Collaborative Method to Develop an Enterprise Architecture in a Public Institution

Nuno Paulo Rocha Roboredo

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Supervisors: Prof. Miguel Leitão Bignolas Mira da Silva
Prof. Anacleto Cortez e Correia (CINAV)

Examination Committee

Chairperson: Prof. Miguel Nuno Dias Alves Pupo Correia

Supervisor: Prof. Miguel Leitão Bignolas Mira da Silva

Member of the Committee: Prof. Pedro Manuel Moreira Vaz Antunes de Sousa

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Resumo

O crescimento da complexidade de uma organização degrada a eficiência dos seus processos de negócio. A Arquitetura Empresarial (AE) é um instrumento para gerir a complexidade, promovendo o autoconhecimento organizacional. A AE permite melhorar o alinhamento entre o negócio e as Tecnologias da Informação (TI), garantindo que as TI entregam valor ao negócio e promovendo a racionalização dos recursos da organização. No entanto, dependendo da cultura e das características da organização, surgem vários problemas que dificultam a implementação e o desenvolvimento de uma capacidade AE.

As atuais *frameworks*, como o TOGAF, requerem um número significativo de recursos humanos qualificados. Existem organizações, como as instituições públicas, que não têm esses recursos humanos qualificados disponíveis para dedicar em exclusivo às atividades da AE.

O objetivo da nossa investigação é promover o desenvolvimento da capacidade de AE em instituições públicas, abrindo-lhes a possibilidade de tirarem partido dos benefícios da AE. Exploramos os contextos das instituições públicas e as preocupações das suas partes interessadas, assim como as questões que poderão potenciar ou dificultar o desenvolvimento de uma capacidade AE.

Com base nessa análise, propomos um método colaborativo para desenvolver a capacidade AE numa instituição pública, aplicando princípios *Lean* e *Agile*. O nosso método colaborativo tenta capturar o conhecimento organizacional, espalhado pelos funcionários, num modelo de AE, mapeando a cartografia empresarial da instituição.

O método proposto foi demonstrado e avaliado na Superintendência das Tecnologias da Informação da Marinha Portuguesa.

Palavras-Chave: Arquitetura Empresarial, Cartografia Empresarial, Instituições Públicas, Método Colaborativo, *Lean*, *Agile*.

Abstract

The growth of organizational complexity degrades business processes efficiency. Enterprise Architecture (EA) is an instrument to manage organizational complexity, through the improvement of organizational self-awareness. EA improves alignment between business and Information Technology (IT) to ensure the business value of IT and enabling rationalization of organizational resources. However, depending of organizational culture and characteristics, there are several issues hindering the EA development within an organization.

Actual frameworks, like TOGAF, require a significant number of skilled human resources (HR), which some organizations, like public institutions, cannot assign to EA activities.

Our research goal is to provide an EA capability to public institutions, enabling these institutions to take advantage of EA benefits. Public institution contexts and stakeholder concerns were explored as well as issues acting as enablers or as inhibitors for an EA capability development.

We propose a collaborative method to develop an EA capability in a public institution, applying *lean* and *agile* principles. Our collaborative method tries to capture organizational knowledge, spread among employees, into an EA model, to map the enterprise cartography of the institution.

Our method has been demonstrated and evaluated in the IT sector of the Portuguese Navy.

Keywords: Enterprise Architecture, Enterprise Cartography, Public Institutions, Collaborative Method, *Lean*, *Agile*.

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List of Acronyms

Acronym	Term
ADM	Architecture Development Methodology
AMN	Autoridade Marítima Nacional (National Maritime Authority)
BPMN	Business Process Model and Notation
CDIACM	Centro de Documentação Informação e Arquivo Central da Marinha (Centre of Documentation, Information and Central Archive of the Navy)
DAGI	Direção de Análise e Gestão da Informação (Directorate of Analysis and Information Management)
DITIC	Direção de Tecnologias de Informação e Comunicações (Directorate of Information and Communications Technologies)
DSRM	Design Science Research Methodology
EA	Enterprise Architecture
EAMS	Enterprise Architecture Management System
EPM	Enterprise Project Manager
HR	Human Resources
IS	Information Systems
IT	Information Technology
MVP	Minimum Viable Product
PMO	Project Management Office
STI	Superintendência das Tecnologias da Informação (Superintendence of Information Technologies)
TCO	Total Cost of Operations
TOGAF	The Open Group Architecture Framework
XP	eXtreme Programing

1 Introduction

The increasing complexity of organizations and of their context led to the need of methodologies and practices to manage this complexity in a systematic and holistic approach. Otherwise, lacking such methodologies and practices, misalignments tend to occur and grow between business goals and organizations' internal efforts, consuming organizational resources on inefficient or ineffective activities. Organizational alignment between business and IT is one of the most important drivers for Enterprise Architecture (EA) [1, p. 221].

EA is concerned with the management of organizational complexity to improve realization of business goals and to rationalize organizational resources. EA is one of the available tools to promote systemic governance within organizations. Some of the EA benefits are: improve business confidence in IT; decrease IT risks; optimize integrations in IT landscape; reduce development effort of applications [2, p. 8]. Several EA Frameworks were proposed to achieve such goals and benefits.

However, despite EA goals and benefits, evidence shows the implementation and operationalization of an EA capability in organizations face several difficulties, not only in implementation, but most important in developing and updating same architecture. These difficulties are concerns in any EA initiative, but problems and constraints differ from organization to organization, especially if we take a close look on its legal nature: public or private; for-profit and not-for-profit; local or national scale.

Our motivation is try to understand the main barriers public institutions face to implement an EA capability and propose a method to overcome these barriers, enabling public institutions to benefit from EA. Portuguese public institutions, in general, lack appropriate tools to provide capabilities of systemic governance [3].

Design Science Research Methodology (DSRM) [4] was used to develop our research, in order to guide the development and evaluation of our proposed method. DSRM was instantiated to our research as described in next section.

1.1 Design Science Research Methodology

DSRM incorporates principles, practices and a process model which are adequate to conduct design science research in information system discipline, where effective solutions to real problems are sought through the creation of new and innovative artifacts. Such artifacts may include constructs, models, methods, instantiations [4][5], social innovations [4][6] and new properties of technical, social, or informational resources [4][7]. In other words, these artifacts can be any designed object with an embedded solution to an understood research problem [4].

Our artifact is a method to address the problem of the low level of EA capability in public institutions.

Design science paradigm seeks to create and evaluate *"what is effective"* in the problem space, which constitutes fundamentally a problem-solving paradigm [5].

The approach followed by DSRM includes six steps or activities [4]:

1. Problem identification and motivation;
2. Definition of the objectives for a solution;
3. Design and development;
4. Demonstration;
5. Evaluation;
6. Communication.

Figure 1 shows an instantiation of the six activities of DSRM to our research. Following sub-sections summarize how we performed each activity.

Identify problem & motivate	Define objectives of a solution	Design & Development	Demonstration	Evaluation	Communication
Low level of EA capability in public institutions	Improve stakeholders' awareness and value recognition on EA. Make EA activities intrinsically attached to organizational culture	Create a method to develop an EA based on collaboration of organizational human resources and an EA unit, applying lean & agile principles	Collaborative method instantiation in IT sector of Portuguese Navy	Online evaluation form, applied to participants in demonstration, to evaluate the method against evaluation criteria from system dimensions	Workshops during the method demonstration. Results presentation in public discussion session. Thesis report

Figure 1: DSRM process – adapted from Peffers [4]

1.1.1 Activity 1 – Problem Identification and Motivation

Low level of EA capability in public institutions was identified as an important and relevant problem [8] [9]. The value of a solution to this research problem is to enable public institutions to take advantage of EA benefits. The relevance of EA and of their benefits to organizations motivates the work of a large community of practitioners and researchers, the development of dozens of commercial and open-source tools [10] and countless proposals of EA frameworks [2, p. 106]. Any organization benefits from having a clear understanding of its structure, products, operations, technology, and the web of relationships tying these together and connecting the organization to its surroundings [1, p. 5].

1.1.2 Activity 2 – Define the Objectives for a Solution

The solution should enable public institutions to develop an EA capability. To be possible and feasible, solution should consider specific constrains of public institutions, like the lack of awareness to EA benefits by public servants, rigid structures or inertia of bureaucracy that hinders change.

Objectives for a solution, enumerated in section 4.1, include the improvement of stakeholders' awareness and value recognition about EA utility and benefits to the organization and for themselves. This improved awareness and value recognition will contribute to another solution objective: rise of stakeholders' willingness to collaborate to maintain updated a model of enterprise cartography and to improve this model and their views. All these objectives contribute to the primary goal of the solution: develop an EA capability in the organization.

1.1.3 Activity 3 – Design and Development

Increase an EA capability is a sociotechnical challenge. In addition to technical tools, it requires substantial social, organizational, and intellectual investments to achieve desired results [11]. We propose a collaborative method to develop an EA capability in a public institution, based on collaboration of human resources (HR) and coordinated by an EA unit.

Our collaborative method should create awareness, in public servants from the institution, to the value delivered by an EA, to the institution and to themselves, by facilitating their work and improving their performance. This awareness should be enough to create will to cooperate in the process of building an EA.

Our method takes advantage of *lean* principles, seeing public servants as customers. *Lean* principles will help to develop only those EA artifacts that public servants value, with minimum required effort.

Agile principles will leverage public servant involvement in the development of an EA capability, which is essential for building EA artifacts that fit public servants' needs.

Our collaborative method is composed by five phases:

1. **EA-MVP creation**: Creation of an initial cartography of the organization, based on information stored and managed by Information Systems (IS) already in operation within the organization. The initial cartography should have a special focus on the business layer of the architecture because this layer is less technical and it is better known by common public servants.
2. **Key Stakeholders Involvement**: Conduct personal interviews with key stakeholders to better understand the ground reality.
3. **Workshops**: Realization of workshops for public servants.
4. **Sprints**: One week sprint where public servants are invited to contribute to the development of the EA model, of their viewpoints and to suggest improvements to the collaborative method.
5. **Result Analysis**: Analyse sprint results to improve the collaborative method, the EA model and their viewpoints.

1.1.4 Activity 4 – Demonstration

Our collaborative method was instantiated in the IT sector of Portuguese Navy, for demonstration purposes.

We created an initial EA model only in business layer of the EA. The EA model was populated with information obtained from the HR database (organizational structure, roles, assignments to roles, functions, etc.) and from the Enterprise Project Manager (EPM) (projects and assignments of HR to projects). We constructed nine navigable viewpoints of this model, where one is the *"Employee Context"*. This special viewpoint contains only elements, from the model, directly related with a selected public servant: his department, his section, the roles assigned to him, the projects where he participates as manager or as team member, etc.

Having an initial model, 41 public servants were invited to participate in one of the six workshops scheduled previously. In these workshops, public servants were requested to send contributions, during a week (a sprint), to improve the EA model, to improve their viewpoints and to improve the collaborative method.

1.1.5 Activity 5 – Evaluation

After the demonstration's sprints, participants were asked to fill an evaluation form to evaluate our collaborative method. The evaluation form, in *"Appendix D: Online Evaluation Form"*, was composed by 25 statements to be rated from *"strongly disagree"* to *"strongly agree"*. The purpose is to evaluate 11 of the 28 criteria from the hierarchy of criteria for IS artifact evaluation, proposed by Nicolas Prat et al. [12].

1.1.6 Activity 6 – Communication

The collaborative method includes workshops where the problem, identified in activity 1 – low level of EA capability – is explained and highlighted in the context of the specific organization. The EA benefits, not achieved due the absence of an EA capacity, are explained and highlighted too. So, in the context of the demonstration, we communicated to practitioners, the problem and its relevance, the method (our artifact) and its utility, as DSRM proposes in the 6th activity [4].

The design of the method, its effectiveness and the results of the demonstration and evaluation are exposed to three directors of the three military units which compose the IT sector of Portuguese Navy, in the last workshop.

We will present our results in the public discussion session of this thesis, to the Examination Committee, and publish the thesis report in university channels.

1.2 Thesis Structure

Our research problem is exposed in chapter 2: The low level of EA capability in public institution. This chapter discusses the relevance of the research problem and describes the public institutions' context. Next, chapter 3 present the related work, discussing the theoretical background and methodologies that will support our proposal. This chapter argues, also, why current methodologies do not solve our research problem. Our research proposal is presented in chapter 4, where our proposed collaborative method to develop an EA is described and why it fits better in the context of a public institution. Chapter 5 describes the demonstration of our method, applied in the IT sector of the Portuguese navy.

Chapter 6 exposes how the evaluation of our collaborative method was performed and the evaluation results. The evaluation was made by participants after one iteration of the method, through an online evaluation form. We present our conclusion in chapter 7.

2 Research Problem

Chapter starts addressing the generic problem of organizations' governance and presenting EA as a tool to support integrated and systemic governance. Section 2.2 discusses the specific context of public institutions and their own characteristics. Within public institutions, we focus the Portuguese public institutions, which the weakness in EA capability is recognized [3]. Section 2.3 states our research problem.

2.1 Governance of Organizations

Organizations can be abstracted as dynamic systems [13] [14, p. 9], composed by smaller systems interacting with each other. A system is more than the sum of its components. This *"extra"* in the sum comes from the alignment of components' interactions with a common purpose. We need an integrated and systemic vision of the organization to articulate their internal interactions, in line with organization purposes [3]. Such vision is a requisite to enable systemic governance of organizations.

In IT domain, a systemic governance needs tools to increase the alignment between organization purposes, organization goals, business processes to realize purposes and goals, information handled by business processes, software applications supporting business processes and, in the bottom, the technology where the applications run and where information is stored [1]. An enterprise cartography is a tool to map all instances of these concepts for a specific organization, showing their internal reality of what exists, what they do, how they do, who do, when do, why do [3]. Such cartography, mapping the AS-IS of an organization, is essential to uncover misalignments, support change planning, manage transformational projects, share and align internal conceptions and visions, among other features of a systemic governance.

Systemic governance includes also the governance of organizational transformations and change management, to adapt organizations to their context in permanent evolution, to rationalize resources, to promote efficacy and efficiency. EA contributes to organizational transformation as it enables modelling the organization's structure and dynamics along with the underlying restrictions and design principles [1]. The enterprise cartography, as a part of EA discipline [13], is needed to show where we are (AS-IS) and help us to realistically define where we want to be, when, and how to reach this point in the future (TO-BE) [3].

An organization can be seen as a network of independent actors in collaboration with each other, creating a dynamic collaborative network with common purposes. These actors are people and computers [13], which makes organizations and their IS as sociotechnical systems [2, p. 140]. Build the cartography of a sociotechnical system and keep it updated is itself a sociotechnical problem [2, p. 141] requiring insights from both technical and social features of these systems. The technical side is focused on formal models and systems' capabilities, and the social side has a behavioural approach focusing on the design, implementation, management, and business impact of systems [11].

2.2 Public Institutions

Having in mind all possible variables that can affect the outcomes, for the analysis of the present master thesis is crucial to delimit the research to a kind of organization that can somehow relate in its structure and environment to others similar, where the results can produce a set of coherent and comprehensible guidelines for upcoming works and implementations.

From a broad classification of organizations, we can immediately set as a preferred scope of the investigation the public sector institutions, which have in common some contextual premises allowing a better preliminary analysis effort, such as:

1. Are not aimed to profit, but as much as sustainability;
2. Have an annual budget granted by the central government, which depends on unclear and mutable rules, and is managed in a decentralized matter;
3. Have a more rigid organizational structure, but its departments tend to be governed in a more autonomous way;
4. Hiring HR and allocate new staff, with new expertise, involves a lot of bureaucratic work, with plenty of hurdles;
5. A significant number of employees are distantly aware (or motivated) from cost efficiency;
6. Scarcity of HR highly skilled with time to dedicate to an EA initiative;
7. Resistance in promoting change in business processes and in communicating between departments.

These seven constraints (not seen or easily surpassed in private sector organizations) represent by themselves an extra challenge in addressing the implementation and sustainability of a strong EA initiative, compressing all the expected benefits which an EA can provide.

Some of the above stated characteristics appear referred in programmatic and political documents regarding the resistance in rationalizing the IS in public administration [8], or in several assessment documents found in the major EA providers [15].

These organizational characteristics are determinant to understand the sociotechnical problem we want to tackle under the present work. Our investigation includes the analysis of which characteristics are specific to public institutions, determining which act as an advantage and which do not.

An EA initiative, like any transformation initiative, needs support and commitment of the executive board to be successful. However, this commitment is not enough. Often a gap arises between high-level visions and ground-level reality of organizations. Collaboration of employees working at ground-level is essential to accurately map the AS-IS state. However, employees need to understand some of EA concepts and benefits, and recognize its value, otherwise they will contribute just as their chiefs impose it. As soon as high-level management attention goes away, the EA initiative is doomed to die [2, p. 137].

Portuguese public institutions lack proper tools to set up a systemic governance in several domains where this systemic governance is crucial [3]. In IT domain, many institutions have developed their IT and their business processes in a non-structured way, acting reactively to the emergence of needs and challenges. But each specific decision often doesn't foresee their impact on an overall view.

Public servants have their tasks, their responsibilities, their motivations and their concerns, taking their time and attention. Quite often, there are new ideas, new tools and new methodologies introduced or imposed within the institution, implying changes in the organization and in the way of doing things, sometimes with low visible results, but requiring extra work to public servants. These experiences increase the natural resistance to change of public servants. We need to address this natural resistance as a part of our sociotechnical problem, not expecting public servants are waiting enthusiastically for our EA initiative. Public servants' time is valuable and scarce and their priorities certainly are not the EA capability. Even if we have a big support from the high-level management, we should not expect be allowed to focus the institution around our EA initiative. We need to have sparingly when asking for use the public servants' time.

EA awareness, in Portuguese public institutions, is usually low [8]. We intend to focus our attention in institutions where the majority of public servants have never heard about EA or if they heard the noun, they don't know what it is or what is it for. This scenario should not be far from the reality of most Portuguese public institutions.

2.3 Problem Formulation

The research problem is **the low level of EA capability in public institutions** that hinders these institutions to take advantages of EA benefits [3].

The relevance of the problem can be measured by the Portuguese government need for legislate to make mandatory the existence of EA in all public administration and the creation of procedures to feed and update these EA [8] [9].

As a sociotechnical problem, we also discuss the impact of EA social dimension and the need for organizational culture to promote an updated and effective EA in a public institution.

3 Related Work

A literature review of topics to support our proposal is presented within this chapter. It starts with a description of Enterprise Architecture (EA), its definition and purpose. Within the Enterprise Architecture (section 3.1), the Enterprise Cartography concept is covered and we present the two best known EA frameworks: *"The Zachman Framework"*, the first widespread EA framework, and *"The Open Group Architecture Framework"* (TOGAF) – the most relevant and widespread EA framework nowadays. Section 3.1 concludes with a discussion of drawbacks of existing EA frameworks.

Section 3.2 presents *Lean* methodology and principles, *Agile* methodologies and ends with *Scrum*. *Agile* methodologies were inspired by *Lean* methodology, adapting it from the manufacturing context to the software development context. *Scrum* is one of the *Agile* methodologies, which we will adapt to our proposal.

Chapter ends with a description of the *"Customer Development Methodology"* and their key concepts (section 3.3). Our proposal will apply these concepts within the development of an EA capability to identify and meet the needs of stakeholders.

3.1 Enterprise Architecture

Small organizations, like a small bakery, can be understood and managed by a single human mind without help of any tool [16]. The baker can memorize and manage all information needed to run the bakery (flour suppliers, stock levels, bread production process, etc.), including their small IS (cash register, notes on paper, etc.). Baker does not need a formal EA effort to efficiently and holistically manage his small bakery [16].

With the growth of organizations, increases its complexity. The understanding and management of an increasing network of internal and external relationships between actors of an organization, is no more manageable by a single human mind. The knowledge of such network spreads by collaborators of the organization, where each one understands and manages a portion (bigger or smaller) of the network. The spread knowledge is part of the organization's collective wisdom. However, if there are no tools to capture and manage such knowledge, is impossible to have a holistic view of the organization. Thereby, a systematic management of complex organizations requires appropriate tools.

An organization is a network of independent actors. Nowadays, such actors are humans and computers [13]. Business processes of the organization are supported by IT, which has their own landscape (IT landscape) with their hardware, multiple devices, system software, applications, etc., making the network complexity bigger and bigger. When a change in the network is required (e.g. the introduction of a new software application), people tasked to this alteration will try to map the portion of the network implied by the change, with or without tools, sometimes only in their minds, sometimes with diagrams. When the task finishes, successful or not, the mapping effort is lost, once soon appear new changes, making these diagrams outdated. More: if diagrams do not use a modelling language,

they are personal representations without commonly accepted semantic in their shapes and connections. To be used, these diagrams will require their authors to explain them. Diagrams of this type become useless in a short time.

All mapping effort needs to be reworked once a new change is required. Frequently some impacted part of the network is forgotten, or not understood, or diagrams do not represent the ground-level reality.

The use of detached diagrams, drawn for specific purposes, makes impossible the traceability among them and to check their coherence. In an ideal situation, we would have a single model for an organization, to ensure coherence and consistency between all different parts [1]. In this model, each element, existing in the real world, is represented only once by a unique object, with all their connections with other objects. When a diagram is needed to a specific purpose, we pick a view from the model with only the relevant objects and connections to our purpose.

EA discipline brings a systemic approach to address these concerns. EA is a coherent whole of principles, methods, and models, used in the design and realization of an enterprise's organizational structure, business processes, IS, and infrastructure [1, p. 3]. EA models allow the building of EA artifacts addressing concerns of specific groups of organization's stakeholders.

The purpose of EA is to optimize across the enterprise the often fragmented legacy of processes (both manual and automated) into an integrated environment, responsive to change and supportive of the delivery of the business strategy [14, p. 6]. EA have two major goals [2]:

1. Control complexity in IT landscape;
2. Align IT with business and the organization strategy.

Control complexity intends to achieve an IT landscape with the following characteristics [2]:

- Stable: reliable, resilient, available and fault-tolerant;
- Agile: enabling new products, new services and new business processes; and be responsive to the market dynamics and customer needs;
- Adaptable: to new business contexts, to new regulations and to mergers, acquisitions and convergences;
- Efficient: to meet or exceed business expectations, service level expectations and reduce Total Cost of Operations (TCO).

These characteristics enable the following benefits [2]:

- Improve business confidence;
- Decrease IT risks;
- Optimize integrations;
- Reduce development effort.

Over the years, several EA frameworks were proposed to achieve such goals and benefits, to address different needs in this field [2, p. 106].

The main function of architectures is the creation of a shared knowledge through the improvement of the communication between stakeholders. Describing architectures is all about communication [1, p. 61]. Part of EA activities is the modelling of reality to transform tacit knowledge into explicit knowledge, and the creation of viewpoints defining views from these models.

An organization modelling starts with the definition of what we want to model. A metamodel addresses this issue by stating concepts and relationships to be included in organization model. Figure 2 shows examples of concepts and relationships defined in the metamodel of ArchiMate modelling language [17].

Figure 2: Examples of concepts and relationships used in the metamodel of ArchiMate [18]

Metamodel also defines which relationships are allowed between different concepts. E.g. an *"actor"* can be *"assigned to"* a *"role"*, but an *"actor"* cannot be *"used by"* a *"function"*. Figure 3 shows the business layer of the ArchiMate metamodel [19].
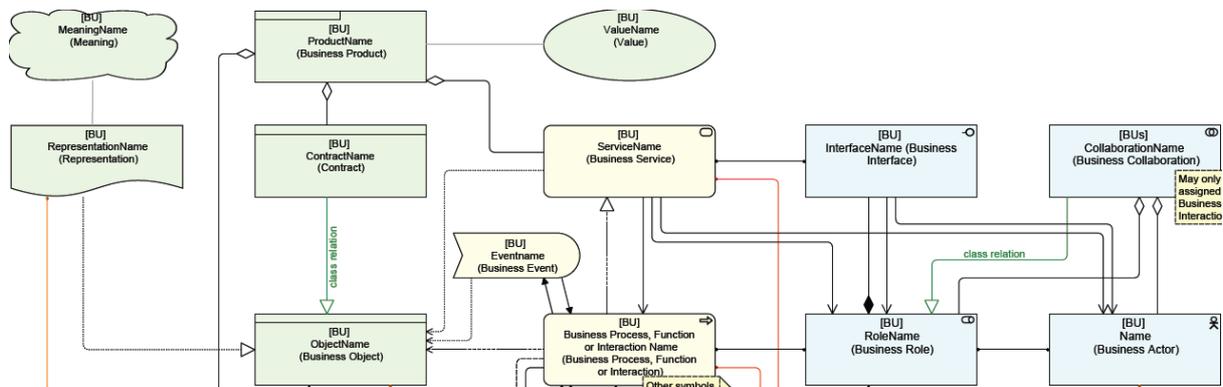
Figure 3: Business Layer of the ArchiMate metamodel [19]

Having defined the metamodel, the modelling of the organization can start. An EA model is a network of instances of concepts, interconnected by instances of relationships, accordingly to the previously defined metamodel.

A complete network of an organization is overwhelming to the understanding of a human mind. To address specific purposes, only part of the network is needed. Concepts of *"Viewpoint"* and *"View"* emerged to configure and manage the selection of parts of the EA model according to specific purposes. Viewpoints define abstractions on part of the EA model, each aimed at a particular type of

stakeholder and addressing a particular set of concerns. Viewpoints can be used both to highlight certain aspects in isolation, and for relating two or more aspects. A viewpoint is a specification to the generation of views from the EA model [1, p. 147].

EA models and their views help architects and stakeholders to reason about systems and organizations, helping to deal with the complexity.

When an EA view from a model is presented to stakeholders, this communication process has the intention to achieve one of the three communication goals [1, p. 72]:

1. Introduction of knowledge to create awareness in the stakeholders;
2. Agreement to knowledge to obtain the validation of models;
3. Commitment to knowledge leading stakeholders to act upon the knowledge they agree to.

3.1.1 Enterprise Cartography

Enterprise Cartography is an EA model representing the AS-IS state of an organization. This EA artifact is essential to govern the transformation processes of an organization [13]. A mapping effort of the AS-IS state is valuable as an enabler of transformation planning [13]. However, the organization's mapping of their business, of their applications, of their information and of their technology, is an endless work. A single person, or a little group of EA architects, will never be able to keep an enterprise cartography updated. A full and update cartography of the AS-IS state of an organization is a demanding task in terms of effort and time. The rate of organizational change quickly make this AS-IS state obsolete [13].

If the mapping task, to raise the cartography of an organization, is assigned to a group of EA architects and they close themselves in the *"ivory tower"* of their offices to complete it, the likely outcome is an inaccurate cartography which can be misleading or useless. The collaboration of employees working in the ground-level of the organization is essential to accurately map such level, closing the breach between strategic vision and ground-level reality. The key success factor of an EA initiative is to what extent a collaboration on EA between all stakeholders comes alive [2].

An updated cartography of the organization reality can be used as a common knowledge base sustaining the standardization and the information sharing. However, to reach such objective in practice, it is only possible with the involvement and the collaboration distributed by all stakeholders, with EA tools available to the generality [3]. This involves a combination of bottom-up and top-down actions [3].

3.1.2 Zachman Framework

In the ending of the 1980's, John Zachman proposed what is now known as *"The Zachman Framework"* [20].The Zachman Framework analyses an organization through six different perspectives: – executive; business management; architect; engineer; technician and enterprise – each one addressing concerns of a specific group of stakeholders. Six questions are asked in each perspective: what; how; where; who; when and why. The interception of each perspective with each

question is a six by six matrix where we can put, in each cell, artifacts (blueprints) that answer the column question for the line perspective. We can also define and construct derived artifacts relating and combining several cells in this matrix. Zachman framework suggests what artifacts an EA should produce [21].

3.1.3 TOGAF

"The Open Group Architecture Framework" (TOGAF) provides methods and tools for assisting setup and development of an EA [14, p. 9]. The framework is agnostic to the technology in use. The core of TOGAF is the Architecture Development Method (ADM), which is a full life-cycle process for planning, designing, realizing and governing EA. ADM is an iterative cycle of continuous architecture definition and realization that allows organizations to transform their enterprises in a controlled manner in response to business goals and opportunities [14, p. 10].

TOGAF methodology requires considerable number of skilled HR dedicated to EA activities, which centralize the accountability of EA development and update. According to TOGAF, a typical architecture team undertaking the development of an EA would comprise roles like: Architecture Board (4 or 5 members); Architecture Sponsor; Architecture Manager; Architects for Enterprise Architecture; Architects for Business Architecture; Architects for Data Architecture; Architects for Application Architecture; Architects Technology Architecture; Program and/or Project Managers; IT Designer; and many others [14, p. 606].

Many organizations, particularly public institution, cannot afford the assignment of such number of skilled HR to EA activities. In organizations with scarcity of HR skilled in EA, where the EA awareness is low, the adoption of TOGAF methodology is not likely to succeed.

When the high-level management of an institution decides to set up an EA capability, realizing that an ad-hoc development of their IT-landscape is not acceptable, a framework like TOGAF seems like a Ferrari to those who just want to learn to ride a bicycle on a rocky path. The Ferrari is too much expensive and seems it will not be useful while the rocky path is not paved. The management needs to see the abstract concepts of EA somehow materialize in their specific institution. They need to see the EA results and how the institution reacts, values and takes advantages of the benefits of an EA capability.

3.1.4 EA Frameworks

Only two EA frameworks were presented, however over the last 25 years, dozens of them have come and gone [2, p. 106]. Despite the well-thought-out repertoire of frameworks and best practices, EA is far from having the sustainable and sweeping effect that it promises [2, p. 137].

Despite the advantages of EA and enterprise cartography, reality and evidences in related works show the way to achieve them is neither easy nor assured. Frameworks propose an extensive work to produce many artifacts which need to be continually updated. This work requires a significant number of skilled HR, which many organizations do not have to assign to an EA initiative.

3.2 Lean

Lean is a customer-centric methodology inspired in the *"Toyota Production System"* [22], also called *Lean* Manufacturing, arisen in the manufacturing world context [23].

The goal of *lean* methodology is eliminate waste in processes. All work effort not adding value to processes' results is considered waste and must be eliminated. The core idea is to maximize customer value while minimizing waste, which represents fewer resources consumed.

This methodology opens our eyes to all kinds of waste, such as piles of unread specifications or extra processing due to following bureaucratic governance. *Lean* gives us a systematic way to eliminate waste to come to a streamlined, demand-driven delivery process. *Lean* techniques bring pragmatism, reduction of bureaucracy, and lightweight processes [2].

The *lean* thinking has five *lean* principles [24]:

1. Identify value – Specify value from the end customer standpoint, by product family;
2. Map the value stream – Identify all steps in the value stream for each product family, eliminating whenever possible those steps that do not create value;
3. Create flow – Make the value-creating steps occur in tight sequence so the product will flow smoothly toward the customer;
4. Establish pull – As flow is introduced, let customers pull value from the next upstream activity;
5. Seek perfection – As value is specified, value streams are identified, wasted steps are removed, and flow and pull are introduced, begin the process again and continue it until a state of perfection is reached in which perfect value is created with no waste.

Figure 4 shows the five steps cycle in the process for guiding the implementation of *lean* techniques.
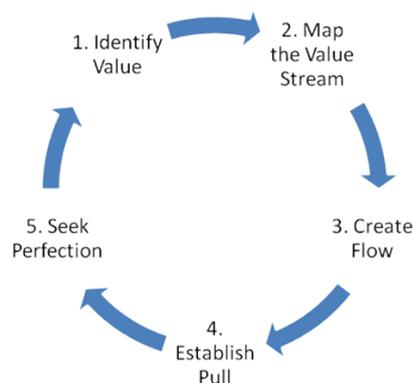
Figure 4: *Lean* Principles [24]

3.2.1 Agile

Agile methodologies arose in the software development context to face uncertainties in changing business contexts. The high rate of business changes led to the impossibility to predict a complete set of stable software requirements in an early stage. *Agile* was influenced by ideas of *lean*

manufacturing, which explains why *lean* manufacturing and *agile* software methods have a very similar philosophy [23].

The goal of *agile* methodologies is to develop products fitting the most possible customer needs. To achieve this goal, *agile* methodologies propose a development process involving the customer in a closely way, with regular demonstrations of the product progress.

They propose iterative and incremental processes to deliver working software frequently, and to allow requirement changings.

Agile teaches us how to approach a problem in an iterative manner. *Agile* methodologies propose an evolutionary problem-solving strategy, with short-term feedback cycles, allowing to learn with a managed trial-and-error approach. The feedback cycles bring all stakeholders together with a constant heartbeat, thereby guaranteeing collaboration [2, p. 138].

To better understand *agile* methodologies, we reproduce the four values of the *Agile* Manifesto [25]:

1. Individuals and interactions over processes and tools;
2. Working software over comprehensive documentation;
3. Customer collaboration over contract negotiation;
4. Responding to change over following a plan.

3.2.2 Scrum

Scrum is an *agile* methodology with an iterative and incremental workflow, based on cycles of work called *"sprints"*, which have a fixed and short duration, typically ranging from 1 to 4 weeks [26]. At the end of each cycle, working software is delivered with new features, previously selected by agreement between developing team and stakeholders.

Scrum has a strong interaction with stakeholders. It delivers periodically a meaningful product from stakeholder perspective at the end of each sprint, which leverages stakeholders' commitment and collaboration.

We choose *scrum* from among *agile* methodologies because it is focused in management practices rather than software technical practices like eXtreme Programing (XP) [27].

As we can see in Figure 5, the process begins with a vision of the new software product to be developed. From this vision is made a list of features called *"Product backlog"* [26].

Product backlog is a dynamic list of features constantly evolving throughout the product life cycle. Each feature is classified in terms of business value by stakeholders, and in terms of work effort to be implemented by team members [26]. The work effort can be expressed in man/hour, where each feature has a value from the Fibonacci sequence, to avoid long time argumentations about irrelevant variations of value.

Features can be expressed in *"user stories"* format, which is *"As a (stakeholder role) I want to do (feature) such that (feature description)"*. This format is *"implementation free"*, allowing stakeholders to focus on their needs without deviating for technical details on how to implement.

Sprint planning is composed by two meetings. The first one is to define the *"sprint backlog"* which is a list of features, taken from the *product backlog*, to be implemented in current sprint. The second is to translate features from the *sprint backlog* into tasks to implement each feature and distribute them by team members. *Scrum* gives a strong emphasis to obtain a *"working product"* at the end of each sprint [26].

During the sprint every workday occurs a *"Daily Scrum meeting"*, which is a short meeting (15 minutes) to assess the sprint progress [26].
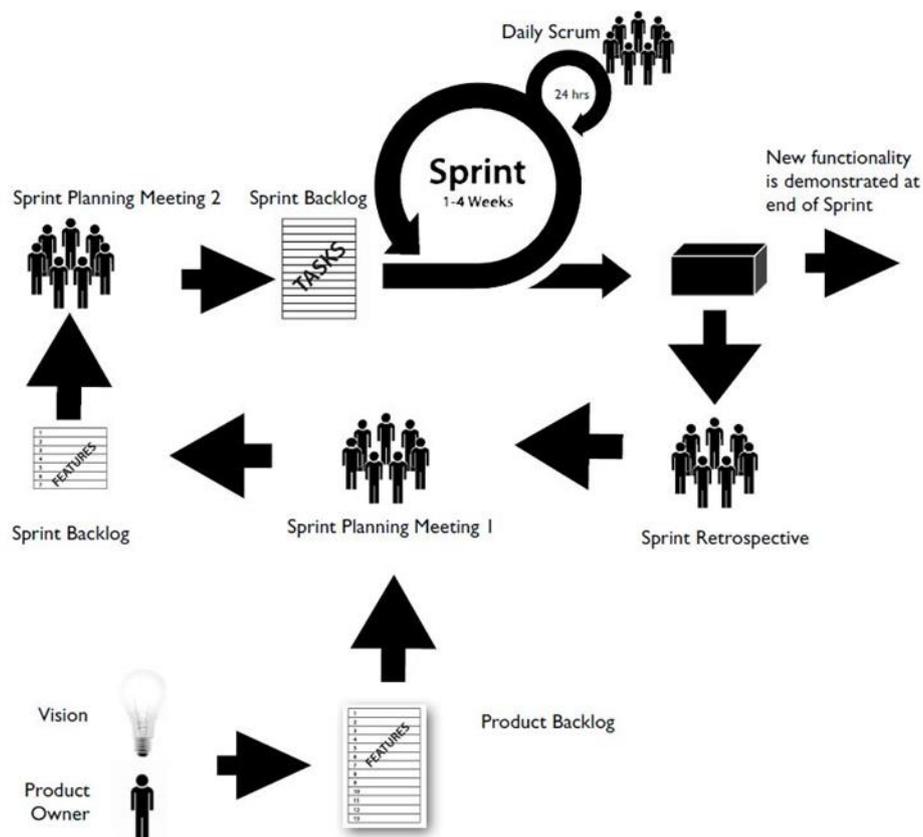
Figure 5: *Scrum* process [26]

After the sprint, another meeting takes place, *"the sprint retrospective"*, to assess the sprint and learn what can be improved in the next one. In this meeting the new features implemented are shown to stakeholders [26].

3.3 Customer Development Methodology

To choose which EA artifacts to develop – EA views and organizational realities to model – is worth to follow the *lean* principle of *"Identify value"* that states to specifying value from the end customer standpoint.

Customer Development Methodology is helpful to reach this goal in the context of EA development. The methodology was proposed by Steve Blank to assure product success of startups and entrepreneurs [28]. It follows a scientific approach to research and understand customers of a product under development.

Looking at statistics, where only 1 out of 10 new products have success in the market, Steve found that companies (large and small) develop new products based in guess of what customers need and want. When finally these new products reach the market, they find that no one wants to buy.

Initially, when an entrepreneur envisions a new product and the process to produce and deliver it, he is only able to make guesses based on his knowledge and his experience. The methodology proposes to check this guesses in real world before start to develop anything.

Entrepreneurs need to contact and interview real people who are likely to become customers, partners, suppliers and other stakeholders. He needs to follow the famous order given by Steve Blank: *"Get out of the building!"* to contact with reality. The goal of interviews is to check the entrepreneurs' guesses and transform them in facts observed in real world [22] [28].

Product development must be driven by real customers' needs and wants, with a balanced relationship between developing a product and understanding the customer. Entrepreneurs need to study customers' pains and gains that the new product can solve, study the relevance of this pains and gains to customers, their willing to pay for a solution, to find the *Value Proposition* of the new product.
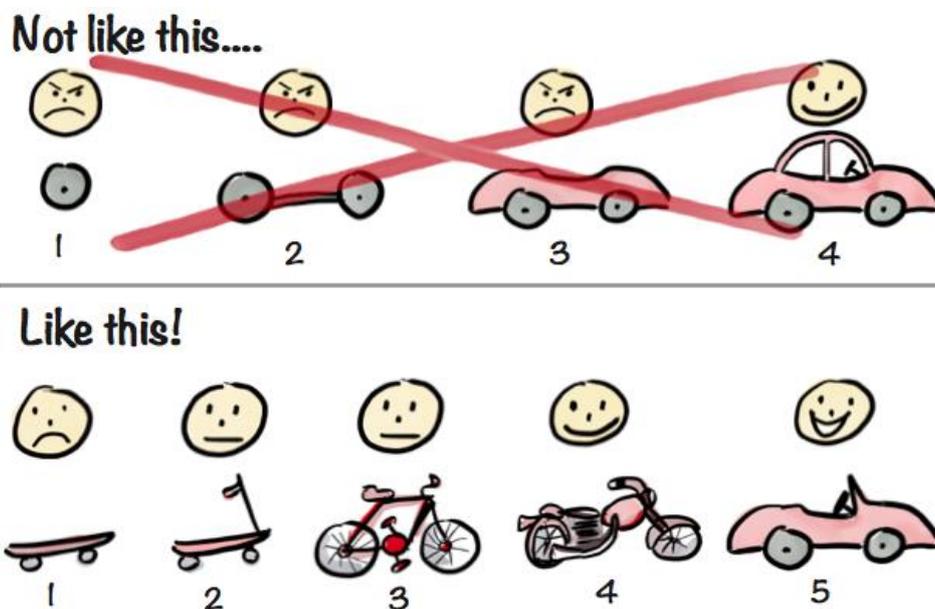
Figure 6: MVP - Minimum Value Product development [29]

Based on an initial customer understanding, the first step in the building process is to develop a Minimum Viable Product (MVP). MVP is a low cost product that should contain the smallest feature set which customers are willing to pay for in a first release. Figure 6 caricature the development of a MVP, empathizing that a complete product shouldn't be developed. Instead we should develop a minimal

usable product to test customer reactions, and develop subsequent improvements based on customer reactions. The MVP release is the first reality check which will confirm or refute guesses about customer responsiveness to new product and its features. The low cost of MVP reduces risk of developing features not valued by customers.

Customers who buy this first release are called *"early adopters"*. These enthusiastic customers are very useful to uncover relevant information about responsiveness to new features and customer willingness. However, early adopters don't represent the mainstream customers who are much more demanding in terms of product features and defects.

This first reality check uncovers a lot of relevant information, about willingness of customers, used to develop new product features. Product development is done based on facts uncovered by reality checks with real customers, rather than based on entrepreneurs' guesses and beliefs. This approach prevents development of products or product features not valued by customers.

4 Research Proposal

The related work done so far, although it greatly contributes for the body of knowledge towards the objective of developing an organizational EA, is still not assertive in which methodology and available instruments are considered suitable for such endeavour.

A sequential list of steps or activities to be mechanically performed by humans, ordered by their hierarchical chiefs is not suitable method to solve a sociotechnical problem, as our research problem stated above. We propose a collaborative method to develop an EA capability in a public institution, which takes a special care to motivational issues and to institution context. Our method has an iterative and incremental approach, like proposed by *agile* principles, to show quickly results for stakeholders, obtained with few resources. This approach aims to show how the abstract concepts of EA materialize in a specific institution and how the institution reacts, values and takes advantages of benefits of an EA capability.

A simple start, with few resources, to gain insides in the EA world will avoid a high risk of a big EA initiative. This is what the Customer Development Methodology teaches us. With the EA capability evolution, asking for more work and more resources, *Lean* principles warns us to keep a watchful eye on EA activities and keep them *"lean"*, avoiding develop EA artifacts which nobody will value.

Section 4.1 defines objectives for the solution. Section 4.2 presents our method, answers how it addresses the research problem and frames the context for which our solution is designed. In the following sections we present our collaborative method in their five phases. Each phase is detailed in a separate section.

4.1 Objectives

Our solution to the research problem should improve the stakeholders' awareness on EA, their value recognition and make EA activities intrinsically attached to organizational culture.

The solution should meet the following objectives:

1. Develop EA capability in a public institution;
2. Improve awareness of public servants about EA utility and benefits;
3. Improve value recognition of the EA to the institution and to its public servants;
4. Create willingness to collaborate in the process of improving and updating the EA, by public servants;
5. Make EA activities intrinsically attached to organizational culture of the institution.

All these stated objectives aim in the way to promote EA knowledge and value added perception in the institution, which is other way of saying that the EA can only be successful in a collaborative environment when is also being captured by the organization culture. If an institution has not in its culture genetics a collaborative approach towards EA added value to the business, any EA initiative

will tend to need a great number of specialized resources, will tend to be a more heavily burden to update, and will tend to last for years fading in the organization.

Changing the culture of an institution is not easy and tends to need a large number of years to embrace a transformation of this magnitude. However, the set objectives is an attempt to foster collaboration by making EA work appropriated by the day to day of public servants, and not with a specialized team that is hired and, most likely, find a great deal of resistance to change.

4.2 Proposed Method

We propose a collaborative method to develop an EA, which aims to develop a strong involvement of stakeholders to obtain their commitment in EA improvement and update activities. If our collaborative method achieves this required involvement by stakeholders, we expect to overcome the constringent imposed by scarcity of dedicated HR to EA by having the responsibility for updating the EA atomized and widespread throughout the organizational structure, rather than having this responsibility concentrated in the EA board. To coordinate a collaborative development of EA artifacts, we propose to raise an EA unit with a small structure, having 1 or 2 elements.

To leverage the stakeholder's involvement, the collaborative method will take advantage of *agile* and *lean* principles adapted to the EA activities.

4.2.1 Scrum Adaptation

Scrum is a well suited method to software development. However, programing is not the same as modelling. The main difference is that programming aims to produce working software, while describing architectures is all about communication [1]. Therefore some concepts from software development and from *scrum* in particular, are not well suited or even unsuitable in the context of EA modelling.

We will interpret *"Working product"* as set of understandable and coherent views of an EA model, from the public servants standpoint.

Scrum method proposes a *scrum* team composed by several members (typically 5 a 9), with three different roles – Product owner, *Scrum* Master and the team elements. However, our collaborative method aims to solve the problem of the scarcity of HR available to dedicate to EA. So, our *"Scrum team"* can be interpreted as the EA unit elements and the public servants involved in a collaboration process to update the EA model. EA unit has a full time dedication to EA while public servants have a sporadic contribution.

We interpret *"Daily Scrum"* as a workday where the interaction between the EA unit and public servants is made whenever necessary.

Programming can be a complex task that requires high levels of concentration. To avoiding interferences during the sprint by stakeholders that can be very disturbing for software developers, and to avoiding repudiation of the commitment made in the sprint planning, *scrum* states during the

sprint, items in the sprint backlog do not change. However, modelling is not as complex as programming. Some requests for change in models and viewpoints can require low work effort. The short delay between a request for change and its implementation in the architecture can leverage the involvement and commitment of public servants. Architecture is a communication process and a real-time implementation can leverage this communication. For all those reasons we propose, in our method, EA unit can decide to add to backlog *"requests for change"* received during the sprint.

The above adaptations to the *scrum* process lead us to propose that the workshop between sprints includes all responsibilities of the three meetings stated in *scrum*.

4.2.2 Phases of the Collaborative Method

Our collaborative method has five phases, summarized in Table 1, which we will detail in the following sections.

Table 1: Phases of the Collaborative Method

Phase	Description	Output
1. EA-MVP creation	• Develop an EA model populated with information managed by IS in production – an initial Enterprise Cartography; • Create viewpoints from this cartography.	• EA-MVP – an enterprise cartography as a Minimum Viable Product.
2. Key Stakeholders Involvement	• Conduct personal interviews with key stakeholders to better understand the ground reality; • Identify viewpoints that can be valued by stakeholders; • Gather information about institution's organization, not present in the IS, to enrich the EA-MVP.	• Ground-level understanding of the institution; • List of viewpoints to develop; • Initial product backlog to develop the EA-MVP; • Emotional involvement from stakeholders; • Perception of emotional reactions.
3. Workshops	• Workshops to 10 / 15 participants each one: • EA concepts and benefits; • EA in their institution; • Employees contribution; • Employees need to have access to the EA-MVP and be able to navigate through their views.	• Employees awareness level towards EA concepts and benefits; • Shared vision of how to implement EA capability in the institution; • Knowledge of the employees of how to contribute to the improvement and updating of the EA-MVP.
4. Sprints	• Updates to the data in the EA-MVP; • Updates to the viewpoints from the EA-MVP; • Requests to employees validation and additional contributions.	• EA-MVP improved and updated; • Backlog updated.
5. Result Analysis	• Assess metamodel; • Assess viewpoints; • Assess data coherence and consistency in the model; • Assess collaborative method.	• Proposals to improve: • Metamodel; • Viewpoints; • EA-MVP model; • Collaborative method.

The method starts in phase 1 – EA-MVP creation and follows the sequence of phases illustrated in Figure 7. The EA-MVP is created iteratively with contributions and suggestions gathered from the interviews. The phase 3 starts when we think that public servants will minimally recognize value to our EA-MVP. This phase includes the preparation of a presentation to conduct workshops, the logistic

activities to realize workshops (room with computers and a projector, authorizations, invitations, scheduling, etc.) and the workshops themselves.

Public servants who were invited to participate in workshops should be divided into groups not bigger than 15 participants each. After each workshop a sprint begins for this group of participants. The EA unit can realise a set of workshops to several groups and the sprints occur simultaneously.

When all sprints have finished, comes the last phase: Result analysis. The results will be presented in the next set of workshops. The method ends to this set of public servants when they keep their context updated in the EA model, without having to ask them to do that, and when they are satisfied with EA viewpoints.
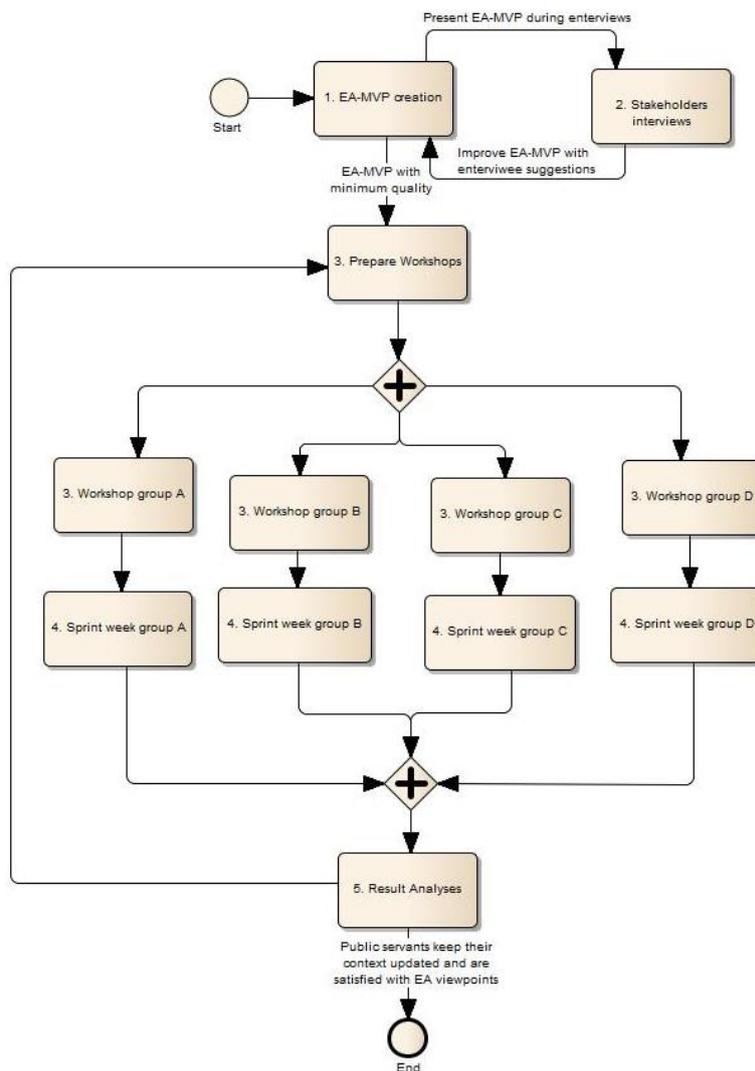
Figure 7: Collaborative Method - Phases sequence

4.3 Phase 1 – EA-MVP Creation

The collaborative method begins with the creation of an initial MVP (our EA-MVP) driven by principles and learnings of Customer Development Methodology. Our EA-MVP will be constituted by a model of the institution, stored in a repository, and viewpoints that allows views of the model. We need to

develop a product, with a minimum features set, which public servants (our customers), may value for the first release [22], [28]. This EA-MVP should be developed with a minimum amount of effort and the least amount of development time [22].

4.3.1 EA Tool

To this endeavour, we need a software tool to construct and manage the model of the institution, in a repository, and to construct viewpoints that allows views of the model. Manage the EA with plain drawing tools, like Microsoft Visio or Archi [18], is an impossible undertaking [2]. The costs of keeping the data up to date are prohibitive, and the rift between model and reality will soon be insurmountable [2]. Bente et al., in the book *"Collaborative EA"* recommends the following requirements for an EA tool [2]:

1. The tool has a timeline for planning and simulating future states of the architectures.
2. It supports quantitative assessments and optimizations of the IT landscape; in other words, it supports application rationalization.
3. It has rich facilities to visualize models and craft views addressing specific stakeholder viewpoints as well as publishing functions for sharing knowledge.
4. It is integrated with other tools.
5. It facilitates communication by feedback, collaborative authoring, and other means of participation.

Figure 8 [2] highlights the importance that these authors give to the integration of the EA tool with other IS.
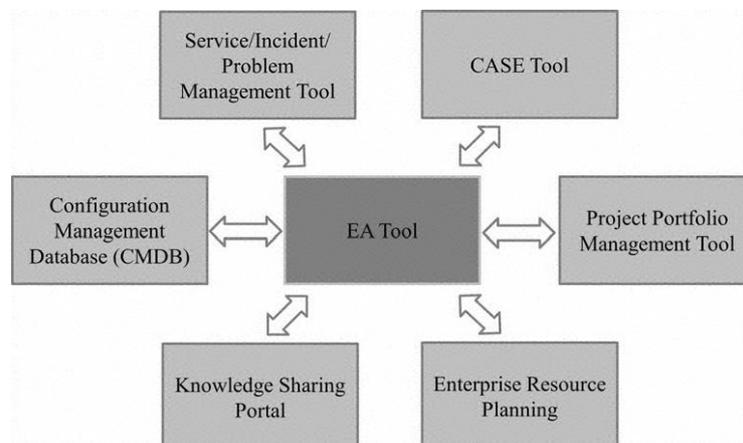
Figure 8: An EA dream: The integrated EA tool [2, p. 57].

4.3.2 EA-MVP Creation Process

Our initial model should begin with a small part of the network that constitutes our institution. The business layer is the part of this network which most public servants better knows. The extension of EA model to other EA layers (application, technology and information) should be developed at a later stage, when a higher level of maturity of the EA capability has been reached. The knowledge of those layers requires technical skills usually not found in common public servants. So, common public

servants are not so much helpful in the modelling activities of those layers. We will need the collaboration of IT staff for this later stage.

We start the creation of our EA-MVP by defining which concepts, from the business layer, and which relationships between these concepts, we will capture in our initial model. This task is the definition of our initial metamodel for the EA model. Figure 9 shows a possible example of a simple metamodel modelled in the Archi tool [18].

Public institutions already have IS that manage information related with the business layer, e.g. the HR system should have the assignments of public servants to job positions. We should to take advantage of this fact in the construction of our initial metamodel. On the one hand, we can leverage the value recognition of our EA-MVP if we present a model pre-populated with valuable information. On the other hand, we need to evaluate the required effort to integrate these IS with our EA tool, since an information entity should be created only once in a unique IS and updated only in this IS, to avoid duplications and inconsistencies. So, we should to construct our metamodel thinking how can we populate our future model with information from other IS.
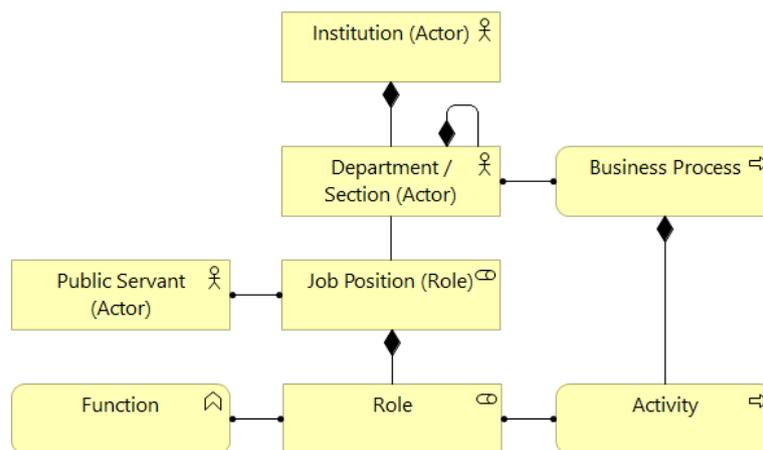
Figure 9: Initial metamodel example - only in the Business Layer

We try to construct a model, from the metamodel, with information gathered from existing IS, improving the both (model and metamodel) in an iterative and incremental way. In this process, we will evaluate what can be valued by public servants, but managing sparingly the integration effort.

Our model will be an initial cartography of the organization, based on information stored and managed by IS already in operation within the organization. Finally we need to define initial viewpoints to allow views of the model showing the parts that interest to each public servant. The definition of a viewpoint consists on the selection of which elements of the model (instances of concepts) and which relationships should be shown in the views generated from this viewpoint.

We will construct a special viewpoint focused in the public servants, which we named *"Employee Context"*. This viewpoint generates views showing the network of elements that directly relate whit a given public servant.

With these views, we expect a part of public servants easily recognize what EA has to do with each of them. We also hope that such *"familiar"* views will trigger an emotional involvement of public servants with the EA model. This involvement is important to leverage the willingness to collaborate in the correction and update of the EA-MVP. Although not all public servants will be persuaded to collaborate, we can gain part of them to help us in the initial development of the EA-MVP.

Figure 10 shows a simple example of a view generated by an imaginary *"Employee Context"* viewpoint, to illustrate the concept. However, elements shown in such viewpoint depend of the specific institution, the metamodel developed and the information available in the IS in production, which will automatically feed the model.

Some elements and relationships may not yet have been captured and managed by any existing IS. In the example of Figure 10, we can see activities assigned from roles which in turn compose a job position which in turn is assigned from a specific public servant. Probably there are no IS capturing such activities or the relationships between activities and specific roles. Are these elements and relationships that we will ask public servants to create and update.
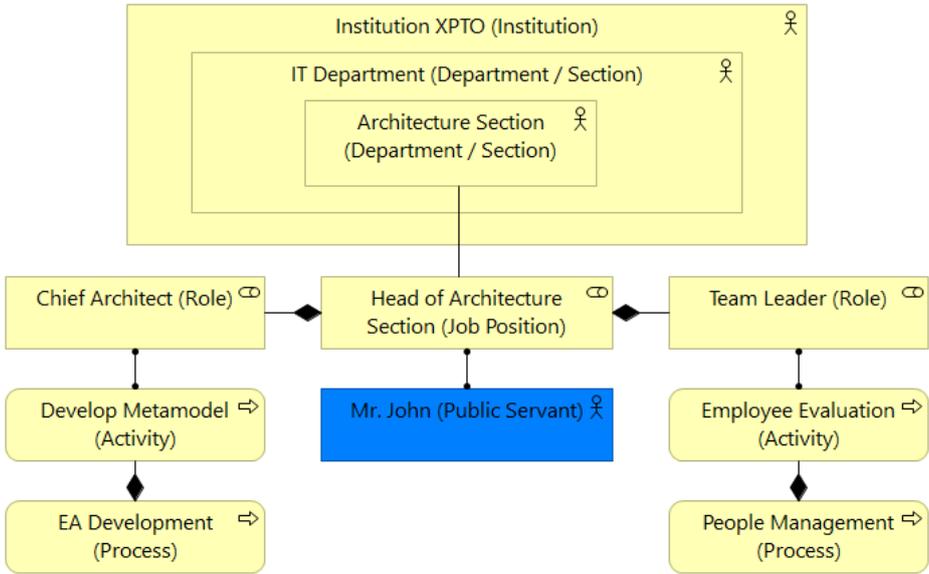
Figure 10: *"Employee Context"* View Example

We can compare the collaboration that we will ask to public servants with the collaboration that Google asks to their users in the updating of the *"Google maps"* web application. The users of Google maps are invited to add missing places in the maps, which can be the restaurant, the church or the garden of their own street or other places that each one better knows. Similarly, we will ask to public servants to add missing elements in the model that composes their working context, which each one better knows.

This initial cartography will show to public servants the concepts and potential benefits of an EA model of the organization. It also allows the EA unit elements gain or deepen insights over the organization.

The EA-MVP creation should follow *lean* principles. It should take care of the EA-MVP value from the public servants standpoint *("Identify value" lean* principle), modelling realities and creating viewpoints

that fulfill public servants' needs. We should avoid spend time and effort to model realities and develop viewpoints that do not add value to public servants.

4.4 Phase 2 – Key Stakeholders Involvement

Having an initial model of the organization and their initial viewpoints, is time to test it with a small, but representative public servants. Following the customer development process, we propose to conduct personal interviews to realize the extent to which our EA-MVP is valued by our *"customers"* – the public servants. This phase is the *"Get out of the building!"* equivalent of the Customer Development Methodology [22], [28]. In this phase we will conduct interviews with public servants selected from the middle management that are accountable for a part of the institution and have a deep knowledge of how it works in the ground-level.

In these interviews we present our EA-MVP, we put our doubts about the department specificities, we ask for contributions to improve viewpoints and suggestions for new viewpoints, among other relevant contributions. In addition to the relevance of information gathered, we need to construct the idea that the EA model has a shared ownership, and is the result of a collaborative effort, that can be useful to each one and to the institution.

In those interviews, we expect to find public servants' needs of an EA, the pains that the EA can reliever and gains that can create [22], [28].

The objectives of these interviews are the validation of data and viewpoints our EA-MVP, to their improvement, and the emotional involvement of key stakeholders in our mission. So, these interviews have informative and emotional objectives.

The informative objectives are the following:

- **Ground-level reality**: Gain and deepen insides about the ground-level reality;
- **Data collection and validation:** Confirm and/or collect information to the model that is not managed by existing IS;
- **Viewpoints improvement**: Collect suggestions and contributions to new viewpoints and improve existing ones.

And the emotional objectives are:

- **Spread the word and evangelize**: to convey the message of the potential benefits of EA;
- **Shared ownership**: Construct the feel of a shared ownership of the EA model;
- **Allies and early adopters**: Win allies and early adopters to help us to convey our message.
- **Emotional reactions**: Collect reactions of the EA-MVP;

4.4.1 Ground-level Reality

The interviews will help us to better understand the ground-level reality. We can test our initial assumptions about what is the information that an EA can provide to the day-to-day of the public servants that they most value.

4.4.2 Data Collection and Validation

There are data managed by existing IS that is incorrect, inaccurate or incomplete. This may happen for many reasons, e.g. the correction process is bureaucratic and / or unknown to public servants; public servants do not feel responsible for having accurate data in the IS; the incorrect data is not visible to public servants; etc. During the interviews is impossible to validate all the data provided by other IS. However, we can grossly visualize the model and views of the EA-MVP, by sampling, to detect errors in the integration of the EA tool with the IS, errors in data, or other kind of systematic errors.

During the next two phases (Workshops and Sprints phases), we will ask for a large number of public servants to collaborate in the update of our EA model. To be successful, this *"crowd"* collaboration should be as simple as possible. If we ask to the *"crowd"* to populate our model with new instances of concepts existing in our metamodel, the net result is that there will be the creation of various instances with different names to the same element in the real world, and the misunderstanding of concepts that lead to the creation of wrong instances. E.g. if we ask for new instances of the concept *"business process"*, we will certainly get different names to the same business process and names for sequences of activities that are not business processes.

We need to pre-populate our model with data collected in these interviews. These new data, which are not present in existing IS, are raised by key stakeholders, who spend some time thinking about it. We hope that such data are likely to have a minimum of consensus.

To this endeavour, before the interviews, we need to develop a preparation work which consists on the creation of lists with instances of concepts (of our metamodel), based on our own knowledge of the institution and on existing documentation. We can send these lists to our interviewees before the interview for validation. During the interviews, we will discuss these lists and ask our interviewee to correct, update and validate them.

4.4.3 Viewpoints Improvement

As mentioned above, our EA-MVP is composed by a model of the institution's business layer and viewpoints of this model, which define views from parts of the model. Initial viewpoints are made by the EA unit based on their guesses of what can be interesting to public servants visualize in the model. Now, during the interviews, we can validate our initial guesses and collect suggestions to adjust viewpoints, or create new ones. Our interviewees can help us to identify viewpoints that can be valued by public servants.

4.4.4 Spread the Word and Evangelize

Our method is designed to be applied in public institutions where the majority of public servants have never heard about EA. During the interviews we should ensure that our interlocutor understands the benefits of an EA and the way to achieve them. We should try to conquest the hearts of our interviewees to have their enthusiasm that can help us in the increase of the EA capability of the institution. If we convince and conquer our interviewees, they can be valuable helpers to spread the word and influence the willingness of other public servants to collaborate in the process of improving and updating the EA.

4.4.5 Emotional Reactions

We should capture the reactions and feelings from public servants when they hear about the promised benefits of an EA and when they see our EA-MVP. These reactions may range from fear of another work burden to recognition of EA utility for IT-landscape management and evolution. Another possible reaction is the indifference. These reactions will help us to adjust our message.

4.4.6 Shared Ownership

An EA model developed through a collaborative method is a result of a shared effort. From the perspective of a public servant, it can be seen as a contribution to an artifact under the responsibility of someone. Alternatively, as the public servant was committed in the construction of the EA model, this model can be seen also belonging to him. This acceptance of ownership, if achieved, will increase the emotional commitment which will leverage the quality and extension of the contribution. During the interview we should try to get that feeling of a shared ownership of the EA-MVP, from our interviewee, through the receptiveness and discussion of their suggestions. We cannot allow the growth of the idea that EA is just a toy of the EA unit.

4.4.7 Allies and Early Adopters

We must also try to win our interviewee as an ally and an early adopter of our EA-MVP. That will help us to convey our message and evangelize public servants about the imperative need for an EA to rationalize decisions and drive the evolution of IT-landscape, among other benefits.

4.4.8 Backlog

At the end of each interview, we get a set of data to correct and update our EA-MVP, and a set of suggestions to improve it. The suggested improvements need to be prioritized. Some of them can be easy and quick to implement, others have to be thought if it make sense or not. Having a backlog is worthwhile to control all these updates and improvements.

4.5 Phase 3 – Workshops

After the EA-MVP improvements made from contributions of the interviews, we hope to have a product which public servants will minimally recognize value. This is the concept of MVP [22]. So it's time to show our initial product to our *"customers"*.

Assuming that the majority of public servants have never heard about EA, we need to explain what EA is and what is it for, since we will ask them their collaboration to update and improve our EA-MVP. Ask them information without explaining why, will certainly result in inaccurate information and we do not get the benefit of their collective wisdom. If we do not involve public servants, the EA initiative will not deliver good and sustainable results over time. So, we need to explain them the EA concepts, their expected benefits, how to implement it in their specific institution, how EA is related with each of them and how it can be useful to their work.

Conquest public servants attention to pass all these information is not a simple task, which will not succeed if we choose the e-mail, a report or an intranet site as a channel. It needs to be explained in person, face to face, to have their attention, catch their doubts, and, the most important, obtain their emotional involvement that enables their commitment. On the other hand, contact all public servants of an institution, one by one, is not feasible. These reasons led us to choose the workshop format. However, we should not expect that public servants are sitting waiting for our lectures. They have their tasks, their responsibilities, their motivations and their concerns, which is unlikely to be directly related with the EA initiative.

Another concern that we need to address is that we cannot dispose indiscriminately of the public servants' time. Their time is valuable and scarce. We need to prepare carefully the workshops to be effective and time efficient.

We recommend that each workshop is attended by no more than 15 participants to be possible give attention to each one. All participants should have access to the EA-MVP through the EA tool during the workshop and the sprint week after that. They should be able to navigate through the views of the EA-MVP, so that they can to suggest updates and improvements about the data, the model and the viewpoints.

Our workshops are the following agenda:

1. EA concepts, goals and benefits;
2. How to implement an EA capability in the institution;
3. The Collaborative Method;
4. EA-MVP presentation and navigation;
5. The special viewpoint: *"Employee Context"*;
6. Public servants collaboration.

The first point is to explain the concepts, goals and benefits of the EA, which, in the first contact, will seem too generic and abstract to common public servants. So, in point 2 we explain how was

constructed the initial metamodel of their institution, that we are using in our EA-MVP, how was populated the initial model and how the metamodel relates with the initial model. We also present our EA tool, their interconnections with existing IS and which data these IS provide to our EA-MVP. We present views of our EA-MVP, populated whit information that public servants easily recognize from their institution. EA-MVP and their views will provide the materialization of EA abstract concepts in to their institution.

In point 3 we explain our collaborative method and their objectives, along with the way we construct and feed our EA-MVP. We explain which collaboration we expect from public servants. This collaboration should focus in three aspects:

1. **Data**: correction and update;
2. **Viewpoints**: suggestions for improvements and for creation of new ones;
3. **Collaborative Method**: suggestions to improvements.

In the 4th point we explain how public servants should collaborate and how to browse through the EA-MVP views. For this purpose, we invite our attendees to open the EA-MVP at EA tool and browse through the EA-MVP views to reach their own *"Employee Context"* view. During the browse we present the EA-MVP and explain how to explore it.

When all participants reach their own *"Employee Context"* view, we move to the 5th point of our agenda. At this point, we focus on the *"Employee Context"* viewpoint, where each public servant can see a view with information related to himself, in the model. Here we explain the origin of the data they are seeing: which IS fed our model. We also highlight the missing data in each of the *"Employee Context"* views which we expect the collaboration of public servants to fill.

The collaboration of public servants, in an embryonic phase of the EA capability, should be as simple as possible, to enable the assimilation of the EA concepts, and to avoid errors and misunderstandings as explained in the subsection *"4.4.2 Data Collection and Validation"* above. So, we will just ask public servants to focus on pointing out errors in exiting data and on adding missing relationships to the model. E.g. the missing relationship between one of the roles that constitute the job position they are assigned with the business processes already identified in the model.

They can also identify missing instances of concepts such a missing business process that exists in the institution and as not yet identified in the model. However, to avoid the rise of erroneous suggestions of instances which do not fit the intended concepts, we must to deepen in the concepts that belong to our metamodel, showing the rational to create and nominate new instances and real examples in practice.

In the last point of the workshop (point 6), we explain the collaborative process that allows public servants to propose updates to the EA model. Public servants are invited to complete their own view in the *"Employee Context"* viewpoint during the workshop. This collaboration is not intended to be exhaustive. In addition to their contribution, it aims to explain and test the collaborative process and

raise eventual doubts. Public servants are also invited to send updates of this first collaboration during the sprint that starts with the workshop and lasts the next week.

The workshop ends with a focus on activities to be performed by public servants during the sprint:

- Update the missing relationships in *"Employee Context"* views;
- Update / error correction in the data of the EA-MVP model;
- Suggestions to improve viewpoints:
  - Suggestions to improve existing viewpoints;
  - Suggestions to create new viewpoints;
- Comments / improvement suggestions to the collaborative method.

4.6 Phase 4 – Sprints

Each sprint starts after each workshop to the group of public servants which participate in the workshop. In the final part of the workshop, public servants are invited to send updates and improvements proposals to the EA unit during the next week – our sprint week.

After the workshop of each group, in the first opportunity, the EA unit should update the EA-MVP with the information collected from public servants during the workshop. As soon as the EA-MVP is updated with the information of one public servant, the EA unit sends an e-mail inviting him to visit the EA-MVP and asking for their validation and for new updates.

To be possible this step, the EA tool, as mentioned above, needs to be accessible to all participants and allow them to browse throw the views of the EA model, in a quick and easy way. The tool should also allow participants to do requests for change on the EA, in an easily and quickly way, and send them to the EA unit.

Some contributions need to be validated before their integration into the EA model, especially those that are suggestions of new instances. Some suggestions like those that require the creation of new viewpoints or changes in the metamodel, if accepted, need more time and effort from the EA unit than a mere update. These contributions and suggestion should be registered on the backlog to be analyzed, discussed and eventually implemented later, after the sprints.

All suggestions and contributions gathered during workshops and during the sprint time should be immediately implemented or registered in the backlog or eventually rejected. These actions should be communicated to the public servant that gives this contribution, with the explanation of the reasons especially in the case of rejection.

When we ask for contributions to public servants, we should establish a deadline. Otherwise there are those who respond soon and those who delay their response until they have time to elaborate a perfect one, which never happens, especially given that EA is not a priority to them. These reasons lead us to set that the sprints should last about a week.

During the sprint week, the EA unit should maintaining close contact with the participants, sending them notices of new updates, discussing suggestions and alternatives. The aim is get their involvement and build a feeling of shared ownership of the EA model, like with the key stakeholders during the interviews. The EA unit will promote the collaboration and involvement of public servants, discussing their questions and encouraging requests for change. As soon as an update or suggestion is implemented in the EA model, participants should be notified and be asked for validate them.

The sprint duration of one week helps to overcome the initial resistance generated by the fear of another work burden, since this extra effort is limited in time. The second sprint with the same participants will be easier to them, once the EA concepts are already familiar and the EA model is more mature, more complete and better thought. The effort to upgrade will be lower.

At the end of the set of sprints, we should have a coherent EA model representing the part of the institution that we proposed to model. We should have a set of viewpoints, from which we can generate views from our model, which public servants understand, value and use. This EA-MVP improved and updated is our *"working product"* for our *"customers"*. But it also needs a lot of improvements. Some of them are already registered in the backlog and others await the opportunity to be identified in future sprints.

We do not need to wait for a final product – a complete EA model of our institution – to start take advantages of our EA model. But, most important, is that we learn from the public servants what they value, avoiding to spend time and effort to model irrelevant parts of the institution and to develop viewpoints which no one cares.

4.7 Phase 5 – Result Analysis

During the parallel sprints, where each sprint corresponds to a group of public servants that participate in a workshop, the EA unit will be very busy, contacting all participants, collecting updates and suggestions and improving the EA model and their viewpoints. There has no time to analyse and make depth improvements. With the end of a set of sprints, the EA unit should analyse the results and evaluate the relevance of suggestions registered in the backlog.

The analysis should be made with the collaboration and involvement of key stakeholders which are responsible for the part of institution represented in the EA model impacted by the suggestions. These key stakeholders are selected in the same way as for interviews: from the middle management that are accountable for a part of the institution and have a deep knowledge of how it works in the ground-level.

Looking at the backlog, the analysis should address the following issues:

1. **Assess Metamodel**: Is it adequate to answer the public servants concerns? Should we add other concepts and relationships? Should we remove concepts and relationships that do not add value to the model?

2. **Assess Viewpoints**: Are their views adequate to visualize relevant parts of the EA model that answer the public servants concerns? Are there simple and comprehensible? Are there overcrowded with irrelevant information to public servants? Should we create new ones? Which improvements can we do in our viewpoints?

3. **Assess data coherence and consistency in the model**: Likely, during the sprints we uncover errors, incorrectness, incoherence or inconsistency in the data provided by existing IS. However the owners of these data and IS cannot be the EA unit. This assessment should address and propose an easy and simple way to validate, correct and update these data in the IS that is the data source.

4. **Assess collaborative method**: our collaborative method can be continuously improved to better fit the context of each institution. We should follow the *lean* principle of *"Seek perfection"*, looking to eventual wasted steps or practices in our method. Is our way to collect suggestions and data updates efficient? Can we automatize some steps? Public servants value our EA?

The EA unit should prepare a session to present their results and analysis to the high-level management that sponsors the EA initiative. This session aims to report results and to reinforce the high-level management support and involvement. It can also be seen as a milestone: The EA model is presented to the sponsor of EA initiative, with the improvement of a set of sprints. This milestone has a motivational effect and sets rhythm to the EA initiative.

At this phase we need to decide whether we should promote another round of workshops and sprints to the same groups of public servants, showing the improvements in the EA model and viewpoints and asking for their collaboration to update the new version of our EA model. To make this decision we need to assess whether public servants keep their context updated and to what extent are they satisfied with EA viewpoints. We need also to consider that we are not allowed to take the time of public servants indiscriminately. Workshops are time consuming and need to be efficient and effective. So we need to define our objectives before start another round.

Alternatively we can decide to select another set of groups of public servants (e.g. from other department of the institution) to model a different portion of the network that constitutes the institution.

5 Demonstration

The Portuguese Navy is taking the first steps in building of an EA capability. This mission is assigned to a military unit named *"Directorate of Analysis and Information Management"* (DAGI - *Direção de Análise e Gestão da Informação*). DAGI is under the hierarchical command of the *"Superintendence of Information Technologies"* (STI - *Superintendência das Tecnologias da Informação*) which constitutes the IT sector of the Portuguese Navy. The STI have three subordinated military units: DAGI (already mentioned), DITIC and CDIACM. Figure 11 shows the hierarchy of these four military units on the STI organizational chart.
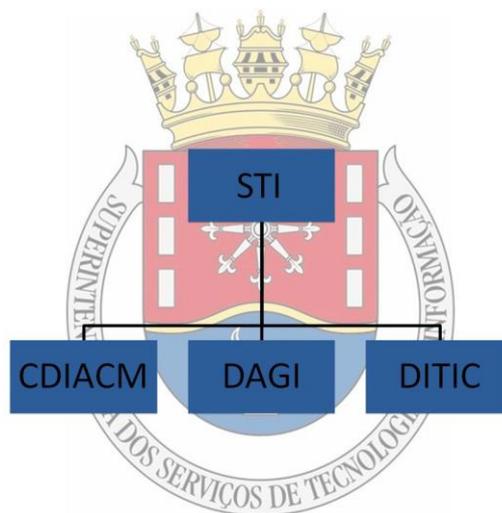
Figure 11: STI Organizational Chart

Portuguese Navy has about nine thousand public servants of which nearly eight thousand are military, spread over more than one hundred of military units.

The desire to raise an EA capability in the Portuguese Navy makes this institution eligible to perform the demonstration of our method. It is a public institution with low level of EA capability. In fact, it was this desire that create our awareness to our research problem and motivate us to this research. It constitutes the entry point to our research. However, Portuguese Navy is too large to perform the demonstration of our method in all its military units simultaneously. So we decided to limit the scope of our demonstration to STI and their three subordinate units: DAGI, DITIC and CDIACM.

These four units have about one hundred and sixty public servants, including civilian and military, which we considered reasonable to perform the demonstration of our method.

5.1 Phase 1 – EA-MVP Creation

As discussed in section 4.3, the initial EA model should be focused in the business layer, which is the layer better known by common public servants.

To build our EA-MVP, we need EA tools to define an initial metamodel, to develop our EA model, to collect data from other IS and to develop viewpoints from our model. The initial metamodel was

developed in the Archi tool [18]. Here we define the abstract concepts that we will use in our EA model and the relationships allowed between these concepts.

However, as discussed in subsection 4.3.1, Archi is not suitable to integrate with existing IS. So, to develop our EA-MVP, we used EAMS, which is an information integrator and a visualizer [30] of our EA model. EAMS have two components:

- A desktop application: To develop the EA model, the viewpoints to generate views from the model (called blueprints on this tool), to configure the navigation through views, to configure the integration with data sources (other IS);
- A web application: To make the EA views available on a website. It allows also users to create and submit architectural scenarios, which are proposals for changes and updates of the model.

We choose two of IS in operation in the Navy, to use as data sources to our EA model: the HR database and the Enterprise Project Manager (EPM). These two systems manage information related to the business layer of the organization. The HR database manages information related with each employee: the military unit where he is serving, their job position assignments, roles that composes job positions, functions of each role, etc. The EPM manages projects of the Navy, and includes the employees' assignments to project manager and project team.

The full automated integration between these two systems and the EAMS requires effort and time that could compromise deadlines of our thesis, so we decide to make the integration in a semi-automated manner recurring to excel sheets and a manual copy-past process to update our EA model. Not ideal but we believe that is sufficient to demonstrate our collaborative method.
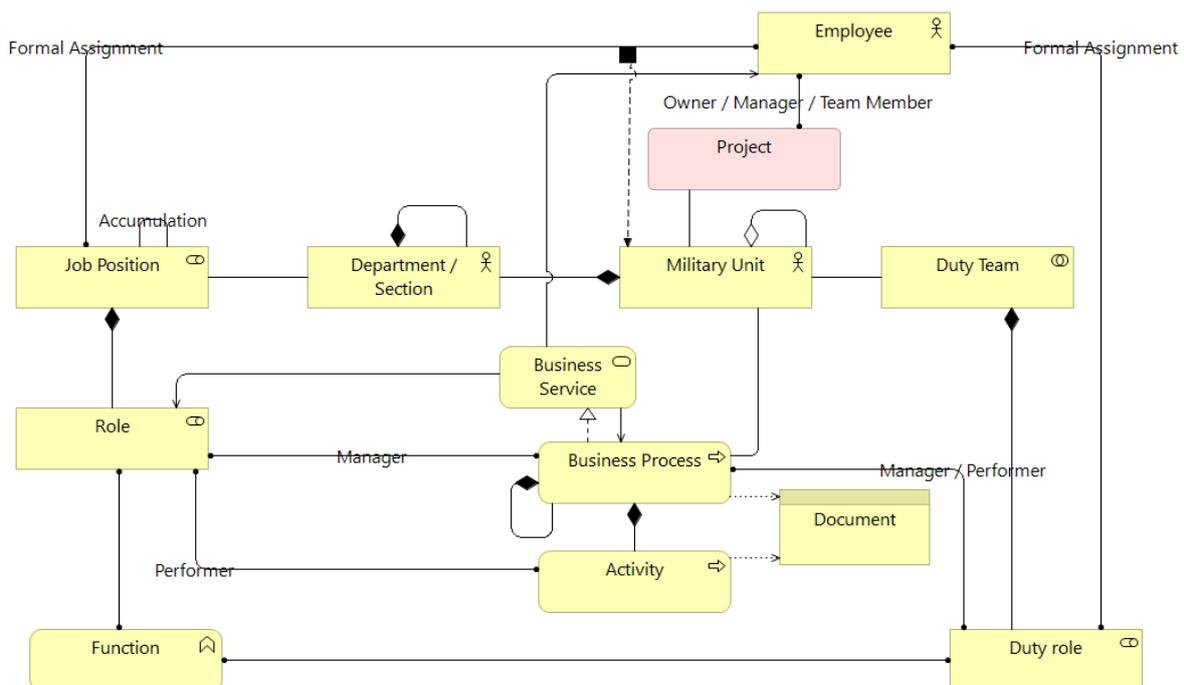

Figure 12: EA-MVP metamodel

The information available in these IS influenced the design of our initial metamodel, which was developed in an iterative way, trying several possibilities with experiments of data integration from our selected IS to the EAMS. After several iterations, we got to the metamodel showed in Figure 12.

In EAMS, the abstract concepts of the metamodel are represented as datatypes (or classes). The relationships can be represented in two ways: as an attribute (or property) of one of the datatypes involved in the relationship or as an autonomous datatype, with attributes representing the connections to the datatypes involved in the relationship. The first way is the simplest as illustrated in Figure 13.

Figure 13: Relationship modelled directly

However this simplest way has a drawback: retain the historical of these relationships is impossible. Each time we change the value of the attribute that represent the relationship, we lose the old one. To overcome this drawback, we can use the second way to model the relationships: we create a datatype that represents our relationship, as illustrated in Figure 14.
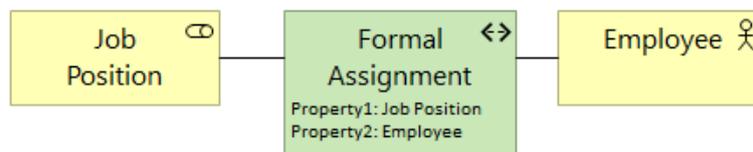
Figure 14: relationship modelled as a datatype

In our metamodel, showed in Figure 12, we gave an explicit name to the relationships that we wanted to model the second way.

The relationship *"Formal Assignment"* was modelled as a datatype that contains connections to three datatypes: *Employee*, *Job Position* and *Military Unit*. The reason was to simplify the integration of the EA model with the HR database and to ease the detection of errors and missing data. In HR database, employees normally are assigned to a *Job Position* that belongs to one *Department* that belongs to one *Military Unit*. However, there are employees assigned only to their unit, but their assignment to a job position is not registered in the database.

Are such details that justify our decision to design the metamodel iteratively with experiments on real data and integration of systems. If we develop a theoretically ideal metamodel, not looking at the real data and the real systems, we risk to waste time fighting the reality without added value.

In the development of metamodel, we had the concern to model all behaviour performed by a public servant to serve the Navy, which includes the duty roles of the watch systems of the military units. However, the composition and functions of these watch systems are regulated by publications and internal norms, which can differ from unit to unit. These roles and functions are not stored or managed by any IS. We can use our method to capture collaboratively this information to our model, however, we decide postpone this work to simplify the first iteration. The relationship *"Used by"* between *"Business Service"* and *"Employee"*, *"Role"* or *"Business Process"*, although it exists in the metamodel,

was not modelled in our EA-MVP, also to keep simple the first iteration. Thereby, the metamodel used to the first iteration is presented in Figure 15.
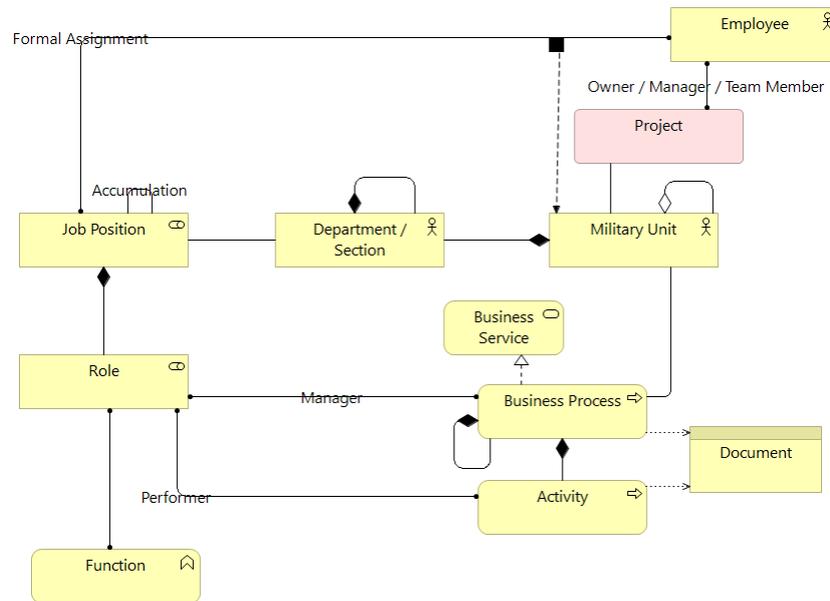
Figure 15: Metamodel used in the first iteration

In parallel with the design of our metamodel, we start to populate our EA model with data gathered from HR database and from EPM. The EAMS imports data through xml files that contains instances of datatypes and their properties which some of them can be relationships with other instances, as mentioned above. To populate our model, we develop an excel sheet that transform tables copied from the databases of HR system and of EPM, to tables formatted in a way to be possible easily convert to xml files imported by EAMS.

We populate part of our model in a semi-automatic way. The HR database provided data for populate the blue shaded part in Figure 16, and the EPM provided data for the red shaded part.
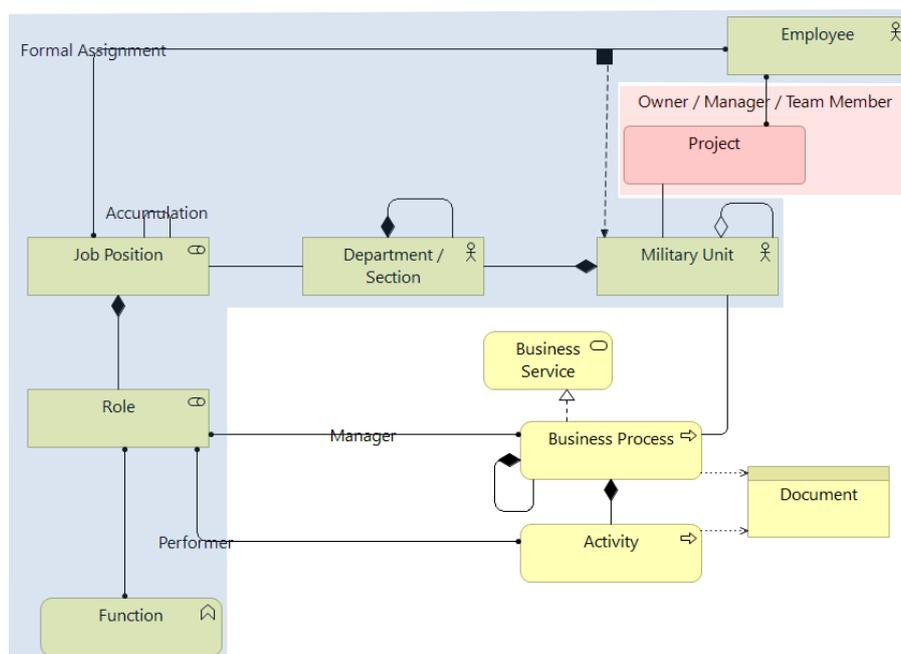
Figure 16: Part of the model filled in a semi-automatic way

Later we will ask the collaboration of public servants to verify the correctness of this data and to populate the unshaded part.

Figure 17 shows the instantiation of datatypes from the metamodel, with entities related to the employee *"CTEN EN-AEL ROCHA ROBOREDO"*. The data was gathered from HR database and from EPM. This view was built manually in Archi [18] only to exemplify what we have in our model when we populate it.
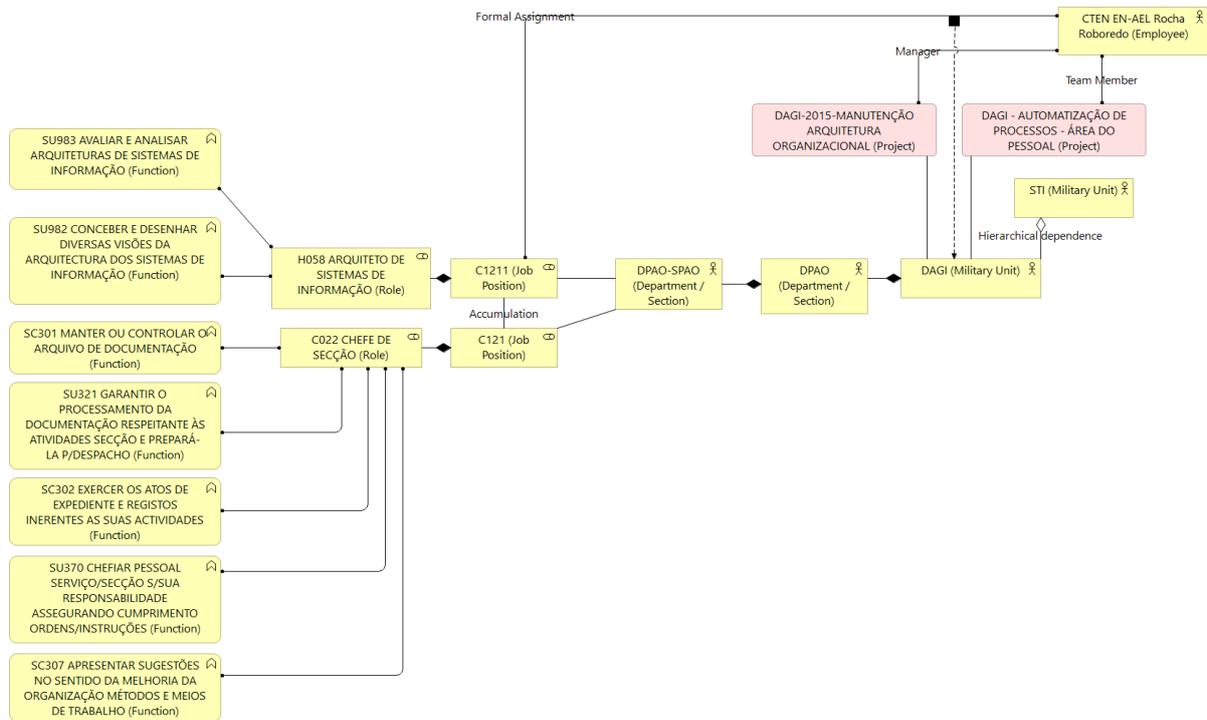
Figure 17: Archi view of *"CTEN EN-AEL ROCHA ROBOREDO"* context

In addition to the building of our model, we developed nine viewpoints on EAMS to generate blueprints from our model, which can be found in Appendix A: EAMS Blueprints.
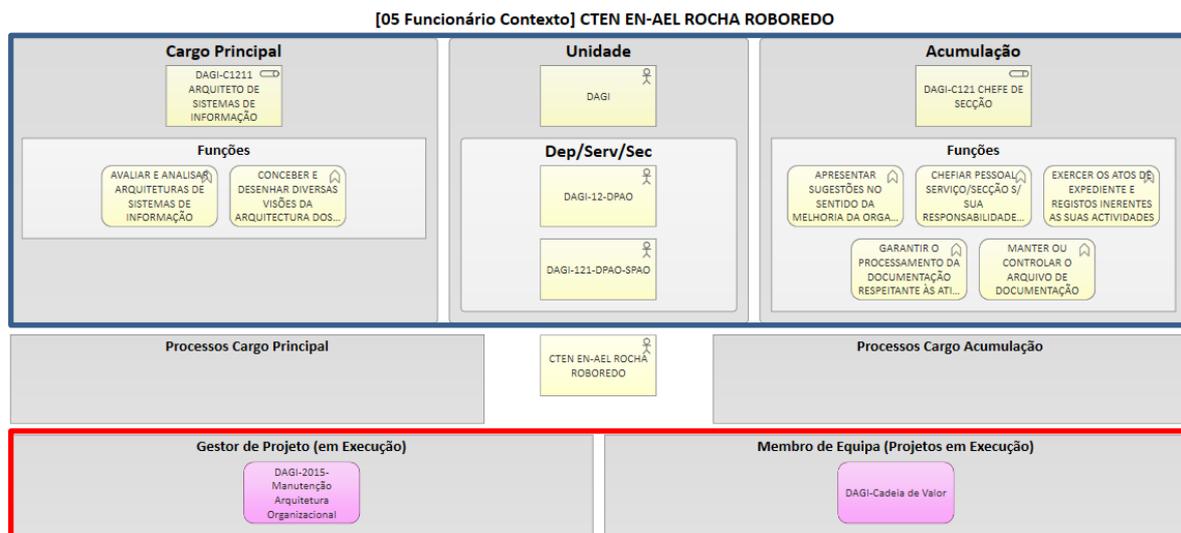
Figure 18: *"Employee Context"* view of *"CTEN EN-AEL ROCHA ROBOREDO"* from EAMS

One of the nine viewpoints was viewpoint *"Employee Context"*. Figure 18 is a view generated from this viewpoint, to the employee *"CTEN EN-AEL ROCHA ROBOREDO"*. This figure has the same information as Figure 17, however was generated automatically giving as argument the instance of employee. This viewpoint shows elements of EA model directly related with a concrete employee. Information inside the blue rectangle was gathered from HR database. Inside the red rectangle we can see the projects assigned to this employee as we gather from EPM.

In our model are missing the business processes, assigned from the roles, performed by public servants while occupying their job positions. We will ask to public servants to populate our model with this information: in which business processes they participate as executors. When the EA model is populated with this information, business processes will appear inside the two grey box maned *"Processos Cargo Principal"* (Processes primary role) and *"Processos Cargo Acumulação"* (Processes accumulation role).

Our EA model and their viewpoints were developed in the EAMS desktop application and made available on the EAMS web application in the Navy intranet, for participants in our demonstration.

5.2 Phase 2 – Key Stakeholders Involvement

This phase occurs simultaneously with the previous one and contributes to the creation of our MVP.

We started with a presentation to the high-level management of the IT sector of the Navy, which includes the admiral superintendent of information technologies, three directors of their subordinate units and senior officers of the sector, rounding twelve participants. Here we presented an historical background of EA, the concept of EA, the problems that EA addresses, and the EA associated concepts. Next, we presented what is done in the Navy in this field, particularly a project developed in the *"National Maritime Authority"* (AMN - *Autoridade Marítima Nacional*), and we present our EA-MVP, on EAMS web application, as it was at that time. We promote a discussion on the relevance of an EA capability to the Navy and how to build it. The involvement of participants on the discussion and their intervention was indicative of an improvement in their awareness about EA utility and benefits. We conveyed our message and obtained their support to the initiative of our demonstration.

Taking advantage of other initiative of elicitation of business processes, we performed another session where we discuss and explore complementarity and synergies of the two initiatives: Building of an EA capability and elicitation of business processes of IT sector. In this session, we stress again the EA utility and possible benefits.

As mentioned in subsection 4.4.2, the collaboration which we intended to ask to public servants should be as simple as possible during the first iteration. When they perform a simple requested task, they should feel that they fulfilled what was asked. But we should not limit them if they want to collaborate deeper. In the first iteration, we will ask public servants to only update the relationships between entities already existing on our model. These relationships are the assignments between roles that they are assigned to and the business processes that they participate when performing

these roles. We had already the roles in our model, gathered from the HR database, but we hadn't yet, in our model, the business processes running inside the military units of the IT sector of the Navy. So, we needed to populate our model with a set of business processes before ask the public servants collaboration.

First we tried to define an initial set of business processes based on the internal regulation of each military unit. In DAGI we also used a previous work of the identification of the Porter's value chain [31]. In this elicitation of business processes, we divided them into three categories:

- **Key Business Processes**: those that meet each unit's mission. They are specific for each unit and the services that these business processes realise are what justify the existence of the each unit.
- **Strategic Business Processes**: those that address the organizational change of the unit and their evolution.
- **Support Business Processes**: those that, not being what justify the existence of the unit, enable, with their support, the running of the key business processes.

To help the reasoning, we grouped our business processes in macro-processes where each macro-process is aligned with mission and competencies of military unit.

We also tried to model some of these business processes in BPMN, as exemplified in Figure 19 to check their coherence and to gain insides of what we are gathering.
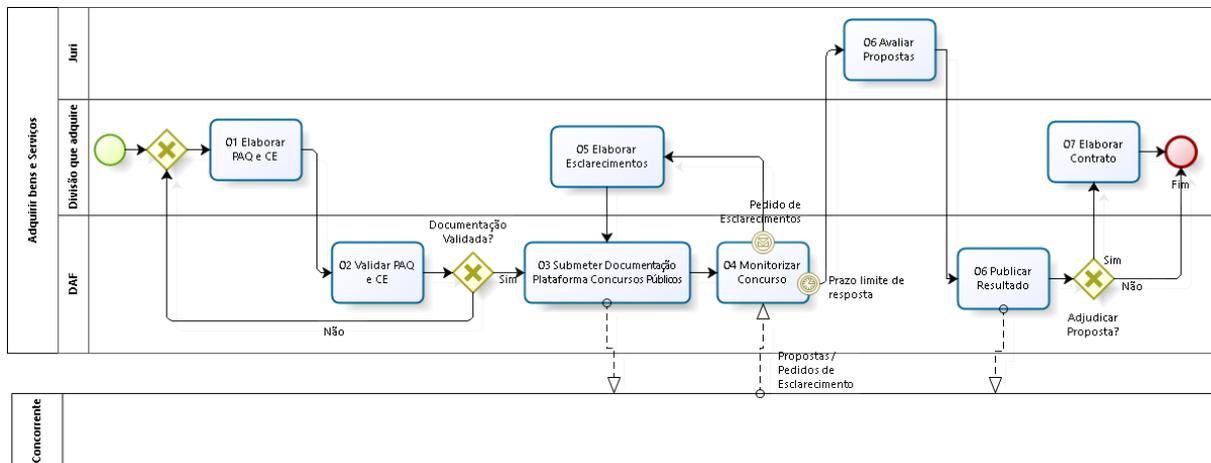
Figure 19: Example of a business process modelled in BPMN

Having an initial list of business processes from the IT sector, and a few models in BPMN, we tried to validate and improve this list through the interviews to our key stakeholders.

We conducted five interviews: with three division heads of DITIC, with one officer representing one of the DAGI divisions and one interview with the only three officers of CDIACM. CDIACM is a small unit with just eleven public servants, including their director and two officers.

Each of these five interviews constituted the first approach to an iterative process that produces a list of business processes from the IT sector. This list of business processes is embryonic and should be improved and completed on the scope of the parallel initiative mentioned above, since a rigorous

initiative to elicit business processes is itself a big workload. We cannot wait for results of the elicitation of business processes' initiative, otherwise we could compromise deadlines of our thesis.

To conduct this mini elicitation process, we ask for our key stakeholders, in each business process to identify the business service(s) realized, the clients of those business services and the business objects accessed by this business process.

The interaction with our key stakeholders allowed us to better understand the ground-level reality. They validated and enriched our list of business processes which was a data collection and validation. During the interaction with stakeholders we had the opportunity to show our EA-MVP, however it was not possible to collect contributions to improve our initial viewpoints, once our stakeholders were not yet familiar with the EA tool and with the EA model and views.

At the emotional field, we conveyed the message of the potential benefits of EA, through the initial presentations and through the fieldwork developed with the key stakeholders. We cannot assess to what extent was constructed the feel of a shared ownership of the EA model in our stakeholders, but asking their opinion about the relevance of having an EA capability in the Navy, we felt we won allies to help us to convey our message.

5.3 Phase 3 – Workshops

In this phase we prepared a presentation to conduct workshops, we selected our 38 participants, we invited them, we scheduled five workshops plus one only the three directors, we managed the availability of participants and finally we performed six workshops.

5.3.1 Workshops Presentation

To the workshops we prepared a presentation with the following agenda:

1. Enterprise Architecture;
2. Enterprise Architecture in the Navy;
3. Collaborative Method to update the EA of the Navy.

In the first point we explained the EA concept; problems with detached architectural diagrams without an EA model; the EA layers; the EA model and what is it for.

In the second point we explained how to implement an EA capability in the Navy; how to construct an initial EA model and their views; we presented the EA tools that we intended to use (Archi and EAMS); we explained what is and how to construct a metamodel; we presented the metamodel we are using in our EA-MVP; we showed a sample of a view from our EA model in Archi and the same view in EAMS; we showed the correspondence between datatypes from our metamodel and instances of these datatypes in views from our EA model.

In the third point we exposed our collaborative method; the objectives of the method; how to feed our EA model with data automatically and with public servants collaboration; how to develop

collaboratively viewpoints; the importance of public servants contributions to improve the collaborative method; we explained in detail the collaborative method.

During the detailed explanation of the collaborative method, we invited public servants to access to the EAMS web application, login it and browse through the views of our EA-MVP until reach their own *"Employee context"* view. At this point, we explained the origin of the data that they are visualizing and the missing data expected to be provided by public servants to update our EA model.

Now we interrupted the flow of presentation to introduce four concepts: business process; macro-process; business service; and business object (that we call document). Establish a common understanding about these concepts was important to put all participants at the same pace. We explained what a business process is; that a business process should realize a business service; that a business service should bring value added to some internal or external client.

We returned to the explanation about our collaborative method introducing the procedures that public servants should follow to send their contributions to the EA unit.

Here we decided not use the EAMS feature to create and submit architectural scenarios because it requires a comfortable understanding of the metamodel. Furthermore, in the architectural scenarios of EAMS, is not possible to restrict the instances of datatypes to a certain context, e.g. when we want to assign a role to a business process, it is not possible to restrict the list of roles, showing only roles belonging to the military unit of the user. These drawbacks require a learning curve from our participants, which can be discouraging to their willingness to collaborate.

Figure 20: Excel sheet prepared to collect contributions from public servants

To overcome this barrier, we prepared an excel file where, through a set of interlinked list boxes, participants can select their military unit, their own name, their roles, and finally select the business processes they participate while performing such roles. This way they could identify assignments of roles to business processes, where the role(s) of each public servant can be assigned to multiple

business processes. Both roles and business processes are already available in lists inside the excel file. Participants only need to select roles and business processes from these lists to register a relationship.

The excel file has several sheets, ones with instructions others with lists of business processes from the military units and other lists of instances of datatypes from our EA-model. However, to simplify the use of the excel file, only the main sheet, called *"processes by role"*, could be edited, where public servants could register their contribution. The list of roles and the lists of business processes available to select depended on the military unit selected before. Figure 20 shows a sample of this excel sheet.

There were two types of editable cells in this excel sheet: the yellow ones where participants should select an item from a list box, and the pink ones where participants could write free text. Table 2 lists all the nineteen fields whish participants could fill.

The minimum contribution we asked to public servants was to fill fields 1, 2, 3 and 5. If they were assigned to an accumulation role, they should additionally fill fields 4 and 9. Fields 6 and 10 were to fill if public servants wanted to add new business processes not listed in the list boxes of the fields 5 and 9, and if their roles were assigned to these business processes not listed.

Table 2: Fields of excel sheet to fill by public servants

Nr	Field	Type
1	Military unit	List box
2	Employee	List box
3	Primary Role	List box
4	Accumulation Role	List box
5	Business Processes assigned to Primary Role	List box
6	New Business Processes assigned to Primary Role to add	Free text
7	Macro-Process to which the newly added Business Process belongs	List box
8	Business Service that is realized by the newly added Business Process	Free text
9	Business Processes assigned to Accumulation Role	List box
10	New Business Processes assigned to Accumulation Role to add	Free text
11	Macro-Process to which the newly added Business Process belongs	List box
12	Business Service that is realized by the newly added Business Process	Free text
13	Business Objects accessed by Business Processes assigned from Primary Role	Free text
14	Business Objects accessed by newly added Business Processes assigned from Primary Role	Free text
15	Business Objects accessed by Business Processes assigned from Accumulation Role	Free text
16	Business Objects accessed by newly added Business Processes assigned from Accumulation Role	Free text
17	Suggestions to improve or to create new viewpoints	Free text
18	Suggestions to improve the collaborative method	Free text
19	Other suggestions	Free text

We added the fields 7, 8, 11 and 12 to help reasoning about the identification of new business processes, in order to avoid designation as business processes a sequence of activities not fitting the concept of business process. Fields 7 and 11 asked for categorization of the new business process in an existing macro-process. Fields 8 and 12 asked for business service(s) realized by the new business process, since if a sequence of activities was not organized with the purpose of realize a business service which creates value to some internal or external client, then this sequence does not fit the business process concept.

Fields 13 to 16 asked for business objects accessed and manipulated by business processes identified before. We called *"Documents"* to business objects, since the concept of business object is

not easy to explain and be understood quickly. These fields were not mandatory, but they were here to help reasoning about business processes and to public servants who wanted to extend their contribution.

Fields 17 to 19 were to collect suggestions to improve viewpoints, the collaborative method and other suggestions.

At this point of the workshop, we presented in detail this excel file. Before each workshop we saved this file in on disk folder of all the computers in the classroom. So, we asked to participants to fill the main sheet during the workshop and we asked to send us their first version of it. We recommended them to fill out the sheet with their *"Employee context"* view opened in EAMS to verify the accuracy of the information in the EA model.

Next, we showed samples of views generated from the nine viewpoints from our EA model, as these shown in Appendix A: EAMS Blueprints. We asked to public servants to explore these views, to find errors or missing data. We also asked them to send us suggestions to update and correct data and suggestion to improve viewpoints through the excel file, by email or by phone. We told them that we created a backlog to register their suggestions.

At the final, we informed participants we will update the EA model with their contributions and we will notify them by email, as soon as possible. We informed participants about the sprint in the next week where we will stay in close contact and we will expect to receive their contributions.

The contributions can be:

- New versions of the excel file with the business processes wherein each one participates;
- Corrections and updates to the data in the EA model that participants can visualize through the views;
- Suggestions to new viewpoints and improvements of existing ones;
- Suggestions to improvements of the collaborative method.

5.3.2 Workshops Execution

As mentioned above, the IT sector is constituted by about a hundred and sixty public servants, including civilian and military. We had not time to realize workshops with all of them. Furthermore, in this early stage of EA maturity, with our low experience in the EA practice and being at first demonstration of our method, with the consequent need to test their concepts and practices, we considered that would not be worth to extend, this time, the participation to all public servants.

Were selected military with rank of officer to participate in our workshops, because they are involved in the management of the organization. The only exception was a civilian assigned to manage the Project Management Office (PMO). Thus, we had a set of 38 participants in our workshops.

These 38 participants were distributed by five workshops, according their availability. The number of participants of each workshop ranged from 6 to 9. Each workshop lasted between 90 and 105 minutes.

Four workshops were scheduled to the same week continuously, from Wednesday PM to Friday AM, as showed in Table 3. The fifth was performed one week later, to adjust it to the calendars of the participants. At the end of each workshop we obtained a set of excel files, sent by email with information to update our EA model.

Table 3: Workshops Schedule

Workshop	Schedule	Nr. Participants
A	03FEV PM: Wednesday 14:00 - 15:30	8
B	04FEV AM: Thursday 10:00 - 11:30	7
C	04FEV PM: Thursday 14:00 - 15:30	9
D	05FEV AM: Friday 10:00 - 11:30	8
E	15FEV PM: Monday 14:30 - 16:00	6
	Subtotal:	38
Directors	22FEV (Monday) PM – 14:30 – 16:00	3
	Total:	41

Workshops ran as described in section 5.3.1. A week later of the fifth workshop we performed the last workshop to the three directors of DAGI, DITIC and CDIACM, where we include a presentation of the results of the previous five.

5.4 Phase 4 – Sprints

As mentioned above, in the first week were performed four workshops. At Friday PM, after completion of the four workshops, there were four sprints running simultaneously, one for each group of participants. We decided to end the four sprints at the same time, at the end of the next Friday (February 12th). We run a separate sprint to the group of participants of workshop E, from February 15th to 19th, Monday to Friday.

These two Fridays (12th and 19th February) we opened an online evaluation form with 25 questions, on the intranet of the Navy, asking participants to evaluate our collaborative method. The results will be presented in chapter 6 Evaluation.

After each workshop we received the excel files by email and we updated our EA model with the information relative to each participant. As soon as we had processed one file, we sent an email to the respective participant inviting them to visit again the EA model through the EAMS to check the updates. We also ask them to send us updates of their excel file with more accurate information and new suggestions.
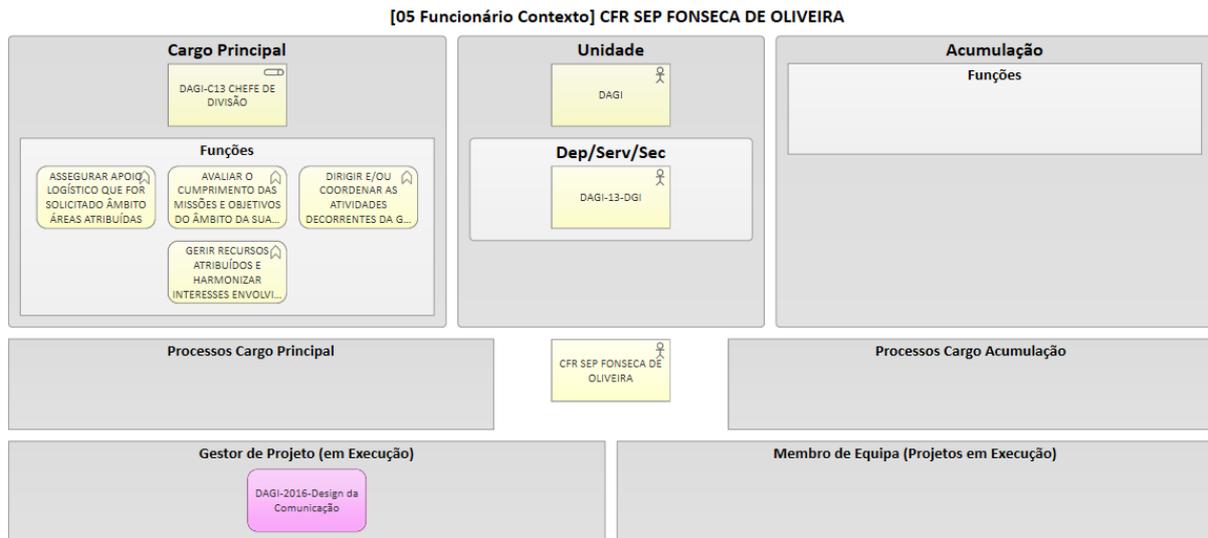
Figure 21: *"Employee Context"* view of *"CFR SEP FONSECA DE OLIVEIRA"* before sprints

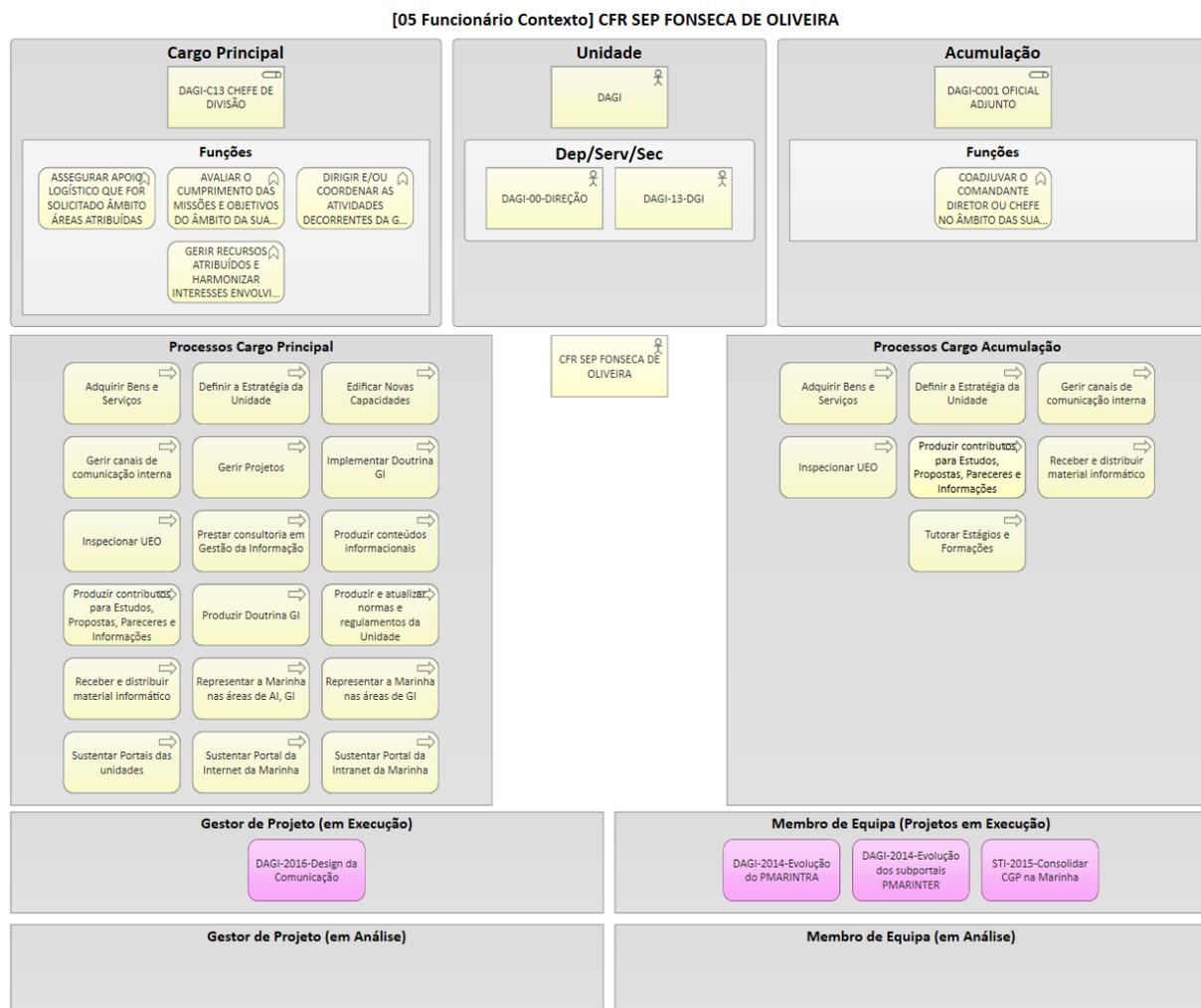Figure 22: *"Employee Context"* view of *"CFR SEP FONSECA DE OLIVEIRA"* after sprints

Figure 21 shows an example of one view generated from the viewpoint *"Employee context"* before the sprints, which belongs to the employee *"CFR SEP FONSECA DE OLIVEIRA"*. Figure 22 shows the same view updated and improved with the contributions of participants after the sprints.

In these two figures, we can see the differences are not limited to the business processes updating. It was added an accumulation role *"DAGI-C001 OFICIAL ADJUNTO"* to this employee. Although this role was already written in the HR database, was not possible to extract automatically the *Accumulation* relationship because this role is assigned to the officer with the highest rank, selected from the three heads of division.

Figure 22 have also three new projects inside the box *"Membro de Equipa (Projetos em Execução)"*: Team Member (Ongoing Projects), which was not in Figure 21. This information was supposed to be automatically extracted from the EPM. However there was an error in the query that extracts this from the EPM database, which was only detected and reported during sprints, by some participants. We believe that if there was no involvement of participants in workshops and sprints, even if this error was detected by someone who eventually browsed the EA model views, it would be very unlikely that the inconsistency in views were reported.

Not only the view of the employee *"CFR SEP FONSECA DE OLIVEIRA"* was updated with new data, but also the layout of the viewpoint was improved with two new boxes: *"Gestor de Projeto (em Análise)":* Project Manager (under analysis), and *"Membro de Equipa (em Análise)"*: Team Member (under analysis). The reason was: Projects, in the EPM, can be in one of fifteen distinct states, ranging from *"Draft"* to *"Guarantee – concluded"*. If we had considered show all EPM projects, within the viewpoint *"Employee context"*, it would be generated some views overcrowded with a bunch of projects completed for a long time, other cancelled, others in proposal to approve, etc. We decide to include only the ongoing projects. However, there are projects already approved for execution, not started yet, which their project managers started working in their planning. When these managers did not see such projects in their view *"Employee context"*, they report us missing projects in the view. Despite the explanation of the reason for this miss, we realize that the view of all projects that concern to public servants currently is important for them, regardless the projects state. Another reason: we realize if public servants do not find what they expect to find in EA views, their confidence lows in the reliability of the information which they see in the EA views. So, we decided to include these two extra boxes in the layout of the viewpoint *"Employee context"*, improving it based on what is valued by public servants.

Funcionário	Sugestão	Observações
850488.CTEN ST-EELT PINTO ALVES	Apresentar ao utilizador o produto final, com vista a ele ver a sua aplicabilidade	
26704.2TEN EN-AEL CORREIA DE OLIVEIRA	Actividades de Inspeção Setorial não estão directamente associadas ao meu cargo.	
9102203.2TEN ST-EINF GUERREIRO PACHECO	O software que suporta a AO deverá de alguma forma manter a pessoa "comprometida" com a informação que directamente com ela está relacionada. Por exemplo, sempre que existam alterações num determinado conteúdo em que o indivíduo está directamente envolvido, este deveria ser informado por email com um link directo para a respectiva alteração.	
9102203.2TEN ST-EINF GUERREIRO PACHECO	A atualização deve ser o mais automatizada possível a partir das diferentes fontes (SIIP, EPM, EasyVista, etc).	
9102203.2TEN ST-EINF GUERREIRO PACHECO	A fita de tempo deve estar configurada para que desta forma qualquer pessoa posso ver o seu envolvimento nos diferentes projetos ao longo do tempo e de alguma forma se tenha a possibilidade de comparar, num espaço temporal, o envolvimento pessoal Versus toda a atividade da seção/unidade.	
9104410.2TEN TN (DSG) SOFIA DANIELA ALVES	Sustentar Portais das Unidades ALTERAR PARA: Apoiar e gerir Portais das Unidades (intra e internet)	Já alterado no EAMS
20005.2TEN EN-AEL GONÇALVES CAPELA	Estou formalmente nomeado para o cargo DITIC-C01111 ENGENHEIRO TELECOMUNICAÇÕES mas desempenho funções no cargo DITIC-C1123 ENGENHEIRO TELECOMUNICAÇÕES	Enviado email para o chefe (CTEN SEP Saraiva de Oliveira) a sugerir um contacto com a DP
20005.2TEN EN-AEL GONÇALVES CAPELA	Incluir as competências necessárias para desempenhar o cargo e as competências que a pessoa possui.	Necessidade: mapear as competências dos funcionários e as competências exigidas pelos

Figure 23: Screenshot of suggestions in EA backlog

We received suggestions to improve the excel file, such as increasing the rows for business processes, as changes and additions to business processes, or as the possibility to assign more than one accumulation role to the same employee.

There are suggestions that we added to our backlog, since they need to be analysed and / or they require a workload that exceeds the sprint scope. Figure 24 and Figure 23 are two screenshots of our backlog.

As mentioned above, at the final of each sprint, participants are asked to evaluate our collaborative method through an online evaluation form.

	Tarefa	Pr
2	Construir Blueprint "Atividade": Executante, Cargo, Processo, Documento	1
3	Atualizar EAMS com o cargo do Courela Alexandre	2
4	Atualizar BD-Pessoal com o cargo do Courela Alexandre	3
5	Processo de atualização da lotação - modelar	4
6	Função de Adjunto do Coordenador-Geral do SIG-Marinha - Cte. Penim Garcia	5
7	Como mapear cargos eventuais / cargos secundários: ADU / GODU / Gestor do chaveiro, etc	6
8	Projetos com uma dimensão tal que têm uma estrutura própria com cargos definidos SIG-DN, GPESI, GCCs, GPIs, GTs	7
9	Construir Blueprint "Documento Contexto"	8
10	Preocupação: Participação em projetos externos à Marinha - não mapeados no EPM	
11	Alterar "9.Documentos Produzidos" no datatype "Processo" e "04.Documentos associados" no datatype "Atividade" para "Documentos"	
12	Cargo Acumulação CFR NA Parraço Trindade - DITIC-C14 Chefe de Divisão	
13	Link para a página do projeto no EPM	
14	Membros de equipa propostos (ainda não aceites) - retirar do EAMS - melhorar a query	
15		

Figure 24: Screenshot of tasks in EA backlog

5.5 Phase 5 – Result Analysis

Having finished the sprints is time to a deeper analysis of their results. In this section we will present our findings on the first iteration of our collaborative method.

We realized our initial list of business processes was very immature and needs great improvements to be consistent and valuable. It contains several levels of granularity, which ranges from very generic processes becoming meaningless, to processes at the task level. The definition of a business process based only on a name with a few words definitely is not enough. Our attempts to better define them through the nomination of the business services realized, their aggregation in macro-processes and the nomination of business objects accessed, were also insufficient. They remain ambiguous allowing different and erroneous interpretations, which led public servants consider that they are assigned to it, when looking through one perspective, and consider the opposite, when looking through other perspective. E.g. one of the business processes that we have in our model is *"Produce Doctrine on Information Management"*. This business process comes from one of the competences assigned to DAGI in their internal regulation document. We had also defined a business service that this business service realizes: *"Standardization of Information Management Activities"*. The clients are all the military units of the Navy. The business objects accessed are publications and norms. It belongs to the macro-process *"DAGI - Produce and Implement Doctrine"*. However, despite all these definitions, what really means this business process? Which activities compose it? Which roles should be assigned to it?

It will be worth to spend time and effort in an effective and systematic initiative of elicitation of business processes before another iteration of our method. This initiative should include the process modelling in BPMN to unambiguously assign activities to roles, so that public servants can understand what exactly the business process is and if they participate in their activities or not.

We realized public servants value to see all the issues that they are accountable in the view *"Employee context"*. In fact this is one of the purposes of this viewpoint. However there are assignments to activities that don't belong to projects in EPM nor are assigned under the context of roles registered in the HR database. One example is the aforementioned assignment to watch systems, already covered by the metamodel, but we decided not to include in the first iteration. Other example is the assignments to roles in big and long-time projects. Some of these projects are not controlled in the EPM because they are managed by entities external to the Navy, like the Ministry of Defence or the Armed Forces General Staff. Sometimes, these projects are big and long enough to have their own structure that endures in time. But this structure is stated in detached documents of the project and are not managed by any IS. So we need to analyse how we can gather this information in our EA model. We were not aware of these and other issues before the sprints. They were raised by public servants.

5.5.1 Metamodel Assessment

We did several versions of our metamodel until we get that one presented in Figure 12 on page 36. The last changes were made during sprints, as a result of our findings.

As mentioned above, we realize the assignment of roles to business processes is not straightforward due the ambiguity of our business processes. Instantiation of abstract concept of business process is neither easy nor quick. Even if we had a good set of business processes modelled in BPMN, it would be unlikely that public servants would consult all these models during the sprints to give their contributes. They would remain limited to the few words that compose the names of the business processes.

We thought it would be simpler to public servants assign their roles to activities, since the *"Activity"* concept is easier to materialize and less ambiguous. We can decompose business processes in their activities and ask for public servants to identify which activities they perform under the scope of their roles. So we added the *"Activity"* concept to our metamodel during sprints and we tried to decompose some business processes. The decomposition of the business process *"Adquirir Bens e Serviços"*: Acquire Goods and Services, can be found in the Appendix Figure 13: Improvement of "9 Business Process Context, in the Appendix C: Improved EAMS Blueprints.

We concluded that the concept of *"Document"* did not bring added value at this stage of maturity. It brings more misunderstandings than added value, so we consider not use it in future iterations.

We need to analyse whether we should to add new concepts to our metamodel, to enable the modelling of roles within projects under control of external entities, assigned from public servants of our institution.

5.5.2 Viewpoints Assessment

We need to improve the viewpoint *"Employee context"* to include the *"Duty roles"* and the roles of public servants in projects under control of external entities, to see all the issues public servants are accountable.

During sprints we had developed three new viewpoints shown in Appendix B: New EAMS Blueprints, which are: Processes of a Macro-process, Unit Processes and Macro-processes.

Viewpoint *"Business Process Context"* was improved to include activities of the business processes, as we can see in Appendix C: Improved EAMS Blueprints.

As mentioned and explained in section 5.4, we also improved the viewpoint *"Employee context"* to add the boxes *"Gestor de Projeto (em Análise)":* Project Manager (under analysis), and *"Membro de Equipa (em Análise)"*: Team Member (under analysis).

We also have registered in our backlog the intention to build the *"Activity Context"* viewpoint, and eventually the *"Document context"* viewpoint, if we preserve the *"Document"* concept. We will analyse the possibility of build a viewpoint to show the subordinates of a given public servant.

5.5.3 EA Model Assessment

During sprints we found missing assignments, in the HR database, of public servants to their actual job positions. These public servants are only assigned to their military unit. There are also several vacant job positions formally approved. This happens for few different reasons:

- Misalignment between the job positions formally approved and the availability of HR;
- Misalignment between the military rank of the public servant and the military rank of the approved job position that he fulfils;
- Public servant assigned to the military unit, but there are no vacant job positions for his military rank;
- Public servant have been assigned to a job position, but changed later and the change was not updated in the HR database.

The viewpoint *"Unit Job Position"*, which a sample of their views is shown in Appendix Figure 3: Unit Job Positions, from Appendix A: EAMS Blueprints, uncovers and highlights all this situations. This has enabled the data correction of the HR database and to have a clearer picture of the vacant positions of each military unit.

As mentioned above, we also found inconsistencies in the data gathered from EPM, however, this time it was because of an error in our queries to EPM database.

5.5.4 Collaborative Method Assessment

We realize we cannot implement our method as we had thought at the beginning, with a sequence of sprints to the same public servants, with one workshop between each sprint. Workshops are time-

consuming. Nor public servants neither their respective chiefs are willing to spend the public servants time in periodic workshops for an EA initiative, when they have their own tasks and workload assigned, for which they are accountable. However, the initial workshop is fundamental to enable the collaboration of public servants. It sets up a common understanding of the purpose of an EA initiative and the way to go. We teach the minimal concepts of EA to enable the collaboration. The emotional involvement of the public servants starts during this first workshop.

We need to rethink the steps of our collaborative method without workshops beyond the first one. We think the sprint format is useful to establish rhythm and limit the time in which we ask the effort of the public servants.

However, the start of each sprint needs to be signalled in another way, may be by email.

We realize also that our method is very dependent on the public servants' willingness to collaborate, which is a weakness. We have to think in ways to overcome the situations where some public servants are not willing to collaborate, despite the effort in increase their emotional involvement. It may be through the introduction of some kind of accountability for the network that respects to each public servant. E.g. requiring update of the part of EA model under the accountability of a public servant when he needs an approval for his own projects.

6 Evaluation

Practitioners, who participated in our demonstration, were asked to evaluate our collaborative method through an online evaluation form. This online evaluation form had 25 statements to be rated from *"strongly disagree"* to *"strongly agree"* in a four-position scale. It aims to evaluate to what extent our method achieves its goals, through the evaluation of 11 of the 28 criteria from the hierarchy of criteria proposed by Nicolas Prat et al. [12], as mentioned in subsection 1.1.5 Activity 5 – Evaluation.

Using the model of generic evaluation methods also proposed by Nicolas Prat et al. in the same paper [12], we can characterize our evaluation in their four fundamental characteristics as follows:

1. Form of evaluation: Qualitative and measured;
2. Secondary participant: Practitioners;
3. Level of evaluation: Instantiation in a real example;
4. Relativeness of evaluation: Absolute.

6.1 Evaluation Procedures

The evaluation form, present in *"Appendix D: Online Evaluation Form"*, was deployed in a web application on the Navy intranet. This web application only allows one thousand of characters to the introductory text, which forced to a telegraphic message. We have scheduled the application to send emails to public servants who participated in the collaborative method demonstration, with a link to the online evaluation form. These emails were sent in the last day of respective sprints, and was given a week to answer. During that week, we resent emails, through the application, to those who had not yet answered. The evaluation form was anonymous.

We purposely have placed contradictory statements to throw off those who answer without reading the evaluation form, as we can see in statements 14 and 15:

14. *"The METHOD is time-consuming to public servants involved, whereby, I ADVISE AGAINST their implementation in all Navy units."*

15. *"The relevance of information collected through the METHOD justifies the time taken from public servants, whereby, I RECOMMEND their implementation in all Navy units."*

No one seriously can *"strongly recommend"* and simultaneously *"strongly advise against"* the implementation of the method in all units of the Navy.

To evaluate our collaborative method according to the holistic view of evaluation criteria [12], we mapped the agreement or disagreement with our 25 statements to the 11 of the 28 criteria, of the hierarchy of criteria proposed by Nicolas Prat et al. [12].

System dimension	Goal	Environment		Activity	Evolution
Evaluation criteria		Consistency with people	Consistency with organization		
Sub-criteria	1. Efficacy 2. Validity 3. Generality	4. Utility for people 5. Understandability 6. Ease of use	7. Utility for organization 8. Fit with organization	9. Efficiency	10. Robustness 11. Learning capability

The 11 selected criteria are summarized in the Table 4. The mapping from the 25 statements to the 11 criteria is presented in the Appendix Table 1 and Appendix Table 2 of the Appendix E: Mapping from Statements to Criteria.

Statements 4, 6, 14, 19, 22 and 24 contribute reversely to the respective criteria. They are marked in orange in the two tables of Appendix E. If a respondent evaluates one of those statements as 1 – Strongly disagree, it contributes to the respective criteria as 4, because when a respondent agrees with these statements, it means the respective criteria are evaluated negatively.

The column *"Efficacy"* of the *"Goal"* dimension is filled with numbers. These numbers correspond to objectives for the solution stated in section 4.1. These objectives are evaluated by the statement of the row in the Appendix Table 1 and 2 of the Appendix E. All the other columns have *"X"* meaning the row statement row contributes to the evaluation of the column criteria.

The average of responses to each statement was calculated and placed in all cells filled with numbers (Efficacy column) or with *"X"*, of the respective statement row. Then, we calculated the average of each column to obtain the rate of each criteria.

6.2 Evaluation Results

Our 38 participants were invited to fill the evaluation form. We obtained 37 responses, four of them invalid, as we can see in the graphic of Figure 25. The four invalid responses, plus the unanswered one, are about 13% of the 38 responses. For these five public servants, our objectives for the solution are not achieved at all, since their behaviour is indicative of EA's irrelevance to them.
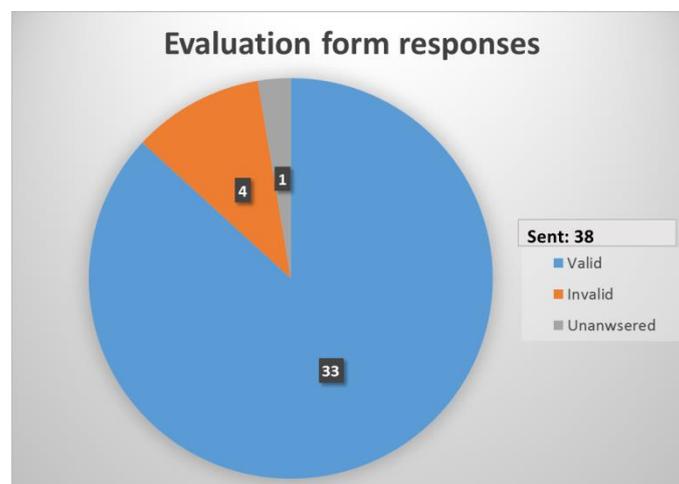
Figure 25: Evaluation form responses

6.2.1 Responses Analysis

The averages of each statement ratings, obtained from the 33 valid responses, are summarized in Figure 26. The overall rate average of all statements was 2,88.
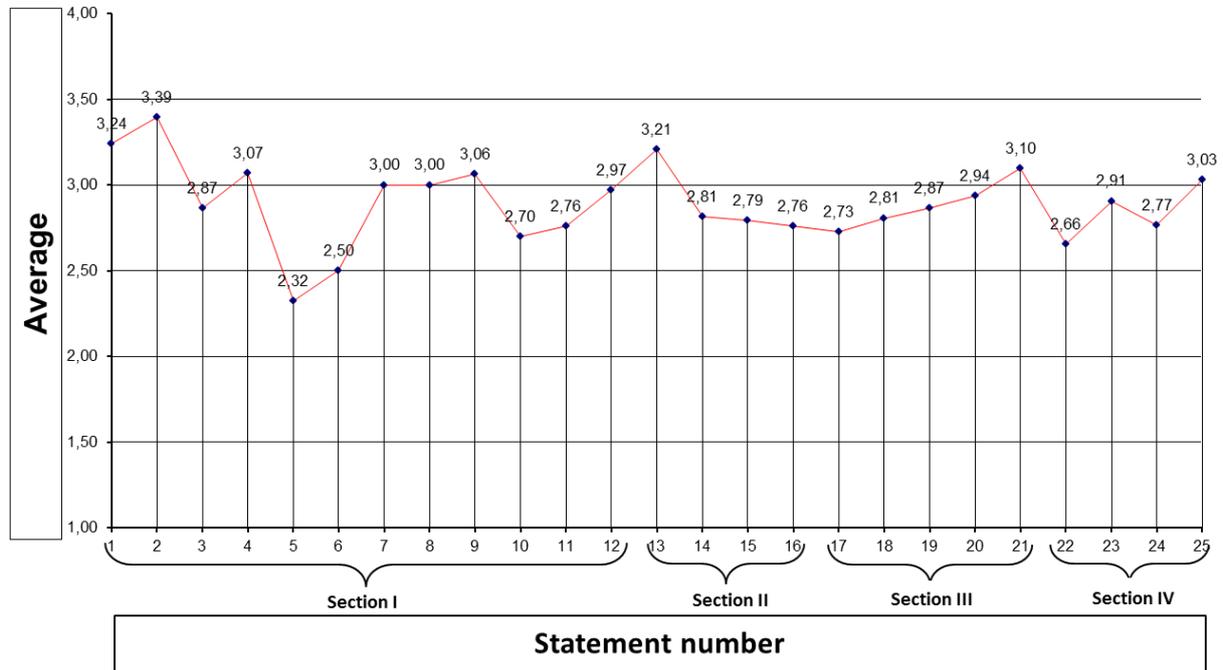
Figure 26: Average of statements evaluation

As mentioned in section 6.1, statements contributing negatively to criteria evaluation were rated reversely in all our analysis. Thus, a higher rating of a statement means a better evaluation of the collaborative method, regardless of how the statement was built.

Figure 26 shows statements 5th and 6th were the worst rated (average of 2,32 and 2,50 respectively):

5. *"Most of public servants from my military unit will update information in this system because they will recognize usefulness on it."*

6. *"Most of public servants from my military unit will NOT update information in this system, unless their chiefs order them to do so."*

We remember we used a four-position scale, which means their middle is 2,5. So, the 5th statement obtained a negative score: the majority of the respondents disagree with this statement. The 6th statement is rated exactly in the middle of the scale: the respondents who agree are balanced with those who disagree.

It means respondents don't believe the other public servants of their military unit (not themselves) will develop willingness to collaborate in the update process of EA model.

Curiously, statements 3rd and 4th are similar to 5th and 6th, only changes the subject – instead of other public servants, the subject is the respondent himself:

3. *"Information collected by the METHOD is useful, so I will keep updated the information that concerns to me."*

4. *"I DO NOT intend to spend my time to update another system. I will only do so if my chief will order me."*

Here the rate is about six tenths higher: 2,87 and 3,07 respectively, which is a big increase in our four-position scale, putting these two statements above the general average of all statements (which is 2,88). It can mean different things:

1. The respondents believe that their willingness to collaborate and / or their awareness to the EA benefits are higher than the other public servants. This can be due the natural belief of common human being, with a normal self-esteem, that himself behaves better than their peers.

2. The evaluation form does not mention whether the other public servants have participated in a workshop. The respondents may have assumed that the others public servants have not participated. If so, the gap between rates is an indicator of the relevance of the workshops to improve the EA awareness.

Another interesting detail of these four statements: the 3rd statement was rated two tenths below the 4th and the 5th was rated also almost two tenths below the 6th, approximately the same difference in both cases. It means the respondents consider that public servants could possibly collaborate in the update of the EA model, but that does not mean they recognize usefulness of it or is not the usefulness that will motivate their collaboration. This low valuation of the usefulness of the information collected may possibly be due the low maturity of our EA-MVP, with their inevitable drawbacks of an embryonic product. But this assumption should be tested in subsequent iterations of our method, to evaluate whether the perception of usefulness increases.

Figure 26 shows also that the 2nd statement obtained the best rate (average of 3,39):

2. *"The information I have provided to the MODEL will be useful to the Navy management."*

Followed by the 1st and 13th (average of 3,24 and 3,21):

1. *"The information I have provided to the MODEL will be useful to other public servants of the Navy."*

13. *"The MODEL of the EA-Navy is important and necessary, whereby it should be built and updated in all units of the Navy."*

The perception of a high usefulness of the information to be collected and of a high importance of having a model contrasts with the perception of the low willingness of public servants to update this information and the low usefulness of our concrete and existing model. However we remember that the statements related with the respondent himself obtained a relative high rating (2,87 and 3,07).

Looking to the other statements and their respective rating, we can interpret our results as the recognition of the usefulness and importance of the EA abstractly, despite the low quality of our method to collect information and manage a concrete EA model.

Our results lead us to think that the 2nd and 3rd objectives of our method were achieved in a greater degree than the 4th and 5th:

2. *"Improve awareness of public servants about EA utility and benefits"*

3. *"Improve value recognition of the EA to the institution and to its public servants"*

4. *"Create willingness to collaborate in the process of improving and updating the EA, by public servants"*

5. *"Make EA activities intrinsically attached to organizational culture of the institution"*

Looking to overall results, we can see:

- The overall rate average of all statements was 2,88, which is almost four tenths over than the middle of the scale, and eleven tenths below the maximum;
- The statement better rated obtained 3,39, which is nine tenths over the middle of the scale, and six tenths below the maximum;
- 23 statements were rated higher than middle of the scale; only one statement was rated exactly in the middle; and only one was rated below the middle.

This evaluation, although overall positive, is not enthusiastic, which means we need to work harder to improve our method to achieve consistently the objectives we set in section 4.1.

6.2.2 Collaborative Method Evaluation

Mapping the results from evaluation statements to evaluation criteria, through the tables in the Appendix E: Mapping from Statements to Criteria, we obtained the tables of the Appendix F: Averages of Evaluation Criteria, which are summarized in the graphic of Figure 27.

This figure shows the *"Utility for the organization"* as the highest rated criteria (3,12) followed by the *"Utility for people"* (2,98), which is consistent with our precedent analysis. Responders recognized the utility of an EA capability for the organization and for people. However they were not so convinced with the quality of our method, since they rated worse *"Validity"* and *"Efficiency"* (2,81), meaning the respondents had a low trust in the information provided by the EA model (*Validity*) and our method was time-consuming (*Efficiency*). The *"Ease of use"* and the *"Fit with organization"* criteria had a relative low rate also (2,87).

However, although low, all the criteria were rated positively.
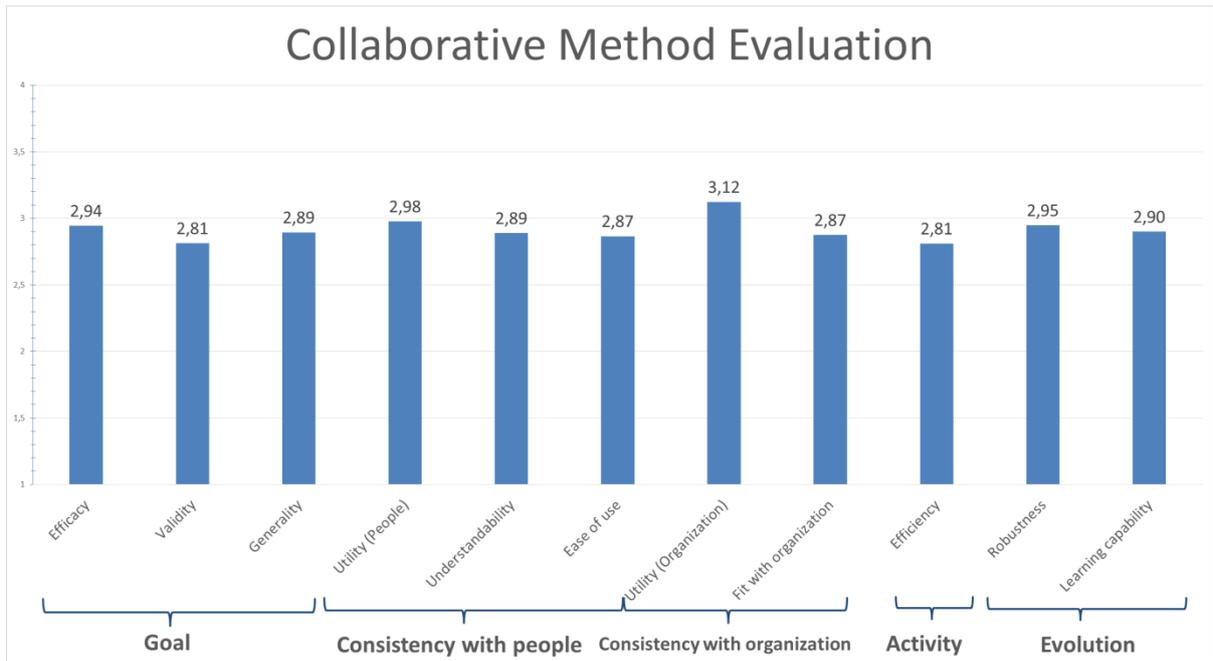
Figure 27: Collaborative Method Evaluation

7 Conclusion

Public institutions are unable to manage their own complexity, including their IT, in a systematic and holistic way, despite all theory from EA discipline and their expected benefits. In this work we have studied the context of public institutions to understand what hinders them from raise an EA capability and how to overcome these barriers.

We conclude that one of these barriers is scarcity of HR skilled in EA, in public institutions, to assign to an EA initiative as recommended by the most known EA frameworks. We propose a collaborative method (our artifact), to overcome the referred barrier, intending to spread the EA effort by their public servants, taking advantage of a crowdsourced effort. This EA effort is to raise an enterprise cartography of the institution and keep it updated.

To enable the collaboration and the crowdsourced effort, we considered we need to obtain recognition of value of EA by public servants, since they will tend to be more motivated and they will tend to be willing to collaborate in the building of a product which is expected to be useful for themselves. We can see here an exchange: we give a product that they value, and they pay with their effort to build and update our EA.

The *"Customer Development Methodology"* was adapted to develop a product valued by public servants. Principles of *"Lean Methodology"* were also used to reduce waste – the effort used in the development of artifacts that no one value. We were inspired by *"Scrum methodology"* to implement the iteratively in our collaborative method. All these methodologies are interrelated, since the *Agile* methodologies, like *Scrum*, are influenced by the *Lean* [23] and the *"Customer Development Methodology"* are influenced by the both, *Agile* and *Lean* [22].

Our artifact was instantiated in the Portuguese Navy for demonstration purposes. The artifact performance, and the extent to which achieves their goals, was evaluated through an evaluation form filled by participants in demonstration. Finally, we communicated our results to the board of directors from the IT sector of the Navy, and in the public discussion session of this thesis.

7.1 Communication

The 6th activity of the DSRM – Communication, comprises the communication of the problem and its importance [4], which we achieved successfully through our six workshops, for an audience of 41 practicing professionals. The results of our evaluation form demonstrate the awareness of them about the research problem, since the participants gave a higher rating to the statements related with the usefulness of the EA information and the importance and necessity of have an EA capability in the Navy.

Our artifact, its utility and novelty, its design, and its effectiveness were also presented during the six workshops performed in the scope of the own collaborative method.

The results of our evaluation were presented in the final of the sixth workshop to the three directors of the IT sector of the Navy.

Our results will be communicated through this thesis report and on the public discussion session of this thesis.

7.2 Lessons Learned

After our demonstration, we have learned that we cannot perform one workshop at the end of each sprint, since workshops are time-consuming to the public servants, which cannot be afforded by the institution. However, we have concluded that the initial workshop is very important, since it enables a common understanding of the purpose of an EA initiative and the way to go. It enables also the emotional involvement of public servants and the raise of the confidence in the initiative. It also opens communication channels.

As our method is based in the willingness to collaborate, it doesn't solve the cases of the public servants who don't develop this willingness. We became aware of this drawback during the demonstration, once we felt the non-adherence of a few of public servants. We confirmed this non-adherence through the evaluation, once we have 13% of absence or invalid responses.

Thinking retrospectively, would be expected to have a percentage of non-adherences. We can also consider that if the percentage of non-adherences was only 13% this would be very good, but a valid response to the evaluation form does not mean an adherence of the public servant to the initiative. In fact, would be very unlikely that all public servants would have adhered to the EA initiative, without resistance.

The demonstration has exposed this weakness of our method, since there are public servants who were not willing to collaborate, or worst, they could update the EA model with erroneous information to avoid the EA unit bother them. This led to an EA model with gaps and errors that will decrease their value to other public servants and consequently decrease their confidence and their own willingness to collaborate also.

We have to think of a way to overcome this weakness and introduce some kind of accountability for the network that respects to each public servant. E.g. requiring update of the part of EA model under the accountability of a public servant when he needs an approval for his projects.

However, even if we decide to introduce this accountability in our method, we consider that would be counterproductive in the first iteration. It needs to be introduced in a higher level of EA maturity.

7.3 Limitations

As mentioned above, our method has the limitation of be dependent of the raise of willing to collaborate in the public servants, which in real world never happens to one hundred percent. In the *"Customer Development Methodology"*, in which we based to uncover what is valued by public

servants, conquer all possible customers to buy our product is not required. However, an outdated EA-model, due public servants indifference, undermines the EA initiative. Not neglecting the importance of the effort to raise the willingness of public servants, we conclude we need to complement our method with some coercive measures when the institution achieves a higher level of EA maturity.

Our method is designed to arise the business layer of EA cartography in public institutions. The other two EA layers – application and technology – require technical skills which common public servants usually do not have. Thus, our method is not adequate to solve the problem of the two other layers.

EA is not just enterprise cartography. Bent et. al., in their book *"Collaborative Enterprise Architecture"* define the following eight core activities of EA:

1. Defining the IT Strategy;
2. Modelling the Architectures;
3. Evolving the IT Landscape;
4. Assessing and Building Capabilities;
5. Developing and Enforcing Standards and Guidelines;
6. Monitoring the Project Portfolio;
7. Leading or Coaching Projects;
8. Managing Risks Involved in IT.

The enterprise cartography, addressed by our method, is only a part of the second activity *"Modelling the Architectures"*, which also comprises the reasoning and design of the TO-BE state of the organizations.

Our demonstration had only one iteration, and had the participation of only 38 public servants, which is a limitation to extract robust conclusions. We need to perform more sprints with these 38 public servants after establish a robust list of business processes and analyse, develop and improve the EA-model and viewpoints, but without more workshops, as we explain above.

It also would be necessary perform more iterations of the DSRM process, which means the improvement of the collaborative method – our artifact – incorporating our findings as the removal of workshops from iterations after the first and the introduction of measures to establish accountability by public servants for their part of the EA model. These subsequent iterations could be performed in other military units of the Navy.

We have applied our method in the military institution, which is a special kind of public institution. The military institution has relevant particularities in their culture, which deeply differs from common public institutions. E.g. their well-creased hierarchy and their sense of discipline. This fact can weaken the generalization of our findings to other public institutions. Thus, it would be necessary to perform our method in other public institutions to assess their generalization.

The EA tool that we used in our demonstration – EAMS – has a feature for update the EA model. However, as explained above, this EAMS feature is not sufficiently straightforward, which led us to a scheme of exchange of excel files with participants, as we have described. Besides the extra work to

the EA unit, this fact is a limitation that affects our results, as it requires an additional and annoying effort from participants, which can generate a sense of rudimentary work and can lowers their willingness to collaborate.

7.4 Future Work

To strengthen the findings of our thesis and to improve our artifact, it will be necessary:

- Implement suggestions gathered in the backlog and improve the procedures to update the EA model, since the exchange of excel files is not a good solution. After that we can perform another sprint with the same participants. The aim is to evaluate whether we can raise the value recognition of the EA-model, by public servants to a level that they assume the ownership of the EA model related to themselves and assume the responsibility of their update without the pressure of the EA unit;
- Execute a second iteration of the DSRM process to improve our collaborative method, with the findings of this first iteration (e.g. only one workshop; measures to implement accountability) and perform a new demonstration in other military units of the Navy;
- Apply the method in other public institution.

To future work beyond our thesis scope, we recommend:

- Develop the EAMS feature of creation and submission of architectural scenarios;
- Develop a method to raise and update the application layer and technology layer of the EA cartography;
- Develop additional iterative procedures of collaboration, as new channels of communication, to leverage the involvement and accountability of public servants in the EA activities. E.g. the development of a collaborative portal within the intranet of the institution customized to the communication needs of the EA activities.

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Appendixes

Appendix A: EAMS Blueprints

Appendix B: New EAMS Blueprints

Appendix C: Improved EAMS Blueprints

Appendix D: Online Evaluation Form

Appendix E: Mapping from Statements to Criteria

Appendix F: Averages of Evaluation Criteria

Appendix A: EAMS Blueprints
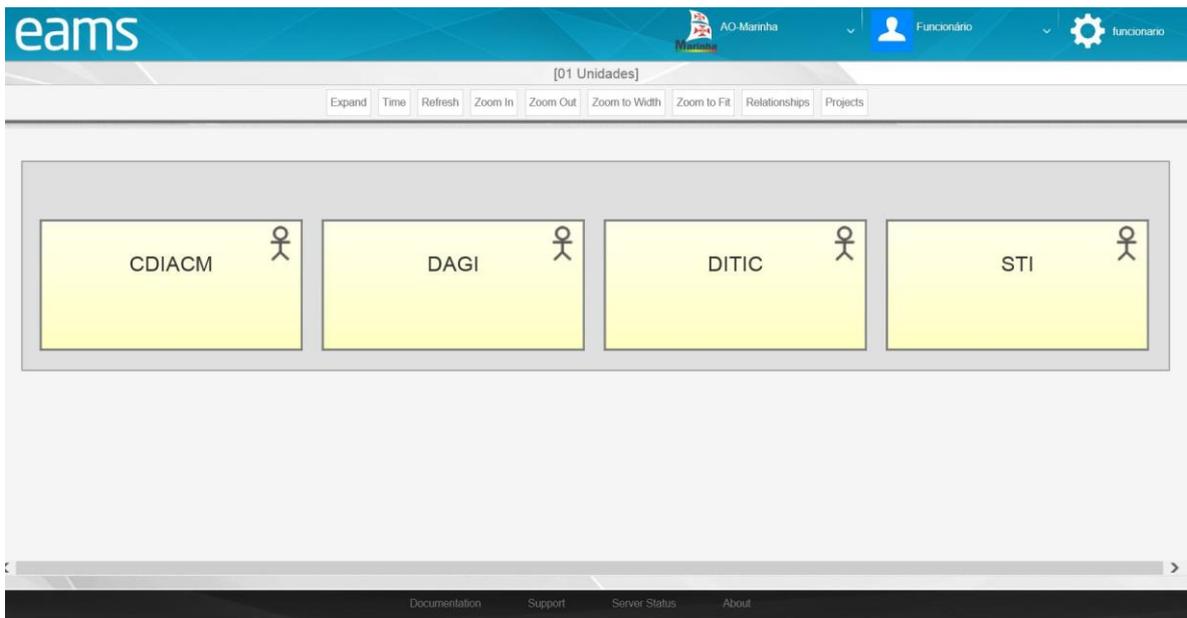
Appendix Figure 1: Military Units
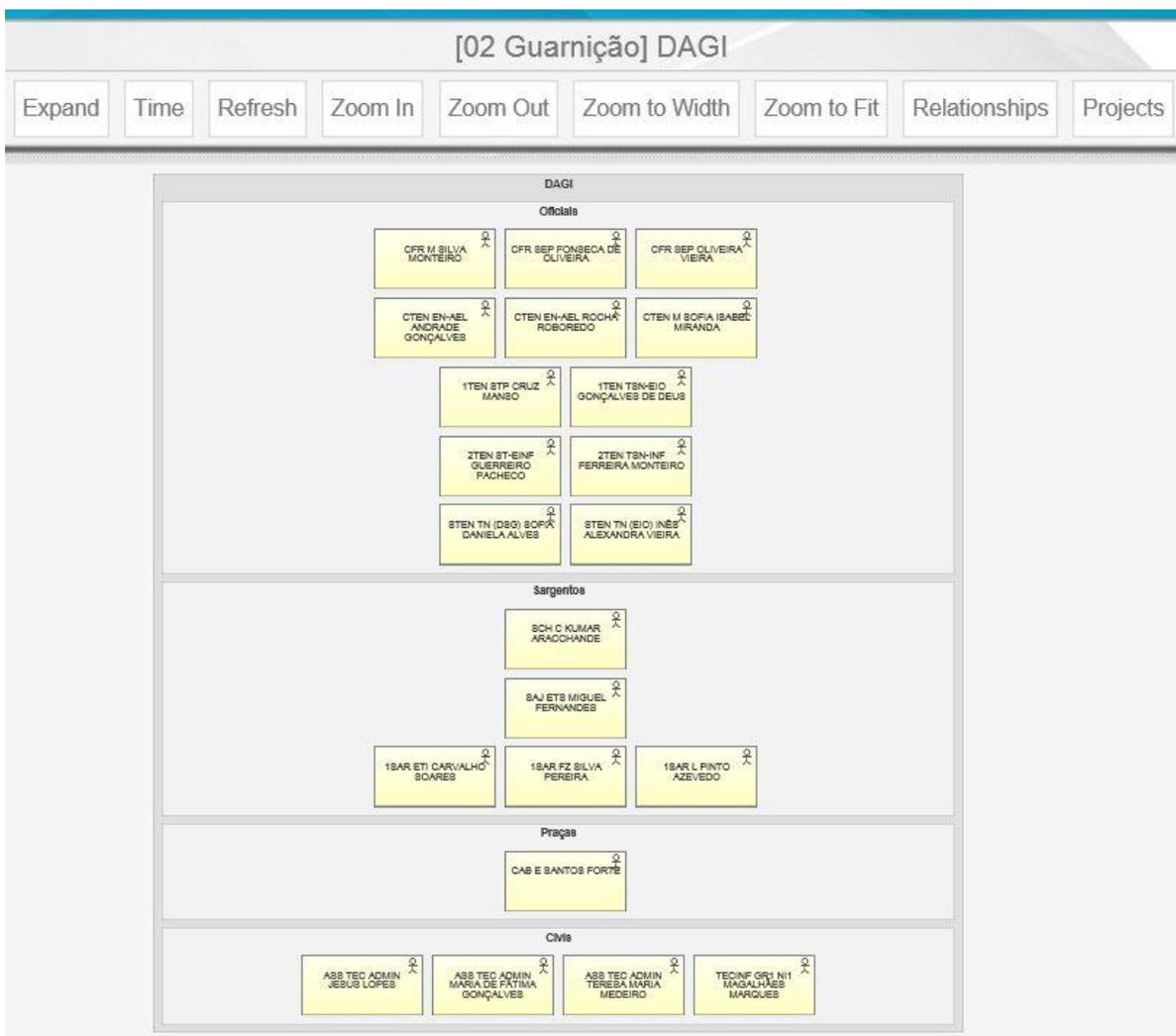
Appendix Figure 2: Unit Garrison
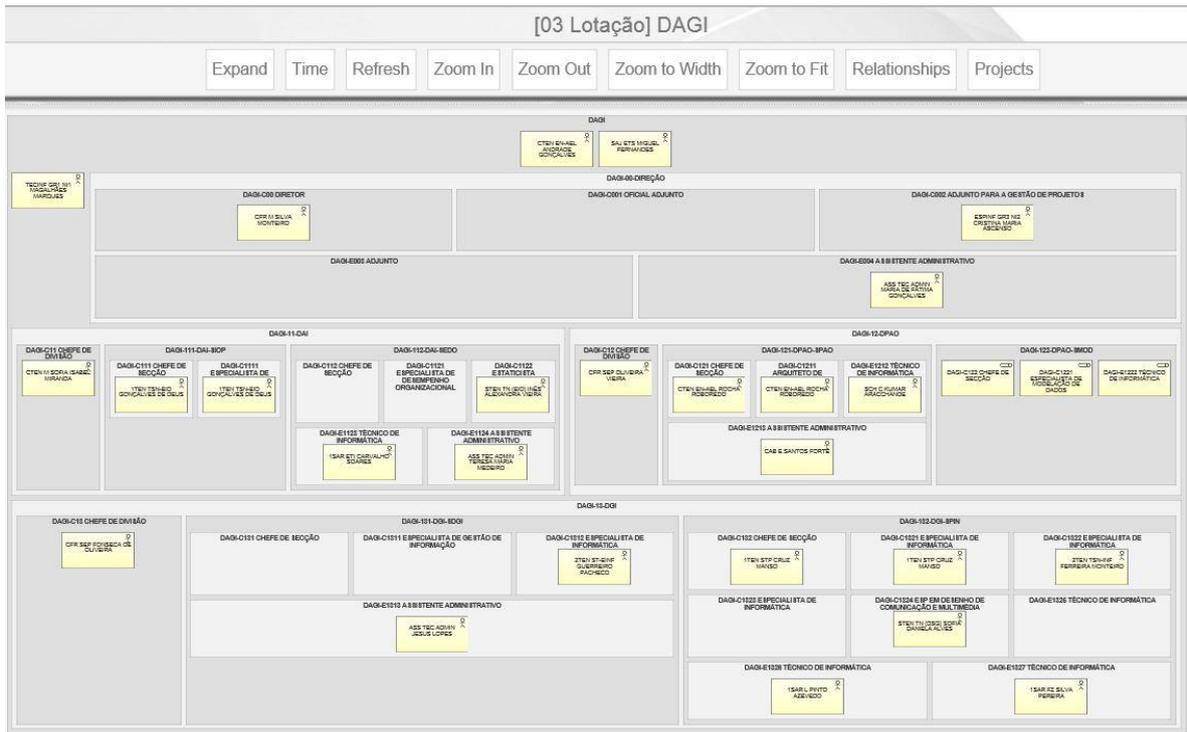
Appendix Figure 3: Unit Job Positions
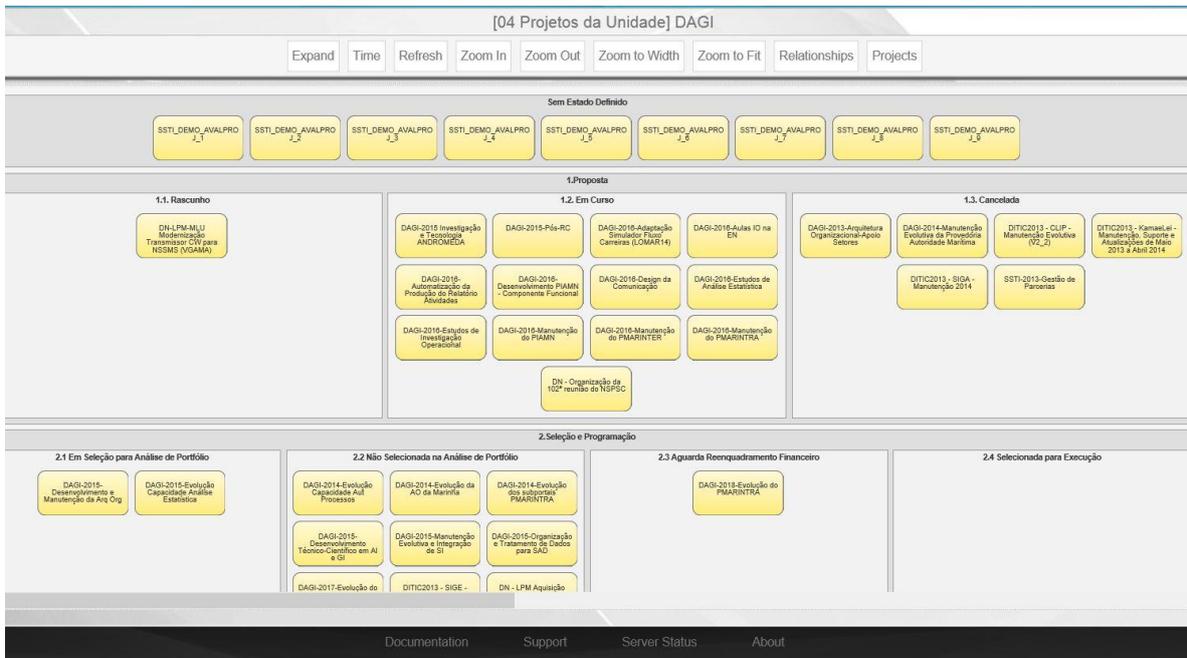
Appendix Figure 4: Unit Projects
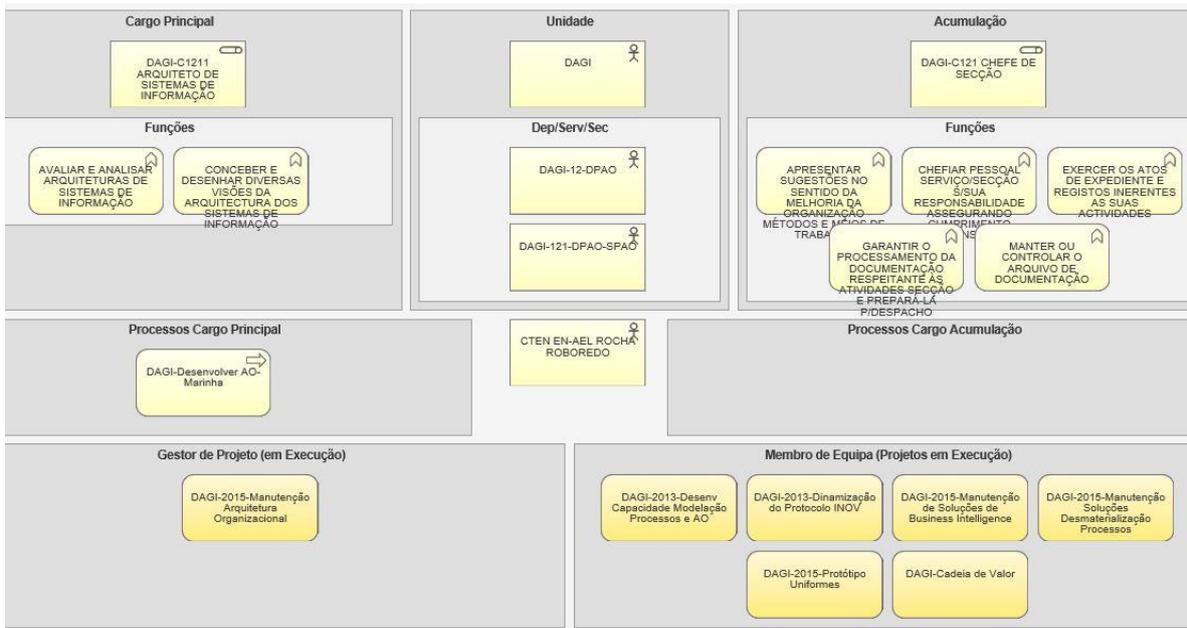
Appendix Figure 5: Employee Context
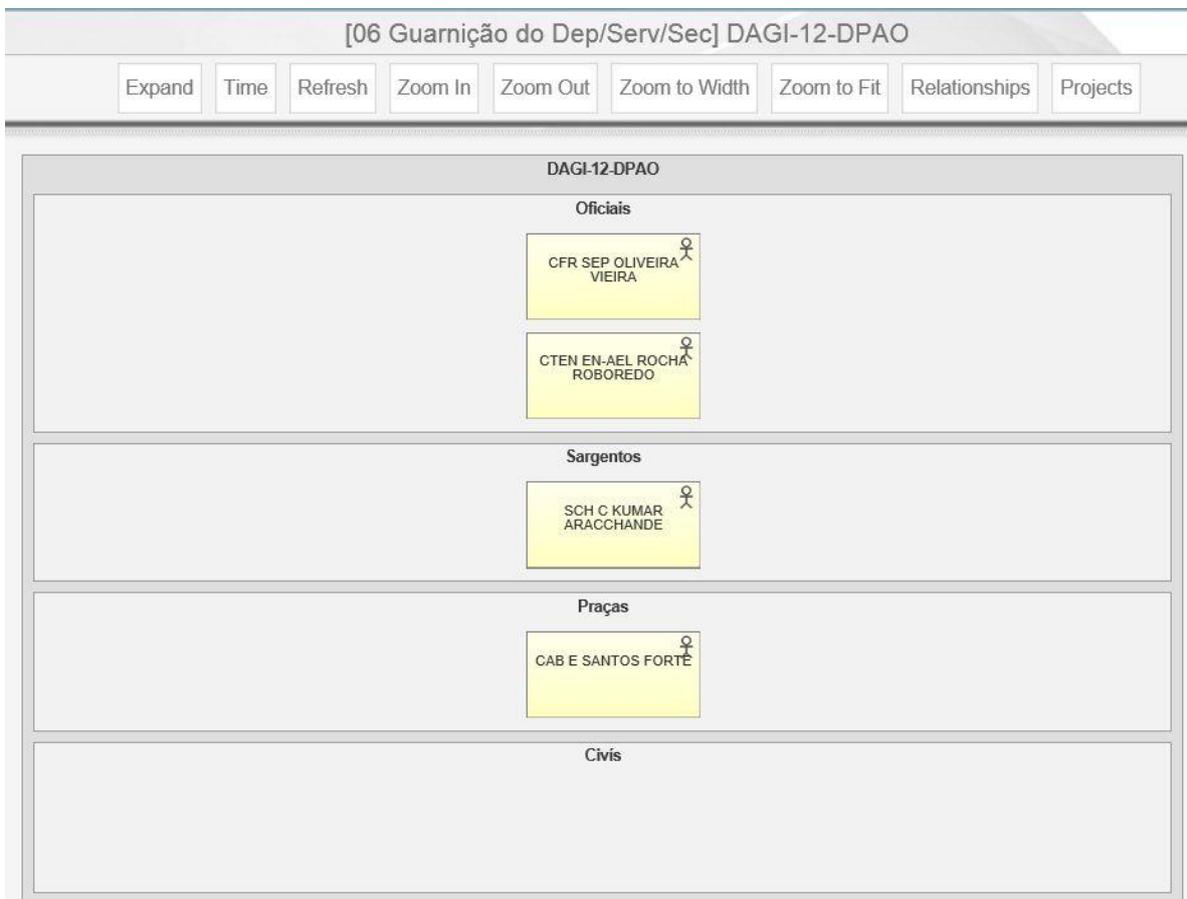
Appendix Figure 6: Department Garrison
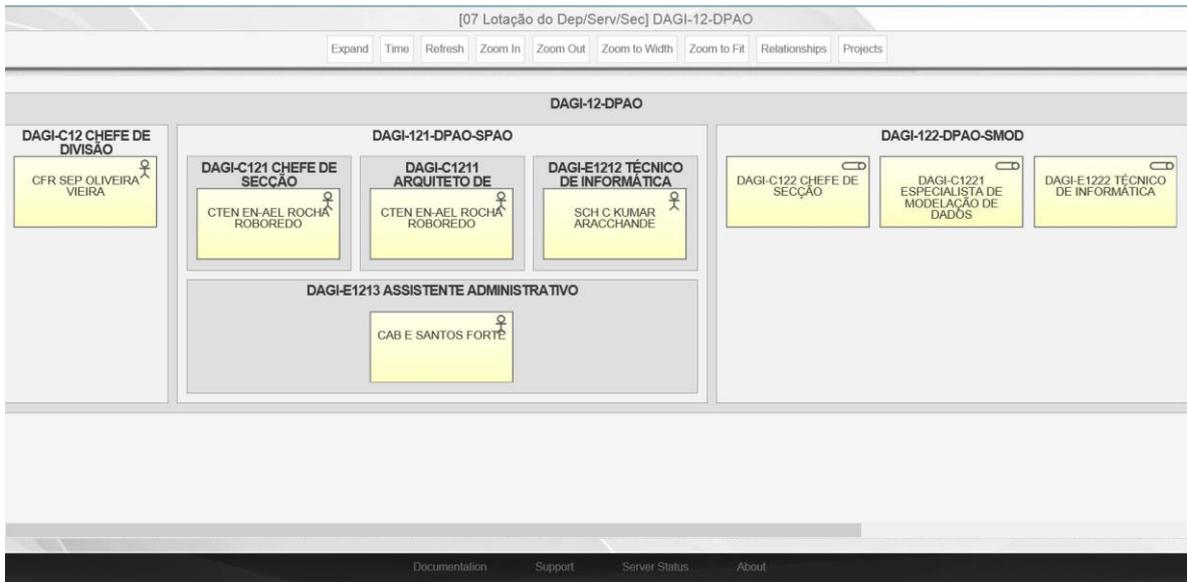
Appendix Figure 7: Department Job Positions

Appendix Figure 8: Project Context

Appendix Figure 9: Business Process Context

Appendix B: New EAMS Blueprints

[10 Sub-processos] OGP-Gerir Pessoal

Appendix Figure 10: Processes of a Macro-process

Appendix Figure 11: Unit Processes

Appendix Figure 12: Macro-processes

Appendix C: Improved EAMS Blueprints

[09 Processo Contexto] Adquirir Bens e Serviços

Macro-Processo

Gerir Recursos Financeiros e Logísticos de Material

Serviços realizados pelo Processo

Serviço administrativo de aquisição de Bens e Serviços

Documentos

- Caderno de Encargos (CE)
- Decisão de adjudicação
- Especificação Técnica (ET)
- Nota Justificativa
- PAQ
- Parecer da AMA
- Programa de Concurso
- Relatório de análise de propostas

Gestor

Adquirir Bens e Serviços

Executantes

- 1TEN EN-AEL SANTOS VELOSO
- 1TEN EN-AEL VIEIRA NEVES
- 1TEN STAEL MARTINS GONÇALVES
- 1TEN STP CARMELINO DE ALBUQUERQUE
- 1TEN STP COURELA ALEXANDRE
- 1TEN STP LOPES CORDEIRO
- 1TEN STP PRATAS QUARESMA
- 1TEN TSN-EIO GONÇALVES DE DEUS
- 2TEN EN-AEL GONÇALVES CAPELA
- 2TEN EN-AEL ROXO FELÍCIO
- 2TEN TSN (ELT) SANTOS JORGE
- 2TEN TSN-INF FERREIRA MONTEIRO
- CFR SEP FONSECA DE OLIVEIRA
- CFR SEP FURTADO MARTINS
- CFR SEP OLIVEIRA VIEIRA
- CFR SEP SEMPITERNO RIBEIRO
- CTEN EN-AEL MENDES SIMÕES
- CTEN EN-AEL ROCHA ROBOREDO
- CTEN SEP PENIM GARCIA
- CTEN SEP SARAIVA DE OLIVEIRA
- CTEN ST-EELT PINTO ALVES

Cargos

- DAGI-C001 OFICIAL ADJUNTO
- DAGI-C111 CHEFE DE SECÇÃO
- DAGI-C12 CHEFE DE DIVISÃO
- DAGI-C121 CHEFE DE SECÇÃO
- DAGI-C1211 ARQUITETO DE SISTEMAS DE INFORMAÇÃO
- DAGI-C13 CHEFE DE DIVISÃO
- DAGI-C1322 ESPECIALISTA DE INFORMÁTICA
- DITIC-C0111 ENGENHEIRO TELECOMUNICAÇÕES
- DITIC-C01112 ENGENHEIRO TELECOMUNICAÇÕES
- DITIC-C11 CHEFE DE DIVISÃO
- DITIC-C1112 ADMINISTRADOR DE REDE
- DITIC-C112 CHEFE DE SECÇÃO
- DITIC-C1123 ENGENHEIRO TELECOMUNICAÇÕES
- DITIC-C113 CHEFE DE SECÇÃO
- DITIC-C114 CHEFE DE SECÇÃO
- DITIC-C12 CHEFE DE DIVISÃO
- DITIC-C121 CHEFE DE SECÇÃO
- DITIC-C122 CHEFE DE SECÇÃO
- DITIC-C13 CHEFE DE DIVISÃO
- DITIC-C131 CHEFE DE SECÇÃO
- DITIC-C1321 ENGENHEIRO DE SISTEMAS
- DITIC-C133 CHEFE DE SECÇÃO
- STI-C013 CHEFE DE SERVIÇO

Atividades

- 01 Elaborar PAQ e CE
- 02 Analise Técnica e Económica
- 03 Validar PAQ e CE
- 04 Submeter Documentação Plataforma Concursos Públicos
- 05 Monitorizar Concurso
- 06 Elaborar Esclarecimentos
- 07 Avaliar Propostas
- 08 Publicar Resultado da Avaliação na Plataforma Concursos Públicos
- 09 Elaborar Contrato
- 10 Acompanhar a execução do Contrato
- 11 Efetuar Provas de recepção
- 12 Efetuar Pagamento

Appendix Figure 13: Improvement of "9 Business Process Context"

Appendix D: Online Evaluation Form

Introductory text

Please answer this evaluation form only if you have participated in one of the workshops about Enterprise Architecture in the Navy (EA-Navy). Goals of the METHOD: 1 – Maintain a MODEL of the EA-Navy updated. 2 – Create VIEWS from the MODEL which meet the information needs of the public servants of the institution. 3 – Populate the MODEL with information useful for decision making. During workshop, you used the software EAMS-WEB to access to VIEWS (Blueprints) from the MODEL of the EA of four military units. We intend to evaluate only the METHOD used to update and development of the MODEL and their VIEWS. You should disregard, as much as possible, the imperfections and qualities of the MODEL, of the VIEWS and of the EAMS-WEB. You should evaluate only the METHOD. This evaluation form is composed by 25 statements. You should rate your concordance with each of these statements in a following scale: 0 – I have no opinion / Not applicable; 1 – Strongly disagree; 2 – Disagree; 3 – Agree; 4 – Strongly agree. The evaluation form is anonymous.

Your Military Rank:_____

Section I

The METHOD asks to public servants to update information on the MODEL of the Navy.

1. The information I have provided to the MODEL will be useful to other public servants of the Navy.
   - 0 - I have no opinion / Not applicable
   - 1 - Strongly disagree
   - 2 - Disagree
   - 3 - Agree
   - 4 - Strongly agree

2. The information I have provided to the MODEL will be useful to the Navy management.
   - 0 - I have no opinion / Not applicable
   - 1 - Strongly disagree
   - 2 - Disagree
   - 3 - Agree
   - 4 - Strongly agree

3. Information collected by the METHOD is useful, so I will keep updated the information that concerns to me.
   - 0 - I have no opinion / Not applicable
   - 1 - Strongly disagree
   - 2 - Disagree
   - 3 - Agree
   - 4 - Strongly agree

4. I DO NOT intend to spend my time to update another system. I will only do so if my chief will order me.

        0 - I have no opinion / Not applicable
        1 - Strongly disagree
        2 - Disagree
        3 - Agree
        4 - Strongly agree

5. Most of public servants from my military unit will update information in this system because they will recognize usefulness on it.

        0 - I have no opinion / Not applicable
        1 - Strongly disagree
        2 - Disagree
        3 - Agree
        4 - Strongly agree

6. Most of public servants from my military unit will NOT update information in this system, unless their chiefs order them to do so.

        0 - I have no opinion / Not applicable
        1 - Strongly disagree
        2 - Disagree
        3 - Agree
        4 - Strongly agree

7. The METHOD allows to maintain the MODEL of EA-Navy with updated information.

        0 - I have no opinion / Not applicable
        1 - Strongly disagree
        2 - Disagree
        3 - Agree
        4 - Strongly agree

8. Information already available on EAMS-WEB is useful to me.

        0 - I have no opinion / Not applicable
        1 - Strongly disagree
        2 - Disagree
        3 - Agree
        4 - Strongly agree

9. I understood easily which information is supposed to be updated by me on the MODEL.

        0 - I have no opinion / Not applicable
        1 - Strongly disagree
        2 - Disagree
        3 - Agree
        4 - Strongly agree

10. Most of public servants from my military unit will easily understand which information is supposed to be updated by them on the MODEL.

        0 - I have no opinion / Not applicable
        1 - Strongly disagree
        2 - Disagree
        3 - Agree
        4 - Strongly agree

11. Information collected through the METHOD is reliable.

       0 - I have no opinion / Not applicable
       1 - Strongly disagree
       2 - Disagree
       3 - Agree
       4 - Strongly agree

12. The way to update information of the METHOD (sending Excel files to the responsible for the MODEL) is practical and easy.

       0 - I have no opinion / Not applicable
       1 - Strongly disagree
       2 - Disagree
       3 - Agree
       4 - Strongly agree

Section II

The METHOD was demonstrated only in four military units: STI, DAGI, DITIC and CDIACM.

13. The MODEL of EA-Navy is important and necessary, whereby, it should be built and updated in all Navy units.

       0 - I have no opinion / Not applicable
       1 - Strongly disagree
       2 - Disagree
       3 - Agree
       4 - Strongly agree

14. The METHOD is time-consuming to public servants involved, whereby, I ADVISE AGAINST their implementation in all Navy units.

       0 - I have no opinion / Not applicable
       1 - Strongly disagree
       2 - Disagree
       3 - Agree
       4 - Strongly agree

15. The relevance of information collected through the METHOD justifies the time taken from public servants, whereby, I RECOMMEND their implementation in all Navy units.

       0 - I have no opinion / Not applicable
       1 - Strongly disagree
       2 - Disagree
       3 - Agree
       4 - Strongly agree

16. Applicability of the METHOD in the whole Navy:

       0 - I have no opinion / Not applicable
       1 - Will NOT be possible to implement the METHOD in the whole Navy.
       2,5 – The METHOD need to be widely amended to be possible implement it in the whole Navy.
       4 – It will be possible implement the METHOD in the whole Navy without big changes.

Section III

The METHOD asks to public servants to suggest improvements to the VIEWS (Blueprints), so, the information available meets public servants needs.

17. Public servants will recognize usefulness in EA-Navy, whereby, they will suggest improvements to the VIEWS adjusted to their own information needs.

    0 - I have no opinion / Not applicable
    1 - Strongly disagree
    2 - Disagree
    3 - Agree
    4 - Strongly agree

18. The way to suggest improvements to the VIEWS is practical and easy.

    0 - I have no opinion / Not applicable
    1 - Strongly disagree
    2 - Disagree
    3 - Agree
    4 - Strongly agree

19. The way to suggest improvements to the VIEWS will generate so many suggestions and so diverse that will be practically IMPOSSIBLE to manage them.

    0 - I have no opinion / Not applicable
    1 - Strongly disagree
    2 - Disagree
    3 - Agree
    4 - Strongly agree

20. The METHOD will enable the EA-Navy meet ever better the information needs of public servants.

    0 - I have no opinion / Not applicable
    1 - Strongly disagree
    2 - Disagree
    3 - Agree
    4 - Strongly agree

21. The METHOD will enable the EA-Navy meet ever better the information needs of the Navy management.

    0 - I have no opinion / Not applicable
    1 - Strongly disagree
    2 - Disagree
    3 - Agree
    4 - Strongly agree

Section IV

The METHOD asks to public servants to suggest improvements to the own METHOD itself, aiming their continuous improvement.

22. Public Servants will experience DIFFICULTY to suggest improvements to the METHOD.
    - 0 - I have no opinion / Not applicable
    - 1 - Strongly disagree
    - 2 - Disagree
    - 3 - Agree
    - 4 - Strongly agree

23. The way to suggest improvements to the METHOD will leverage their own evolution and adaptation to the Navy.
    - 0 - I have no opinion / Not applicable
    - 1 - Strongly disagree
    - 2 - Disagree
    - 3 - Agree
    - 4 - Strongly agree

24. The way to suggest improvements to the METHOD will generate so many suggestions and so diverse that will be practically IMPOSSIBLE to manage them.
    - 0 - I have no opinion / Not applicable
    - 1 - Strongly disagree
    - 2 - Disagree
    - 3 - Agree
    - 4 - Strongly agree

25. The suggestion from the public servants will enable the METHOD meet ever better the needs of update the EA-Navy.

Appendix E: Mapping from Statements to Criteria

Appendix Table 1: Mapping from evaluation statements to evaluation criteria – Part I

System dimension	Goal			Environment					Activity	Evolution	
Evaluation criteria	**Efficacy (a)**	**Validity**	**Generality**	**Consistency with people**			**Consistency with organization**		**Efficiency**	**Robustness**	**learning capability**
Sub-criteria				**Utility**	**Understandability**	**Ease of use**	**Utility**	**Fit with organization**			
Section I: The METHOD asks to public servants to update information on the MODEL of the Navy											
1. The information I have provided to the MODEL will be useful to other public servants of the Navy.	2;3			X							
2. The information I have provided to the MODEL will be useful to the Navy management.	2;3						X				
3. Information collected by the METHOD is useful, so I will keep updated the information that concerns to me.	1;3;4;5										
4. I DO NOT intend to spend my time to update another system. I will only do so if my chief will order me.	1;3;4;5										
5. Most of public servants from my military unit will update information in this system because they will recognize usefulness on it.	1;3;4;5										
6. Most of public servants from my military unit will NOT update information in this system, unless their chiefs order them to do so.	1;3;4;5										
7. The METHOD allows to maintain the MODEL of EA-Navy with updated information.	1										
8. Information already available on EAMS-WEB is useful to me.	1; 3			X							
9. I understood easily which information is supposed to be updated by me on the MODEL.					X						
10. Most of public servants from my military unit will easily understand which information is supposed to be updated by them on the MODEL.					X						
11. Information collected through the METHOD is reliable.		(1)									
12. The way to update information of the METHOD (sending Excel files to the responsible for the MODEL) is practical and easy.						X					
Section II: The METHOD was demonstrated only in four military units: STI, DAGI, DITIC and CDIACM.											
13. The MODEL of EA-Navy is important and necessary, whereby, it should be built and updated in all Navy units.	2;3		X				X				
14. The METHOD is time-consuming to public servants involved, whereby, I ADVISE AGAINST their implementation in all Navy units.			X					X	X		

(a) The numbers are the objectives for the solution stated in section 4.1. See the Appendix Table 3 at the end of this appendix.

Appendix Table 2: Mapping from evaluation statements to evaluation criteria – Part II

System dimension / Evaluation criteria / Sub-criteria	Goal: Efficacy (a)	Goal: Validity	Goal: Generality	Environment – Consistency with people: Utility	Environment – Consistency with people: Understandability	Environment – Consistency with people: Ease of use	Environment – Consistency with organization: Utility	Environment – Consistency with organization: Fit with organization	Activity: Efficiency	Evolution: Robustness	Evolution: learning capability
15. The relevance of information collected through the METHOD justifies the time taken from public servants, whereby, I RECOMMEND their implementation in all Navy units.	2;3		X				X	X	X		
16. Applicability of the METHOD in the whole Navy (List): 0 - I have no opinion/Not applicable 1 - Will NOT be possible to implement the METHOD in the whole Navy. 2,5 - The METHOD need to be widely amended to be possible implement it in the whole Navy. 4 - It will be possible implement the METHOD in the whole Navy without big changes.			X								
Section III: The METHOD asks to public servants to suggest improvements to the VIEWS (Blueprints), so, the information available meets public servants needs.											
17. Public servants will recognize usefulness in EA-Navy, whereby, they will suggest improvements to the VIEWS adjusted to their own information needs.	1;2;3;4			X							
18. The way to suggest improvements to the VIEWS is practical and easy.					X	X					
19. The way to suggest improvements to the VIEWS will generate so many suggestions and so diverse that will be practically IMPOSSIBLE to manage them.	1	X						X	X		
20. The METHOD will enable the EA-Navy meet ever better the information needs of public servants.	1;3;5			X						X	X
21. The METHOD will enable the EA-Navy meet ever better the information needs of the Navy management.	1;3;5						X	X		X	X
Section IV: The METHOD asks to public servants to suggest improvements to the own METHOD itself, aiming their continuous improvement.											
22. Public Servants will experience DIFFICULTY to suggest improvements to the METHOD.						X					X
23. The way to suggest improvements to the METHOD will leverage their own evolution and adaptation to the Navy.								X		X	X
24. The way to suggest improvements to the METHOD will generate so many suggestions and so diverse that will be practically IMPOSSIBLE to manage them.								X	X	X	X
25. The suggestion from the public servants will enable the METHOD meet ever better the needs of update the EA-Navy.	1;3;4					X				X	X

(a) The numbers are the objectives for the solution stated in section 4.1. See the Appendix Table 3 at the end of this appendix.

The column *"Efficacy"* of the *"Goal"* dimension is filled with numbers which correspond to objectives for the solution stated in section 4.1, which are evaluated by the statement of the row in the Appendix Table 1 and 2. We remember the objectives for the solution in Appendix Table 3.

Appendix Table 3: Objectives for the solution

Objective number	Objective
1	Develop EA capability in a public institution;
2	Improve awareness of public servants about EA utility and benefits;
3	Improve value recognition of the EA to the institution and to its public servants;
4	Create willingness to collaborate in the process of improving and updating the EA, by public servants;
5	Make EA activities intrinsically attached to organizational culture of the institution.

Appendix F: Averages of Evaluation Criteria

Appendix Table 4: Averages of Evaluation Criteria - Part I

System dimension	Goal			Environment					Activity	Evolution	
Evaluation criteria	Efficacy	Validity	Generality	Consistency with people			Consistency with organization		Efficiency	Robustness	learning capability
Sub-criteria				Utility	Understandability	Ease of use	Utility	Fit with organization			
Averages:	**2,94**	**2,81**	**2,89**	**2,98**	**2,89**	**2,87**	**3,12**	**2,87**	**2,81**	**2,95**	**2,90**
1. The information I have provided to the MODEL will be useful to other public servants of the Navy.	3,24			3,24							
2. The information I have provided to the MODEL will be useful to the Navy management.	3,39						3,39				
3. Information collected by the METHOD is useful, so I will keep updated the information that concerns to me.	2,97										
4. I DO NOT intend to spend my time to update another system. I will only do so if my chief will order me.	3,07										
5. Most of public servants from my military unit will update information in this system because they will recognize usefulness on it.	2,32										
6. Most of public servants from my military unit will NOT update information in this system, unless their chiefs order them to do so.	2,50										
7. The METHOD allows to maintain the MODEL of EA-Navy with updated information.	3,00										
8. Information already available on EAMS-WEB is useful to me.	3,00			3,00							
9. I understood easily which information is supposed to be updated by me on the MODEL.					3,16						
10. Most of public servants from my military unit will easily understand which information is supposed to be updated by them on the MODEL.					2,70						
11. Information collected through the METHOD is reliable.		2,76									
12. The way to update information of the METHOD (sending Excel files to the responsible for the MODEL) is practical and easy.						2,97					
13. The MODEL of EA-Navy is important and necessary, whereby, it should be built and updated in all Navy units.	3,21		3,21				3,21				
14. The METHOD is time-consuming to public servants involved, whereby, I ADVISE AGAINST their implementation in all Navy units.			2,81					2,81	2,81		

Appendix Table 5: Averages of Evaluation Criteria - Part II

System dimension	Goal			Environment					Activity	Evolution	
Evaluation criteria	Efficacy	Validity	Generality	Consistency with people			Consistency with organization		Efficiency	Robustness	learning capability
Sub-criteria				Utility	Understandability	Ease of use	Utility	Fit with organization			
15. The relevance of information collected through the METHOD justifies the time taken from public servants, whereby, I RECOMMEND their implementation in all Navy units.	2,79		2,79				2,79	2,79	2,79		
16. Applicability of the METHOD in the whole Navy (List): 0 - I have no opinion/Not applicable 1 - Will NOT be possible to implement the METHOD in the whole Navy. 2,5 - The METHOD need to be widely amended to be possible implement it in the whole Navy. 4 - It will be possible implement the METHOD in the whole Navy without big changes.			2,76								
17. Public servants will recognize usefulness in EA-Navy, whereby, they will suggest improvements to the VIEWS adjusted to their own information needs.	2,73			2,73							
18. The way to suggest improvements to the VIEWS is practical and easy.					2,81	2,81					
19. The way to suggest improvements to the VIEWS will generate so many suggestions and so diverse that will be practically IMPOSSIBLE to manage them.	2,87	2,87						2,87	2,87		
20. The METHOD will enable the EA-Navy meet ever better the information needs of public servants.	2,94			2,94						2,94	2,94
21. The METHOD will enable the EA-Navy meet ever better the information needs of the Navy management.	3,10						3,10	3,10		3,10	3,10
22. Public servants will experience DIFFICULTY to suggest improvements to the METHOD.						2,66					2,66
23. The way to suggest improvements to the METHOD will leverage their own evolution and adaptation to the Navy.								2,91		2,91	2,91
24. The way to suggest improvements to the METHOD will generate so many suggestions and so diverse that will be practically IMPOSSIBLE to manage them.								2,77	2,77	2,77	2,77
25. The suggestion from the public servants will enable the METHOD meet ever better the needs of update the EA-Navy.	3,03					3,03				3,03	3,03