

ARCHITECTURAL REFERENCE MODELS USED IN PROCESS MODELING

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Abstract. *All organizations start their activity with the desired existence as long as possible, and in case they will have notoriety on an international level or, at least, on a national level for the activity carried out, it means that the management of that organization is a successful one. Central public authorities strive to identify solutions to make their activities more efficient, not necessarily because of a strategic management policy, but, above all, because of reduced budgets, year after year, even though the specific attributions remain the same. In this context, architectures can provide some solutions for government organizations, as they have the role of rendering all processes in a conceptual structure, with the inclusion of each element that is part of the system and can help to optimize the modelling of processes, so that they can eliminate what is redundant and unnecessary within a system.*

Keywords: business architecture, central public authorities, management, efficiency, process modeling

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1. Introduction

The dynamics of contemporary society test the skills of a good manager, either a general manager of a private company or a minister, by finding effective technical solutions in the context of unpredictable world situations, such as the COVID-19 Pandemic. Even though ministries are government entities, all public institutions are an integral part of a country's economy, as, among other things, services and goods are purchased through the Public Procurement System (SEAP) (paper, printers, computers, envelopes, pens, bookshelves, cars, fuel, etc.) that are produced by private legal entities.

Thus, the manager of a public institution is obliged, by law, to purchase services and products at the best prices on the market, to be able, in turn, to offer public services to citizens. Also, the global situation generated by the COVID-19 Pandemic has caused considerable social pressure on governments. Citizens of all states felt the effects of the pandemic, in the sense that they could no longer carry out their current activity, no longer obtained the same income or even had no form of income.

Governments were obliged to find solutions for all categories of citizens. The Ministry of Culture found itself in the position of making sustained efforts to identify the best solutions to help individuals and legal entities operating in the cultural-creative

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sector, which was the sector most affected by the economy. This aspect is because cultural activity, as a whole, takes place in public spaces, addresses and interacts with the public. In this context, the most effective management of a ministry's activity involves, among other things, borrowing and applying some concepts that come from specialized literature, as well as various theories applied to the field of enterprises and business, but which we consider can prove their effectiveness and efficiency in the case of governmental organizations as well.

2. Architectural models (MA) developed used by companies

An enterprise architecture [1] of an organization constitutes its representation, having the following components as defining parts:

- the essential elements of the specific activity;
- information, applications and technological strategies;
- impact on business functions and processes.

The expression "enterprise", included in the phrase "enterprise architecture" [2], refers to any type of organization that has a set of values. In this context, an enterprise can also be considered a public institution, namely a ministry, an entire company, a division of a company, a single division, or organizations located in different parts of the world, but with the same management and control.

Architecture and system architecture has the following definitions:

- ✓ presents a system that is presented in a schematic form or a component of a plan within a system, which has the role of facilitating the method of implementing the system;
- ✓ develops what are the components within the structure what are the interdependence relationships between them, and what leads to the design and transformation process in a certain period;
- ✓ has the role of generating the form in which a system is organized yielded through its defining elements that are related to the environment and the regulation that render the lines of development and design. [2]

Architecture defines the skill and process of structure used to achieve the functional and explicit requirements for people. The styles of architecture are not conditioned by creators but by the community according to the necessities of its different organisations. [3]

Definition of architecture, according to CIMOSA:

- ✓ refers to the format and configuration of something (company domain, procedures, systems etc.) = CIMOSA special architecture;

- ✓ the set of components that permit structuring and developing something in a uniform method = the CIMOSA reference architecture;
- ✓ the methodology required to use the reference elements for structuring and designing the particular architecture CIMOSA = CIMOSA System - Life cycle methodology.

An architecture [4] "is a model or framework which represents an enterprise at one point in its life cycle. This framework can be useful to help plan and analyze the enterprise, select hardware and software products, design organizational "reporting structures," and study the flow of materials and information through the enterprise. Without an enterprise architecture model, executives, managers and technologies in an company are essentially 'blind': making decisions based on their perception of the enterprise, which is often not shared with the rest of the organization".

One of the methods used in management to identify the best solutions to successfully manage the changes that intervene in the activity carried out by any organization is Process Modeling.

A modelling architecture [5] to be efficient must be able to represent activity in three different planes: present, future and visionary era. Thus, it will outline aspects such as the current situation of the institution's activity, which are the factors involved in its main activities, trying, with objectivity, realism and rigour, to identify which are the aspects that need to be improved, but from the point of view of the beneficiary of public services. The plan analysis will focus on the forecast of the public services delivered to citizens in the medium term. Thus, it is known with certainty that the future of organizations will emphasize digitization, so the public services offered to citizens are bound to change in this direction. The visionary analysis represents the result we want to achieve, represents the absolute goal we want to achieve.

The primary objective of the outcome of universal enterprise architectures is to deliver a formal standard for the assimilation of inner functions and adequate governance of the specialised and informational resources of the business. Similar standardization includes as its main advantages the enlargement of the management quality and the efficiency in the enterprise engineering methodologies.[6]

For a central public authority to provide a quality public service, it must have the ability to use the benefits of new technologies. It is also necessary to have an "end-to-end view" [7].

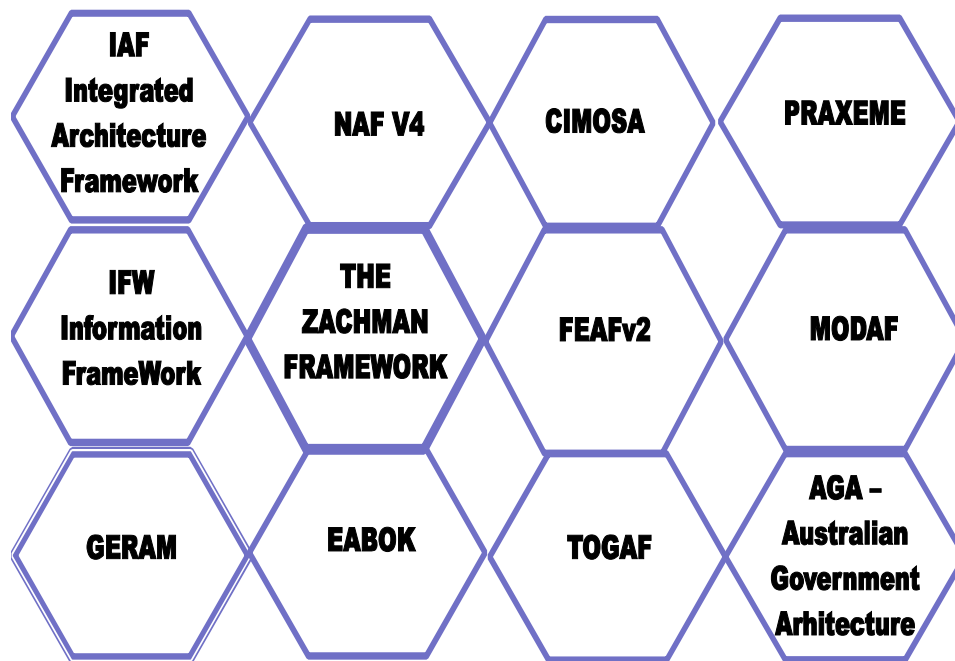


Fig. 1 Architectural models (MA) developed by companies

This type of analysis encounters certain difficulties at the ministry level, as the vision differs depending on the alternation of governments. Thus, a liberal-oriented government will have a different "vision" compared to a social democratic government, although the area addressed is, in the present case, the cultural one. In the specialized literature, there are different process modelling architectures, see Figure 1, which can be classified differently [1], among which we mention:

Architectural models (MA) developed by companies:

- ✓ CIMOSA - Computer Integrated Manufacturing Open System Architecture, system initiated by program no. 688/5288-AMICE, European Specific Program for Research and Development in Information Technology [3];
- ✓ GERAM - Generalized Enterprise Reference Architecture and Methodology. This architecture was developed in 1990, based on the CIMOSA architecture;
- ✓ TOGAF – The Open Group Architectural Framework.

Classification of MA according to the type of architectural model:

- ✓ RM-ODP or ITU-T Rec. X.901-X.904 or ISO/IEC 10746, - The Reference Model - Open Distributed Processing;

✓ EABOK [8]- The Guide to the Enterprise Architecture Body of Knowledge, – is a guide to enterprise architecture, which projects an overview of the subject and provides a series of references that lead to new information;

"Open Source" models:

✓ PRAXEME [9] – represents a methodology that can be applied to an organization, information systems or technical systems, based on an approach

✓ interdisciplinary. The purpose of this methodology is to help transform an enterprise by connecting the specialties within it.

✓ The Zachman model [10] The Zachman Framework for Enterprise Architecture - represents the updated architectural model in 1990 of the original model, developed by John Zachman in 1987 called "A Framework for Information Systems Architecture";

✓ IAF Integrated Architecture Framework - created, in 1993, by the Capgemini company, it is an architecture that had the Zachman Model as its starting point;

✓ IFW Information FrameWork – represents an architectural framework specific to the banking environment, being developed by Roger Evernden in 1996;

Models created for the defence industry:

✓ DoDAFv2 [11] – is an architecture used by the American State Department;

✓ MODAF – is an architecture that was developed by the Ministry of Defense of the United Kingdom of Great Britain and Northern Ireland to manage the planning of the defence system and the management activities involved;

✓ NAFv4 – the architecture developed by NATO [12] aims to develop the architecture for use in the economic field, but especially for use in the defence field;

Models of government-type architectures:

✓ AGA – Australian Government Architecture [13] is a government architecture that developed from the FEAF architecture, specifically designed to deliver cohesive services to citizens through the effective use of information and ICT.

✓ FEAFv2 [14] - the first design of the architecture prototype was released in 1999, so later, in 2013, the White House published version 2. The purpose of this architecture was to develop the processes and information that are managed by federal agencies and various government entities.

In specialized literature we find several architectural levels [1]:

- business architecture - the main business processes;
- information architecture - applications, data and how to integrate them;

➤ technological architecture - the technologies that support the information architecture through operating platforms, networks, various applications for collaboration, data representation and manipulation, integration, security and systems management.

The frameworks above-mentioned are used by organizations to achieve various advantages, including:

- collecting data/information necessary for the organization's activity promptly;
- synthesizing the description of the processes used within the organization;
- obtaining data that for various statistical reports;
- better communication between the actors involved in the organization's activity;
- achieving the standardization of the processes carried out at the level of the organization, which will lead to the reduction of costs and the efficiency of the activity;
- understanding the entire activity system of an organization, providing an overview by synthesizing processes;
 - can reduce the complexity of activities;
 - unnecessary processes should be eliminated;
 - can provide information that can lead to a better decision-making/managerial process;
- facilitates the decision to allocate budgets for essential activities;
- favours the decision to allocate new IT investments where changes are needed and where different components or applications could be abandoned;
- technologies can be implemented to achieve the organization's objectives;
- favours interoperability;
- induces the integration of technologies in the processing system.

We believe that among the most used and well-known architectural models are CIMOSA, PERA, and TOGAF, which are present in the following:

The CIM-OSA architecture was brought to public knowledge in 1985, by program no. 688/5288-AMICE, ESPRIT (European Specific Program for Research and Development in Information Technology), which laid the foundations of a CIM – CIMOSA (Computer Integrated Manufacturing – Open System Architecture).

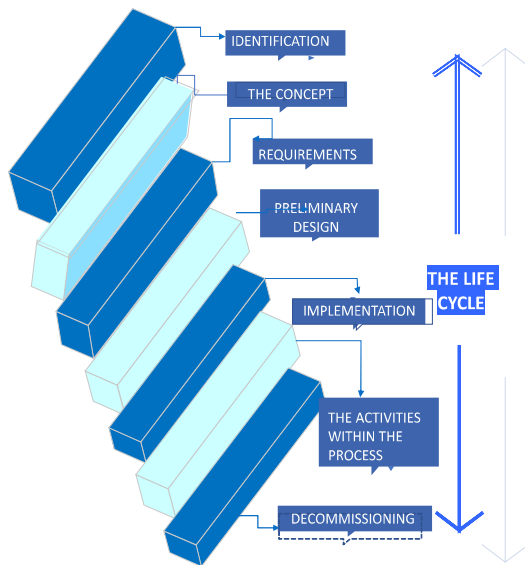


Fig. 2 - CIMOSA Modelling

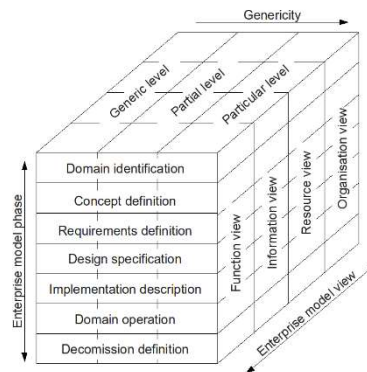


Fig. 3 The basics of reference architecture [3]

The CIMOSA concept, see Figure 2 and Figure 3, strives for enterprise modelling and model-based process and examination.

CIMOSA offers advantages [3] to businesses or organizations by:

- improving the flexibility and efficiency of the organization's operation by re-engineering and streamlining procedures;
- promoting change management, considering options through process simulation;
- enhancing adjustability and functional efficiency and diminishing expenses through more suitable managing of the organization's management (people, procedures, resources, information);
- reducing delivery time/service provision, by sharing and reusing pertinent data, and modelling structure blocks and system elements.

PURDUE ENTERPRISE REFERENCE ARCHITECTURE (PERA) [4] – is an business reference architecture developed to help the enterprise in its efforts to develop and implement unified manufacturing procedures. The PERA architecture prototype, see Figure 4, was designed by Purdue University, USA, in partnership with different industrial companies, and this architecture incorporates three essential elements:

- production facilities;
- people and the organization;
- control and information systems.

„The adoption of standard models is the basis for integrating enterprise processes. Thus, decision-making heavily relies on process models and technologies that tackle specific problems”.[15]

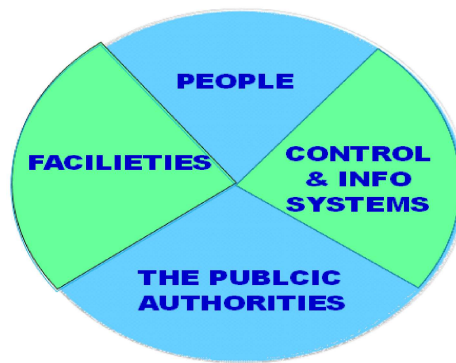


Fig. 4 PERA the enterprise life cycle model [4]

There are many ways to create process maps, and today there are various software programs specifically elaborated to facilitate process mapping. For example, the Microsoft company created a program dedicated to processing mapping called Microsoft Office Visio. In the specialized literature, we find the following tool among different ways of mapping:

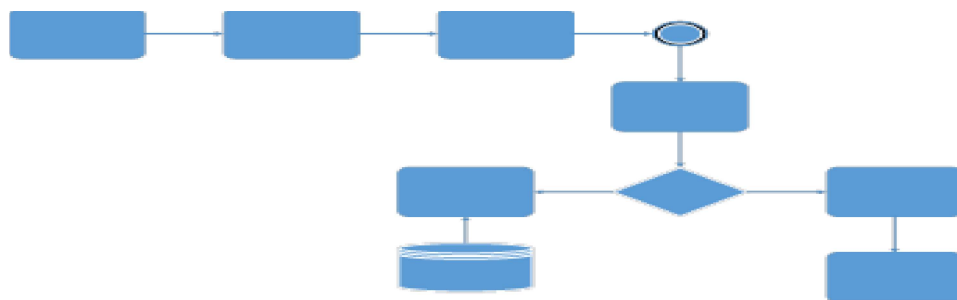


Fig. 5 Swimlane diagram example

The Swimlane diagram or the Rummler-Brache diagram, through which the subjects are defined, respectively those who do a certain activity and it is specified which one it is, trying to ensure clarity, what is redundant and what is ineffective within a process. This diagram, see Figure 5, was first published in 1990 in the book "Improving Process" by Geary Rummler and Alan Brache.



Fig. 6 TOGAF architectural vision – source <https://pubs.opengroup.org>

TOGAF – is a specially created framework for enterprise architecture used by the world's leading organizations and provides users with a group of processes and instruments to design an extensive spectrum of various IT architectures. In essence, TOGAF [2] is a practical method that allows IT users to develop, estimate and create their organization-specific architecture, reducing the expenses of planning, developing and executing architectures that operate available solution procedures. For the representation of a specific TOGAF architectural vision, see Figure 6.

2.1. Reference architectural models proposed to be used at the level of the Ministry of Culture.

Various architectural models are used in the literature, such as the Zachman Model or "Zachman Framework", Federal Enterprise Architecture (FEA), and Open Group Architecture Framework (TOGAF), that can be used to develop an enterprise architecture for cloud adoption computing [16].

The Zachman Model, also called the "Zachman Framework™" [10] was defined by its creator, John Zachman, as follows: "it is a scheme - the intersection of two historical classifications that have been used for literally thousands of years. The first is fundamental to communication found in primitive interrogatives: What, How, When, Who, Where, and Why. Integrating the answers to these questions allows for the comprehensive and composite description of complex ideas. The second is derived from reification, the transformation of an abstract idea into a rendering by example that was originally postulated by ancient Greek philosophers and is labelled in the Zachman Framework™: Identification, Definition, Representation, Specification, Configuration, and Rendering by Example". The author of the model also states that: "in order not to let the business break down, the architecture concept of information systems becomes less and less an option and more and more a necessity". John Zachman, starting in 1980, was involved at IBM in the development of Business Systems Planning (BSP). He publishes 1987, an article entitled "A framework for the architecture of information systems". In trying to identify a suitable framework for information systems architecture, Zachman analyzed both classical architecture and the architecture of various engineering projects in the industry. Thus, the author concluded that architectures are found within several levels and contain at least three elements:

- informations and data;
- the function of processes;
- location or networks.

In 1990, Zachman developed the model, see Figure 7, with an updated version in 1987, used by organizations in industry and business to improve their information infrastructure. The Zachman Framework™ takes a "matrix" form, consisting of 6 x 6 columns, with communication interrogatives as columns and transformations as rows.



Fig. 7 The fundamental structure for Enterprise Architecture source: <https://www.zachman.com>

Frame classifications rendered via cells positioned at the intersection of transformations and interrogatives. In the specialized literature, it is considered that Zachman's model would represent the total package of descriptive representations essential to present an organization. Following the comparative analysis of the Zachman Model and Laswell's Communication Model, also known as the 5W Theory, we found that there are similarities between the two models, thus, the Zachman Model uses the defining elements of the 5W Theory Who? What does it say? Through which channel? To whom? With what effect?

We recall the fact that Harold Dwight Lasswell developed one of the first models of communication, see Figure 8, being the author of the famous study: "The structure and function of communication in society", published in 1948 [17]. Lasswell claimed that to understand the processes of mass communication, it is necessary to understand each of its stages, which become the main elements of his model.

- What: presents data, such as system data, relational tables, and field definition;
- Who: describes functionality - processes, the function of a software application, etc.);
- Where: network description, indicates positions and interconnections within the organization;
- Who— nominates who are the people involved in the process;
- When — sets the allocated time;
- Why – presents the objectives;
- (Why) Goal List – high-level objectives of the organization;
- (How) Process List – list of all known processes;
- (What) Material List – list of all organizational entities.

2.2. The information flow model proposed at the level of the Ministry of Culture for document management

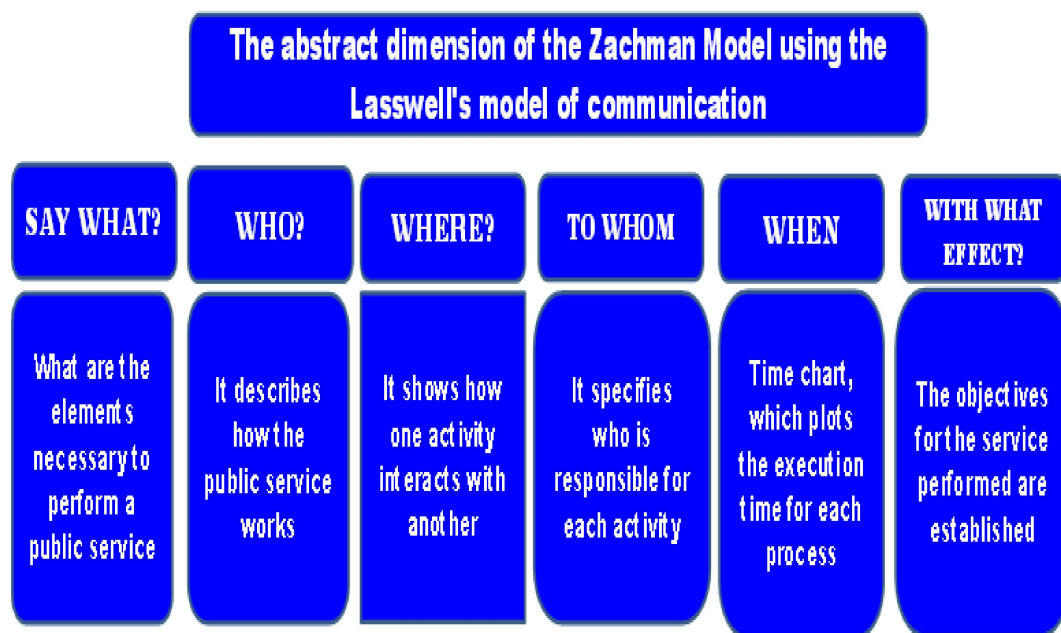


Fig. 8 The The abstract dimension of the Zachman Model using the Lasswell's model of communication

Various architectural models are used in the literature, such as the Zachman Model or "Zachman Framework™", Federal Enterprise Architecture (FEA), Open Group Architecture Framework (TOGAF), which can be used to develop an enterprise architecture for cloud adoption computing [16].

The information flow [18], regardless of the field of activity of an organization, is the basis of management processes, made up of the information transmitted through informational channels, which are subsequently elaborate in a specific time. Since the Ministry of Culture [19] is a technical body of the main governance, directly subordinated to the Government, which elaborates and ensures the application of the strategy and policies in the field of culture, the majority of the information that is processed is considered documents. You can see in Figure 9 the graph of how the documents flow and how each department processes them.

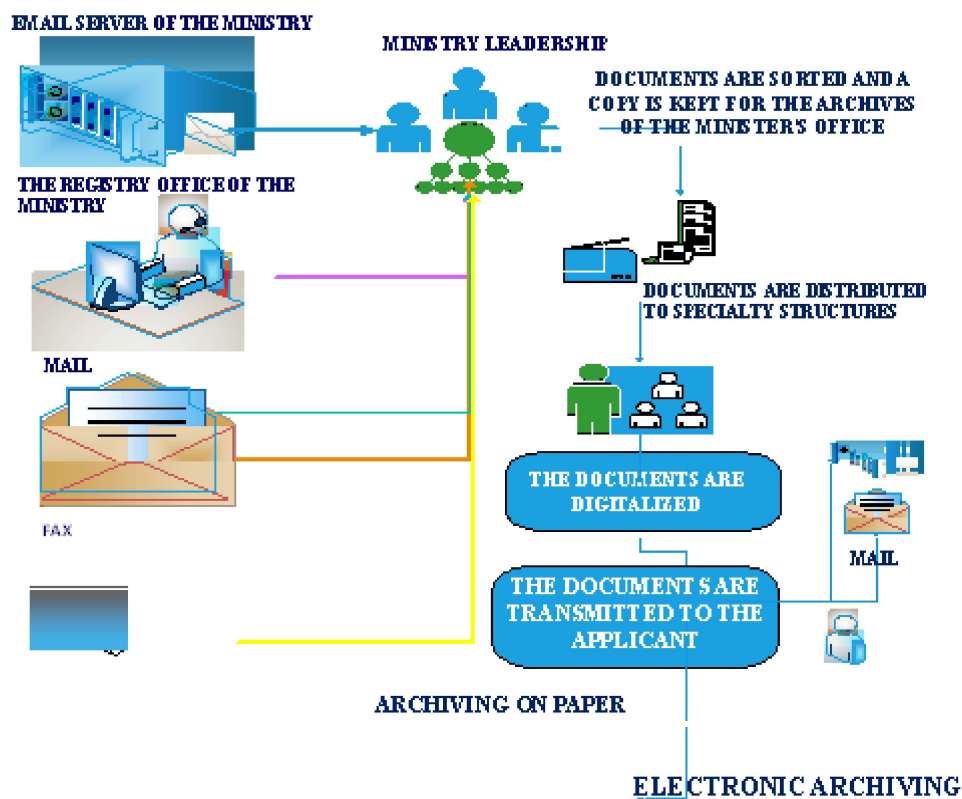


Fig. 9 Model of a document circuit process

For example, a citizen submits documentation, accompanied by an application, to obtain the necessary approval for the rehabilitation of a building, classified as a historical monument. The delay in analyzing the file submitted within the scientific body, respectively the specialized commission, will lead to the discontentment of the applicant. He will return with another request addressed to the ministry so a new input

will emerge. This input appears, most of the time, in the form of a request for information of public interest, through which details will be solicited regarding the submitted file due to not resolving the request, within the legal deadline for issuing the opinion etc.

Conclusions

Failure to process documents within the term established by the law and methodological norms attracts the sanctioning of the institution by the courts. So, the effectiveness of the information flow at the ministry level rest, to some extent, on the punctuality of the way documents are processed. Another essential aspect is related to the quality of the output of the information coming out of the ministry. The better the quality of the output is, the more certain objectives will be achieved, such as:

- eliminating/avoiding the generation of a new input.
- reduction of court actions filed by beneficiaries of public services against the ministry;
- improving the image of the ministry;
- providing quality public services.

REFERENCES

- [1] ASE. Academia de Studii Economice - București. (Facultatea de Cibernetică, Ed.) Preluat pe 02 06, 2021, de pe ASE <http://www.ia.ase.ro/sie/sie-5-2013.pdf>, (2013).
- [2] Open Group. The Open Group Architecture Framework: Introduction, <http://pubs.opengroup.org/architecture/togaf9-doc/arch/chap01.html>.
- [3] AMICE, E. C. CIMOSA: Open System Architecture for CIM (Vol. 2nd, revised and extended edition). Brussels, Belgium: Springer-Verlag, ESPRIT Consortium AMICE, (1993).
- [4] Williams, T. J., The Purdue Enterprise Reference - Architecture and Methodology (PERA). Preluat de pe http://www.pera.net/Pera/Report160%281996%29Handbook//PERA_Handbook.pdf, (1992).
- [5] Holt, J., & Perry, S., Modelling Enterprise Architectures. London, United Kingdom: The Institution of Engineering and Technology (2010).
- [6] Mureșan Mihaela, Generic Integrating Business Architecture București, Revista Informatica Economică nr.2, (2006).
- [7] Jeston, J., Nelis, J., Management by Process, London, eBook ISBN9780080943244, Routledge.A. Sandulescu and O. Dumitrescu, (2008).
- [8] Hagan, P. J., www.mitre.org. McLean, Virginia: The MItre Corporation. Preluat de pe https://www.mitre.org/sites/default/files/pdf/04_0104.pdf. (2004).
- [9] Vauquier, D., & Desfray, P., Introducing Praxeme - An initiative for an open method. Noisy-le-Grand, France: Praxeme Institute. Preluat de pe <http://www.praxeme.org/wp-content/uploads/2020/04/SLB02-EN.pdf>. (2010).

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- [10] *Arhitecture*, Z. I., *zachman.com*. Preluat pe 02 16, 2021, de pe <https://www.zachman.com/>: <https://www.zachman.com/>, (1990).
- [11] Defense, D., The Department of Defense Architecture Framework (DoDAF), Version 2.0. U.S.A.: Office of the Assistant Secretary of Defense (OASD) for Network Infrastructure and Integration. Preluat pe 02 14, 2020, de pe <https://dodcio.defense.gov/Library/DoD-Architecture-Framework/>, (2010).
- [12] NATO, NAF - NATO Architecture Framework. NATO Science and Technology Organization. https://www.nato.int/nato_static_fl2014/assets/pdf/pdf_2018_08/20180801_180801-ac322-d_2018_0002_naf_final.pdf, (2018).
- [13] Office, A. G., Australian Government Architecture Reference Models. Guvernul Australiei. Commonwealth of Australia. Preluat de pe <https://www.wa.gov.au/sites/default/files/2018-06/Australian-Government-Architecture-Reference-Models-Version-3.0.pdf>, (2011).
- [14] The White House, Federal Enterprise Architecture Framework v2. Preluat pe 02 14, 2020, de pe https://obamawhitehouse.archives.gov/sites/default/files/omb/assets/egov_docs/fea_v2.Pdf, (2013).
- [15] Muñoz, E.; Capon-Garcia, E.; Muñoz, E.M.; Puigjaner, L. A Systematic Model for Process Development Activities to Support Process Intelligence. *Processes*, MDPI, Basel, Switzerland, , 9, 600. <https://doi.org/10.3390/pr9040600>, (2021).
- [16] Scarfe, D., Morris, S., Bennett, F., & Bricknell, R., Building a Digital Operating Model with Microsoft Cloud Adoption Framework for Azure? Ormond - Australia: Smart Questions, (2019).
- [17] Lasswell, H.D. The Structure and Function of Communication in Society. In *The Communication of Ideas*; The Institute for Religious and Social Studies: New York, NY, USA, (1948).
- [18] Oprean, C., Kifor, V. C., Suci, O., & Cătălina Alexe, Managementul integrat al calității. București: Editura Academiei Române, (2012).
- [19] Guvernul României, Hotărâre nr. 90 din 10 februarie 2010 privind organizarea și funcționarea Ministerului Culturii. Monitorul Oficial, București, România, (2010).
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