A Reference Application Architecture for Citizen Relationship Management of the Portuguese Public Administration

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October 2016

Abstract

Public sector organizations aspire to provide a new experience, more personalized and where the interaction between clients and companies are easier and agile, starting to adopt Citizen Relationship Management - the Customer Relationship Management processes that fits government needs.

With the birth of this new concept arose the need to build a design that is expected to help its implementation and, reference enterprise architectures achieve this objective. This is this research goal: to create a reference application architecture for the Portuguese public administration.

This research follows the action research methodology, a five phases methodology, that allies theory with practice. This holds true in the evaluation of the reference application architecture reached with a practical example, the Câmara Municipal de Cascais, a Portuguese municipality.

With this work we conclude that the reference application architecture reached, that holds six modules – client/citizen module, case module, human resources module, security module, legal module, administrative module, reporting and analysis module and knowledge module – and the functionalities: client/citizen access; case management; administrative management; licensing, permitting and code enforcement; knowledge database; human resources management and business intelligence management. We assess the fit to the Portuguese public administration by evaluating, improves CRM implementation in Portuguese public administration organizations.

Keywords: Citizen Relationship Management, Reference Architecture, Enterprise Architecture, Customer Relationship Management.

1. Introduction

Since the early 1990s that the expression Customer Relationship Management (CRM) has been in the world [5], and up to the present day has been growing. However this growth is applied to the private sector. Private organizations realized they need in-depth and integrated customer knowledge in order to build close cooperative and partnering relationships with their customers which is provided by CRM. CRM represents an enterprise approach to developing full-knowledge about customer behaviour and preferences and to develop programs and strategies that encourage customers to continuously enhance their business relationship with the company[22].

This approach of the private organizations accustomed people to seamless, personalized and convenient self-service options and now people expect the same from public organizations. Thus leading to the creation of the Citizen Relationship Management (CiRM) concept, that is the CRM applied to public administration. This is becoming a priority in the public sector considering it helps them to achieve their goals of developing models of service that are more responsive, more citizen-centric, and more efficient [1].

Herewith emerged the need to build a design that will help implement and integrate CiRM in the public administrations. Enterprise Architecture is the key to build it since it's, according to Mark Lankhorst, *"a coherent whole of principles, methods, and models that are used in the design and realisation of an enterprise's organisational structure, business processes, information systems, and infrastructure."*[18] But the purpose of this research is not only to build an enterprise architecture for CiRM, it's to build one that fits the Portuguese public administration organizations. This introduces the concept of Reference Architecture, which according to Paul Reed consists of *"information accessible to all project team members that provides a consistent set of architectural best practices. [..]"* [24]

Hereupon, the main goal of this research is to build a Reference Application Architecture for

CiRM to the Portuguese Public Administration. To achieve it, we will address the questions in the following subsection, by collecting the theoretical concepts, analyzing it and assembling data from CiRM already present in the market.

1.1. Research Questions
To reach our main goal we will have to understand and answer the following questions:

- What are the main differences between Customer Relationship Management and Citizen Relationship Management?

- What are the essential functionalities of Citizen Relationship Management?

- What are the essential information entities of Citizen Relationship Management?

- Where do the Reference Application Architecture for Customer Relationship Management and the Reference Application Architecture for Citizen Relationship Management differ?

1.2. Research Methodology
The research methodology chosen to elaborate this work is the *action research methodology.* This associates research and practice, so research informs practice and practice informs research synergistically [3]. This method is composed by several phases, existing different theories about how many. In this work we will follow the five phases defined by Baskerville [4].This phases are:
Phase I: define the problem;
Phase II: gather information to create a solid theoretical basis;
Phase III: build the solution taking into account the information gathered in the previous phase;
Phase IV: validate the solution with practical examples;
Phase V: make modifications according to the result of the evaluation to improve the solution;

Phase I is portrayed in this section, where we introduced and detailed the problem as well as the questions we wish to answer with this research. Phase II can be found in section 2 and section 3, where we collect the theoretical data and information of information systems already in the market, respectively. Phase III lies also in section 3, where we instantiate our reference application architecture. Phase IV corresponds to section 4 of this research. Here we validate our solution by comparing it with scenarios withdrawn from a municipality and one theoretical. Phase V is present in the last section, chapter 6, mainly, where we indicate the future work to me made.

2. Related Work
2.1. Enterprise architecture
The Gartner defines enterprise architecture (EA) as: *"Enterprise architecture is the process of translating business vision and strategy into effective enterprise change by creating, communicating and improving the key requirements, principles and models that describe the enterprise's future state and enable its evolution. The scope of the enterprise architecture includes the people, processes, information and technology of the enterprise, and their relationships to one another and to the external environment. Enterprise architects compose holistic solutions that address the business challenges of the enterprise and support the governance needed to implement them."* [19]

2.1.1 Enterprise Architecture framework

An enterprise architecture framework, according to Oracle, "provides a collection of best practices, standards, tools, processes, and templates to assist in the creation of the Enterprise Architecture and architectures of various scopes." [9]

The language that will be used throughout this work is the ArchiMate notation, represented in Figure 1. It was chosen for it has a simple architecture framework but comprehensive enough to provide a good structuring mechanism. [11] The ArchiMate will be used to describe, analyse and visualize the relationships among business domains. This has three layers: business, application and technology layer.

2.1.2 Enterprise architecture principles

The definition of enterprise architectural principles (EAP) according to TOGAF is:*"general rules and guidelines, intended to be enduring and seldom amended that inform and support the way in which an organization sets about fulfilling its mission."* [13]

2.1.3 Information Systems Evaluation

The evaluation of Information System (IS) should answer two questions [6]:
Question 1: Is this architecture suitable for the system for which it was designed?
Question 2: Which of two or more competing architectures is the most suitable one for the system at hand?

2.2. Customer Relationship Management
Simon Know et. al. defines Customer Relationship Management (CRM) as *"a strategic approach designed to improve shareholder value through*

developing appropriate relationships with key customers and customer segments. CRM unites the potential of IT and relationship marketing strategies to deliver profitable, long-term relationships". [17]

2.3. Citizen Relationship Management

Public administrations are organizations where the customers are citizens. However, citizens are also stakeholders and may be their employees. All these requirements force a different approach when it comes to the public sector and that's why the concept of Citizen Relationship Management (CiRM) was created. Kavanagh defines it as "a combination of people, processes, and technology used to deliver superior service to the constituent" [16], and Schellong as "a strategy and set of management practices, enabled by technology with a broad citizen focus, to maintain and optimize relationships and encourage new forms of citizen participation" [26].

Just like CRM, CiRM presents advantages to the public administrations, its can improve the service, efficiency and effectiveness and consequently increases the decision making of the government, decreases their response time to the citizens requests and enhances the trust of citizens in the public office. To better understand what are the differences between this two concepts, CiRM and CRM, consult Table 1.

2.4. Reference Architecture

Cloutier et. al states that a Reference Architecture "captures the essence of existing architectures, and the vision of future needs and evolution to provide guidance to assist in developing new system architectures[7]." Also states they have two principles:

Reference architecture principle 1: A Reference Architecture is an elaboration of company (or consortium) mission, vision, and strategy. Such Reference Architecture facilitates a shared understanding across multiple products, organizations, and disciplines about the current architecture and the vision on the future direction.
Reference architecture principle 2: A Reference Architecture is based on concepts proven in practice. Most often preceding architectures are mined for these proven concepts. For architecture renovation and innovation validation and proof can be based on reference implementations and prototyping.

2.5. CRM Reference Application Architecture

Cruz proposed a Reference Application Architecture for the CRM domain, which model can be seen in 1. These Reference Application Architecture has the following modules: Account/Contact module; Sales module; Service module; Marketing module; Security/Administration module; Scheduler module; Portal; Contact Center System; Document and Knowledge Management System; Workflow Management System; and Reporting and Analytics System.
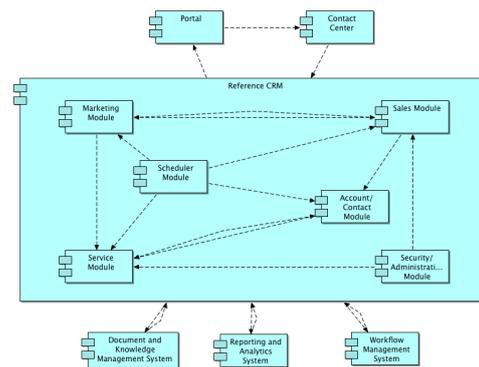

Figure 1: Reference Application Architecture for CRM domain from [10].

3. Architectural Solution

To build our Reference Architecture we needed to fulfill the two reference architecture principles presented in section 2.4. This principles will translate in two steps to reach our reference application architecture: in step one we will define the mission, vision and strategy of our architecture and in step two, we will gather concepts proven in practice by analysing CiRM information systems already in the market. In the research methodology, which can be consulted in section 1, this corresponds to phase II and III.

3.1. Step 1 : Mission, Vision and Strategy

As explained in section 2.4, the first reference architecture principle defined by Cloutier et al., a reference architecture is an elaboration of company (or consortium) mission, vision, and strategy [7]. In order to fulfill this principle we defined our reference architecture mission, vision and strategy as:

Mission: provide guidance, knowledge, an architectural blueprint and architectural improvement in CiRM domain.

Vision: provide a Reference Application Architecture for the CiRM domain capable of supporting all Portuguese public administration organizations.

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Table 1: Differences between CRM and CiRM adapted from [25] and [2] .

	Customer Relationship Management	Citizen Relationship Management
Sector	Private	Public
Strategy	Organizations	Government
Approach	Customer-centric	Citizen-centric
Competition	High	None
Goals	Optimize customer long-term value within the customer lifecycle; Increase sales;	Improve citizen orientation; Better accountability; Modify the citizen-government; Relationship;
Concern	Intense competition; No profits; Customer disloyalty; Costs;	Complaints from citizens; Insufficient communication and accountability with citizens; Bureaucracy; Costs;
Relations	Few	Many
Personalization	For each customer or group of customer	None
Measures	Quality and performance	Information and participation
Outcome	Profit; Customer loyalty; Maximising the shareholder value;	Close citizen relationship strengthening democracy and legitimacy; Citizens reactions and participation;

Strategy: extract best practices regarding the CiRM domain and evaluate the Reference Application Architecture in case studies, in order to improve it.

3.2. Step 2: Build the Reference Application Architecture for CiRM

First, we collected information sources about the processes and activities that should be supported by the CiRM system, more specifically about requirements of this three CiRM systems:

- Microsoft Dynamics CRM for Public Sector [20] [12] [8];

- Infor Public Sector CRM or Infor Hansen CRM [14] [15] [27];

- Oracle Siebel Public Sector [21];

- Constituent Relationship Management [?].

After analysing the requirements from the systems above, we collected the main ones: client/citizen access; case management; administrative management; licensing, permitting and code enforcement; knowledge database; human resources management; business intelligence management; unique records; offline access; security management; social listening; accountability and performance measurement;

grand management and incident management. Next, we identified the information entities required: client/citizen, worker, policy, event, clearance, credentials, department, permit, license, request, service, program, analytics, report, communication, e-mail, call, social network, frequently asked questions (FAQ), case, incidents, funds and benefit plan. Finally, we were able to construct a CRUD matrix where we connected each information entity to each process. With this information, we could build our Reference Application Architecture for the CiRM domain, Figure 2.
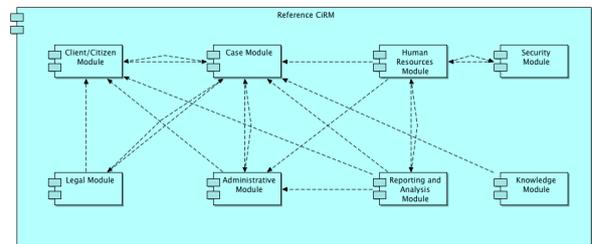

Figure 2: Reference Application Architecture for Citizen Relationshion Management.

Our Reference Application Architecture for the CiRM domain has six modules:

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- Client/Citizen Module: this module contains the Client/Citizen Access functionality;

- Case Module: this module contains the case management functionality, that includes the eligibility determination and the benefit plan functionalities;

- Human Resources Module: contains the human resources management functionality;

- Administrative Module: contains the administrative management functionality;

- Reporting and Analysis Module: contains the

- Legal Module: contains the licensing, permitting and code enforcement functionality;

- Security Module: contains the security management functionality;

- Knowledge Module: contains the knowledge database functionality;

4. Evaluation

This chapter is dedicated to the evaluation of our Reference Application Architecture, corresponding to the phase IV of our research methodology. Our goal is to evaluate if:

- the proposed architecture is suitable for the CiRM domain;

- the proposed architecture is most suitable than other architectures.

In order to prove that our reference architecture fulfill the goals presented above, we will apply our reference architecture best practices to existing application architectures, namely the CiRM used by *Câmara Municipal de Cascais* and the reference application architecture for the CRM domain proposed by André Cruz [10] that we mentioned in the chapter Related Work, by performing the following stages: identify the business processes related to the CiRM/CRM domain; identify the information entities related to the CiRM/CRM domain; identify the CiRM/CRM modules and the systems that interact with the CiRM/CRM; represent the current state of the Application Architecture; propose an Application Architecture based on the Reference Architecture guidance; identify the EA principles fulfilled by both Application Architectures; measure in both Application Architectures the Change Facility; measure in both Application Architectures the Test Facility; measure in both Application Architectures the fulfillment of the Alignment Heuristics; compare the results.

4.1. Câmara Municipal de Cascais

Câmara Municipal de Cascais (CMC) is a local public administration, more specifically the municipality of Cascais. CMC is now working to improve its relation with their citizens, since nowadays they only communicate with them via their store named "FixCascais". Their plan is to use CiRM as an entities manager.

CMC gave us some documents from which we extracted its information entities and business processes. The first are [23]: customer, customer status, customer type, origin type, name, interest area, iteration, iteration status type, criticality, priority type, email, relationship email, relationship, relationship type, relationship address, address, address type, unvalidated address, relationship unvalidated address, street layout, locality, police number, parish, county, district, country, phone contact, phone contact type, gender, marital status, marital status type, identification document, identification document type, identification document image, temporary identification, authentication, authentication access group, access group, permission, authentication type, functionality, site functionality, site, service;and the business processes are:

- **Customer functions:** Create Login User, Reset Login User, Create Customer, Search Customers, Associate Customers, Update Customer, Add Customer Phone, Remove Customer Phone, Update Customer Phone, Add Customer Email, Remove Customer Email, Update Customer Email, Add Customer Address, Remove Customer Address, Update Customer Address, Delete Customer, Add Customer Identification Document, Remove Customer Identification Document, Update Customer Identification Document, Add Customer Identification Document Image, Remove Customer Identification Document Image, Validate Customer Identification Document and Get Duplicated Customers.

- **Requests functions:** Consult request and its state, Submit CMC services, Submit new requests, Consult customer interaction and Access customers requests.

- **Other functions:** Statistics analysis.

Having this information we built the CRUD Matrix of the CMC CiRM and its application architecture that, as it can see in Figure 3, is composed by three modules: module 1 is responsible for business processes related to Clients/Citizens, module 2 related to interactions
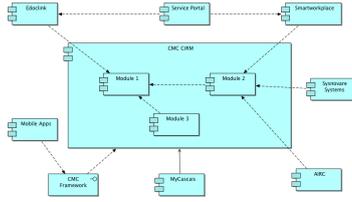
Figure 3: CMC CiRM Application Architecture

Figure 4: CMC CiRM Application Architecture Scenario 1 Evolution

between the CMC and its Clients/Citizens, namely the services provided by CMC, and module 3 related to its security functions. There is a process that does not have a system responsible for it, the statistics analysis.

Since CMC does not have concrete information about their following steps, so that we can evaluate it using best practices extracted from our reference architecture, we are going to simulate some TO-BE scenarios of their application architecture. This also happens since its current architecture can be fully mapped with our reference architecture not existing alterations to be made: module 1 corresponds to our Client/Citizen Module, module 2 to our Case Module and module 3 to our Security Module.

Scenario 1

In this scenario we are considering that in the TO-BE of CMC they are adding five business processes: add department, remove department, new license, update license and remove license. Consequently, the information entities: department and License, are going to be added. Since this will result in the same three modules, the application architecture does not need to be modified, so the one in Figure 3 is suitable to this scenario.

Having the TO-BE application architecture we can apply the best practices extracted from our reference architecture, so we can compare the two. Therefore, the changes to be made are:

- Module 1 corresponds to the Client/Citizen Module and Legal Module of our reference architecture;

- Module 2 corresponds to the Case Module and Administrative Module of our reference architecture;

- Module 3 corresponds to the Security Module in our Reference Architecture;

This changes will result in a application architecture with five modules: module 1 corresponds to Client/Citizen Module in our reference architecture, module 2 corresponds to the Case Module, module 3 corresponds to the
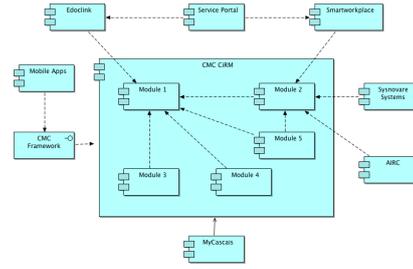
Security Module, module 4 to the Legal Module and module 5 to the Administrative Module.

Scenario 2

In this scenario the TO-BE plan is adding six business processes: create event, remove event, notify event, new worker, update worker and remove worker. Like the previous scenario this will lead to adding the information entities: event and worker. Since the three modules are maintained the application architecture do not need to be modified, Figure 3 also applies to this scenario.

Applying the best practices of our reference architecture the following changes need to be made:

- Module 1 corresponds to the Client/Citizen Module of our Reference Architecture;

- Module 2 corresponds to the Case Module and Human Resources Module of our Reference Architecture;

- Module 3 corresponds to the Security Module in our Reference Architecture;

Thereafter, the application architecture from Figure 5 are the result of this changes.
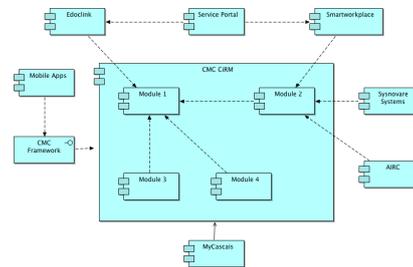

Figure 5: CMC CiRM Application Architecture Scenario 2 Evolution

Scenario 3

In this scenario we are going to join scenario 1 and scenario 2, that is, the TO-BE plan of CMC is to add eleven business processes: add department,

remove department, new License, update License, remove License, create event, remove event, notify event, new worker, update worker and remove worker; that will lead to adding four information entities: department, License, worker and event. The application architecture do is the same of the AS-IS, Figure 3.

Now we going to build a specific architecture based on our Reference Architecture by applying the best practices of our Reference Architecture to reach a solution architecture. The changes made as a result of the best practices are:

- Module 1 corresponds to the Client/Citizen Module and Legal Module of our Reference Architecture;

- Module 2 corresponds to the Case Module and Human Resources Module of our Reference Architecture;

- Module 3 corresponds to the Security Module in our Reference Architecture;

Since this will result in the same addition of modules of Scenario 1, the CMC CiRM Application Architecture os Scenario 3 is the same of Scenario 1.
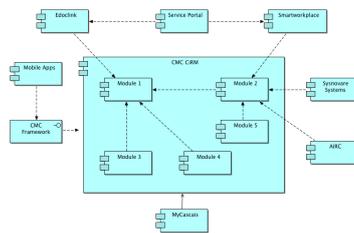

Figure 6: CMC CiRM Application Architecture Scenario 3 Evolution

4.2. Reference Application Architecture for CRM domain

In this section we will compare our Reference Application Architecture with the one proposed by André Cruz, already presented in section 2.4.2, namely in Figure 1.

Since we already have the current state of the Application Architecture we will not perform the first three steps of identification of business processes, information entities and modules.

The changes made are:

- The Security/Administration Module corresponds to the Security Module in our Reference Architecture;

- We divided the Service Module into two: the Case Module and the Administration Module of our Reference Architecture;

- The Account/Contact Module in our Reference Architecture is named Client/Citizen Module;

- The Marketing Module, the Sales Module and Scheduler Module were not covered by our Reference Architecture stayed the same.
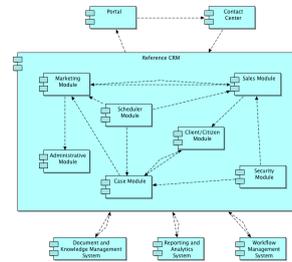

Figure 7: Evolution Application Architecture of Reference Application Architecture for CRM domain

Both versions of the architectures fulfil the principles: A.2, A.5, A.11, A.13, A.23, A.24, A.28, A.29, A.41, A.52 and A.55.

5. Critical Analysis

In Table 2 we present a summary of the results of the application of our reference application architecture best practices. With this data collected, we are now able to answer our two main goals:

Is the proposed architecture suitable for the CiRM domain?

Looking to the data, we can state that our Reference Application Architecture is suitable for the CiRM domain. In almost every scenario, the values obtain from the application of our best practices were better than the values obtained from the original application architecture. Also, since we built it based in real CiRM information systems' already in the market, what we did was collect their main functionalities and best practices.

Is the proposed architecture most suitable than other architectures?

We evaluate our reference application architecture in four aspects: EA principles fulfillment, changing facility, test facility and alignment fulfillment.

Relatively to the first aspect, EA principles, the application of our best practices did not improve the number of principles the original application concretized. This happened because we only modified the architecture in terms of business processes, information entities and application systems, and the EA principles not concretized by the architectures where related to a more wide

architecture where we could know more technical and business aspects.

In the matter of the changing facility aspect, in the architecture where we applied our reference application architecture best practice, this value was higher in every scenario. This is why we can state that our reference application architecture best practices improves changing facility, ie, ours is easier to adapt to changes.

Regarding the test facility aspect, our reference application architecture best practices did not improve it, in all four calculations, our values were equal or slightly under the value obtained in the original architecture. This values refer to the number of methods responding to and input in the system and being ours lower means that our architectures decreases the number of methods responding to a given input.

This happened because when we applied our best practices we created more systems where the business processes were clustered but still needed to access the original system from where they were separated.

Relatively to the alignment fulfillment, our reference application architecture best practices did not improve ou worsened since the values remained equal.

6. Conclusions

Public organizations are increasingly adapting to the new reality - the need to know their citizens/clients in a 360° view – so they can provide a better service by improving their relationship with them. This is the motivation of this thesis. We built a Reference Application Architecture for the CiRM domain to help public organizations, particularly Portuguese public organizations, implement their own CiRM adapting their every day need.

To achieve this point, as we stated at the beginning of this thesis, we needed to answer a few questions that by as from this point, we should be able to determine if our Reference Application Architecture will help Portuguese public organizations. In this paper we address the following questions:

What are the main differences between Customer Relationship Management and Citizen Relationship Management?
In section 2 we did a complete analysis of the differences between CRM and CiRM and elaborate Table 1. With this we realize that CiRM, being to the public sector, has the same objective of CRM but different concerns, for example: public sector does not have personalization for its clients and group of clients like private sector does, public sector wants to improve relationship with their citizens to improve their lifestyle and private sector wants to increase sales and the number of relations is higher in public sector.

What are the essential functionalities of Citizen Relationship Management?
To answer this question, we collected functionalities from four CiRM systems' already present in the market and mapped the ones that were common to the majority of them. Some of the essential functionalities are client/citizen access; case management; administrative management; licensing, permitting and code enforcement; knowledge database; human resources management and business intelligence management.

What are the essential information entities of Citizen Relationship Management?
Once again, this question is answered in section 3, where we built the information architecture diagram that contains the information entities essential to a CiRM and that we used to built our reference application architecture: client/citizen, worker, policy, event, clearance, credentials, department, permit, license, request, service, program, analytics, report, communication, e-mail, call, social network, frequently asked questions (FAQ), case, incidents, funds and benefit plan.

Where do the Reference Application Architecture for Customer Relationship Management and the Reference Application Architecture for Citizen Relationship Management differ?
Since the concerns of a CRM information system and a CiRM information system are different, their corresponding Reference Application Architectures are different in some aspects. When we compare them, we see that some modules have the same functionalities but in our architecture the modules for marketing, sales and scheduler functionalities do not exist, since public organizations do not compete with each other and do not want to sell a product that many organizations sell, they sell/give a specific one. On the other hand, public organizations have a lot more bureaucracy, reason why the use of a Legal Module.

After building our Reference Application Architecture, it was time to evaluate and answer two more questions: if the proposed architecture was suitable for the CiRM domain and if the proposed architecture was most suitable than other architectures. We respond to this questions

in chapter 4. Since in almost every scenario we tested the results from our application architecture were better and we built it based in real CiRM information systems', we answer positively to the first question. Regarding the second, we also answered affirmatively because when we looked to the four aspects used in the evaluation, two of them (EA principles and alignment fulfillment) remain equal to the original architectures, changing facility improve in every scenario tested and test facility was always equal or slightly under.

References

[1] A. M. Al-Khouri. Customer relationship management: proposed framework from a government perspective. *Journal of Management and Strategy*, 3(4):34, 2012.

[2] V. Andrade and P. Camacho. Citizen relationship management: What are the determinants that influence the implementation of citizen relationship management in governments? In *eDemocracy & eGovernment (ICEDEG), 2014 First International Conference on*, pages 97–102. IEEE, 2014.

[3] D. E. Avison, F. Lau, M. D. Myers, and P. A. Nielsen. Action research. *Communications of the ACM*, 42(1):94–97, 1999.

[4] R. L. Baskerville. Investigating information systems with action research. *Communications of the AIS*, 2(3es):4, 1999.

[5] F. Buttle and S. Maklan. *Customer relationship management: concepts and technologies*. Routledge, 3nd edition, 2015.

[6] P. Clements, R. Kazman, and M. Klein. *Evaluating software architectures*. Tsinghua University Press, 2003.

[7] R. Cloutier, G. Muller, D. Verma, R. Nilchiani, E. Hole, and M. Bone. The concept of reference architectures. *Systems Engineering*, 13(1):14 – 27.

[8] M. Corporation. Microsoft dynamics crm for government.

[9] R. Covington and H. Jahangir. The oracle enterprise architecture framework. 2009.

[10] A. G. B. C. da Cruz. An information systems reference architecture for the crm domain. Master's thesis, Instituto Superior Técnico, 2015.

[11] T. Group et al. Archimate 2.0 specification. *The Open Group, Berkshire, UK*, 2012.

[12] P. Hernandez. Hud opens its doors to microsoft dynamics crm online. *eWeek*, page 1, 2015.

[13] D. Hornford. *TOGAF Version 9.1*. TOGAF Series. Van Haren Publishing, 2011.

[14] Infor. Enterprise resource planning with infor.

[15] Infor. Municipality of anchorage reaps big savings with infor.

[16] S. C. Kavanagh. Revolutionizing constituent relationships: The promise of crm systems for the public sector. *Government Finance Officers Association, retrieved January*, 14:2008, 2007.

[17] S. Knox, A. Payne, L. Ryals, S. Maklan, and J. Peppard. *Customer Relationship Management: Perspectives from the marketplace*. Routledge, 2011.

[18] M. Lankhorst. *Enterprise Architecture at Work: Modelling, Communication and Analysis*. Springer Berlin Heidelberg, 2005.

[19] A. Lapkin, P. Allega, B. Burke, B. Burton, S. Bittler, R. Handler, G. James, B. Robertson, W. Newman, Deborah, et al. Gartner clarifies the definition of the term enterprise architecture. *Gartner, Inc*, 2008.

[20] A. E. Marques. Projecto inovador de atendimento coloca cascais na linha da frente do e-citizen.

[21] Oracle. Siebel public sector 8.2.2. http://www.oracle.com/us/industries/public-sector/058291.pdf, 2012.

[22] A. Parvatiyar and J. N. Sheth. Customer relationship management: Emerging practice, process, and discipline. *Journal of Economic and Social research*, 3(2):1–34, 2001.

[23] R. Querido and T. Valentim. Caderno técnico de projeto - cascais id, 2015.

[24] P. Reed. Reference architecture: The best of best practices. 2002.

[25] A. Schellong. Crm in the public sector: towards a conceptual research framework. In *Proceedings of the 2005 national conference on Digital government research*, pages 326–332. Digital Government Society of North America, 2005.

[26] A. Schellong. *Citizen relationship management: A study of CRM in government*, volume 560. Peter Lang, 2008.

[27] I. P. Sector. Infor public sector : Quick guide.

Table 2: Evaluation Results.

Evaluation Criteria	Original Arch.	Evolution Arch.
CMC Scenario 1		
Changing Facility (Information/Application)	0,9927	0,9956
Changing Facility (Application)	0,0857	0,1428
Test Facility (Application)	0,8	0,7058
Alignment between Business Arch. and Information Arch.	0,9904	0,9904
Alignment between Business Arch. and Application Arch.	0,9857	0,9857
Alignment between Application Arch. and Information Arch.	1	1
CMC Scenario 2		
Changing Facility (Information/Application)	0,9927	0,9945
Changing Facility (Application)	0,0833	0,1111
Test Facility (Application)	0,8	0,8
Alignment between Business Arch. and Information Arch.	0,9904	0,9904
Alignment between Business Arch. and Application Arch.	0,9857	0,9857
Alignment between Application Arch. and Information Arch.	1	1
CMC Scenario 3		
Changing Facility (Information/Application)	0,9930	0,9958
Changing Facility (Application)	0,0731	0,1219
Test Facility (Application)	0,8235	0,7368
Alignment between Business Arch. and Information Arch.	0,9918	0,9918
Alignment between Business Arch. and Application Arch.	0,9878	0,9878
Alignment between Application Arch. and Information Arch.	1	1
CRM		
Changing Facility (Information/Application)	0,9981	0,9983
Changing Facility (Application)	0,2444	0,2666
Test Facility (Application)	0,2368	0,2093
Alignment between Business Arch. and Information Arch.	1	1
Alignment between Business Arch. and Application Arch.	1	1
Alignment between Application Arch. and Information Arch.	1	1