategies interacted to transform the sector suddenly from one populated mostly by state-owned firms to one populated increasingly by multinational corporations (Aharoni, 1997).

The telecommunication sector plays a crucial role in the digital economy and is essential to supporting modern communication and the delivery of online services and applications. It is a rapidly evolving industry, driven by advances in technology and changing consumer behavior, and continues to shape the way we communicate and access information.

However, in the 1980s, the opinion prevailed that competition could contribute to the development of this sector and consequently to the increase of wealth in society. Thus, the desire for a truly competitive strategy and differentiation in telecommunications was aroused.

3.1.2. Business Areas

The telecommunication sector includes the following business areas:

1. Mobile phone services;
2. Landline telephone services;
3. Internet services (fixed and mobile broadband);
4. Television services (cable, satellite, IPTV);
5. Data and network services (cloud computing, hosting, managed services);
6. Equipment manufacturing and sales.

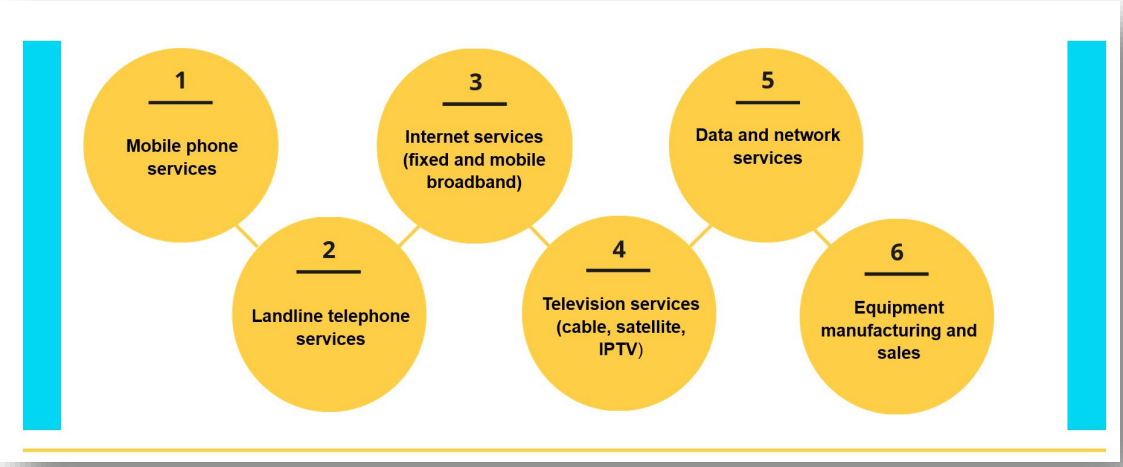


Figure 3-1 – Business areas of the telecommunication sector

1. **Mobile phone services** include the following:
   - Voice calls;
   - Text messaging (SMS);
   - Mobile internet access;
   - Mobile payment services;
   - Mobile entertainment (music, video, gaming);
   - Mobile apps and services (e.g., navigation, social media);
   - Mobile advertising.

These services are typically offered by mobile network operators, which own and manage the mobile network infrastructure, and sell services to customers through various distribution channels.

2. **Landline telephone services** refer to traditional, fixed-line telephone services that are connected to the public switched telephone network (PSTN). These services typically include:
    - Voice calls;
    - Text messaging (TTY, TDD);
    - Call forwarding, call waiting and other call management features;
    - Voice mail;
    - Emergency services.

Landline telephone services are typically offered by telecommunications companies and can be delivered over copper wires or fiber-optic cables. They are used by businesses and consumers for voice communication and sometimes for data transmission. With the increasing popularity of mobile phones and internet-based communication services, the use of landline telephone services has declined in recent years.

3. **Internet services** refer to services that provide access to the Internet and its resources. The two main types of Internet services are fixed broadband and mobile broadband:
    - Fixed broadband: This type of Internet service is delivered over a fixed line, such as fiber-optic or coaxial cable, and provides high-speed, reliable Internet access to homes and businesses. It is commonly used for activities such as web browsing, online gaming, and video streaming.
    - Mobile broadband: This type of Internet service is delivered over a mobile network, such as 3G, 4G, or 5G, and provides Internet access on the go. Mobile broadband is commonly used for activities such as web browsing, email, and social media.

Internet services are typically offered by telecommunications companies and internet service providers (ISPs). They play a crucial role in enabling the growth of the digital economy and the delivery of online services and applications.

4. **Television services** refer to services that deliver television programming to viewers. The three main types of television services are cable, satellite, and IPTV:
    - Cable TV: Cable TV services are delivered over a cable network and provide a range of television programming, including local and national channels, premium channels, and on-demand content.
    - Satellite TV: Satellite TV services are delivered via satellites in orbit and provide a range of television programming, including local and national channels, premium channels, and on-demand content.

- IPTV: IPTV (Internet Protocol Television) services are delivered over a broadband Internet connection and provide a range of television programming, including local and national channels, premium channels, and on-demand content. IPTV services may also offer interactive features, such as the ability to pause and rewind live TV.

These services are typically offered by telecommunications companies, cable companies, and satellite providers. They play a crucial role in the entertainment industry and provide a major source of news, information, and entertainment for millions of viewers.

5. **Data and network services** refer to services that provide businesses and organizations with the infrastructure and support they need to manage and process data. Some common data and network services include:
    - Cloud computing: This service provides businesses and organizations with access to a shared pool of computing resources, such as servers, storage, and applications, over the Internet. This enables users to store and process data in the cloud, rather than on their own servers, and provides a cost-effective and scalable solution for data management.
    - Hosting: Hosting services provide businesses and organizations with the infrastructure and support they need to host their websites, applications, and databases on servers located in data centers. Hosting services can include shared hosting, dedicated hosting, and cloud hosting.
    - Managed services: Managed services provide businesses and organizations with the support they need to manage and maintain their IT systems and infrastructure. This can include managed security, managed storage, and managed network services, among others.

These services are typically offered by telecommunications companies, cloud service providers, and hosting companies. They play a crucial role in enabling businesses and organizations to manage and process their data and support their digital operations.

6. **Equipment manufacturing and sales** refer to the production and distribution of the hardware and software components used to support the telecommunication sector. This includes:
    - Network infrastructure equipment: This includes hardware such as base stations, routers, switches, and other equipment used to build and manage telecommunication networks.
    - Telecommunication devices: This includes hardware such as mobile phones, landline phones, modems, and other telecommunication devices used by consumers and businesses.

- Software and applications: This includes software and applications used to support the telecommunication sector, such as operating systems, network management systems, and customer relationship management (CRM) software.

These components are typically manufactured by telecommunications equipment companies and sold to telecommunications companies, internet service providers, and businesses and organizations. They play a crucial role in enabling the telecommunication sector to provide services and support digital operations.

3.1.3. Supporting technologies

The telecommunication industry is supported by several technologies that help to enhance communication and information exchange. Some of the key supporting technologies in the telecommunication industry include:

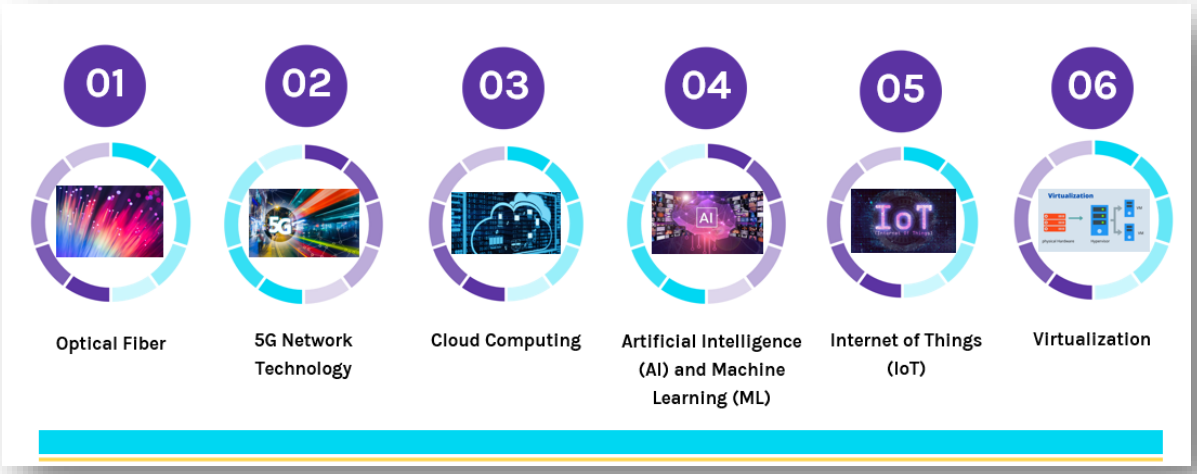


Figure 3-2 – Supporting technologies of the telecommunication industry

- **Optical Fiber**: Optical fiber technology provides high-speed, secure, and reliable data transmission over long distances.
- **5G Network Technology**: 5G is the latest generation of mobile network technology, offering faster speeds and lower latency than previous generations.
- **Cloud Computing**: Cloud computing enables telecommunication companies to store, manage, and process large amounts of data, providing new opportunities for innovation and growth.

- **Artificial Intelligence (AI) and Machine Learning (ML)**: AI and ML technologies can be used to improve network security, automate network management, and optimize network performance.
- **Internet of Things (IoT)**: IoT technology enables devices to be connected to the internet, providing new opportunities for data collection, analysis, and communication.
- **Virtualization**: Virtualization technology allows telecommunication companies to create virtual network functions, improving network flexibility and reducing costs.

These technologies are driving innovation and growth in the telecommunication industry, helping to improve communication and information exchange for people around the world. Below more complementary and detailed aspects of the technologies that support the telecommunication industry.

Network infrastructure: e.g., fiber optic cables, cell towers, routers, switches

- Fiber optic cables provide high-speed transmission of data, voice, and video.
- Cell towers facilitate the transmission of wireless signals for mobile communication.
- Routers direct traffic between networks, enabling communication between devices.
- Switches provide connectivity between devices within a network, enabling communication and data transfer.
- The combination of these technologies forms the backbone of telecommunications infrastructure, allowing for the delivery of various telecommunication services such as voice, internet, and multimedia.

Wireless communication technologies: e.g., 5G, 4G LTE, Wi-Fi, Bluetooth

- Mobile communication: Wireless technologies like 4G, 5G and LTE allow for the provision of mobile internet and voice services to users on the go.
- Wireless local area networks (WLANs): Wi-Fi enables wireless access to the internet in homes, offices, public spaces, etc.
- Short-range communication: Technologies like Bluetooth enable short-range wireless communication between devices like headphones, speakers, and smartphones.
- Machine-to-machine communication: Wireless technologies allow for the integration of smart devices on the Internet of Things (IoT) ecosystem.
- Wireless backhauls: Wireless technologies like microwave and millimeter wave transmission can be used to provide connectivity between cell towers and other network infrastructure, reducing the cost and complexity of installing wired connections.

- Wireless broadband: Wireless technologies like WiMAX, LTE and 5G provide high-speed broadband services to areas without access to traditional wired broadband.

Satellite technology: e.g., geostationary satellites, low earth orbit satellites

- Global coverage: Satellites can provide telecommunication services to remote and underserved areas that are difficult to reach with terrestrial networks.
- Mobile communication: Satellites can provide mobile voice and data services to users via satellite phones and mobile terminals.
- Broadcasting: Satellites are used for the transmission of television and radio signals, allowing for the distribution of multimedia content globally.
- Emergency communication: Satellites can provide reliable communication during natural disasters or other emergencies when ground-based communication networks are damaged or unavailable.
- Internet access: Satellites can provide high-speed internet access in areas without terrestrial broadband infrastructure.
- Navigation: Satellite-based navigation systems like GPS support various industries and applications such as transportation, logistics, and military operations.
- Remote sensing: Satellites equipped with sensors can gather data for scientific and environmental research, weather forecasting, and resource management.

Network security: e.g., firewalls, encryption, virtual private networks

- Protecting confidential information: Network security technologies like encryption and virtual private networks (VPNs) protect sensitive information from unauthorized access and cyber-attacks.
- Threat detection and response: Firewalls, intrusion detection systems (IDS), and intrusion prevention systems (IPS) help detect and respond to security threats in real-time.
- Compliance with regulations: Network security technologies and practices help telecom companies comply with regulations such as data privacy laws and industry standards.
- Maintaining network availability: Network security measures help ensure the reliability and availability of telecommunication networks, minimizing downtime and ensuring continuity of service.
- Protecting customer data: Network security technologies and practices help protect customer data and prevent data breaches, preserving customer trust and loyalty.
- Protecting intellectual property: Network security measures help protect the confidential information and intellectual property of telecom companies and their partners.

Data center technology: e.g., servers, storage systems, cloud computing

- Scalability: Data center technology like servers, storage systems, and cloud computing solutions enable telecom companies to scale their services as demand grows.
- Efficiency: Data center technologies like virtualization and automation can improve operational efficiency and reduce costs for telecom companies.
- Reliability: Data centers with redundant power and cooling systems, backup generators, and disaster recovery systems ensure high levels of availability and reliability for telecommunication services.
- Processing power: Data centers provide the computing power necessary to support complex network functions, such as billing systems, customer management platforms, and network optimization software.
- Flexibility: Data centers allow telecom companies to rapidly deploy new services and respond to changing market demands.
- Cost savings: Data center technologies like cloud computing can reduce capital expenditures and operational costs for telecom companies.
- Green initiatives: Data center technologies can support telecom companies' sustainability efforts by reducing energy consumption and minimizing carbon emissions.

Software and applications: e.g., call center software, messaging platforms, billing systems

- Customer experience: Telecommunications software and applications like call center software, messaging platforms, and customer relationship management (CRM) systems help improve the customer experience.
- Network management: Applications like network management systems and network optimization software enable telecom companies to efficiently manage and maintain their networks.
- Business operations: Software and applications like billing systems, revenue management platforms, and workforce management systems support the day-to-day operations of telecom companies.
- Marketing and sales: Customer data analysis, marketing automation, and sales force management tools can help telecom companies target and acquire new customers and retain existing ones.
- Network security: Security applications and software like firewalls, intrusion detection systems (IDS), and intrusion prevention systems (IPS) help secure telecommunication networks and protect against cyber threats.

- Collaboration and productivity: Telecommunications software and applications like video conferencing, voice over IP (VoIP), and team collaboration platforms improve collaboration and productivity for both employees and customers.
- Innovation: Telecommunications software and applications drive innovation and new services, enabling telecom companies to stay ahead of the competition.

Hardware devices: e.g., smartphones, modems, set-top boxes

- Mobile devices: Smartphones, tablets, and other mobile devices are essential components of the telecommunications industry, providing customers with access to voice and data services.
- Network infrastructure: Hardware devices like routers, switches, base stations, and cell towers support the physical infrastructure of telecommunications networks.
- Servers and storage systems: Data centers rely on servers and storage systems to support the processing and storage of large amounts of data.
- Optical transmission equipment: Optical transmitters, receivers, and amplifiers are key components of fiber optic networks, enabling high-speed data transmission.
- Customer premises equipment (CPE): CPE devices like modems, routers, and set-top boxes provide customers with access to telecommunication services.
- Satellite equipment: Satellites, ground stations, and terminals are necessary components of satellite-based telecommunication systems.
- Test and measurement equipment: Hardware devices like network analyzers, signal generators, and oscilloscopes are used to test and maintain telecommunication networks.

Analytics and AI tools: e.g., machine learning, predictive analytics, network optimization software.

- Network optimization: Analytics and AI tools help telecom companies optimize network performance by analyzing data from network sensors and using machine learning algorithms to identify patterns and predict issues.
- Customer insights: Analytics and AI tools can provide telecom companies with valuable insights into customer behavior and preferences, helping them to better target and retain customers.
- Fraud detection: Analytics and AI tools can detect fraudulent activity in real-time, protecting telecom companies from financial losses and enhancing customer trust.
- Network security: AI-powered security tools can detect and respond to threats more quickly and effectively than traditional security methods.
- Marketing: Analytics and AI tools can be used to target customers with personalized marketing campaigns and to analyze customer behavior data.

- Network planning and deployment: Analytics and AI tools can help telecom companies plan and deploy network infrastructure more efficiently and cost-effectively.
- Predictive maintenance: Analytics and AI tools can predict equipment failures and schedule maintenance before issues arise, improving network availability and reducing downtime.

Cybersecurity

Cybersecurity refers to the practice of protecting internet-connected systems, including hardware, software, and data, from attack, damage, or unauthorized access. It is a critical component of the telecommunication industry as it helps to safeguard sensitive information and prevent data breaches, hacking, and other cyber threats. Key practices in cybersecurity include:

- Network security: protecting the physical and logical infrastructure of the network.
- Application security: protecting the software applications that run on the network.
- Data security: protecting the confidential and sensitive information stored on the network.
- Identity and access management: controlling and monitoring access to systems and data.
- Incident response: planning and preparation for responding to cyber threats.
- Threat intelligence: gathering and analyzing information about potential security threats.
- Encryption: transforming data into a secure code to protect it from unauthorized access.
- Firewalls: filtering incoming and outgoing network traffic based on pre-defined security rules.
- Penetration testing: simulating a real-world cyber-attack to identify security weaknesses.

Cybersecurity is a constantly evolving field, and telecommunication companies must stay vigilant and implement best practices to ensure the protection of their networks and customers' data.

Blockchain

- In telecommunication technology, blockchain can be used to improve network security, data privacy, and overall efficiency. Some potential applications of blockchain in telecommunication include:
- Identity Management: Blockchain can be used to securely store and manage user identity information, reducing the risk of identity theft and fraud.
- Secure Inter-carrier Transactions: Blockchain can be used to securely transfer data and information between different telecommunication carriers, reducing the risk of fraud and improving transaction speeds.

- Decentralized Network Management: Blockchain can be used to create decentralized networks that are not controlled by any single entity, improving network security and reliability.
- Billing and Settlement Systems: Blockchain can be used to create secure, efficient, and transparent billing and settlement systems, reducing the risk of fraud and improving overall efficiency.
- Supply Chain Management: Blockchain can be used to track the journey of telecommunication equipment, parts, and services through the supply chain, improving supply chain transparency and security.

Overall, the use of blockchain in telecommunication technology has the potential to bring numerous benefits, including increased security, improved efficiency, and reduced costs.

Software-defined networking (SDN) is a networking architecture that separates the control plane from the data plane, allowing network administrators to programmatically manage and control network traffic. In telecommunication technology, SDN can be used to improve network agility, scalability, and overall efficiency.

Some potential benefits of SDN in telecommunication technology include:

- Network Automation: SDN enables network administrators to automate network configuration, management, and troubleshooting, reducing manual errors and improving overall efficiency.
- Dynamic Resource Allocation: SDN allows network administrators to dynamically allocate network resources based on changing traffic patterns, improving network performance and reducing costs.
- Improved Network Visibility: SDN provides network administrators with centralized visibility and control over the entire network, allowing them to quickly detect and resolve issues.
- Scalability: SDN enables networks to be easily scaled up or down as needed, improving network flexibility, and reducing costs.
- Virtualization: SDN enables the virtualization of network functions, improving network agility and reducing costs.

Overall, SDN can bring significant benefits to telecommunication networks, including improved network performance, reduced costs, and increased agility and flexibility.

3.1.4. Challenges and Opportunities

The three trends sweeping across this industry are the privatization of state-owned enterprises, deregulation of the sector, and globalization of the sector occurring through the participation of foreign capital in privatizations and in new entry after deregulation (Ramamurti, 2000). But overall, the most recent challenges and opportunities are mentioned below:

Challenges:

Competition: The telecommunications industry is highly competitive, with new entrants constantly entering the market and existing players struggling to maintain market share.

Regulation: Telecommunications companies are subject to a range of regulatory requirements, including licensing, spectrum allocation, and data privacy regulations, which can be challenging to navigate.

Network investment: Keeping up with the increasing demand for data and video services requires significant investments in network infrastructure, which can be challenging for telecom companies with limited financial resources.

Cybersecurity: Protecting networks and customer data from cyber threats is a major challenge for the telecommunications industry, requiring ongoing investment in security technologies and personnel.

Spectrum scarcity: The increasing demand for wireless services is putting pressure on available spectrum, making it more difficult and expensive for telecom companies to acquire the spectrum they need to provide services.

Opportunities:

5G deployment: The deployment of 5G networks provides an opportunity for telecom companies to offer new and improved services, including enhanced mobile broadband and the Internet of Things (IoT).

Cloud services: The growing demand for cloud-based services provides an opportunity for telecom companies to expand their offerings and compete with established cloud providers.

Emerging markets: The telecommunications industry is growing rapidly in emerging markets, providing opportunities for companies to enter new markets and expand their customer base.

IoT and M2M: The Internet of Things (IoT) and machine-to-machine (M2M) communication are growing markets that offer opportunities for telecom companies to provide new and innovative services.

Big data and analytics: The growth of big data and the increasing importance of data analytics provide opportunities for telecom companies to monetize customer data and improve their operations.

3.2. ENTERPRISE ARCHITECTURES

Enterprise architecture (EA) is a description of an enterprise from an integrated business and IT perspective intended to bridge the communication gap between business and IT stakeholders (RMIT University & Kotusev, 2018). Using EA helps companies to improve business and IT alignment and brings several other benefits (Bradley et al., 2011; Schmidt and Buxmann, 2011; Tamm et al., 2011). Unsurprisingly, EA is practiced by most large companies (Ambler, 2010; van der Raadt et al., 2007) and makes a significant contribution to their success (Ross et al., 2006).
Enterprise architecture captures the essentials of the business, IT, and its evolution (Lankhorst, 2017, p. 3), and it is the holistic expression of the main strategies of an enterprise in terms of business, applications, and technologies, and the impact they have on its processes and functions, not to mention that also plays a role in digital transformation (Gomes, 2019).

3.2.1. Concepts

Architecture: fundamental concepts or properties of a system in its environment, embodied in its elements, relationships, and in the principles of its design and evolution (Lankhorst, 2017).

Enterprise: any collection of organizations that has a common set of goals and/or a single bottom line (Lankhorst, 2017).

Enterprise architecture

- EA is a coherent whole of principles, methods, and models that are used in the design and realization of an enterprise's organizational structure, business processes, information systems, and infrastructure (Lankhorst, 2017).
- EA is the architecture definition process for the use of information in business support and the implementation plan of these architectures (Spewak, 1992).
- EA is a coherent whole of principles, methods, and models that are used in the design and realization of an enterprise's organizational structure, business processes, information systems, and infrastructure (ArchiMate Foundation, 2021).

- EA is a discipline for proactively and holistically leading enterprise responses to disruptive forces by identifying and analyzing the execution of change toward desired business vision and outcomes. EA delivers value by presenting business and IT leaders with signature-ready recommendations for adjusting policies and projects to achieve targeted business outcomes that capitalize on relevant business disruptions (Gardner, 2021).

Business architecture: The business architecture describes the organization's goals, objectives, processes, and capabilities, and defines the relationship between business functions and business systems. It is a blueprint of the enterprise that provides a common understanding of the organization and is used to align strategic objectives and tactical demands (Lankhorst, 2017).

Information System Architecture

- The architecture of an information system is a description of the design and contents of a computerized system and encompasses the hardware and software used to deliver the solution to the final consumer of services.
- May include information such as a detailed inventory of current hardware, software, and networking capabilities; a description of long-range plans and priorities for future purchases, and a plan for upgrading and/or replacing dated equipment and software.
- The architecture should document: What data is stored? How does the system function? Where are components located? When do activities and events occur in the system?, and Why does the system exist? (Santos, 2022)

3.2.2. Architecture Types

There are several types of enterprise architecture, including:

- **Business Architecture**: focused on defining an organization's business processes, products and services, and customer interactions.
- **Information Architecture**: focused on data management and the flow of information within an organization.
- **Technical Architecture**: focused on the technology infrastructure and systems that support an organization's operations. The technical architecture describes the organization's technical infrastructure, including hardware, software, and network components. It also describes the relationships between these components and the standards and technologies used to build and maintain the infrastructure.

- **Solution Architecture**: focused on specific solutions for business problems and how they integrate with the overall architecture.
- **Security Architecture**: focused on ensuring the confidentiality, integrity, and availability of an organization's information and systems. The security architecture describes the organization's security policies, standards, and technologies, and defines the measures used to secure information and systems.
- **Operational Architecture**: focused on the day-to-day operations and management of an organization's systems and processes. The operations architecture describes the organization's processes and practices for managing and operating systems and applications, including incident management, change management, and capacity planning.
- **Software architecture** defines a structure that organizes the software elements and the resources of a software system. Software elements and resources are represented by subsystems. In each software architecture, these subsystems have specific responsibilities and relationships to other subsystems (Weske, 2019).
- **Data architecture**: The data architecture describes the organization's data assets, including data sources, data structures, and data relationships. It provides a common understanding of the organization's data and helps to ensure data quality and consistency.
- **Application architecture**: The application architecture describes the organization's applications, including their functional capabilities, technology platforms, and inter-application relationships.
- **Integration architecture**: The integration architecture describes the mechanisms and technologies used to integrate systems and data across the organization, including APIs, middleware, and data exchange formats.

Each type of enterprise architecture has a different focus and scope, but they all work together to support the overall goals and objectives of the organization.

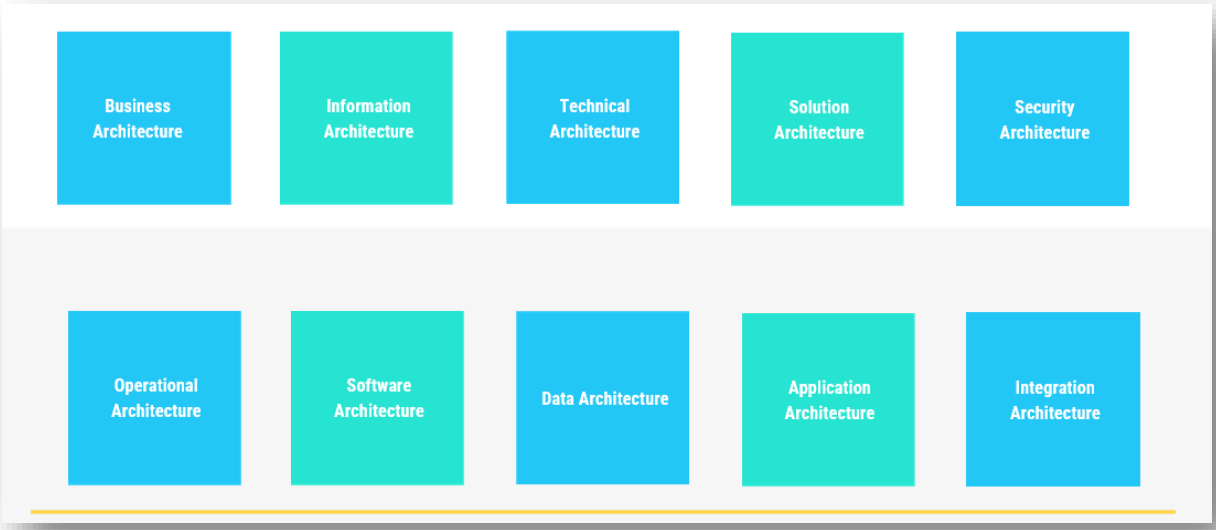


Figure 3-3 – Types of Enterprise Architecture

3.2.3. Building a new Enterprise Architecture

Building a new enterprise architecture involves the development and implementation of a comprehensive, integrated IT infrastructure that supports an organization's business objectives and goals. The following steps can be used to build a new enterprise architecture:

- Define Business Objectives: Clarify the business goals and objectives that the new architecture must support. This will serve as a foundation for the rest of the architecture development process.
- Assess the current state: Evaluate the current AS-IS enterprise architecture, including hardware, software, data, and processes, to identify areas for improvement and areas of alignment with business goals.
- Develop the Future Envision Architecture: Based on the assessment of the current state, develop a vision for the future architecture, including technology solutions, data, processes, and governance.
- Define the Transformation Plan: Create a roadmap for transitioning from the current state to the future envision architecture, including a timeline, budget, and resource requirements.
- Implementation: Execute the transformation plan, including the deployment of new technology solutions, processes, and governance.
- Monitoring and Adjustment: Regularly monitor the architecture and adjust as needed to ensure it stays aligned with business goals and supports the company's ongoing success.

Building a new enterprise architecture requires a significant investment of time and resources, but it can deliver significant benefits, including improved efficiency, increased agility, and enhanced security.

The current project will however be focused on the As-IS, future envision and the transformation plan.

Diagnosis (AS-IS)

AS-IS enterprise systems architecture refers to the current state of a company's information technology (IT) infrastructure, including all hardware, software, data, and processes. This architecture provides a snapshot of how information is being stored, processed, and communicated within the enterprise. The term "AS-IS" is used to emphasize that this is the existing architecture, not a desired or future state. An AS-IS architecture is a key reference point for organizations looking to make changes to their IT infrastructure, such as updating technology, improving processes, or consolidating systems.

Future Envision

Future envision of the enterprise systems architecture refers to the desired future state of a company's information technology (IT) infrastructure. It is the result of a strategic planning process that seeks to align the company's technology with its business objectives and goals. The future envision architecture defines the technology solutions, data, processes, and governance that will support the company's future growth and success. This architecture is often created by conducting a gap analysis between the current AS-IS architecture and the desired future state, and then developing a roadmap for implementing the necessary changes. The future envision architecture provides a clear vision for the company's technology future and serves as a guide for decision-making and investments in technology.

Transformation Plan

A transformation plan for enterprise systems architecture is a roadmap for transitioning from the current AS-IS architecture to the desired future envision architecture. It outlines the steps and activities required to bring the company's technology infrastructure in line with its business objectives and goals. The transformation plan typically covers a range of aspects, including:

1. Assessment: A thorough evaluation of the current technology infrastructure to identify areas for improvement and areas of alignment with business goals.
2. Planning: The development of a detailed roadmap for the transformation, including a timeline, budget, and resource requirements.
3. Implementation: The execution of the transformation plan, including the deployment of new technology solutions, processes, and governance.

4. Monitoring and adjustment: Regular monitoring of the transformation process to ensure it stays on track and adjusting as needed to ensure success.

The transformation plan serves as a blueprint for the technology transformation, and provides a clear understanding of the resources, time, and budget required to achieve the desired future state. It also helps organizations to mitigate risk and ensure that the transition to the new architecture is smooth and successful.

3.2.4. Enterprise Architecture for telecommunications

Most architecture frameworks are quite precise in establishing what elements should be part of an enterprise architecture. However, to ensure the quality of the enterprise architecture during its life cycle the adoption of a certain framework is not sufficient. The relations between the different types of domains, views, or layers of the architecture must remain clear, and any change should be carried through methodically in all of them. For this purpose, several methods are available, which assist architects through all phases of the life cycle of architectures (Lankhorst, 2017).

Telecommunications enterprise architecture frameworks provide a blueprint for organizing and aligning technology and business goals in the telecommunications industry. They aim to help companies efficiently manage their technology assets, define, and implement new systems, and ensure that their technology investments align with their overall business strategies. Common frameworks used in telecommunications include TOGAF, Zachman Framework, and the Telecommunications Operations Map (TM Forum). These frameworks provide a structured approach to defining and organizing the various components of a telecommunications enterprise, including business processes, information systems, technology infrastructure, and organizational structure.

TOGAF (The Open Group Architecture Framework) is a widely adopted enterprise architecture framework used to develop, manage, and govern an organization's enterprise architecture. It provides a comprehensive methodology for designing, planning, implementing, and governing enterprise information systems and technology.

TOGAF defines a four-layer architecture development method (ADM) that covers business, data, application, and technology domains. The framework provides a step-by-step approach to defining the architecture and helps organizations align their technology investments with their overall business strategies. TOGAF also provides a set of tools, techniques, and models for architecture development, including architecture artifacts, architecture development method, architecture repository, and architecture governance.

TOGAF is not specific to any industry or technology, making it a widely used framework across a variety of organizations. However, it can be customized to fit the specific requirements of individual organizations and industries, such as telecommunications. TOGAF provides a comprehensive and flexible framework that supports the development of both current and future enterprise architectures, helping organizations to stay ahead of technological change and meet the ever-evolving needs of their business and customers.

The **Telecommunications Operations Map (TM Forum)** is a framework used in the telecommunications industry for managing and optimizing business and operational processes. It provides a common language and methodology for companies in the telecommunications industry to align their business processes, systems, and data. The TM Forum framework covers key business areas such as customer management, product and service management, network operations, and finance and billing.

The TM Forum framework is used by telecommunications service providers, system integrators, and technology vendors to improve their operational efficiency and reduce costs. It provides a common set of best practices and guidelines for managing processes, systems, and data, which enables companies to streamline their operations and reduce the time and resources required to deploy new services. The TM Forum framework also supports the integration of new technologies, such as cloud computing and virtualization, into existing operations.

There are many other several frameworks that can also be used for enterprise architecture in telecommunications, including:

Telecommunications Information Networking Architecture (TINA) - provides a standard for integrating and interconnecting telecommunication networks.

The Telecommunications Management Network (TMN) - provides a common management architecture for telecommunication networks, services, and resources.

The ITU-T Z.100 - defines a framework for open systems interconnection for telecommunications management.

The 3GPP (3rd Generation Partnership Project) - develops standards for mobile telecommunications systems.

The IMS (IP Multimedia Subsystem) - provides a framework for delivering multimedia services over IP networks.

In terms of business processes there are two frameworks that are important to mention also eTOM and APQC.

eTOM (enhanced Telecom Operations Map): This is a framework for business process management in the telecommunications industry, providing a common understanding of the end-to-end business processes used by telecom service providers. It covers areas such as customer relationship management, order management, and service delivery.

APQC (American Productivity & Quality Center) Process Classification Framework (PCF): This is a comprehensive framework that categorizes business processes into a common structure and provides a common language for process improvement. APQC's PCF is widely used in the telecommunications industry to improve business processes, including customer service, network operations, and supply chain management.

All these frameworks are widely used in the telecommunications industry and provide a structured approach to planning and implementing enterprise architecture.

4. PROJECT DESCRIPTION

4.1. THE ORGANIZATION – AS IS

4.1.1. Purpose and Mission Business Sector

- "The Organization" is a telecommunications company that aims to provide high-speed connectivity and digital services to customers in Africa, South America, and beyond.
- The company's focus is to develop and operate a world-class submarine cable network, which connects Angola and other African countries to Brazil, the United States, and Europe.
- The company through its network offers a range of services, including wholesale data transmission, cloud services, and content distribution.
- The company's goal is to help bridge the digital divide between Africa and other parts of the world by providing reliable, high-speed internet access to businesses and consumers in the region.
- In addition to its submarine cable network, the company is also involved in building and managing data centers, providing cybersecurity solutions, and supporting research and development initiatives in the telecommunications industry.
- The company's mission is to enable digital transformation and economic growth across the African continent and beyond.
- The company's business activity is to operate in the wholesale market, providing international connectivity and related services. The company was founded in 2009 and is based in Luanda, Angola. The company owns and operates a submarine cable network that connects Africa, South America, North America, and Europe. This network includes:
    - **SACS**: The South Atlantic Cable System, which is the first direct submarine cable connection between South America and Africa.
    - **MONET**: Cable system which connects Brazil, the United States, and Colombia.
    - **WACS**: The WACS (West Africa Cable System) is a submarine fiber-optic cable system that spans the western coast of Africa. The cable system connects South Africa to the United Kingdom, with landings in 14 African countries along the way, including Namibia, Angola, Democratic Republic of Congo, Congo-Brazzaville, Cameroon, Nigeria, Togo, Ghana, Cote d'Ivoire, Cape Verde, Canary Islands, and Portugal. The WACS cable system is owned and operated by a consortium of telecommunications companies, including MTN, Vodacom, Orange, Telecom Namibia, "The Organization", and others. The cable system provides high-speed broadband connectivity and

international connectivity for voice, data, and video traffic, and helps to support the growth and development of the digital economy in Africa.

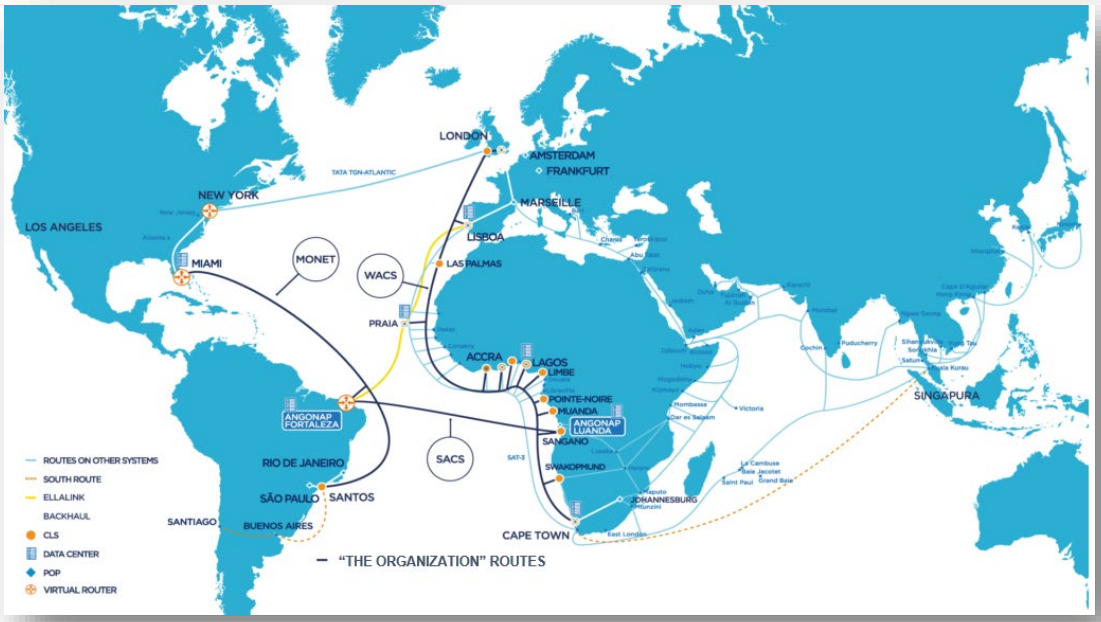


Figure 4-1 - "The Organization" Cable System

- In addition to its submarine cable network, the company also provides connectivity services, internet protocol (IP) transit services, data center, ICT and GDI to businesses and other telecommunications providers.
    - **Connectivity:**

      CIRCUIT**:** The Connectivity Product (EPLC and IPLC) allows the diversity of point-to-point or multi-point connections, with high resilience and low latency for the main digital content sourcing destinations (Data Centers and Traffic Exchange Points – IXP's) in Africa, Europe, Brazil, and USA.

      AC CLOUD: Flexible and scalable solution that can deliver cloud computing services offering customers greater performance, productivity, and cost savings.

      REMOTE PEERING: Remote peering services provide customers with the ability to peering without a physical presence, using instead a remote peering provider (in that case "The Organization") to connect to Internet Exchange Points (IXP's).

- **IP Services:**

  IP TRANSIT**:** Local and international connectivity to content providers (CDNs) and access to major ISP's (Tier 1).

  SMART IP: Entry-level solution in IP Services' portfolio, which guarantees connectivity to global TIER 1 networks, low latency, and excellent cost-effectiveness.

  IP GAMER: Specialized solution that can help gamers to overcome common connectivity issues and enjoy a smoother gaming experience.

  IP EXCHANGE: Solution that enables a network to exchange traffic with multiple operators through a single connection. IP Exchange provides seamless connectivity to more than 20 traffic exchange points (IXP) in Africa, Brazil, the United States and Europe – and more than 6 000 networks worldwide.

- **Data Center:**

  ANGONAP**:** Infrastructure designed with high-security standards, scalability, and energy redundancy able to provide hosting services and continuous connectivity. Accommodates services such as Colocation, Cross Connect, Remote Hands, Cloud, Smart Hands, Angonix – Internet Exchange Point, PIX.

  MANAGED SERVICES: The Managed Services service allows a company to have support for items such as routing, switching, security, VoIP, infrastructure, and others to be designed, implemented, and managed by a team of specialists from "The Organization", saving the company from errors in their network or supplying the need for manpower to do so.

- **ICT:**

  ANTI-DDOS**:** Solution for Internet Service Providers who want to ensure complementary layers of security in their services and additional levels of protection against DDoS attacks, using an intelligent solution, automated and adapted to the emerging threats in the online environment.

  SDWAN**:** Solution for entities that have more than one access point and convergence of their network, interested in centralising their WAN network and optimising the use of their circuits, resulting in a reduction in network costs.

  DARK FIBER**:** Solution for ISPs and other network providers looking for bandwidth to expand theirnetworks while retaining autonomyand service control.

- **GDI:** Solution for ISPs, carriers, multinational enterprises for the corporate and financial markets to streaming and gaming service providers or any other network operators wishing to connect to the main international hubs and data centers.

- The company's services are aimed at improving connectivity and reducing the digital divide between Africa and the rest of the world.
- “The Organization” is a telecommunications company that provides connectivity solutions for the African and South American regions. Some of its main competitors in the industry include other international and regional telecommunications companies that are:
    - MTN Group - a multinational mobile telecommunications company based in South Africa with operations in several African and Middle Eastern countries.
    - Orange S.A. - a French multinational telecommunications corporation that operates in more than 30 countries.
    - Vodafone Group - a British multinational telecommunications company that operates in Europe, Asia, Africa, and Oceania.
    - Telkom SA SOC Limited - a South African wireline and wireless telecommunications provider.
    - Liquid Telecom - a pan-African telecommunications company providing voice, data, and Internet services to businesses and individuals.
    - Tata Communications - is a global telecommunications company based in Mumbai, India. It provides a range of services including network connectivity, cloud services, security solutions, and unified communications to customers in more than 200 countries and territories worldwide.
    - China Unicom - is a Chinese state-owned telecommunications company that provides a range of services including mobile and fixed-line voice and data services, broadband access, and various value-added services.
- “The Organization” legal nature is a private company that is incorporated under the laws of Angola. It was established in 2009 as a limited liability company (LLC) under the name “ The Organization” and Sistemas de Telecomunicações Limitada, with its headquarters located in Luanda, Angola. As an LLC, “The Organization” is a separate legal entity from its owners, and its liability is limited to its assets.

  In 2014, “The Organization” was transformed into a joint-stock company, and its name was changed to “The Organization” S.A. The company is owned by a group of private investors, including the Angolan state-owned oil company Sonangol, and it operates as a commercial entity in the telecommunications and undersea cable industry. The CEO was António Nunes since its foundation until the year of 2021. The actual CEO is Ângelo Gama as well as the chairman of the Management Board.

- Stakeholders:
    - Shareholders: Unitel (51%), Sonangol (31%), MS Telcom (9%), Angola Telecom (6%), Startel (3%).
    - Customers: The Organization's customers are the businesses and organizations that use its telecommunications and undersea cable services. They have a stake in the company's success and depend on its services to operate their businesses.
    - Employees: The Organization's employees are a vital stakeholder group who contribute to the company's success. They have a stake in the company's financial performance, reputation, and work environment.
    - Government: The Organization's operates in Angola and is subject to the laws and regulations of the Angolan government. The government has a stake in the company's success and can impact its operations through its policies and regulations.
    - Partners and suppliers: The Organization's works with various partners and suppliers to provide its services. These stakeholders have a stake in the company's success and may be impacted by its financial performance or operational changes.
    - Local communities: The Organization's operates in communities where it has an impact on the local economy and society. The company has a stake in maintaining positive relationships with these communities and being a responsible corporate citizen.
- "The Organization" is a multinational with offices in 3 countries and a highly skilled team of about 135 employees from different backgrounds and cultures from Angola, Brazil, South Africa, Portugal, Ghana, and Nigeria. The three representative offices are in Luanda (Angola), Fortaleza (Brazil) and Johannesburg (South Africa). The company consists of 2 main directions formed by several departments and several departments which are:
    - Technical Direction
        - Operations Department
        - Engineering Department
        - Infrastructure Department
        - Information Systems Department
        - Technological Innovation Department
        - Project Management Department
    - Commercial Direction
        - Sales Department
        - Customer Care Department
        - Post Sales Department

        - Channels and Operations
    - Marketing Department
        - Pre-Sales Section
        - Product Management Section
    - Procurement Department
    - Planning and control Department
    - Finance Department
    - Legal Department
    - Secretariat Department
    - Human Resources Department
    - Administrative Services Department

4.1.2. Business Architecture

The company's business strategy is focused on building a strong network infrastructure and leveraging that infrastructure to provide new and innovative services to customers in Africa and around the world. By doing so, the company is well-positioned to take advantage of the growing demand for connectivity and cloud services in the region. The company's strategic processes are geared towards providing reliable, secure, and high-speed connectivity solutions to its customers through a combination of subsea cable systems, data centers, and cloud services, while also investing in innovation and forging strategic partnerships with key players in the industry. Hence, the processes are resumed in subsea cable system development, data center expansion, partnership and alliances, customer focus, and innovation.

The business architecture of the company consists, therefore, of several components:

1. Infrastructure: The company owns and operates a network of submarine and terrestrial cables that connect Africa to the Americas and Europe. This infrastructure enables the company to provide high-speed, reliable internet connectivity to its customers.

2. Products and services: The company offers a range of products and services to its customers, including internet connectivity, cloud services, data center hosting, and managed services. These offerings are designed to meet the needs of businesses of all sizes, from small startups to large enterprises.

3. Sales and marketing: The company uses a combination of direct sales and marketing to reach potential customers. The company works with channel partners, such as system integrators and value-added resellers, to expand its reach and offer customers a complete solution.

4. Operations and support: The company has a dedicated team of professionals who are responsible for managing the company's network and ensuring that its services are available to customers 24/7. The company also provides customer support to help customers troubleshoot any issues they may encounter.
5. Partnerships and alliances: The company has formed strategic partnerships and alliances with other companies in the telecommunications industry to expand its reach and offer customers a wider range of products and services.

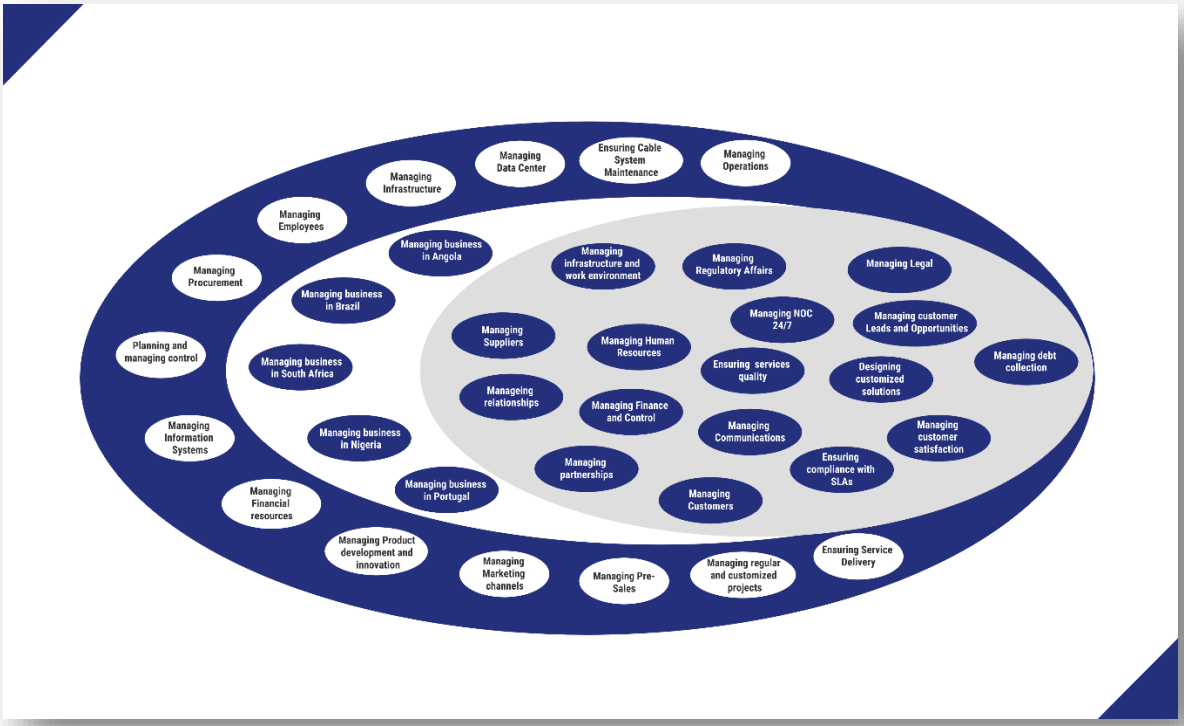


Figure 4-2 – “The Organization” Business Architecture

4.1.3. Processes Architecture

The Organization presents on its portfolio 4 macro processes that work together to enable the company to deliver reliable and high-quality connectivity solutions to its customers. The macro processes are the following:

1. Infrastructure Development: The Organization develops and operates submarine and terrestrial cable networks, data centers, and other telecommunications infrastructure.
2. Network Operations: The Organization manages the day-to-day operations of its network, ensuring high availability and reliability of its services.

3. Sales and Marketing: The Organization engages with customers to promote its services and develop new business opportunities. This includes marketing campaigns, customer support, and sales activities.

4. Business Support: The Organization has various support functions, including finance, human resources, legal, and regulatory compliance. These functions enable the company to operate efficiently and in compliance with relevant laws and regulations.

Main Value Chain Process	Name	Description
Infrastructure Development	Cable Systems Maintenance processes	Ensure that the company operates the cable systems MONET, SACS and WACS effectively and efficiently and periodically performs maintenances to guarantee business continuity by providing providing reliable communication or transmission of data. These processes include Cable System Inspection, Cable System Cleaning, Cable System Repairs, Cables Systems Testing, Cable System Documentation.
	Data Center Maintenance processes	Ongoing process that requires regular attention and upkeep to ensure optimal performance and uptime in both data centers the company owns in Angola and Brazil. The processes are: Cooling system maintenance, Electrical system maintenance, Server and network equipment maintenance, Security system maintenance, Environmental monitoring.
	Innovation, new infrastructure, and upgrade strategy processes	Processes related to the innovation, upgrade of the cable systems and/or data center. Upgrading the cable system to support newer technologies or higher bandwidth, which may involve replacing cables, connectors, or other components of the system. As for the data center, the strategy processes of innovation and upgrade are designed to improve the performance, capacity, and reliability of the infrastructure.
Network Operations	Network Monitoring	NOC processes that continuously monitors the network infrastructure to identify any issues or anomalies that may affect network performance or availability.

Main Value Chain Process	Name	Description
Network Operations	Incident Management	The NOC process responsible for managing incidents that occur within the network infrastructure, including identifying, prioritizing, and resolving incidents.
	Change Management	Processes that manage changes to the network infrastructure, ensuring that all changes are properly planned, tested, and implemented to minimize the risk of disruption to network operations.
	Performance Management	NOC processes that monitors network performance to identify areas where improvements can be made, including monitoring of network traffic, bandwidth utilization, and response times.
	Vendor Management	NOC processes that manages relationships with vendors and suppliers to ensure that the network infrastructure is properly supported and maintained.
	Documentation Management	The NOC maintains documentation on network infrastructure, including network diagrams, configuration files, and other important documents to ensure that the network infrastructure is properly managed and maintained.
	Reporting and Analysis	NOC processes to generate reports on network performance, incidents, and other key metrics to identify trends and areas for improvement. This analysis helps the NOC to proactively manage the network infrastructure and improve network performance and availability.
Sales and Marketing	Market Research	Marketing processes for gathering and analyzing data on the target market, including customer needs, preferences, and behaviors.
	Product Development	Processes for developing products or services that meet the needs of the target market.

Main Value Chain Process	Name	Description
Sales and Marketing	Branding and Positioning	Processes for creating a brand identity and positioning the company and its products or services in the minds of potential customers.
	Advertising and Promotion	Processes for creating and implementing advertising campaigns to promote the company's products or services to potential customers.
	Sales Process	Developing a sales process, including lead generation, prospecting, qualifying, and closing sales.
	Customer Relationship Management	Developing and maintaining relationships with customers, including providing customer service and support.
	Sales Forecasting and Analysis	Forecasting sales, analyzing sales data, and adjusting sales strategies as needed.
	Channel Management	Processes for managing the distribution channels for the company's products or services, including partnerships, resellers, and retailers.
	Pricing Strategy	Processes for developing pricing strategies that reflect the value of the company's products or services and are competitive in the market.
	Metrics and Analytics	Processes for measuring and analyzing the performance of sales and marketing efforts, including ROI, conversion rates, and customer acquisition costs.
	Service Delivery Management	Processes related to the operation to activate or deactivate a service and notify the customer.
Business Support	Customer service	This process includes handling inquiries, complaints, and feedback from customers, providing support to customers, and resolving any issues they may have.

Main Value Chain Process	Name	Description
Business Support	Financial management	This process involves managing the company's finances, including budgeting, accounting, and financial reporting.
	Procurement and supply chain management	This process includes sourcing, purchasing, and managing the delivery of goods and services that the company requires to operate.
	Human resources	This process involves recruiting, hiring, and training employees, managing employee benefits and compensation, and ensuring compliance with labor laws.
	Information technology	This process includes managing and maintaining the company's IT infrastructure, including hardware, software, and networks.
	Legal and regulatory compliance	This process involves ensuring that the company complies with all applicable laws and regulations, including those related to data privacy, security, and intellectual property.

Table 4.1.3-1 – Main processes of the company

Considering the nature of the business the main processes of the value chain involve a huge number of processes that couldn't be here express on an effectively way, not to mention that some processes are confidential to the company and have not been shared with me during the survey process and interviews. Therefore, the processes that will be exposed in this project work will be the ones related to the consumer to complete a sale, naming **Sales and Marketing** processes along with the **Business Support** systems that make the sale happen.

4.1.4. Informational Architecture

The Organization informational architecture depends on the specific technologies and systems the company uses to support its operations and services. At a high level, the Organization's informational architecture for Sales and Marketing, and some Business support systems would likely include entities such as:

1. **Lead**: A lead for “The Organization” is a potential customer who has shown interest in the company’s products or services. This could be through a website inquiry, a phone call, or any other form of contact where the potential customer has expressed some level of interest.

2. **Opportunity**: An opportunity for “The Organization” is a potential sale that has progressed beyond the lead stage. This means that the sales team has identified a specific need or problem that the potential customer has, and they have a solution that could potentially solve it. The opportunity represents a chance to make a sale.

3. **Customer**: A customer for “The Organization” is someone who has purchased the company’s products or services. Once a lead has been converted into a customer, they are considered to be part of the company’s customer base.

4. **Communication**: The communication entity is responsible for storing all the communications that are sent to the customers.

5. **Contract**: A contract for “The Organization” is a legally binding agreement between the company and the customer. It outlines the terms and conditions of the sale, including the product or service being sold, the price, the payment terms, and any other relevant details. The contract is signed by both parties as a way of formalizing the agreement.

6. **Product or service**: “The Organization” offers a range of telecommunications products and services, such as connectivity solutions, internet services, cloud services, and data center services.

7. **Inventory or Stock**: In the context of “The Organization”, inventory or stock refers to the physical equipment and materials used to provide its telecommunications services, such as cables, routers, servers, and other network equipment.

8. **Asset**: The company’s assets would include its physical infrastructure, such as undersea and terrestrial fiber optic cables, data centers, and other facilities, as well as its intellectual property, such as patents, trademarks, and proprietary technology.

9. **Supplier**: “The Organization” would have suppliers that provide it with the equipment, materials, and services it needs to operate and provide its services. These could include suppliers of network equipment, cables, software, and other technology, as well as service providers for things like maintenance and repair.

10. **Last Mile Provider**: A last mile provider for “The Organization” is a company or organization that provides the final leg of connectivity between Angola Cables' telecommunications network and end-users, such as homes, businesses, or other organizations. In other words, the last mile provider connects the end-users to Angola Cables' network.

11. **Sales Orders**: Also known as Order Forms is a document that outlines the details of a customer's request for products or services provided by “The Organization”. It typically includes information such as the quantity of items ordered, the unit price, the total amount owed, shipping and billing addresses, and other terms and conditions of the sale.

12. **Operation**: Entity or process responsible for the provisioning of the necessary equipment, network connections, and configurations to provide the subscribed service to the customer, testing which verifies that the service is working correctly and meets the service level agreement (SLA) requirements before activating it for the customer, service activation that activates the service that has already been provisioned and tested, and notification that notifies the customer that their service is ready for use and provides any necessary login credentials or other details needed to access the service.

13. **Payment**: Entity responsible for processing al the transactions to ensure the provisioned and activated service is paid by the customer.

14. **Debt Collection**: Entity responsible for ensuring that the customer debts are properly claimed within the terms and conditions celebrated in the agreement and enforce to the customer the penalties involved.

15. **Customer Service**: Entity responsible for managing customer accounts, including billing and payment issues, as well as managing customer feedback and complaints. Ensure also that customers have a positive experience with “The Organization” and that they are satisfied with the company's services.

16. **Pricing**: Entity responsible for determining the prices of the company's various products and services that are competitive and reflect the value that the company provides to its customers.

17. **Procurement Database**: Entity that stores all the procurement information such as contracts, proposals, supplier details, etc., that serves a support to complete the sale.

18. **Service Delivery**: Entity that stores all the processes related to the delivery of a service such as activation or deactivation.

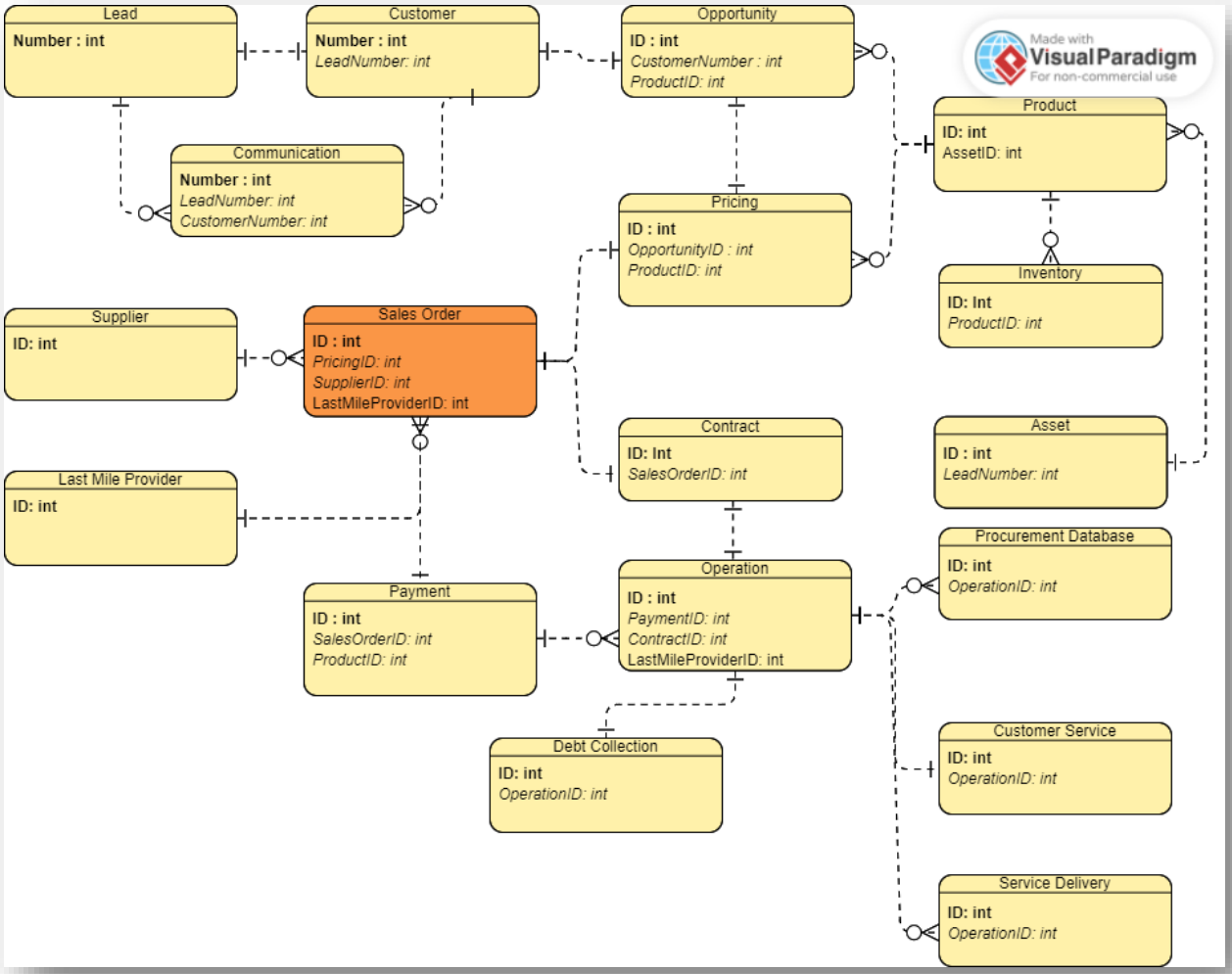


Figure 4-3 - Informational Architecture Diagram of Sales Process

4.1.4.1. Informational Entities

Name	Lead	
ID	LD	
Description	Information about Leads	
Breakdown	Divided by Lead Type	
Attributes	Name	LDID
	Description	Lead ID
	Name	Type
	Description	Define the Lead Type
	Name	OTHER
	Description	Define other not as important details

Table 4.1.4-1 – Lead Entity

Name	Opportunity	
ID	OPTY	
Description	Information about Opportunities	
Breakdown	Divided by Opportunity Type	
Attributes	Name	OPTYID
	Description	Opportunity ID
	Name	Type
	Description	Define the Opportunity Type
	Name	CustomerID
	Description	Define the Customer ID
	Name	ProductID
	Description	Define the Product ID
	Name	OTHER
	Description	Define other not as important details

Table 4.1.4-2 – Opportunity Entity

Name	Customer	
ID	CSTMR	
Description	Information about Customers	
Breakdown	Divided by Customer Type	
Attributes	Name	CSTMRID
	Description	Customer ID
	Name	Type
	Description	Define the Customer Type
	Name	LDID
	Description	Define the Lead ID
	Name	OTHER
	Description	Define other not as important details

Table 4.1.4-3 – Customer Entity

Name	Communication	
ID	CMM	
Description	Information about Communication sent to Customers	
Breakdown	Divided by Lead and Customer IDs	
Attributes	Name	CMMID
	Description	Communication ID
	Name	LDID
	Description	Define the Lead ID
	Name	CSTMRID
	Description	Define the Customer ID
	Name	OTHER
	Description	Define other not as important details

Table 4.1.4-4 – Communication Entity

Name	Product	
ID	PRD	
Description	Information about Products	
Breakdown	Divided by Product Type	
Attributes	Name	PRDID
	Description	Product ID
	Name	Type
	Description	Define the Product Type
	Name	AssetID
	Description	Define the Asset ID
	Name	OTHER
	Description	Define other not as important details

Table 4.1.4-5 – Product Entity

Name	Asset	
ID	AST	
Description	Information about Assets	
Breakdown	Divided by Assets	
Attributes	Name	ASTID
	Description	Asset ID
	Name	Description
	Description	Define the Asset Description
	Name	OTHER
	Description	Define other not as important details

Table 4.1.4-6 – Asset Entity

Name	Supplier	
ID	SPLR	
Description	Information about Suppliers	
Breakdown	Divided by ID	
Attributes	Name	SPLRID
	Description	Supplier ID
	Name	Name
	Description	Define the Supplier Name
	Name	OTHER
	Description	Define other not as important details

Table 4.1.4-7 – Supplier Entity

Name	Last Mile Provider	
ID	LMPVRD	
Description	Information about Last Mile Providers	
Breakdown	Divided by ID	
Attributes	Name	LMPVRD ID
	Description	Last Mile Provider ID
	Name	Name
	Description	Define the Provider Name
	Name	OTHER
	Description	Define other not as important details

Table 4.1.4-8 – Last mile Provider Entity

Name	Inventory	
ID	ITEM	
Description	Information about Inventory items	
Breakdown	Divided by ID	
Attributes	Name	ITEMID
	Description	Inventory Item ID
	Name	Name
	Description	Define the Item Name
	Name	OTHER
	Description	Define other not as important details

Table 4.1.4-9 – Inventory Entity

Name	Pricing	
ID	ID	
Description	Information about pricing of an apportunity	
Breakdown	Divided by ID	
Attributes	Name	ID
	Description	ID of the specific pricing
	Name	OpportunityID
	Description	Define the Opportunity ID
	Name	ProductID
	Description	Define the Product ID
	Name	OTHER
	Description	Define other not as important details

Table 4.1.4-10 – Pricing Entity

Name	Sales Order	
ID	ID	
Description	Information about a Sales Order	
Breakdown	Divided by Sales ID	
Attributes	Name	ID
	Description	ID of the Sales
	Name	PricingID
	Description	Define the ID of the final and approved pricing of an opportunity
	Name	SupplierID
	Description	Define the Supplier ID
	Name	LastMileProviderID
	Description	Define the ID of the Last Mile Provider
	Name	OTHER
	Description	Define other not as important details

Table 4.1.4-11 – Sales Order Entity

Name	Contract	
ID	CNT	
Description	Information about Contracts	
Breakdown	Divided by ID	
Attributes	Name	CNTID
	Description	Contract ID
	Name	SalesOrderID
	Description	Define the ID of the sales order
	Name	OTHER
	Description	Define other not as important details

Table 4.1.4-12 – Contract Entity

Name	Payment	
ID	PYMNT	
Description	Information about the payment details of a Sales Order	
Breakdown	Divided by Sales ID	
Attributes	Name	ID
	Description	ID of the Payment
	Name	SalesOrderID
	Description	Define the ID of the Sales Order
	Name	ProductID
	Description	Define the Product ID
	Name	OTHER
	Description	Define other not as important details

Table 4.1.4-13 – Payment Entity

Name	Operation	
ID	OPRT	
Description	Information about the operation of a Sales Order	
Breakdown	Divided by Operation ID	
Attributes	Name	ID
	Description	ID of the Operation to activate the request of the sales order
	Name	PaymentID
	Description	Define the ID of the payment
	Name	ContractID
	Description	Define the Contract ID
	Name	LastMileProviderID
	Description	Define the ID of the Last Mile Provider
	Name	OTHER
	Description	Define other not as important details

Table 4.1.4-14 – Operation Entity

Name	Customer Service	
ID	CS	
Description	Information about Customer requests after the activation of the service	
Breakdown	Divided by requests ID related to customers	
Attributes	Name	CSID
	Description	Customer Service ID
	Name	OperationID
	Description	Define the ID of the Operation related to a Sales Order
	Name	OTHER
	Description	Define other not as important details

Table 4.1.4-15 – Customer Service Entity

Name	Debt Collection	
ID	DC	
Description	Information about Customers that have debt	
Breakdown	Divided by processes of customers who have debts	
Attributes	Name	DCID
	Description	Debt Collection ID
	Name	OperationID
	Description	Define the ID of the Operation related to a Sales Order
	Name	OTHER
	Description	Define other not as important details

Table 4.1.4-16 – Debt Collection Entity

Name	Procurement Database	
ID	PROC	
Description	Information about procurement processes	
Breakdown	Divided by Procurement ID	
Attributes	Name	PROCID
	Description	ID of Procurement Request
	Name	OperationID
	Description	Define the ID of the Operation related to a Sales Order
	Name	OTHER
	Description	Define other not as important details

Table 4.1.4-17 – Procurement Entity

Name	Service Delivery	
ID	SD	
Description	Information about the delivery of a service	
Breakdown	Divided by Procurement ID	
Attributes	Name	SDID
	Description	ID of the service delivery process
	Name	OperationID
	Description	Define the ID of the Operation related to a Sales Order
	Name	OTHER
	Description	Define other not as important details

Table 4.1.4-18 – Service Delivery Entity

4.1.5. Applicational Architecture

"The Organization" contains an applicational architecture that is formed by singular applications responsible to manage the tasks that support the business, but the majority isn't whatsoever integrated between each other. Some of the supporting processes are handled through excel sheets which makes the operation to be very manual and dependent mostly on human effort.

The applications portfolio that supports the sales process are SAP, SPIRO, BMC Remedy, Web APC, Procurement Database, Pricing Management, Product Management, Service Delivery Management, Contract Management, Customer Care.

SAP: Is "The Organization" ERP that stands for Systems, Applications, and Products in Data Processing. SAP is used in "The Organization" for finance and accounting, human resources management and part of contract management.

SPIRO: Is "The Organization" CRM that stands for Customer Relationship Management, is designed to help sales team increase their productivity, and improve their sales outcomes. Spiro CRM uses artificial intelligence (AI) to automate many of the tasks associated with sales, such as lead generation, contact management, and sales forecasting. It integrates with email, calendars, and other sales tools to provide a comprehensive view of sales activities and opportunities.

Order Form: Homemade application developed in SharePoint that communicates with SPIRO CRM via API and it is responsible to generate the proposal of the customer. Contains information about the customer, products he wants to purchase, pricing and legal terms.

BMC Remedy (OSS): Is the software "The Organization" uses to help the operations (NOC and Engineering department) to manage and automate their IT service management (ITSM processes), most specifically Incident and Problem Management and Service level management. The incident and problems management provides tools for logging, tracking, and resolving incidents and problems. It also includes features for categorizing and prioritizing incidents and problems based on their impact and urgency. Service level management includes tools for defining and tracking service level agreements (SLAs) and service level objectives (SLOs). It provides real-time monitoring and reporting on service performance, as well as tools for identifying and addressing service-related issues.

Technical Information Form (TIF): Document that contains the technical information that needs to be sent to the Engineering team to activate the service the customer purchased.

Web APC: Is an application built in-house responsible to manage the Purchase Requisition process from the requisition until the approval process. Is integrated with SAP as it functions as a front end with a more user-friendly interface that allows normal users to create requests with no difficulties.

Procurement Form: An extension of Web APC that accommodates the requests a user sends to Procurement team.

Procurement database: Is an excel sheet that procurement team uses to keep record of their activities and to do list after a request is made through the platform Web APC by a user.

Pricing management: Manual process that gathers documents that the Pricing team uses to establish the pricing of a contract based on the technical specifications of the sale.

Product management: Manual process that gathers documents that the Marketing team uses to manage the conception of a product.

Service Delivery management: Manual process that gathers documents that the Customer Service team uses to manage the activation, deactivation, maintenance of a product once the sale is finalized with the costumer.

Contract management: Manual process that gathers documents that the Legal team uses to manage customer and supplier contracts.

Customer Care: Manual process that gathers documents that the Post Sale team uses to manage the customer experience and debt collection.

Marketing APP: An application used by Marketing to send communications to the customers.

Customer Care APP: An application used by Post Sales team to measure the customer satisfaction.

Legal Requests Management: SharePoint form developed in-house to accommodate requests that are sent to legal team for treatment.

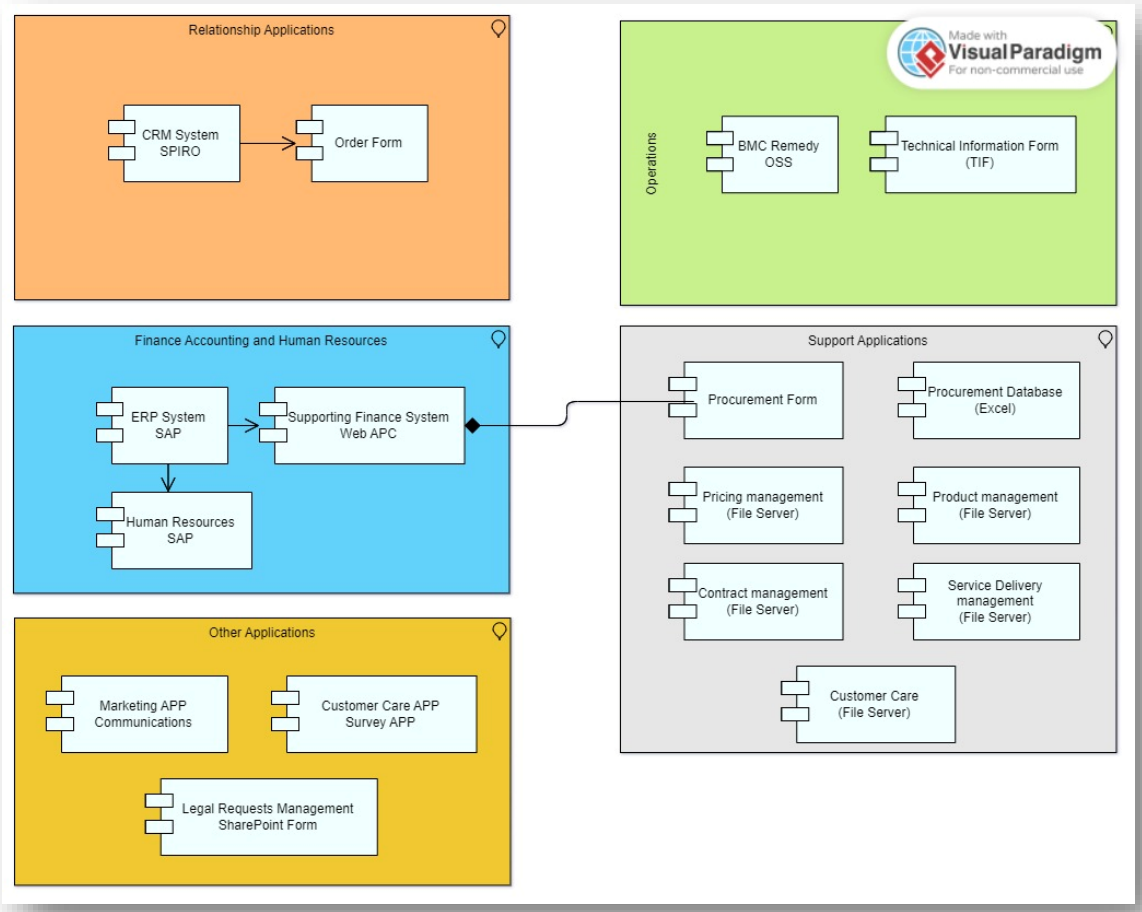


Figure 4-4 - Applicational Architecture Diagram of Sales Process

The actual above information systems architecture of "The Organization" leads to several setbacks and challenges such as:

1. Data Redundancy and Inconsistency: Without an integrated architecture, different systems may store and manage data independently, resulting in data redundancy and inconsistency. This can lead to errors, inaccuracies, and difficulties in maintaining data integrity and consistency across the organization.

2. Lack of Data Accessibility and Timeliness: In the absence of integration, accessing and sharing data across systems becomes cumbersome. It can be challenging to retrieve real-time or accurate information from various systems, impeding decision-making processes and delaying responses to business needs.

3. Inefficient Business Processes: Disconnected systems hinder streamlined and automated business processes. Each system may have its own set of workflows, leading to redundant manual tasks, data entry duplication, and inefficient coordination among different departments. This can slow down operations, increase costs, and introduce errors.

4. Limited Reporting and Analytics Capabilities: An integrated information systems architecture allows for centralized data repositories and enables comprehensive reporting and analytics. Without integration, generating accurate and meaningful reports becomes difficult, hindering strategic decision-making and the ability to derive insights from data.

5. Higher IT Costs: Maintaining and supporting multiple non-integrated systems can be costlier in terms of licensing, hardware, maintenance, and training. It also requires dedicated IT resources to manage and support each system separately, leading to increased complexity and higher overall IT costs.

6. Scalability and Flexibility Challenges: Non-integrated systems often lack scalability and flexibility, making it harder to adapt to changing business requirements and technological advancements. Integrating systems allows for easier expansion, integration of new applications, and leveraging emerging technologies.

7. Security and Data Privacy Risks: In the absence of an integrated architecture, it can be challenging to implement consistent security measures and ensure data privacy. Each system may have its own security protocols, making it difficult to manage and protect sensitive information across the organization effectively.

Overall, not having an integrated information systems architecture can result in operational inefficiencies, data inconsistencies, limited decision-making capabilities, higher costs, and security risks. Organizations can benefit greatly from implementing an integrated architecture that promotes data consistency, streamlined processes, and agility in responding to changing business needs.

4.1.6. Technological Architecture

In terms of technological architecture “The Organization” contains a robust infrastructure whether on-premises as cloud applications to guarantee the continuity of the sales operation.

The technological infrastructure that is going to be mentioned in this section is the one that support the applicational architecture. Therefore, each system will be represented individually.

4.1.6.1. SAP

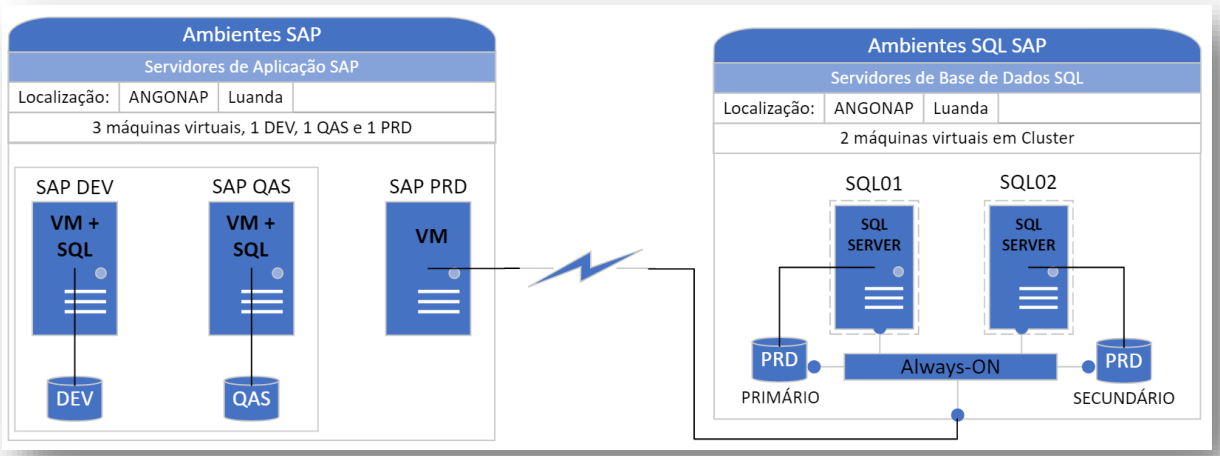


Figure 4-5 – SAP Technological Infrastructure

The SAP environment is divided into two parts, the Application servers, and the Database servers. Both groups of servers are located at the Angonap Datacenter in Luanda, in VM (Virtual Machines) format.

The Application server groups are divided into 3 servers, 1 for Development (DEV), 1 for Quality (QAS) and 1 for Productive (PRD). The 3 environments serve for segregation and layered developments, where all initial developments are done in the DEV environment, then tested in the QAS environment, to finally be transported to PRD.

The DEV and QAS servers are Single Server servers, where the Application and the Database are installed and configured in the same VM. For the 3 servers, the same OS and SQL requirement must be met for SAP to work properly. That is, they must all have the same OS and the same version of SQL Server.

The database server groups are divided into 2 Cluster servers in an Always-ON structure, which are SVANGSQL001 as Primary Server and SVRANGSQL002 as Secondary Server. The SAP instance (ANG_SAPERP) only has a single database called PRD.

For DEV and QAS environments, the database instance is configured on the same Application server and are in SQL 2012 and Windows Server 2012 versions.

4.1.6.2. BMC Remedy (OSS)

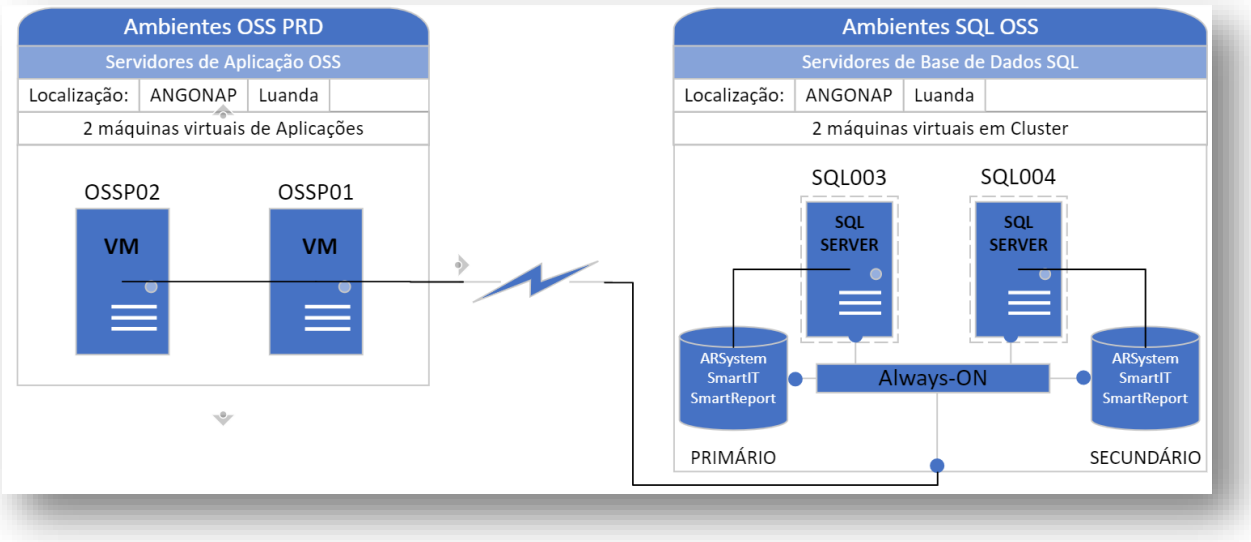


Figure 4-6 – OSS Production Technological Infrastructure

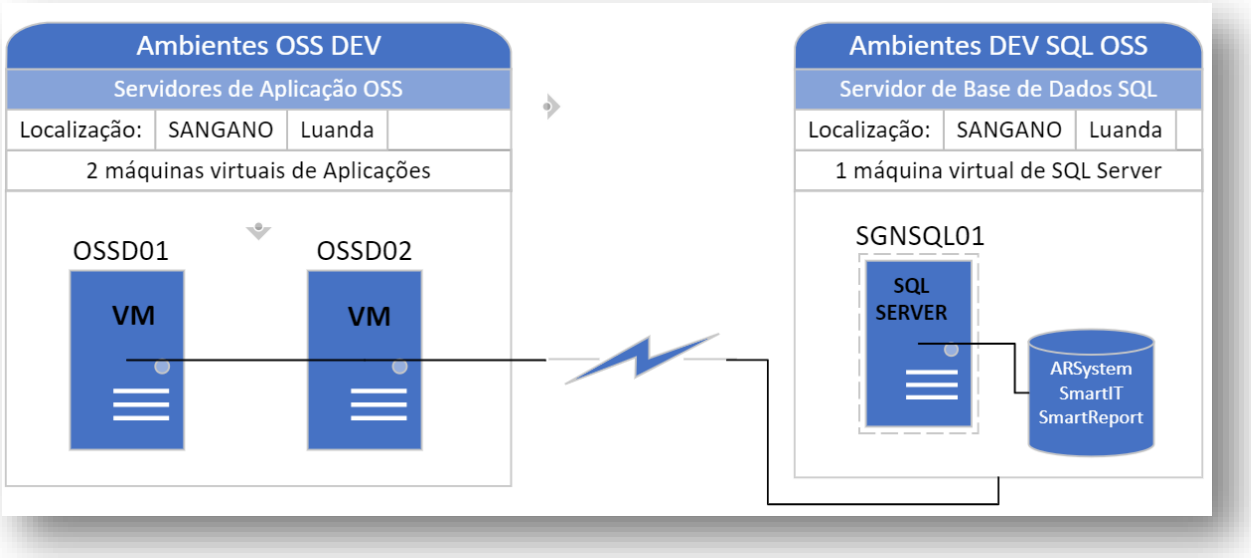


Figure 4-7 – OSS Development Environment Technological Infrastructure

The OSS environment is divided into two parts, the Application servers, and the Database servers.

Both groups of servers are located at the Angonap Data Center in Luanda, in VM (Virtual Machines) format. It only has the DEV Database server (SVRSGNSQL001) which is located at CLS Sangano in Sangano.

The Application server groups are divided into 4 servers, 2 for Development (DEV) and 2 for Production (PRD), where the BMC services are executed in server mode for connecting their clients.

The database server groups are divided into 2 Cluster servers in an Always-ON structure, which are SVANGSQL003 as Primary Server and SVRANGSQL004 as Secondary Server. The OSS instance (ANG_OSS17) on both servers has three databases called ARSystem, SmartIT and SmartReport.

For the DEV environment, the database instance (SGN_OSSDEV17) is configured on another server (SVRSGNSQL001) in Sangano, shared with other instances of other Applications.

4.1.6.3. SPIRO

SPIRO is a third party developed AI-driven software cloud-based. “The Organization” uses it under the cloud computing model SaaS (Software as a Service) in which software is licensed on a subscription basis and is centrally hosted, meaning “The Organization” pays as it goes from a cloud service provider.

4.1.6.4. Order Form

On-premises infrastructure developed on SharePoint on-premises 2013 composed by one server that runs Windows Server and SQL.

4.1.6.5. Web APC and Procurement form

On-premises infrastructure developed on SharePoint on-premises 2016.

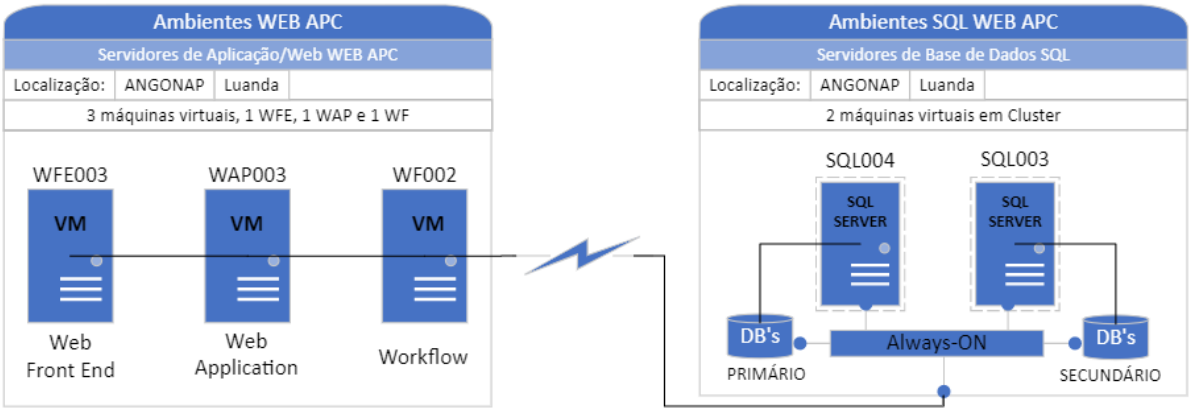


Figure 4-8 – Web APC Technological Infrastructure

The Intranet environment where the APC Web resides is divided into two parts, the Application/Web servers, and the Database servers.

Both groups of servers are located at the Angonap Datacenter in Luanda, in VM (Virtual Machines) format.

The Application/Web server groups are divided into 3 servers, 1 as an application server (WAP), 1 as a Web Front End server (WFE) and 1 as a Workflow Server (WF).

For the correct functioning of the APC Intranet and Web, the Application and Front-End Servers are mandatory. In this case, the WAP server is responsible for running some applications needed on the intranet (e.g., Profile) and some websites. The WFE server is considered the web server or where most of the necessary websites reside. The Workflows server was used for some additional configuration that is no longer in use.

The database server groups are divided into 2 Cluster servers in an Always-ON structure, which are SVANGSQL004 as Primary Server and SVRANGSQL003 as Secondary Server. The Intranet instance where Web APC resides (ANG_MSSPS2016) on both servers has several databases, in which the Web APC instance is WSS_Content_Forms_8000.

4.1.6.6. TIF (Technical Information Form)

Homemade form hosted on-premises in one server that runs Windows Server and SQL.

4.1.6.7. Procurement Database

Excel sheet used to store information about Procurement tasks and SLAs. Procurement also uses a synchronized file server on One drive to store all the information related to contracts, proposals, and suppliers.

4.1.6.8. Pricing management

A synchronized file server on One drive based on SharePoint online to store all the information related to pricing of customers proposals.

4.1.6.9. Product management

A synchronized file server on One drive based on SharePoint online to store all the information related to products Portfolio.

4.1.6.10. Contract management

A synchronized file server on One drive based on SharePoint online to store all the information related to contracts both of customers as suppliers.

4.1.6.11. Service Delivery management

A synchronized file server on One drive based on SharePoint online to store all the information related to contracts both of customers as suppliers during the activation or deactivation of a service.

4.1.6.12. Customer Care

A synchronized file server on One drive based on SharePoint online to store all the information related to contracts both of customers as suppliers after the activation or deactivation of a service to manage the customer experience.

4.1.6.13. Marketing APP

A third party developed cloud-based software. “The Organization” uses it under the cloud computing model SaaS (Software as a Service) in which software is licensed on a subscription basis and is centrally hosted, meaning “The Organization” pays as it goes from a cloud service provider. Used by Marketing for sending automatic communications to customers.

4.1.6.14. Customer Care APP

A third party developed cloud-based software. “The Organization” uses it under the cloud computing model SaaS (Software as a Service) in which software is licensed on a subscription basis and is centrally hosted, meaning “The Organization” pays as it goes from a cloud service provider. Used by Post Sales for running surveys to measure customer satisfaction.

4.1.6.15. Legal Requests Management

SharePoint online based form developed by using Power Automate to accommodate all requests sent to Legal department.

4.1.7. CRUD Matrix

Informational Entities

CRUD MATRIX	E1 - Lead				E2 - Opportunity				E3 - Customer				E4 - Contract				E5 - Product or service			
Market Research	R				R				R											
Product Development	R				R				R								C	R	U	D
Branding and Positioning	R				R				R								R			
Advertising and Promotion	R				R				R								R			
Sales Process	C	R	U		C	R	U		C	R	U	D					R			
Customer Relationship Management	R				R				R				R				R			
Sales Forecasting and Analysis	R				R				R								R			
Channel Management	R				R				R				R				R			
Pricing Strategy	R				R				R				R				R			
Metrics and Analytics	R				R				R				R				R			
Customer service	C	R	U		C	R	U		C	R	U		R				R			
Financial management									R				R				C	R	U	
Procurement and supply chain management									R				R				R			
Legal and regulatory compliance					R				R				C	R	U	D	R			
Service Delivery Management									R				R				R			

CRUD MATRIX	E6 - Inventory				E7 - Asset				E8 - Supplier				E9 - Last Mile Provider				E10 - Sales Orders			
Market Research																				
Product Development	R				R															
Branding and Positioning																				
Advertising and Promotion					R															
Sales Process	R				R				R				R				C	R	U	
Customer Relationship Management									R				R				R			
Sales Forecasting and Analysis	R				R															
Channel Management	R				R				R								R			
Pricing Strategy	R				R				R				R				R	U		
Metrics and Analytics	R				R				R				R				R			
Customer service	R				R				R				R				R			
Financial management	C	R	U	D	C	R	U		C	R	U	D	C	R	U	D	R			
Procurement and supply chain management	R				R				C	R	U		C	R	U		R			
Legal and regulatory compliance	R				R				R				R				R			
Service Delivery Management	R				R				R				R				R			

CRUD MATRIX	E11 - Operation				E12 - Payment				E13 - Debt Collection				E14 - Customer Service				E15 - Pricing			
Market Research																				
Product Development																	R			
Branding and Positioning																	R			
Advertising and Promotion																	R			
Sales Process	R				C	R	U										R			
Customer Relationship Management	R				R				R				C	R	U		R			
Sales Forecasting and Analysis																				
Channel Management	R				R				R				R				R			
Pricing Strategy	R				R	U											C	R	U	D
Metrics and Analytics	R				R				R				R				R			
Customer service	R				R				C	R	U		C	R	U		R			
Financial management	R				C	R	U		R	U			R				R			
Procurement and supply chain management	R				R				R				R				R			
Legal and regulatory compliance	R				R				R				R				R			
Service Delivery Management	R	U			R				R				R				R			

CRUD MATRIX	E16 - Communication				E17 - Procurement Database				E16 - Service Delivery			
Market Research												
Product Development												
Branding and Positioning	C	R	U									
Advertising and Promotion	C	R	U	D								
Sales Process	R								R			
Customer Relationship Management	R				R				R			
Sales Forecasting and Analysis												
Channel Management	R				R				R			
Pricing Strategy												
Metrics and Analytics	R				R				R			
Customer service	R				R				R			
Financial management												
Procurement and supply chain management					C	R	U	D	R			
Legal and regulatory compliance					R				R			
Service Delivery Management									C	R	U	D

Business Processes

Figure 4-9 - CRUD Matrix

4.2. THE ORGANIZATION – TO BE

This section provides us with the desired future for the Information System and how it should be supported by technology and the way to realize this support.

Basically, is thinking about tomorrow.

GAP	Description
GAP by non-coverage	1. **Product Development**: There is no application or system to stand this process for files on a shared one drive folder are used for this purpose. 2. **Pricing Management**: There is no system to manage the pricing of products and services. The process is handled manually through files located on a shared one drive folder. 3. **Customer Portal**: There is no portal for customers to provide them with secure access to information, services, and support resources related to the Organization's products or services.
GAP for partial coverage	1. **Procurement and supply chain management**: The SAP and Web APC system partially covers the entire process of handling the purchase requisitions, procurement requests, inventory, and asset management. However, the procurement database that contains the procurement activities for each request is managed on an excel sheet. 2. **Channel Management:** The CRM contains the information about customers, sales, products and services, segments, market. But the distribution channels for partners is managed apart from the CRM manually on excel sheets. 3. **Legal and regulatory compliance**: Requests are made to Legal department on a cloud-based form on SharePoint online. However, after that, the management of contracts whether of customers or suppliers are dealt on a manual manner and stored on a shared one drive folder.

GAP	Description
Non integration GAP	1. **Sales Process**: CRM System (SPIRO), ERP system (SAP), Operations System (OSS) aren't integrated. Meaning that each one runs individually, and the merging of information is done manually. 2. **Operations**: There is no integration between OSS and TIF (Technical Information Form). 3. **Service Delivery**: There is no integration between OSS and Service Delivery processes. All the interaction and communication are done via e-mail. The communications to the customer to inform the state of the operation is handled manually. 4. **Customer Service**: The application used by Post Sales for running the surveys isn't integrated with CRM system. 5. **Marketing Communications**: The application Marketing used to send communications to the prospects, customers, is not integrated with CRM system.

Table 4.1.7-1 – Gap characterization

4.2.1. Identification of ISO

ISO 1 – Product Management System

- Origin: ISO by gap
- Description /Justification: Given the nonexistence of an Application System for the process to create a new product, it is important to implement a Product Management system. The existing CRM system contains already a product module, then it is a matter of acquiring the module and customize it accordingly.

ISO 2 – Pricing Management System

- Origin: ISO by gap
- Description /Justification: There is no system to manage the pricings of products based on the specifications of each proposal. Then, the implementation of a system to handle this functionality is a must have. The existing CRM can be customized to accommodate this feature meaning the pricing team would need to have licenses into the CRM too.

ISO 3 – Customer Portal

- Origin: ISO by gap
- Description /Justification: There is no portal for the customer to help him manage its account, have access to the resources, make orders and monitor its purchases. Therefore, it is important that the company develops a portal oriented to the customer.

ISO 4 – System component for Procurement process

- Origin: ISO by partial gap
- Description /Justification: There is no component in the current system Sap or Web APC to cover the procurement process form its beginning to the end. Hence, it is important to implement a system integrated with Web APC that accommodates all tasks procurement process requires.

ISO 5 – System component for Channel Management

- Origin: ISO by partial gap

- Description /Justification: Given the nonexistence of a component to manage the partners channels, it is important to customize within CRM a module to handle this feature.

ISO 6 – System component for contract management

- Origin: ISO by partial gap
- Description /Justification: Given the requests to legal and handled on an application, but the contracts are managed manually, an application integrated with Procurement system too should be implemented for the purpose of handling contracts on a more synchronized and automatic way.

ISO 7 – Integrated Sales Process – Sales Order Management

- Origin: ISO by integration
- Description /Justification: Considering CRM, ERP and Operations systems contribute for the sales process, and both use information interchangeably, the same need to be integrated.

ISO 8 – Integrated Operations

- Origin: ISO by integration
- Description /Justification: OSS and TIF (Technical Information Form) need to be integrated for the TIF is a consequence of the operational process before it goes to the Engineering team.

ISO 9 – Integrated Customer Service

- Origin: ISO by integration
- Description /Justification: The application used by Post Sales team for measuring the customer satisfaction isn't integrated with CRM. An integration must occur between these two systems to avoid Post Sales team to duplicate customer information in a separate database.

ISO 10 – Integrated Marketing Communications

- Origin: ISO by integration

Description /Justification: The application used by Marketing team for sending communications isn't integrated with CRM. An integration must occur between these two systems to avoid Marketing team to duplicate customer information in a separate database.

4.2.2. Organic matrix X ISO

	Organic X ISO matrix	Operations	Sales	Customer Care	Service Delivery	Channels and Operations	Marketing	Finance	Legal	Procurement
ISO	Product Management System						X			
	Pricing Management System						X			
	Customer Portal			X			X			
	System component for Procurement process									X
	System component for Channel Management					X				
	System component for contract management								X	X
	Integrated Sales Process – Sales Order Management	X	X	X	X	X	X	X	X	X
	Integrated Operations	X			X					
	Integrated Customer Service			X						
	Integrated Marketing Communications						X			

Table 4.2.2-1 – Organic matrix X ISO

4.2.3. Grouping of ISO and existing applications AS

		Application Systems			
	Applicational Systems / Exisiting Apps + ISO	AS1 - CRM	AS2 - ERP	AS3 - Sales Order Management	AS4 - IT Service Management System
Existing Applications/ISO	ISO 1 - Product Management System	X			
	ISO 2 - Pricing Management System	X			
	ISO 3 - Customer Portal	X			
	ISO 4 - System component for Procurement process		X		
	ISO 5 - System component for Channel Management	X			
	ISO 6 - System component for contract management		X		
	ISO 7 - Integrated Sales Process - Sales Order Management			X	
	ISO 8 - Integrated Operations				X
	ISO 9 - Integrated Customer Service			X	X
	ISO 10 - Integrated Marketing Communications	X			
	APP 1 - SPIRO	X			
	APP 2 - SAP		X		
	APP 3 - WEB APC		X		
	APP 4 - ORDER FORM			X	
	APP 5 - BMC REMEDY (OSS)				X
	APP 6 - MARKETING APP	X			
	APP 7 - CUSTOMER SERVICE APP			X	
	APP 8 - TIF				X

Table 4.2.3-1 – ISO & Existing AS

5. RESULTS AND DISCUSSION

Based on the gaps found in the previous chapter, the results found to improve "The Organization" information system are centered on the implementation of some target applicational systems to guarantee the centralization of the information.

5.1.1. Identification of Applicational Systems – Target AS

Product Management, Pricing Management and Channel Management – Customer Relationship Management

- Mission: The CRM applicational system's mission is to manage the relationship with the customer, also allows the promotion of products according to the customer's profile and his last orders, typify the customers according to market segments and customer relationship tracking. A Product, pricing and channel management modules can be part of the existing CRM, thus "The Organization" must invest o the acquisition of these modules to guarantee efficiency on Marketing team when dealing with Products and Pricing Management.
- Informational Entities used: Lead, Opportunity, Customer, Product, Pricing
- Supported Processes: Sales Order, Inventory, Asset, Contract
- Technologies: SPIRO is a third party developed AI-driven software cloud-based. "The Organization" uses it under the cloud computing model SaaS (Software as a Service) in which software is licensed on a subscription basis and is centrally hosted, meaning "The Organization" for the product and pricing module must pay additional cost for customization and activation of the modules from the cloud service provider. Licensing for the activation of these modules isn't needed unless more users need to access the platform.

Customer Portal

- Mission: The mission of this applicational system is enhance the customer experience by allowing customers to self-serve and manage their interactions with a company. The portal should provide features such as:
  - ✓ Account management: Customers can view and manage their account information, such as billing and shipping addresses, payment methods, and order history.
  - ✓ Support resources: Customers can access product documentation, FAQs, and knowledge base articles to help them troubleshoot issues and find solutions to common problems.
  - ✓ Order management: Customers can place new orders.

- ✓ Communication: Customers can communicate with company representatives through messaging, chat, or email to get help with their inquiries or issues.
- ✓ Personalization: Customers can customize their experience by setting preferences, opting-in or out of marketing communications, and receiving personalized recommendations.

- Informational Entities used: Lead, Customer, Opportunity, Product, Pricing
- Supported Processes: Inventory, Asset, Customer Service, Debt Collection
- Technologies: There are several technologies that can be used to develop a customer portal, depending on the specific requirements and functionality needed. Below are some that can be used:
  - ✓ Web development frameworks: Popular web development frameworks such as Ruby on Rails, Django, Laravel, and Node.js can be used to build a customer portal. These frameworks provide a range of features such as database integration, user authentication, and session management.
  - ✓ Content management systems (CMS): CMS platforms such as WordPress, Drupal, and Joomla can also be used to create customer portals. These platforms provide a range of pre-built features such as user management, content creation, and e-commerce functionality.
  - ✓ Application programming interfaces (APIs): APIs can be used to integrate various systems and services into a customer portal. For example, a customer portal may integrate with a CRM system, an e-commerce platform, or a payment gateway.
  - ✓ Cloud platforms: Cloud platforms such as Amazon Web Services (AWS) or Microsoft Azure can be used to build and host a customer portal. These platforms provide a range of tools and services to manage and scale the infrastructure of the portal.
  - ✓ Front-end technologies: HTML, CSS, and JavaScript are commonly used front-end technologies to create the user interface of a customer portal. Frameworks such as React, Angular, and Vue.js can also be used to develop the user interface and enhance user experienc

Procurement System

- Mission: To streamline the purchasing process by automating the various activities involved in procuring goods and services. The system will be designed to support the procurement function of “The Organization”, which includes activities such as identifying the need for goods

or services, selecting, and evaluating potential suppliers, negotiating contracts, and managing the purchasing process.

- Informational Entities used: Customer, Sales Order, Inventory, Contract, Asset, Supplier, Last Mile Provider, Procurement database.
- Supported Processes: Operation, Pricing, Payment, Service delivery.
- Technologies: Cloud-based technologies can be used to support procurement activities, such as e-procurement, supplier management, and contract management. Cloud-based technologies can offer benefits such as scalability, flexibility, and cost savings. This application should be integrated with Procurement Form, ERP and CRM.

Contract Management System

- Mission: The system is designed to streamline the contract management process by providing tools and automation to manage contracts, track their performance, and ensure compliance with contractual obligations. The existing online form for handling legal requests should be discontinued considering this application would have their own workflows to manage these requests.
- Informational Entities used: Contract, Customer, Sales order, Supplier, Last Mile Provider
- Supported Processes: Procurement database, Operation, Pricing, Payment, Service delivery, Customer Service.
- Technologies: Some of the technologies used in a contract management system are:
    - ✓ Electronic signature technology: Electronic signature technology is used to enable the digital signing of contracts, making it possible to sign and execute contracts remotely.
    - ✓ Workflow automation tools: Workflow automation tools are used to automate the contract approval process, route contracts for signature, and manage contract renewals and amendments.
    - ✓ Document management systems: Document management systems are used to store and retrieve contract documents and related files, such as invoices and correspondence.
    - ✓ Cloud-based technologies: Cloud-based technologies can be used to support contract management activities, such as contract creation, document storage, and workflow automation.
    - ✓ Artificial intelligence (AI) and machine learning (ML) technologies: AI and ML technologies can be used to automate contract analysis and review, extract key data points from contracts, and identify potential risks and opportunities.

- ✓ Integration technologies: Integration technologies are used to connect contract management systems with other enterprise systems, such as customer relationship management (CRM) and enterprise resource planning (ERP) systems, to ensure consistency and accuracy of data across systems.

Integrated Sales Process – Order Sales Management

- Mission: An integrated sales process aims to foster collaboration and knowledge sharing among different sales functions and teams, such as marketing, sales operations, and customer Service, to ensure a holistic and customer-centric approach to sales. An integrated sales process also aims to enhance customer experience by providing a seamless and personalized buying journey, from initial contact to post-sale support, and by leveraging customer feedback to improve sales performance. Therefore, this integration must involve "The Organization" CRM, ERP and Operations. This integration would have a front end that would be used by Customer Service, Service Delivery with different views and segmented by permissions.
- Informational Entities used: Lead, Customer, Product, Sales Order, Inventory, Asset, Operation, Pricing, Payment, Service delivery.
- Supported Processes: Procurement database, Contract, Supplier, Last Mile Provider.
- Technologies: For this integration to happen a middleware needs to be developed which is a software layer that connects different applications and systems to enable communication and data exchange. It typically uses a combination of software and hardware technologies to provide this functionality. Some of the technologies used in middleware are:

✓ Application Programming Interfaces (APIs): APIs are used to enable communication and data exchange between different applications and systems. Middleware can provide a set of APIs that applications can use to interact with each other.

✓ Enterprise Service Bus (ESB): An ESB is a software architecture that enables communication and integration between different applications and systems using a messaging system. It provides a centralized location for managing and routing messages between applications.

✓ Message Queuing: Message queuing is a technology that enables applications to exchange messages asynchronously, even if they are not connected to the network at the same time. This can help to improve system reliability and scalability.

✓ Data Transformation: Middleware may use data transformation technologies to enable applications to exchange data in different formats. For example, middleware may convert data from one database format to another or from one message format to another.

✓ Service Oriented Architecture (SOA): SOA is an architectural approach that enables different applications and systems to be designed as loosely coupled, reusable services that can be

easily integrated with each other. Middleware can use SOA to enable different services to interact with each other.

- ✓ Cloud-based Technologies: Middleware can use cloud-based technologies to enable different applications and systems to communicate and exchange data across different environments, such as on-premises and cloud-based systems.
- ✓ Security Technologies: Middleware may use security technologies, such as encryption and authentication, to ensure the confidentiality, integrity, and availability of data as it is exchanged between different applications and systems.

Integrated Operations

- Mission: The mission of integrating OSS and TIF is to improve operational efficiency by eliminating redundancies, reducing errors, and streamlining processes across different functions, such as Engineering, Customer Service and Service Delivery.
- Informational Entities used: Operation, Service Delivery
- Supported Processes: Sales Order, Payment
- Technologies: Integration through OSS APIs is the most indicated one because will enable communication and data exchange between the two different applications.

Integrated Customer Service System

- Mission: The mission of integrating a customer survey application with a Customer Relationship Management (CRM) system is to improve the customer experience and the overall performance of "The Organization". The integration aims to create a more efficient and effective way of managing customer feedback by collecting, analyzing, and acting on customer feedback in a timely manner.
- Informational Entities used: Customer, Customer Service
- Supported Processes: Sales Order, Operation, Service Delivery
- Technologies: Integration through CRM APIs is the most indicated one because will enable communication and data exchange between the two different applications.

Integrated Marketing Communications System

- Mission: The mission of integrating a Marketing Communications (MarCom) application with a Customer Relationship Management (CRM) system is to improve the effectiveness of marketing campaigns and the overall customer experience. The integration aims to create a

more personalized and targeted approach to marketing communications, by leveraging customer data and insights available in the CRM system.

- Informational Entities used: Customer, Communication
- Supported Processes: Lead, Opportunity
- Technologies: Integration through CRM APIs is the most indicated one because will enable communication and data exchange between the two different applications.

5.1.1. McFarlan matrix with the target AS (Applicational Systems)

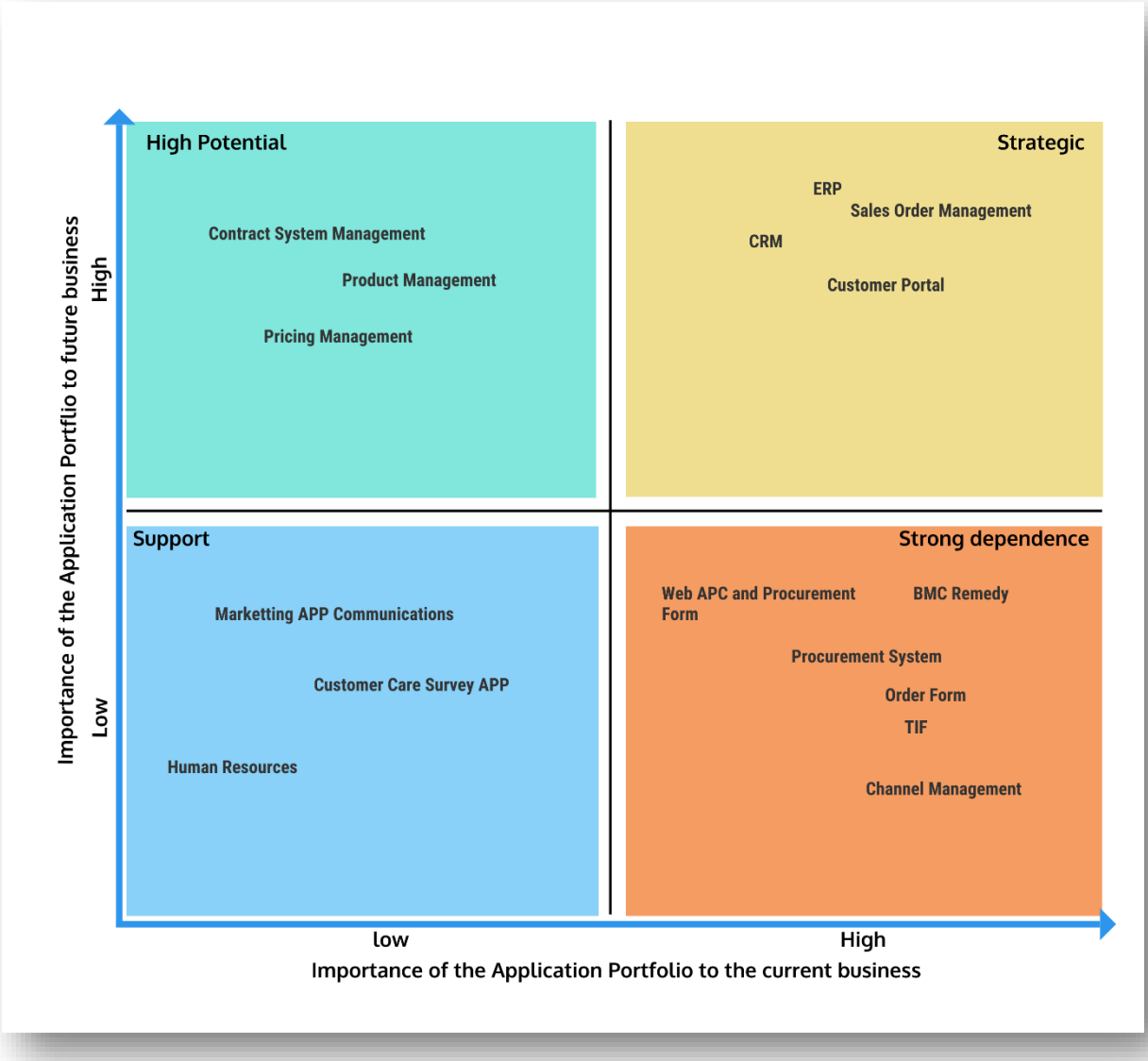


Figure 5-1 - McFarlan matrix

5.1.2. New applications architecture grouped by AS (Applicational Systems)

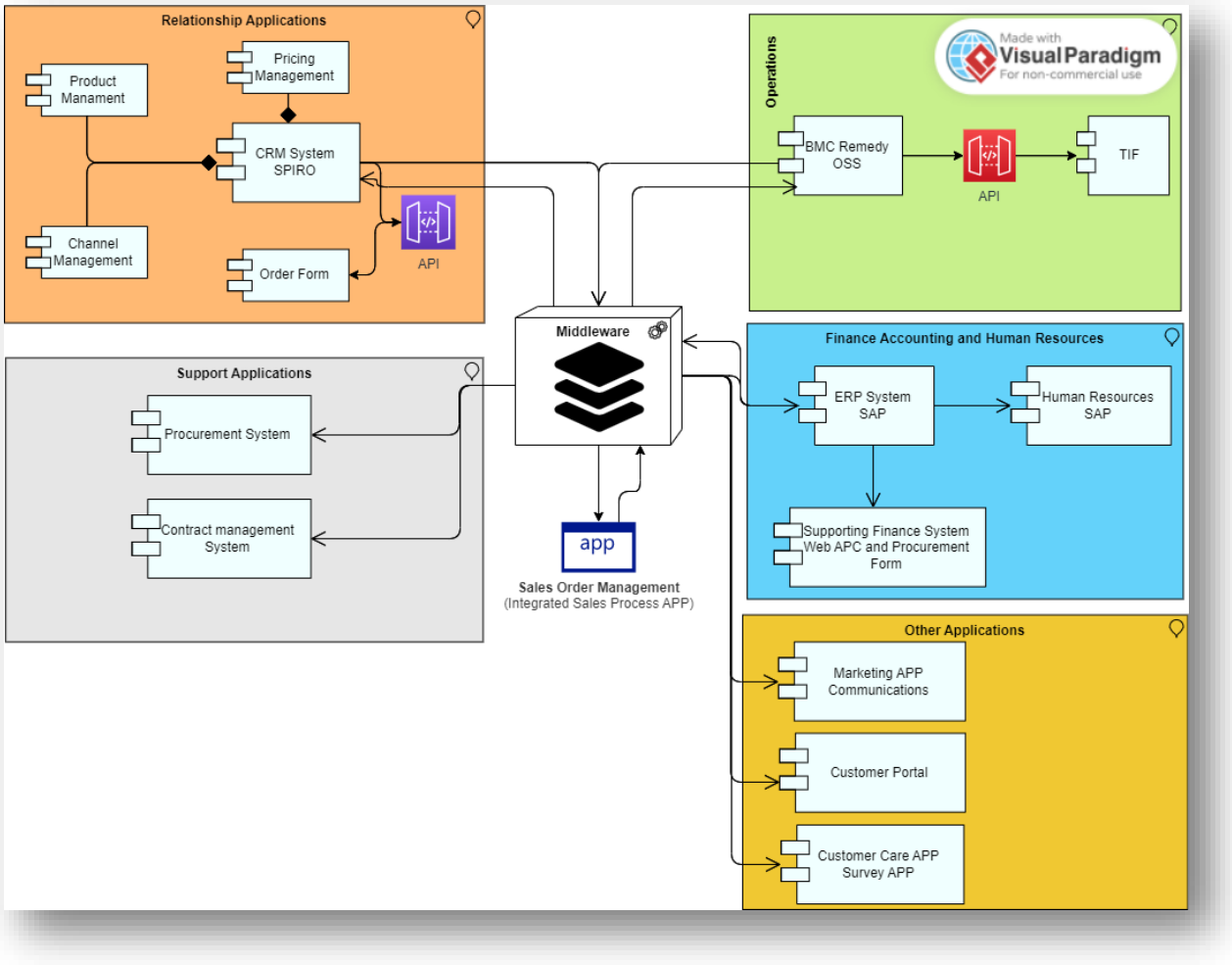


Figure 5-2 - New proposed Application Architecture of “The Organization”

5.1.3. Discussions

Once the final proposal of the information systems architecture was finalized, a meeting with the Technical Director of “The Organization” was held to present the proposed architecture and discuss the benefits of having their information systems architecture fully integrated provided they would move forward with the implementation. The key benefits discussed considering the main pain points they face with the actual architecture were:

- Streamlined Data Flow: Integrated systems architecture would enable the seamless flow of data across various systems and departments within “The Organization” by improving data accuracy, consistency, and availability, ensuring that reliable information is accessible when needed.

- Enhanced Decision Making: Integrated systems would provide a holistic view of "The Organization" data, enabling better decision-making processes. Decision-makers could access real-time and accurate information from multiple sources, enabling them to make informed and timely decisions.

- Improved Efficiency and Productivity: Integrated systems would eliminate redundant manual processes, data entry duplication, and the need for manual data reconciliation. This streamlines business processes, would reduce errors, and would improve overall efficiency and productivity within "The Organization".

- Agility and Adaptability: An integrated architecture would facilitate agility by allowing "The Organization" to quickly respond to changing business needs and market demands. It also enables the seamless integration of new applications, technologies, and business processes, supporting organizational growth and innovation.

- Comprehensive Reporting and Analytics: Integrated systems would provide a centralized and consistent data repository, enabling robust reporting and analytics capabilities. "The Organization" could generate comprehensive and meaningful reports, derive insights from data, and make data-driven decisions to drive business performance.

- Cost Savings: Integrating systems could lead to cost savings in various areas of "The Organization" by reducing the need for duplicate data storage and IT infrastructure, streamlines maintenance and support efforts, and by eliminating manual and error-prone processes. These cost savings contribute to improved operational efficiency and a more cost-effective IT environment.

- Enhanced Collaboration and Communication: Integration would facilitate seamless collaboration and communication among different departments and stakeholders. Data sharing becomes easier, promoting better coordination, teamwork, and a unified approach to achieving organizational goals.

- Scalability and Future-Readiness: The proposed integrated architecture is designed to accommodate growth and scalability which would allow "The Organization" to easily add new systems, functionalities, and modules as the business expands. This scalability ensures that the IT infrastructure remains future-ready and can adapt to evolving business requirements.

- Improved Security and Data Governance: The proposed integrated architecture provides a centralized approach to security and data governance. "The Organization" already implements

consistent security measures, access controls, and data privacy protocols across the different systems they currently use. The integration in terms of security and data governance at this stage would simply allow some key users to avoid having multiple credentials to access different systems but instead have one credential in the Sales order Management App and be able to access all information needed ensuring data protection and compliance with regulatory requirements.

The CTO of “The Organization” agreed on the benefits that the proposed architecture would bring to the company and compromised that they would follow this approach on a gradual manner by starting with the integration of the 3 main systems CRM, BMC Remedy and ERP, and would then focus on the remaining ones. This key stakeholder also mentioned that the internal entity that would be responsible for the implementation of the middleware is DIT (Department of Innovation and Technology) which has the mission to promote continual improvement through the implementation of new systems by using innovative technology. Furthermore, the Project management Department would be responsible for following all the procedures needed to guarantee the management of the project and the fulfillment of the stablished timeline considering all the internal and external factors that might affect the completion of the project. Considering I’m part of the company, I will be a key player of this project that tends to take off in the first quarter of 2024. Undoubtedly for this project to function and succeed rigorous testing, training programs, and change management strategies need to be implemented and thought about to ensure a successful adoption by all stakeholders.

Overall, the CTO declared that this type of initiatives are essential and that an integrated information systems architecture would promote the company efficiency, collaboration, agility, and data-driven decision making and also will enable “The Organization” to optimize its processes, drive innovation, and gain a competitive edge in the market.

5.1.4. Implementation Plan (Timeline)

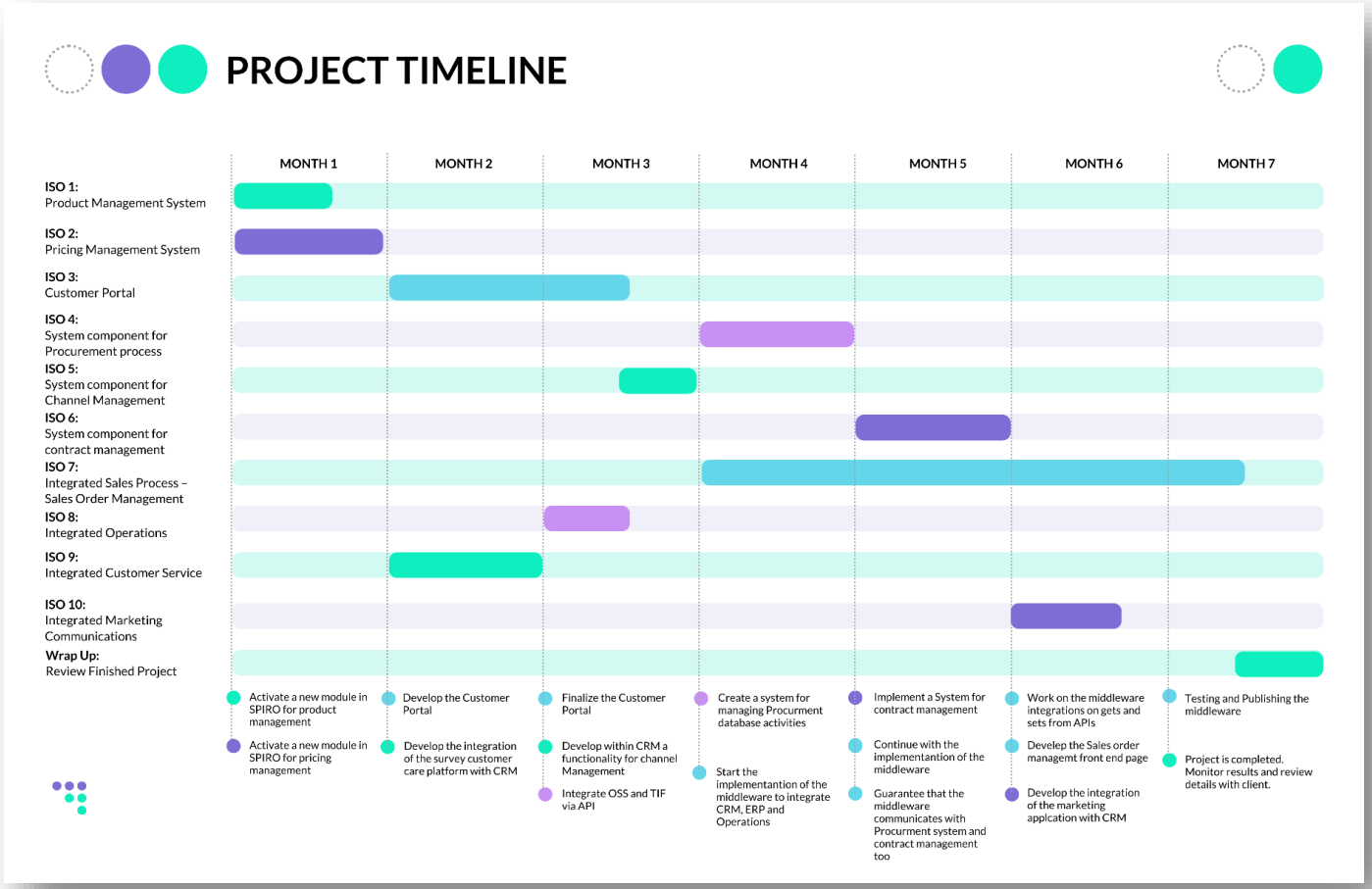


Figure 5-3 - Implementation Plan (Timeline)

6. CONCLUSIONS

6.1. LIMITATIONS

Implementing the proposed integrated systems architecture, where different software applications and hardware components are seamlessly connected and work together, can offer numerous benefits as mentioned previously. However, there are also several limitations and challenges associated with this approach which are related to compatibility issues considering that different systems may use different protocols, data formats, or standards, making it challenging to establish smooth communication between them. The level of complexity involved is also a limitation, followed by the upfront investment an integrated system often requires in terms of software, hardware, and personnel training. Additionally, ongoing maintenance and updates can contribute to high operational costs.

Security related concerns also come into the table because the more integrated systems are, the more vulnerable they might be to security threats. A security breach in one component could potentially compromise the entire integrated system. For the implementation, in case “The Organization” uses vendors to perform it, they can become heavily dependent on them which can lead to challenges if the vendors go out of business, discontinue support, or if “The Organization” decides to switch to a different solution. As the organization grows or its needs change, scalability can be challenging. Adding new components or functionalities might require significant modifications to the existing architecture. Integrated systems, on one hand, may lack flexibility for customization too when a specific business process, for instance, requires a unique solution which may be challenging to integrate that into the existing architecture. On the other hand, regular upgrades and maintenance activities to the integrated architecture can disrupt operations by causing downtime or data loss.

Apart from all the technical limitations the implementation of an integrated information systems architecture carries out, there were also limitations during the execution of the project concerning the availability of key members of “The Organization” in providing confidential information to enrich the level of detail I was aiming for. As a result, information related to internal business processes and how the dataflows are designed were not shared limiting the project to have the key processes diagrams illustrated. For privacy measures, the company opted not to reveal its entity in this project work.

Regarding the effective implementation of the project, there is the limitation of verifying post-production results in the short term, considering that due to the size of the project work, its implementation will require a high investment from the company in terms of both financial and human resources along with the need to implement training and change management strategies to ensure a smooth transition. Hence, factual data analysis of the proposed integrated information systems architecture can’t be reached at this point to compare the metrics of the As is and To be.

Despite these challenges, many organizations successfully implement integrated systems by addressing these limitations through careful planning, thorough testing, and ongoing monitoring and maintenance.

6.2. RECOMMENDATIONS AND FUTURE WORKS

In conclusion, this project focused on improving the information systems architecture of “The Organization”, by recognizing its vital role in supporting efficient and effective operations. Through extensive research and analysis of the current ISA (Information Systems Architecture), several key findings and recommendations emerged.

Firstly, it became evident that the existing information systems architecture within “The Organization” is lacking an integrated approach of the key systems that support the business and its operation. This resulted in various inefficiencies, such as data redundancy and limited interoperability. Consequently, it hindered the organization's ability to respond swiftly to market demands, impeded decision-making, and increased somehow operational costs.

To address these challenges, this project proposed a framework on which the business objectives were firstly defined, an assessment to the current state was performed, a vision of the future architecture was developed and finally the definition of the transformation plan such as an implementation roadmap with the timeline was proposed.

Based on the gap analysis and its characterization, it has been concluded that in terms of governance, structure, processes definition, and people, “The Organization” is well positioned, not to mention that they already use cloud computing which is a valuable resource for scalability, flexibility, and cost optimization. Similarly, they already use enterprise resource planning (ERP) systems and data analytics tools that significantly enhance operational efficiency and provide valuable insights for informed decision-making.

However, concerning their entire applicational architecture and data flow between the different systems, gaps by non-coverage, for partial coverage and non-integration gaps were found. To overcome these gaps a set of ISOs (Information Systems Opportunities) were stablished for enhancing “The Organization” information systems architecture. These ISOs encompassed various aspects, including the need to consider the acquisition or development of new applications, adding more modules to existing ones, and integrate such applications. By integrating these elements cohesively, “The Organization” could achieve a streamlined and future-proof architecture capable of meeting evolving business needs.

Moreover, the project through the ISOs highlighted the importance of having a product, pricing and channel management module within the current CRM the company uses to boost marketing operations and its efficiency when dealing with these affairs. A customer portal to enhance the customer experience has been recommended along with a procurement system to automate activities considering most of the work is still held manually in excel sheets. A contract management system to streamline the process and ensure compliance with contractual obligations is needed.

Additionally, a strong emphasis was placed on establishing an integrated customer service system with the CRM system to create a more efficient and effective way of managing customer feedback by collecting, analyzing, and acting on customer feedback in a timely manner. In terms of marketing communication application, an integration with the CRM is also required to improve the effectiveness of marketing campaigns and the overall customer experience. In pursuit of improving operational efficiency by eliminating redundancies, errors and streamlining processes across multiple areas such

as Engineering, Customer service and Service Delivery, an integration through API of two main systems is recommended.

Furthermore, implementing a middleware to integrate the sales process end to end among different systems, sales functions and teams was identified as a critical success factor in improving the information systems architecture of "The Organization" to ensure a holistic and customer-centric approach to sales by centralizing the information using modern technologies in concordance to industry best practices.

Overall, this project work demonstrated that the use of a middleware for system integration is fundamental in fostering a cohesive, efficient, and agile organizational infrastructure. It will enable “The Organization” businesses to leverage its full potential of their technological ecosystem, driving competitiveness, innovation, and sustained growth in today's dynamic and interconnected telecommunication business landscape and the future work is to successfully implement the action plan within the predefined timeline and to achieve the expected results.

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