BUILDING AN ENTERPRISE ARCHITECTURE FOR PUBLIC ADMINISTRATION: A HIGH-LEVEL DATA MODEL FOR STRATEGIC PLANNING

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ABSTRACT

This paper describes the construction of a generic data model for strategic planning in Public Administration (PA). This model is presented at two distinct levels corresponding to different levels of the Zachman framework. The data model developed covers one of the major generic processes which public administration agencies perform, that of strategy formulation. This model can be used to provide common definitions (vocabulary) in strategic planning and establish a conceptual framework that can be easily adapted for strategic planning to specific PA organizations. This work is part of an overall research effort, which involves building an enterprise architecture for Public Administration following an approach that populates the Zachman Framework for the overall domain of Public Administration. The models developed are generic (process, data, etc.) in order to possess the descriptive power, which allows them to be readily specialized for particular Public Administration agencies.

1. INTRODUCTION

1.1 Motivation

In the era of a highly networked world, Public Administrations (henceforth: PAs) worldwide are facing similar types of problems and challenges:

- Re-inventing Government in a client-focus approach

- Improving performance & quality through measurements

- Changing the organizational boundaries and structure of Public Administration

- Building partnerships with the Private Sector on a novel basis

- Delegating decisions and responsibilities to independent agencies

- Globalization & competition

- Information Technology enabled services

The use of IT to facilitate the major efforts of reorganization, modernization and reinvention of government has proven not to be a simple task. There is an increasing pressure on PA organizations to manage information systems and information technology as an enterprise key capital resource (D. Tapscott 1993). IT-based solutions need to overcome a series of negative PA specific characteristics in order to add value to the administrative outcome:

- High complexity of the administrative procedures since many actors, many interests, and many goals are intertwined,

- Sparse, hierarchical (vertical) and low quality communication amongst PA agencies, leading to "stovepipe" or "legacy" systems both organizationally and from an information viewpoint.

- Diverged views, definitions and terminology for the same piece of information.

- Vague business processes performed by vague human roles.

The need for inter-organizational exchange of information has become indispensable: PAs must shift the proportion of resources dedicated to maintaining existing stove-piped systems to architected systems focusing on enterprise-wide data, processes, and technology.

The ability to analyze and document the processes performed by each agency and identify the necessary information has become a key feature towards this direction. The discipline of Enterprise Architecture provides the enabling framework in which to integrate process & data models (as well as roles, goals and locations) into one enterprise-wide representation. Enterprise Architecture is generally defined as the set of descriptive representations (i.e. 'models') that are relevant for describing an Enterprise such that it can be produced to management's requirements (quality) and maintained over the period of its useful life (change)(Zachman 1987; Zachman 1992).

These representations, if built, constitute a valuable asset for the organization. They document current system state and can be used in various initiatives such as: IT acquisition, IS development, BPR, TQM, ABC and Benchmarking.

1.2   Defining the Problem

Our general and long-term goal is to:

a)   create **an Integrated Process & Data Repository for Public Administration** that could serve as a knowledge base for all PAs. This approach has its analogue in the private sector with the Process Handbook developed by MIT and Phios (Bernstein et al 1999; Phios 1999)

b)   structure the above processes and data in a **Generic Process & Data Model.** Such models can be easily adapted by various PA organizations with minimum effort. There are also similar approaches in the private sector for process modeling (SCOR 1998) and a series of generic data models applicable to a wide range of private enterprises (Silverstone L. 1997), (Hay 1996). More interestingly there are approaches combining generic data and process modeling in an integrated framework, such as that of the Retail Application Architecture, (Stecher P. 1993), SAP Solution Maps (www.sap.com), IDS Scheer Reference Models (www.ids-scheer.com) and ARTS (ARTS, 1996)

In the current paper we present work in the second of the above goals by building a high-level data model for strategic planning in Public Administration. Strategic planning and strategic management are increasingly being adopted in the public sector, but following the private sector with a gap of some years. This model can be used to provide common definitions (vocabulary) in strategic planning and establish a conceptual framework that can be easily adapted to the specific features of any PA organization.

1.3. State of the Art in Enterprise Modelling for Public Administration

Building enterprise representations are necessary for PAs if the new paradigm of e-governance is to be implemented successfully. As already mentioned, several industries in the private sector have already successfully developed generic process and data models describing their business sector. (RAA, SCOR, ARTS). Similar initiatives for the Public Sector have been undertaken only recently.

A number of them has taken place in USA. The most significant are presented below:

a) A major governmental initiative in this area appeared in the end of 1999 by the government of the USA involving the development of a Federal Enterprise Architecture Framework (FEAF) by the Federal CIO Council (CIO COUNCIL, 1999). This initiative is the most relevant to our approach and goals, and marks the most significant effort in the field. It is based on the establishment of a unifying architecture on which all federal information systems would be based in order to become interoperable. FEAF seeks to develop, maintain, and facilitate the implementation of a top-level enterprise architecture for the entire Federal Enterprise.

b) In the same context, the Command, Control, Communications, Intelligence, Surveillance, and Reconnaissance (C4ISR) Architecture Framework, was developed by the U.S. Department of Defense (DoD). C4ISR provides methodological guidance to several IS and re-engineering projects in the U.S. public sector. It is intended to ensure that architectures developed by the Commands, Services, and defense Agencies are interrelatable between and among the organizations' operational, systems, and technical architecture views, and are comparable and integratable across joint and multi-national organizational boundaries. Additionally, C4ISR is intended to ensure that a clear audit trail exists from mission operations and effectiveness measures to the characteristics of current and postulated C4ISR systems and their contributions (performance and interoperability metrics) to mission operations (Sowell P., 2000).

c) Starting from a different point, the need for implementing large-scale ERP systems acted as a lever for the U.S. Naval Air System Command (NAVAIR) to model its business processes. NAVAIR is investing in packaged ERP software to integrate all aspects of its business processes. Prior to selecting ERP implementation consultants, NAVAIR documented business process requirements to scope the implementation project and evaluate consulting team proposals (Blick G, et al. 1999).

d) Another related initiative started in the U.S. in February 1996 when the U.S. Vice President's office of the National Performance Review with the Inter-Agency Benchmarking & Best Practices Council supported the development of a government process classification. This effort is comparable to the Process Classification Framework developed by the International Benchmarking Clearinghouse for the private sector. The four major processes of "Establish Direction", "Acquire Resources", "Provide Capabilities" and "Execute the [Agency's] Mission" are further analyzed providing over 150 fourth level processes (International Benchmarking Clearinghouse, 1996). The scheme provides a standard framework to support present and emerging knowledge-based data systems. Besides, through its implementation and use, government organizations obtain a standard arrangement to collect, manage, and transfer their lessons learned to improve productivity, customer satisfaction, and relations with stakeholders. However, in this approach emphasis is given mostly to supporting operations of a public agency and not those concerning its core mission.

In Europe, the Interchange of Data between Administrations Program (IDA) is the major EU initiative in the field (www.ispo.cec.be/ida/ida.html). Although the focus of IDA I (1993-1999) was mainly on IT standards and infrastructure, the adopted IDA II Program (1999) refers interestingly to standardization of common business processes for European PAs (European Commission, 1996). In the IDA area of "Horizontal Actions and Measures: Information content interoperability", the "Content interoperability between Telematic Networks" (ICOPER) program started in 1999 in order to coordinate the requirements of sector networks for formatted information exchange, to ensure the spread of suitable solutions and to monitor suitable technological developments.

Finally, from the academic field stemmed an effort to present a generic high-level process model for PA (Tarabanis K., Peristeras V., 1999). This model identified three major processes for all PAs at the highest level. These three processes were further analyzed using established modeling techniques. More details on this modeling effort are presented below.

3. A HIGH LEVEL DATA MODEL FOR THE "FORMULATE PUBLIC POLICY" MAJOR PROCESS

3.1 Approach

In order to develop a representation (model) of the data used at the strategic level by PA organizations, we employed the well-known Zachman framework. This framework establishes a matrix in which the different elements (who, why, what, how, why, when) that exist in an organization are described from various viewpoints (planner, user, designer, builder & sub-contractor).

Populating the Zachman Framework for PA organizations has been a major undertaking in our overall research. All the cells in the entire framework represent the total knowledge base of the organization.

Of the six major representations that comprise the Enterprise Architecture of the Zachman Framework (how, what, who, why, when, why) in our previous paper we focused on the HOW (process) column (Tarabanis K., Peristeras V., 1999). There, we developed a top-down approach identifying Major Processes, borrowing insights

from PA theory and other process classification schemes (American Productivity & Quality Center,

Figure 1: Major Processes in PA

1992). We then employed decomposition and specialization as described by the MIT Process Handbook methodology (Bernstein et al., 1999) as a process mapping technique in order to create hierarchical process trees.
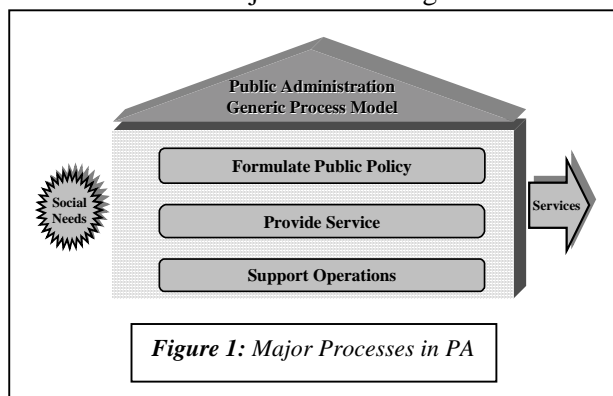
The three major processes identified in our ArchPad model are:

- **Formulate Public Policy**
- **Provide Services**
- **Support Operations**

exhibited in Figure 1.

In this paper attention is shifted from the Process column to that of Data of the Zachman Framework and a generalized data representation corresponding to that of process is created. This effort initiated with the first and perhaps the most critical Major Process for PAs, that of "Formulating Public Policy". This process has been further decomposed using the policy analysis model presented by B.W. Hogwood and L.A. Gunn, (Hogwood & Gunn, 1984) as shown in Figure 2. This process describes the strategic layer of the PA administrative system. The question that is addressed is whether a generic top-down data representation can be built for this process in order to document all the basic participating entities and their relationships.

Towards this direction we employ our work regarding generic enterprise modeling (Tarabanis K., Peristeras V., 1999), (Tarabanis K., Fragidis G., 2000) to the domains of Business Strategy and PA theory. This led to the formulation of a high-level generic data model for Public Administration, which covers its strategy formulation process.
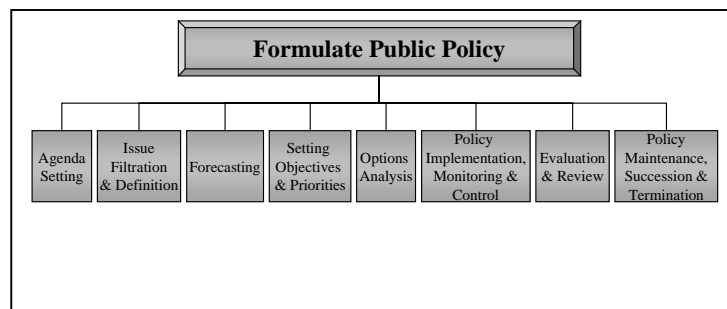

Figure 2: Decomposition of the "Formulate Public Policy"

The Proposed "Public Policy Formulation" Model

The model for **"**Public Policy Formulation" has been developed at two levels of abstraction borrowing insights and concepts from our "Strategic View" model (Tarabanis K., Fragidis G., 2000), which applies to enterprise strategy management, and specializing it to the PA environment.

The first model is called "Strategic View Infrastructure", since it is a model that describes the strategy process at a high level and forms the background for the development of the **"**Public Policy Formulation" model. The "Public Policy Formulation" model is developed next. This model has the form of an entity-relationship diagram, which represents the relationships among the basic strategic concepts, described previously in the Strategic View Infrastructure, in a structured way.

The concepts that we use in the "Public Policy Formulation" process are largely based on concepts employed in business strategy models and adapted to a PA perspective. This adaptation is possible since the differences between business and public administration are decreasing (Hughes, 1994). Hughes states : "The difference between the two sectors are not too great any more: public administrations face analogous problem to the private firms, such as the threat of re-organization, amalgamation with some other agency, privatization or decommissioning, when the government considers the function is no longer needed". In addition, business strategy is a well-established field of study, with a large theoretical and experimental background. It would be useful to build on these developments by investigating the adaptations necessary to apply them to the Public Sector. Finally, profit, a major business factor that is absent from a PA perspective, is no longer the sole focus of modern business philosophy. Business management has broadened its scope and envisages issues such as business ethics, customer satisfaction and loyalty. Some modern strategic management

concepts focus on efficiency (rather than effectiveness), societal environment (rather than competitive environment) and stakeholders (rather than shareholders) that apply equally well in a PA perspective.

Strategic View Infrastructure

At the first level, a conceptual model of the strategy process is developed with the intention to integrate all the necessary and most influential strategic concepts, as described by the numerous strategic models in the literature (Tarabanis & Fragidis, 2000). It is not, in fact, a new strategic model, which is outside our scope, but rather employs strategy concepts from the various schools of thought on strategic management. It should be noted that there are numerous schools of thought regarding the scope and the essence of the strategy process: some researchers emphasize strategy formulation [Mintzberg, 1991], while others on implementation (Andrews, 1998), some believe that strategy is restricted at the higher level of decision making (Mintzberg, 1994), while others consider that the strategy process encapsulates the whole of the organization (Quinn J.B, Yoyer J., 1998).
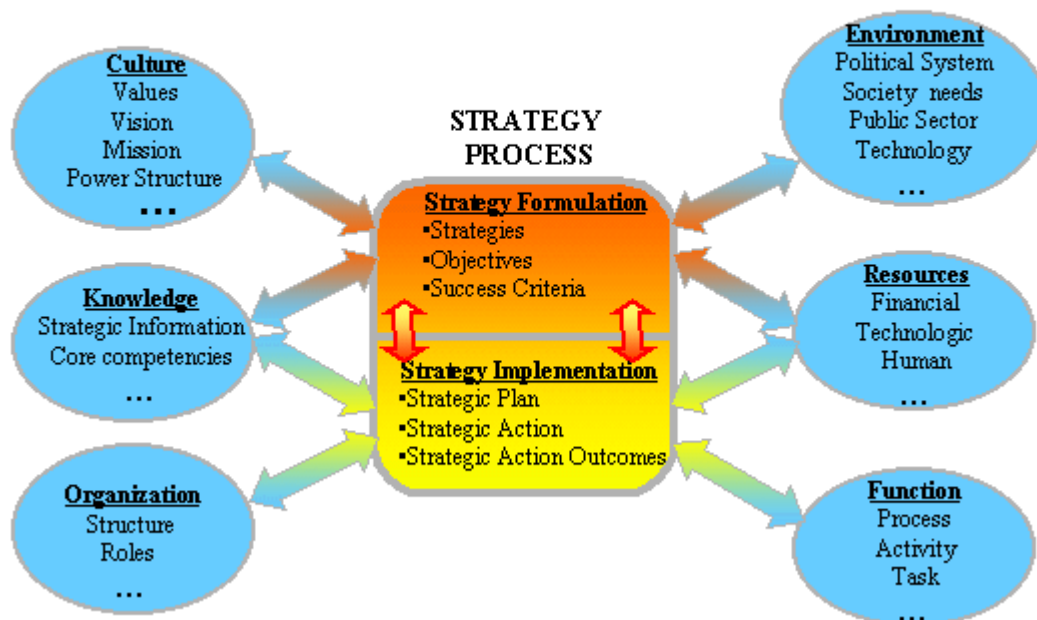

Figure 3: *Strategic View Infrastructure*

Our model can be seen in Figure 3. The strategy process is divided into two interacting sub-processes: *strategy formulation* and *strategy implementation*. Strategy formulation involves concepts such as strategies, objectives, mission and success criteria. Strategy implementation refers mostly to the strategic plan, which forms the passage from strategy formulation to strategy implementation, strategic action and its outcomes. The strategy process takes place under the influence of six major factors:

- Culture (Andrews, 1998)
    - values,
    - vision,
    - power structure, etc.,
- Environment (Porter, 1980)

- o government,
- o the political system as a whole,
- o other PA organizations,
- o the needs of society,
- o technology, etc.,
- Knowledge (Prahalad C.K., Hamel G., 1990)
  - o strategic information,
  - o core competencies, etc.,
- Resources (Hamel G., Prahalad C.K., 1993)
  - o financial,
  - o human,
  - o technological, etc.,
- Organization (Mintzberg, 1991)
  - o structure,
  - o roles, etc. and
- Function (Hamel G., Prahalad C.K., 1993)
  - o processes,
  - o activities,
  - o tasks, etc.

The Strategic View Infrastructure takes into consideration the basic concepts of the GERAM Framework (IFIP- IFAC Task Force, 1999). In particular, the strategy process, as depicted in Figure 4, interacts with the four views of the GERAM Framework, namely the Resource view, the Organization view, the Function view and the Information view (named Knowledge in our model).

It should be noted that the relationship between the strategy process and each of these factors is interacting (bi-directional), which depicts the dynamic nature of the strategy process. All the factors relate to the strategy process as a whole, but some of them refer mostly to one of its phases. In particular, the strategy formulation process is primarily influenced by culture, the environment, knowledge and resources, while strategy implementation is mostly related to knowledge, resources, organization and function. It should also be noted that we are not interested at this level in the relationships among the six major factors (under what circumstances or what influences do they take place? how do they interact with each other, etc.), but we only show the relationship between each of these strategy process enablers and the strategy process itself.

Generic Strategic View

At the second level of analysis the "Generic Strategic View" has been developed. This model has the form of an entity-relationship diagram that represents the basic relationships among the strategic concepts described previously in the Strategic View Infrastructure. Based on the levels of the Zachman Framework (Zachman, 1987), the Strategic View Infrastructure is a conceptual model at the business modeling level, while the Generic Strategic View is a logical model at the business design level.

Such a model can prove useful in several ways. For instance, such a model when instantiated explicitly captures the strategy management process that a particular enterprise or PA is employing with all the benefits stemming from this (e.g. control and corrective action capability). Also, this model can serve as the conceptual background and design framework for the development of a case tool (Popkin, 1999) that

captures the information systems planning process and relates it to business and strategy planning, enforcing through this relationship a business oriented view of information systems planning which is often lacking. Furthermore, the Generic Strategic View can be used as an additional view in the GERAM Framework (IFIP- IFAC Task Force, 1999) that complements the existing views by concentrating on the strategic implications of any enterprise engineering project (redesign, internal/ external integration, new business establishment, etc.). The need for such a view in the GERAM framework has been noted in the literature (Bemelman R., Jarvis D., 1996).
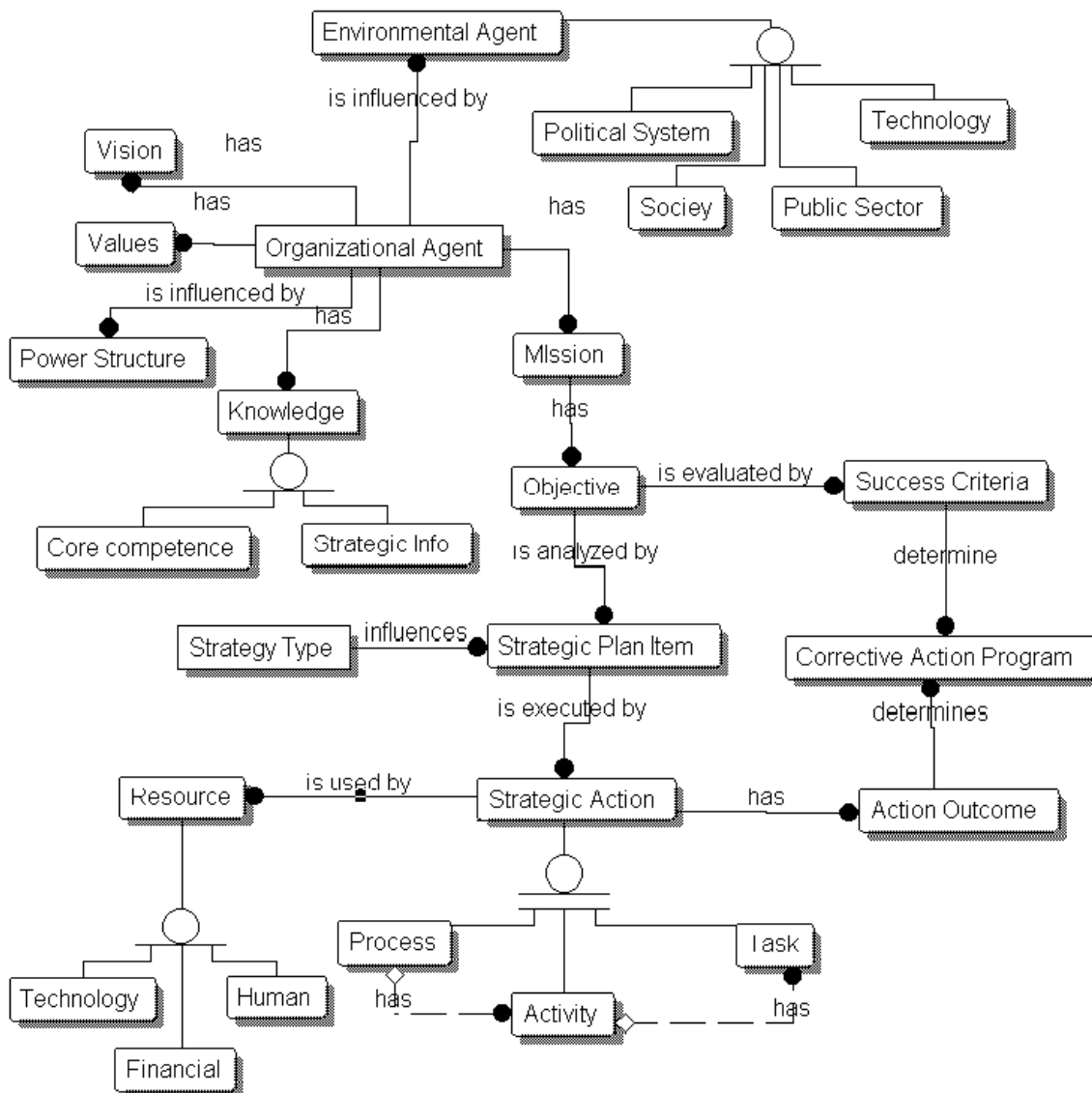

Figure 4: The Entity Relationship Model of the Generic Strategic View

A brief description of the content of the Generic Strategic View follows.

- **Organization**. It refers to the whole organization or to major organization units, such as divisions or departments. It corresponds to the Organization View in the GERAM framework and the organization factor of the strategy process model (Figure 4). As shown in the model, the Organization is considered to

embody factors for the development of the strategy process, such as cultural items, knowledge and influences from the environment.

- **Values**. They refer to the attitudes, beliefs, outlook, ideology, and philosophy of the Organization.

- **Vision.** It refers to the desired situation that the PA organization imagines itself in the long term. It may be considered to be the long-term state of the Organization as conceived by the Organization.

- **Power Structure .** It refers to a diverged set of interests, conflicts and power that affects and even shapes organizational activities.

The concepts Values, Vision and Power Structure correspond to the Cultural View of the strategy process model (Figure 4) (Andrews, 1998).

- **Environment Agent**. It refers to the forces existing at the PA boundaries that (may) exercise any kind of influence on the organization. This generic definition of the concept renders necessary the involvement of many sub-categories, such as the concepts of the **Political System** (the government, particular Ministries, politicians, political theorists, etc.), the **Public Sector** (including other PA Organizations), the needs of the **Society**, **Technology** etc. The specialization of these entities can proceed further to more detailed levels using theoretical documentation from PA theory. The significance and the extent of influence by Environment Agents on the PA Organization should be emphasized in the PA perspective of the strategy process with the most notable example that of the influence of the Political System on the PA Organization.

The concept Environment Agent and its sub-categories correspond to the Environment View of the strategy process model (Figure 4) (Porter, 1980).

- **Knowledge**. It refers generally to the knowledge contained in the Organization and utilized during the strategy process. Instances of this Knowledge follow:

- **Strategic Information**. It refers to the "useful information" employed in strategic decision-making. It is difficult to define in advance the strategic importance of each piece of information, in particular under the assumption that the success of enterprise strategy is often based on the unexpected and the unfamiliar. **Assumption**, **Estimation** and **Critical Success Factor** may all be defined as sub-categories of Strategic Information. (Strategic) Assumption is considered to be of a higher level of analysis compared to (Strategic) Estimation. Critical Success Factor is derived through a filtering process of Strategic Information with respect to the importance of the information for enterprise success. Note that many other sub-categories could also be included, according to the interests and requirements in each case.

- **Core Competence**. It refers to the major competencies the Organization has developed and are very important for the strategy process since such aptitudes may influence both strategy formulation (the direction to which the organization wants to move) and strategy implementation (how it will do it).

The concepts Knowledge and its sub-categories, Strategic Information and Core competence, correspond to the Knowledge View of the strategy process model (Figure 4).

- **Mission.** The concept of Mission refers to a long-term specific goal of the organization. It is considered to be enterprise goals at high levels of abstraction. In business strategy, mission has been the focus of interest for researchers for years (Rumelt R.P., 1998). It is very significant in the PA perspective as well since it is often not made explicit and is taken for granted

- **Objective**. It refers to the desired outcome of the enterprise action, that is it answers the question *"What does the organization want to do?"*. Notice the relationship between Mission and Objective: Mission is considered to be of a higher level of analysis while Objectives form its detailed specification. Objectives are considered to describe more concrete and specific enterprise goals, rather than generic expressions of the future of the organization. As the essence of the new public management is to achieve results

(Hughes, 1994), the place of objectives in the model is to try to specify what the results should be for the PA Organization.

- **Success Criteria**. It refers to the pre-defined criteria according to which the achievement of objectives of the organization will be measured.

- **Strategy Type**. It is a codified description of the planned enterprise action for the fulfillment of enterprise objectives. It refers to strategy patterns, for example "Lowest Cost Producer" porter, 1980]. This instantiation of Strategy Type in a PA perspective requires further work since there has been an emphasis in the literature on private sector strategy types that often do not apply.

The concepts Mission, Objective, Success Criteria, and Strategy Type correspond to the Strategy Formulation phase of the strategy process model (Figure 4).

- **Strategic Plan Item** It refers to a generic action plan, *"what the organization should do in order to attain its objectives"*, not "how to do it". The broad definition of this concept facilitates also the connection of the Strategic View with the other views in the enterprise architecture framework. Strategic Plan is developed in detail in the Activity View of the enterprise architecture framework.

- **Strategic Action.** It describes in detail "how" the Organization implements the Strategic Plan, that is, it answers the question *"how will the Organization implement what it wants to do"*. A certain Strategic Plan may be implemented in many alternative ways and the Strategic Action refers to these ways. The inclusion of this entity makes explicit the real enterprise action implementation (e.g. making evident the fact that real enterprise action implementation differs from the planned implementation). Strategic Action is developed in detail in the Activity View of the GERAM Framework.

- **Process**, **Activity** and **Task** are the sub-categories used to describe in detail the content of Strategic Action (these entities are also used in the Activity View of enterprise architecture frameworks). They are hierarchically structured, with Process on the top of the hierarchy, Activity in the middle and Task at the bottom.

The concepts of Strategic Plan and Strategic Action largely refer to the Activity View of enterprise architectures. The communication and the interaction between the Strategic View and the Activity View are expected to contribute to the improvement of planning and implementation in Organizations.

- **Strategic Action Outcome**. This entity refers to the result of the Strategic Action. Its relationship with Success Criteria permits the evaluation of the enterprise action with criteria pre-defined in the objectives formulation process. The evaluation of strategic action (quantitative or qualitative) may lead to the reform of the Strategy Plan through the concept of Corrective Action.

- **Economic Report**. It is a sub-category of the Strategic Action Outcome referring to its quantitative-economic evaluation. It can be considered to introduce the Economic View in the framework of enterprise architectures. This part of the model is described briefly, including only two basic economic concepts used widely in public policy models. The most important of them is the **Budget**, which represents the initial economic report as approved and authorized by the Ministry of Finance for the action plan and aims at the efficient distribution of economic resources. Note than Budget may be used as a means for planning and may be the initial point in the strategy process (Mintzberg H., 1994).

- **Corrective Action**. It is the associative entity between Success Criteria and Strategic Action Outcome. It can be considered (not shown in the model) as a special case of Strategic Plan Item formed under the influence of the outcome of strategic action.

- **Resource.** It refers to the Resource View. Resources exercise major influence on the strategy process. The model depicts the specialization of the various types of resources employed by a PA Organization.

CONCLUSION – FURTHER RESEARCH

In this paper a framework consisting of two high-level data models for the "Formulate Public Policy" major PA process has been presented using a top-down approach. The basic enterprise entities (data) and their primary (conceptual) relationships of these models were documented.

Furthermore, this model is a step towards the development of an overall Enterprise Architecture for Public Administration. Having presented a high-level data model for the first of the three major processes of our proposed ArchPad process model, (Tarabanis K., Peristeras V., 1999) we plan to continue our effort in two complementary directions:

• Utilizing the top-down approach to document the two other major processes with high-level data models and

• Engaging a bottom-up approach for testing and validating the proposed data and process models with real-life data derived from field research.

Should these two approaches meet at some point, the model will have reached a mature descriptive level, providing a valuable architectural framework to any PA organization.

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