

GOVERNANCE ENTERPRISE ARCHITECTURE (GEA): DOMAIN MODELS FOR E-GOVERNANCE

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ABSTRACT

Public administrations all over the world promote ambitious and costly e-government programmes. The required domain analysis is usually conducted on a local and ad hoc basis, due to a lack of commonly accepted domain models - in literature and practice - for the overall governance system. This paper summarizes a broad research modelling effort, which aims at developing a domain description for the overall governance system. We propose the Governance Enterprise Architecture (GEA) as a set of domain models that serve as a top-level enterprise architecture. To this point, the development includes five high-level generic process and objects models. Namely, we present the GEA mega-process model, the GEA interaction model, the GEA public policy formulation object model, the GEA service provision object model and the latest development of the GEA object model for the overall governance system.

Categories and Subject Descriptors

D.2.11. [Domain-specific architectures]

General Terms

Design, Standardization.

Keywords

Domain analysis, enterprise architecture, e-governance, e-government, object models, process models,

1. INTRODUCTION – MOTIVATION

The public administration (PA) domain currently lacks commonly agreed content standards, definitions and vocabularies, not only at the global level among administrative systems worldwide, but even within each country. To make things even more problematic and although some initial attempts have been made [1], PA theory lacks a commonly accepted upper model description or a domain analysis [2] [3].

During the last ten years, many countries foster e-government initiatives and programmes. Initially, the requirements for this development have been generated bottom-up: the special

departments' needs drove the design of the e-government strategy. Soon, more advanced countries realised that for mature e-government development, there is a need for a sophisticated and centrally managed strategy function. So the idea of drafting an overall architecture of various types (e.g. technical, information, enterprise) was introduced, in order to serve as a blueprint for the e-government development [4-7].

At this point, the shortage of available PA domain models became apparent. As a result, some of these top-down initiatives propose high-level descriptions and categorizations of PA functions and/or information, in an effort to overcome the existing shortage of descriptive PA domain models. In this line, the recent Business Reference Model, as introduced by the Federal Enterprise Architecture Program Management Office in the USA, has defined four core "Business Areas", 39 "Lines of Business" and 153 "Sub-Functions" for the overall federal enterprise [8]. In the UK, the e-Envoy Office proposed as part of the e-Services Development Framework [4], the Government Common Information Model (GCIM) which is a generic data model representing the basic entities and relationships during the phase of public service provision.

These descriptions were based on and addressed the specific needs of the projects they were part of. As a result, they were focused on providing solutions to local problems and not to develop models to be accepted on a wider basis. For this reason, they were not adopted or exploited by a wider community outside the country they were proposed.

Furthermore, these descriptions were focused only on the part of the overall administrative domain that was related to "service provision". In recent literature and practice the "e-government" term has been mainly used for describing systems aiming at electronic service provision by public administration agencies. Identifying the governance domain with service provision alone, suffers from certain limitations, as it excludes from "e" development important parts of the overall governance system. The discussion on the differences between "government" and "governance" was triggered during the last decade from the field of political theory [9-12]. This discussion has entered the information systems literature only recently [13]. As it is used here, e-Governance is a wider concept than e-Government including systems and applications aiming at facilitating not only the service provision part of government but also other parts of governmental activity (e.g. mechanisms for collection and prioritisation of society's needs and the decision making process). Actually, the latter is considered to be a part of the former. The scope of the domain analysis in our work has been the overall governance system.

2. DOMAIN ANALYSIS FOR E-GOVERNANCE: THE GOVERNANCE ENTERPRISE ARCHITECTURE (GEA)

Attempting to address the problem of the lack of domain models for public administration, during the last years we have created the Governance Enterprise Architecture (GEA). At the current stage of development, GEA consists of five high-level models. In section 2 of this paper, we briefly present:

- The GEA mega-process model of the overall governance system [14].
- The GEA interaction model of the overall governance system [15].
- The GEA public policy formulation object model (strategic planning) [16].
- The GEA service provision object model [17].

All the above have been presented elsewhere. In section 3, we present the GEA object model for the overall governance system. Finally, in section 4 we elaborate on our plans for future work.

2.1 The GEA mega-process model of the overall governance system

As a first step, we proposed a generic top-level process model for the overall governance domain [14]. This model identifies three basic mega-processes in the governance system (Fig.1):

- Formulate Public Policy. In this mega-process, the demand from the society's side is identified and the core political function of prioritizing public action takes place.
- Provide Service. The production and distribution of public services and goods to society take place in this mega-process.
- Support Operations. All the internal political and administrative operations aiming at facilitating either the formulation of public policy or service provision.

It is these three layers that formulate the overall domain of the governance system. We further analysed these three mega-processes at a second level of description, by employing the MIT Process Handbook methodology (process decomposition, specialization and bundle) [18], the International Benchmarking Clearinghouse Process Classification Framework [19] and the policy analysis model presented by B.W. Hogwood and L.A. Gunn [20]. The second level of our model can be also seen in Fig.1, within each mega-process.

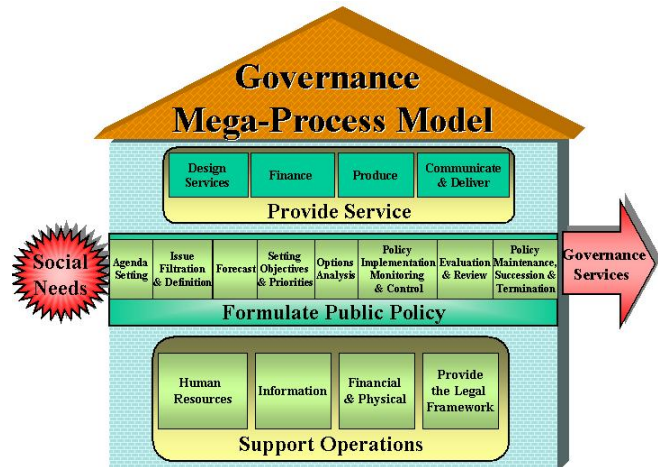


Figure 1. The GEA mega-process model of the overall governance system.

Interestingly, the Gartner's Government Performance Framework™ has recently used these three broad categories to group all actionable activities for a public sector organization [21].

2.2 The GEA interaction model of the overall governance system

We further added to the model presented above by building a top-level interaction diagram. Specifically, we presented a high level description of the overall governance process, incorporating the three basic governance actors, and their interactions [15]. These actors identified to be:

- Society
- The Administrative System
- The Political System

Following a systems' perspective, the model depicts the transformation of the governance system's inputs (society needs) to outputs (services) with detailed descriptions of the participating actors, stages and inherent controls (Fig. 2). The model presents:

- The administrative and political processing for the identification and prioritization of the social needs (demand), which corresponds to the "Formulate Public Policy" (FPP) mega-process of the model in Fig.1. The rightward movement of the information represents this.
- The participation of the political and administrative systems (together with the private sector) in the service provision phase (supply), which corresponds to the "Provide Service" (PS) mega-process of the top-level model. The leftward movement of the information as political decisions/orders and their transformation to services for the ultimate client represents this part.

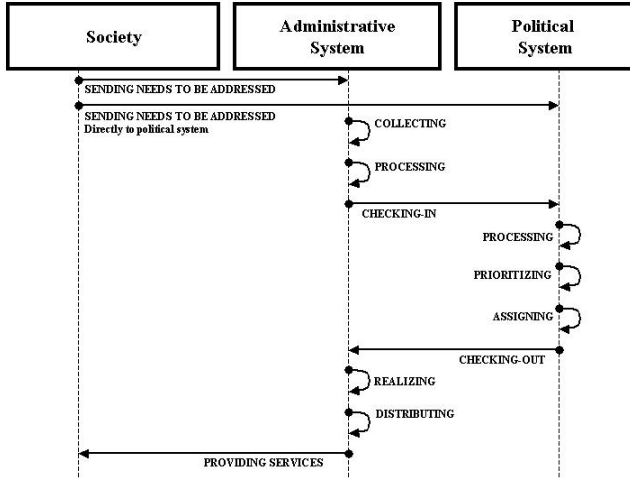


Figure 2: The GEA interaction model of the overall governance system

Moving from the process dimension to the dimension of objects, we analysed the main objects of the governance domain. For this, we followed a slightly different approach compared to process analysis: without having modelled the overall domain as we did for the process dimension (Fig.2), we proposed two partial data models for the two of the three layers, those of “Formulate Public Policy”, and “Provide Service”. These two models are presented in the following sections. The presentation of a generic data object for the overall governance system follows in detail in Section 3.

2.3 The GEA public policy formulation object model

For the “Formulate Public Policy” mega-process, a data model has been proposed [16]. The intention has been to integrate and customize, all the necessary and most influential strategic concepts for the governance system, as described by the numerous private-sector strategic models in the literature [22]. Six main components, represented by several objects compose the model:

- Culture (e.g. Vision, Value, Power Structure)
- Environment (e.g. Political System, Society, Public Sector, Technology)
- Knowledge (e.g. Core Competence, Strategic Information)
- Organization (e.g. Organizational Agent)
- Resources (e.g. Technology, Financial, Human)
- Functions (e.g. Process, Activity, Task)

The strategy process has been divided into two interacting sub-processes: *strategy formulation* and *strategy implementation*. Strategy formulation involves concepts such as strategies, objectives, mission and success criteria (central part of the model in Fig.3). Strategy implementation refers mostly to the strategic plan, which forms the passage from strategy formulation to strategy implementation, strategic action and its outcomes (bottom-right part of the figure).

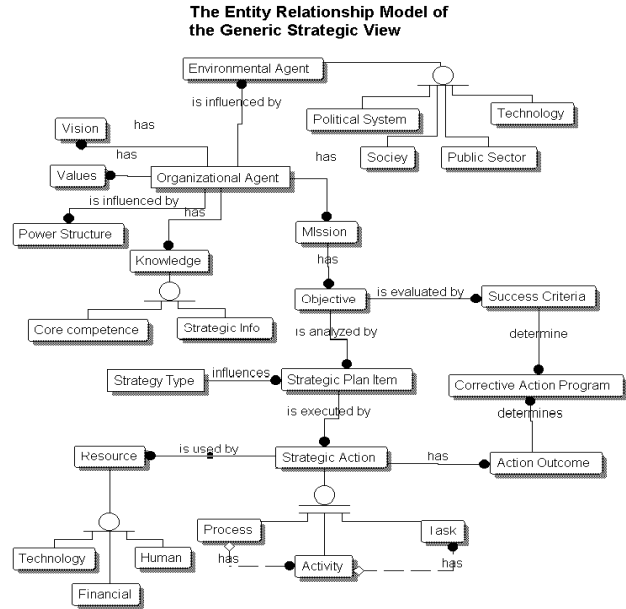


Figure 3: The GEA public policy formulation object model

2.4 The GEA service provision object model

In order to develop an object model for the second mega-process of “Provide Service”, we elaborated on the work that has been conducted by the UK e-Envoy Office [4, 23]. The Office has proposed the Common Government Information Model (GCIM) for describing the public service interaction phase (transaction). Therefore, the model is focused on the execution part of the service provision layer.

Our effort has been to broaden the model in various aspects; for one, in order to cover not only the transactional-operational but also the planning-knowledge aspects of public administration service delivery (or “Provide Service” generic process) [17, 24]. We have added at the current stage of development, a knowledge layer with additional objects (such as Outcome Type and Evidence Type) and their relationships with the operational entities of GCIM (Fig.4).

The distinction between knowledge and operational levels are a common model feature in the object-oriented design and patterns literature [25]. Consequently, we proposed an enhanced object model in which an outer planning or knowledge layer has been added, as shown in Fig. 3. The overall model is layered into two sections:

- The operational (transactional) layer.
- The knowledge (planning) layer.

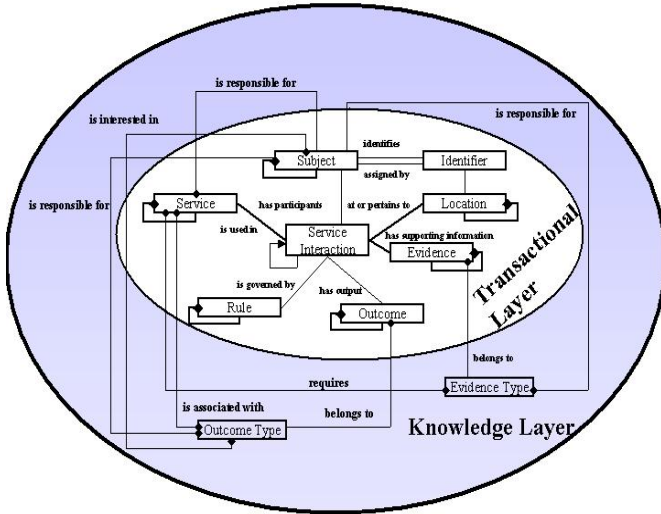


Figure 4: An object model for public administration service provision

Moreover, we analyse the basic entities of the GCIM model, and propose some specializations. In our enhanced model the GCIM object “Subject” models five different actors – roles, namely Client, Service Provider, Evidence Provider, Consequence Receiver, and Broker Actor. Additionally the Outcome object can be further specialized to Output and Consequence. Outputs are the final “products” produced by the Service Interaction and received by the Client who initiated the Service Interaction. Consequences are all the by-products of the Service Interaction (e.g. information that interests other Service Organization Subjects). We present these more detailed models in Fig. 5a&b.

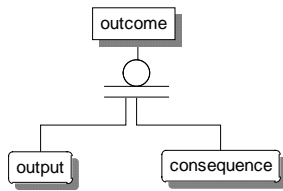


Figure 2a: Object detailed object models

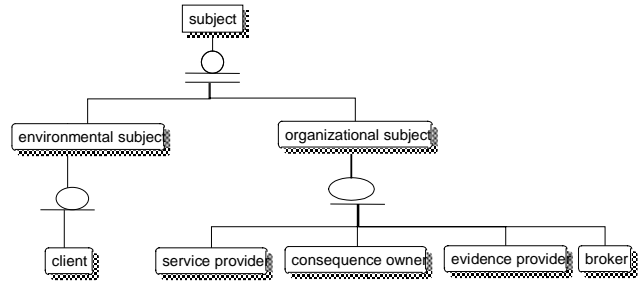


Figure 1b: Subject detailed object models

3. THE GEA OBJECT MODEL FOR THE OVERALL GOVERNANCE SYSTEM

3.1 Overall model presentation

Advancing our domain analysis for e-Governance, we present here the latest development of our work: the GEA object model for the overall governance domain. This model stands at the same level as the generic models presented in parts 2.1 and 2.2. As they cover the process and object aspects of our domain model, together they form a powerful high-level description of the e-Governance domain.

Although the model stands on top of the two partial object models presented in Sections 2.3 (public policy formulation) & 2.4 (service provision), it has been derived in a rather top-down fashion, and not as a bottom-up exercise through the generalization and conjunction of the two existing partial models. The basic model’s entities, instances, and relationships emerged by employing a metaphor in describing the governance system: we used the metaphor of language, and we consider the relationship between administration and society in a linguistic context [26].

The model (Fig.5) depicts the main objects and relationships that constitute the overall governance system. That is, it covers the path that leads from the conceptualisation of administrative action to the realization and process execution in the real world, in correspondence with the “Formulate Public Policy” and the “Provide Service” mega-processes of model 2.1.

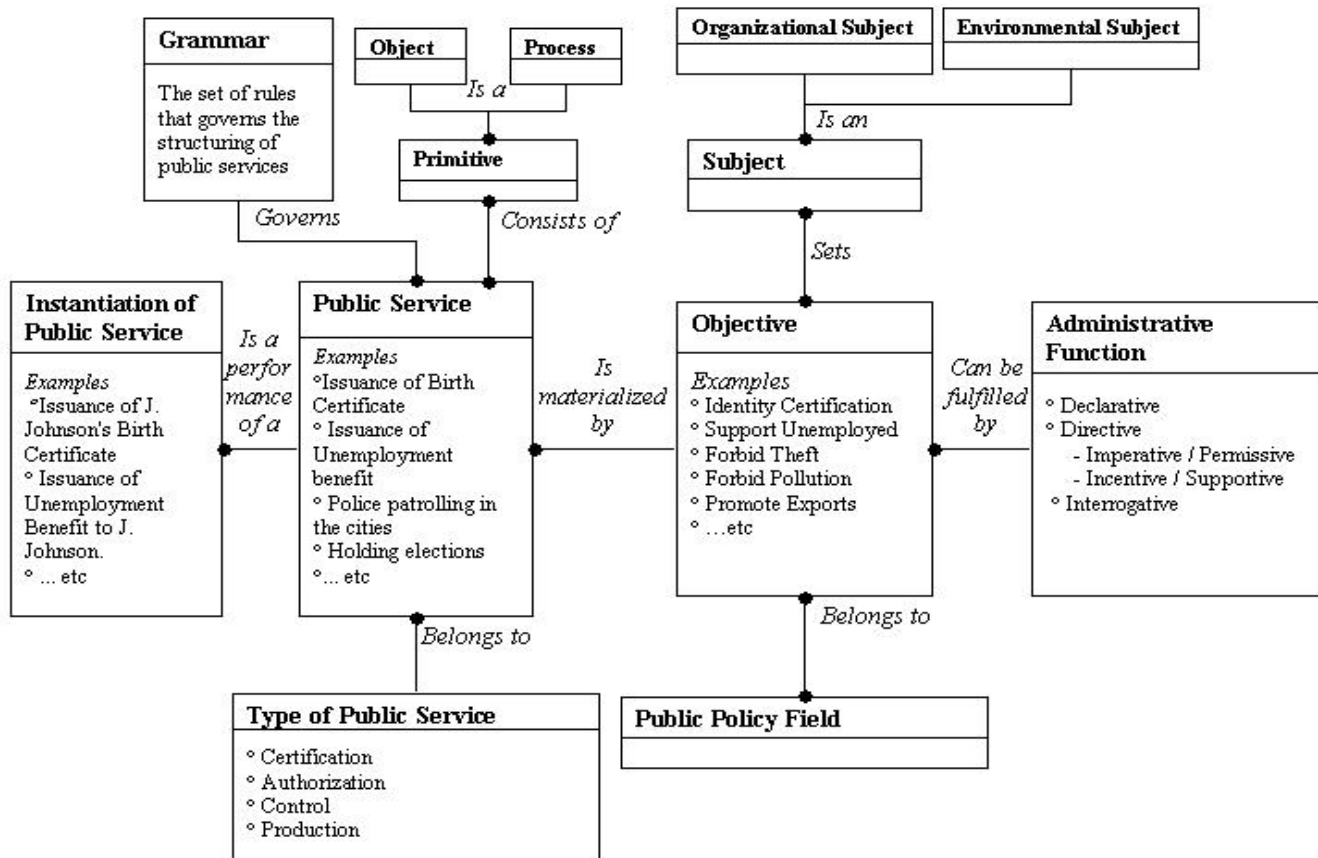


Figure 5: The GEA object model for the overall governance system

As can be seen in Fig.5, we have included instances in some of the model's objects. In some cases, these instances serve simply as examples (e.g. in the Public Service object). Though, in the case of the "Administrative Function" and "Type of Public Service", we propose exhaustive populations of these entities. As these are of particular interest for our domain analysis, we present them separately in Sections 3.2 & 3.3, respectively. The primary entities and the underlying relationships of the model are depicted in Fig. 5. A description follows, starting from the right side of the model.

Administration performs a set of primary Functions. At a high level there are three types of such functions, as derived by the linguistic metaphor we employed. In the society – administration "conversation", there are three types of interaction: Declarative, Directive and Interrogative. The directive administrative function is further broken down into two categories with two sub-categories in each: Imperative/Permissive and Incentive/Supportive.

Administration sets Objectives to be reached. By doing so, administration chooses from a superset of potential objectives, the subset to be realized. Objectives are related to the three primary Functions through the "fulfill" relationship. They are politically defined, and administration sets them as targets to meet.

Objectives are linked to several Public Policy Fields. The latter are defined as functional areas of Public Policy interest. These Public Policy Fields are more or less close to the departmentization introduced to administrative space by ministries.

In order to materialize the Objectives, administration has to organize and to provide Public Services. We identified generic types of public services in two ways:

- Top-Down. Using the administrative functions as a starting point, we examine the ways in which public administration realizes them. The hypothesis has been: "Each basic administrative function is realized characteristically by one generic type of public service".
- Bottom-Up. Studying a great number of public services, we focused on the type of action the administration accomplishes each time. The verbs used in describing the service were used as a guide. The hypothesis has been: "A few verbs can describe all public services and each of these verbs is associated with one generic type of public service"

In this way, we identify four primary types of Public Services:

- Certification
- Authorization
- Control

- Production

In Section 3.3, each of the above is explained in detail.

It is very important for the comprehension of the model to distinguish between “Types of Public Services” and “Types of Administrative Functions”. Although a strong link exists between the two, each Administrative Function can be realized alternatively by all Types of Public Services. So a single Objective can be attained through a number of different Public Services. These different Public Services can even belong to different Types of Public Services. An example can be found in section 3.3. The choice each time of the specific Public Service, through which Administration will reach the satisfaction of an Objective, depends on various factors, such as the administrative capacity, the information technology available, the existing organizational and institutional infrastructure, the administrative culture etc.

As derived from the above, in order to meet Objectives, e.g. of an Imperative type, administration could alternatively activate public services belonging to Certification, Authorization, Control, and/or of the Production type.

Public Services are considered to consist of Objects and Processes (here called Primitives). Their appropriate organization is governed by a set of structural rules, which could be called an (administrative) Grammar.

Public Services as described here are abstract entities. They are units of the administrative system they belong to. What is finally performed in the real world is just the Instantiations of these Public Services. Both the Service and its Instantiation can be perceived either as a process or as a product. The meaning of each Instantiation is richer than the meaning of the Public Service from which it derives. Instantiations consist of the abstract models (Public Service) together with all the intonations of the real world (space, time, real people, behaviour, culture, etc). What finally reaches the citizen is the Instantiation and not the Public Service. For each Public Service (e.g. certification of birth), we have numerous real world instantiations (e.g. certification of birth for J. Johnson, for P. Pauley, for S. Stones produced by different public agencies).

3.2 Administrative Functions

All systems perform a set of primary functions. In the case of the governance system an interesting question can be posed: *What are the categories of administrative action that the governance system performs?*

Researchers of administration usually address this question proposing classifications along various lines [27-29]. One of the more common is based on the functional notion of the public policy field. In this line, administrative function is classified in categories such as securing the existence of the state and internal order, promoting economic growth and welfare of the society, etc.

Although useful for practical purposes, this classification of administration action is not sufficient, as it demonstrates more the variety of the fields in which administrative action can be applied and not the different nature of this action per se. Thus, this taxonomy lies at the surface and cannot appropriately address the posed question.

Getting insights from linguistic theory [26], we tried to identify primary functions performed by administration during its communication with society. We propose three primary administrative functions:

- Declaration
- Direction
- Interrogation

The Interrogative function corresponds to the upward movement of information from society to decision-makers in the generic process model (Fig.2), while the Declarative and Directive functions correspond to the downward movement of the political decision to the administrative system, and society.

These functions lie at the top of our domain analysis, thus clarifying their characteristics is critical. A short description follows.

3.2.1 Declarative function

Through the declarative function administration *declares and certifies the existence and the truth of certain world states*. Thus, this function is referential and descriptive. It is uttered by administration in declarative mood. The logical pattern describing the declarative function is “Certifying X for Entity Y” (e.g. certifying J. Johnson’s family status or place of birth).

Why does society need the administration to certify states of the world? Social entities need to interchange certified information. Administration is considered to be the most reliable certification actor in society: a kind of “honest broker” arbitrating private transactions in a neutral manner.

3.2.2 Directive function

Through the directive function, *administration directs society to certain states*. Thus, this function is constructive and deontological.

The directive function can be further decomposed into two types, describing the two paths administration uses to direct society:

- Imperative-Permissive.
- Supportive.

The first type refers to administrative action that gives direction to society by command. The second fulfils the same purpose in a different way: the direction is given through incentives.

Specifically, as Imperative we define the set of functions through which the administration forces or forbids societal behaviours. These functions are uttered by administration in imperative mood and society owes mandatory compliance and obedience.

We define as Permissive the set of functions through which the administration recognizes special rights and allows behaviours otherwise prohibited. Through the permissive function, exceptions are activated in situations where a universal prohibition has been enforced. These functions are also uttered by administration in an imperative mood, as administration sets a mandatory process that has to be followed, if the subject wants to exercise this kind of behaviours. The permissive function can be perceived as a special case of the imperative one, as it directly relates to command under conditions [26]. The logical pattern describing the permissive function is “X is prohibited, unless Y occurs” (e.g. building a house is prohibited, unless you have a building license).

We define as Supportive, the set of functions through which the administration offers guidance and support to society. These functions are uttered by administration in an optative mood, as the compliance with the specific behaviours is not mandatory (optional). The support function has been further decomposed into the following sub-types [26]:

- Direct (finance consumption), e.g. unemployment benefits
- Indirect (finance production)
 - Subsidize, e.g. free vaccination for children.
 - Incentive, e.g. incite investments.
 - Produce, e.g. infrastructure, services.

Through the Incentive function, administration promotes specific behaviours, while through the other types of supportive functions assists society by financing consumption and/or production of basic infrastructures, goods and services.

3.2.3 Interrogative function

Through the interrogative function, *administration interrogates and collects societal needs*. Administration “asks” and society “responds”. It is the only function in which the subject of the action is ultimately society and not administration. The latter uses the information collected by this function, in order to check the validity and success of the other two functions, and to control the effectiveness of the overall service production system. It is apparent that in non-democratic regimes this function may become weak and volatile.

3.3 Types of Public Services

Modern administrations, in the quest to address the ever-evolving social needs, produce a wide spectrum of services that currently covers almost every aspect of the citizen’s life. All these services are linked with the objectives posed, as depicted in Fig.6. Each different public administration chooses and orchestrates a different set of public services in order to fulfil the selected objectives.

Can we classify the hundreds of public services provided by administrations into general types with common characteristics? When addressing this question, we then can identify generic types of public services with similar characteristics. These generic types could be described once and these descriptions could be used either to analyse existing or to create new instances of services by just reconfiguring the generic types appropriately. A generic process model could be also proposed for each type of public service.

In our work, as already presented, we have identified four generic types of public services:

- Certification
- Control
- Authorization
- Production

A short description of these generic types of public services follows.

3.3.1 Certification

There is a prevailing (characteristic) type of public service for fulfilling the Declarative function and this is “certification”. Through certifications administration declares and certifies

different states of the world. The typical process model followed by administration in order to perform certifications, is composed of the following typical steps:

1. An entity (citizen, business) applies for certification.
2. Administration asks for evidences needed for the certification.
3. The entity gathers all the necessary evidences.
4. Administration checks completeness and correctness of all evidences.
5. Administration processes all inputs (e.g. compares them with what has already been set by a formal decision/law, as indispensable prerequisites for the certification).
6. Administration may ask for additional evidences, information, and clarifications.
7. Administration certifies or justifies the refusal to certify what was initially asked for.

3.3.2 Control

There is a prevailing type of public service through which administration fulfils the Imperative function and this is “control”. In the case of the Imperative function, public administration is responsible for the proper execution and ensuring general compliance to the rules. Its role is to suppress and control. As the offender tends to hide his/her behaviour, the most ordinary type of administrative action is inspections on a periodic or on an impromptu basis. In order to perform controls, public administration follows a process model with the following typical steps.

1. Public administration traces and identifies cases of non-compliance, using a variety of methods.
2. Public administration performs various types of controls.
3. Public administration arrives at a decision regarding compliance or not.
4. In case of proved non-compliance, public administration passes sentences.

3.3.3 Authorization

There is one prevailing type of public service through which administration realizes both the Permissive and interestingly the Support function as well, and this is “authorization”. Administration has to set up a whole mechanism, to exercise this type of services. In general, either the universal prohibitions should be withdrawn (permissive) or a support should be awarded (supportive), if special conditions are met. A typical process model for authorization follows:

1. The entity (citizen, business) asks for an authorization (permission or support).
2. Public administration asks for specific evidences to be presented.
3. The entity brings all the necessary evidences.
4. Administration checks completeness and correctness of all evidences.
5. Administration processes all inputs (e.g. compares them with what has already been set by a formal decision/law as indispensable prerequisites for the authorization).
6. Administration asks for additional evidences, information, and clarifications.
7. Administration issues the authorization or refuses and justifies the rejection.

3.3.4 Production

Production has been identified to be a sub-type of the Supportive administrative function. Production differs significantly from all other administrative functions. Public administration must organize a production mechanism. Thus, production becomes a new type of public services. It is the administrative function closest to the functions of the private sector. We can even question whether production is a straightforward administrative function, or just a private sector function that has been transferred for several reasons to public administrations during the last few decades.

In the table below, the correspondence between public administrative functions and the type of public services typically employed for the implementation of each function. As mentioned, objectives serve as an intermediate entity between these two.

Table 1: Characteristic types of Public Service for Administrative Functions

Administrative Function	Characteristic Type of Public Service
Declarative	Certification
Imperative	Control
Permissive	Authorization
Supportive	Authorization
Production	Production

Although a strong link exists between administrative functions and types of public services, each administrative function can be realized by many types of public services. This statement has many consequences in our overall domain model.

We demonstrate this “multiplicity” feature between functions and public services using an example in Table 2.

Table 2: Multiplicity in “Administrative Functions – Public Services” relationship

<u>Objective: Prohibition of polluting the atmosphere</u>
Administrative Function: Directive, Imperative
(a) Instance of Public Service = Periodic control of pollutant emission from factory flues Type of Public Service = Control
(b) Instance of Public Service= Issuance of an operating license for factories Type of Public Service = Authorization
(c) Instance of Public Service= Issuance of a certificate asserting that no pollution is caused Type of Public Service = Certification

In this case, the objective (prohibition of polluting the atmosphere) is related to the “Directive – Imperative” function. Public administration realizes this objective (alternatively or simultaneously) by exercising public services. These public services can be of the type of control, authorization and certification according to the circumstances. It becomes apparent from the table that although there is a characteristic relationship between administrative functions and the types of public services (Imperative – Control), administration can activate other types of services, in order to meet the objectives posed.

4. CONCLUSION - FUTURE WORK

In this paper, we presented an overview of our work in the field of the e-governance domain analysis, under the framework of GEA. We also presented in more details the latest development of the GEA object model for the overall governance system.

The study on the proposed domain analysis will continue in several directions:

- There are still parts and aspects of the models to be further analyzed. In the GEA object model, the difference between “public service” and “instantiation” and the notion of the “administrative grammar” are indicative examples.
- We plan to analyze the four generic types of public services with the intention to identify and reduce them into “primitive components” (or building blocks). Through this path of work we intend to come up with more detailed descriptions for the processes executed in the “Provide Service” mega-process.
- We will elaborate more on the objectives and administrative functions and their interdependency, as a path to provide detailed models for the processes executed in the “Public Policy Formulation” mega-process.
- We intend to better “tune” all the models in order to enforce consistency amongst them.

In Fig. 7, we present a view of our work so far. The question marks in the two partial process model cells demonstrate directions for future research.

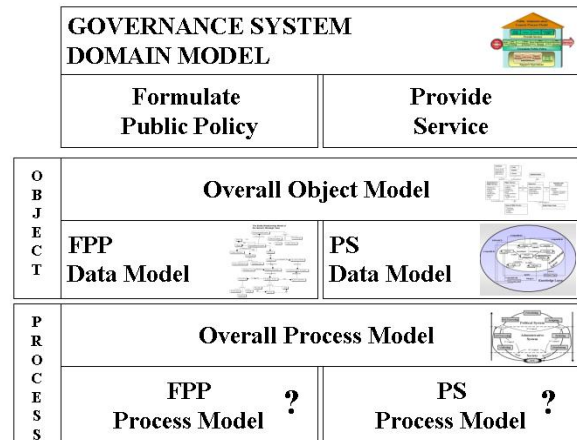


Figure 3: Meta-model of the Governance Enterprise Architecture

5. ACKNOWLEDGEMENTS

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