Organizational and Design Engineering of the Operational and Support Components of an Organization: The Portuguese Air Force Case Study

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Abstract. The general organization of today results from a combination of elements that makes it a very complex entity, in which the operational and support dimensions should co-exist in a dynamic and constant balance, whose configuration must have flexible and adaptable mechanisms to the outside world. The operational dimension of the organization, in this context, performs a key role because it is linked to the executables that generate output to the exterior, representing the added value and allowing it to achieve measurable objectives. Business Processes perform a key role and are essential for ensuring the availability of resources for proper organization functioning. As processes increase in complexity, it is essential to identify, given the complexity of procedures, what is the relationship between the operational component (generator of value) and the support component and, also, how to draw, organize and manage an organization, in the human and material resources domain, considering i) multiple restrictions; ii) critical needs of real time; iii) various configurations. The Portuguese Air Force, based on a coherent set of principles, initiated a process of change. The core business, flying, is a proven success and the evolving principles can be used in the Organization itself to improve self-awareness.

Keywords: Organizational and Design Engineering, Business Architecture, Information Systems Architecture, Information Systems, Business Strategy and Information Systems alignment, Operational Activity, Air Force Mission, Maintenance Activity, Aircraft Operational Use, Strategic, Operational and Tactic Management, Systems Theory.

1 Introduction

The current organization, in its strategic, tactical and operational components results from a combination of elements that makes it a very complex entity, in which the operational and support dimensions should co-exist in a dynamic and constant balance.

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To attain the desired balance, flexible and adaptable mechanisms must be created and maintained. The operational component of the organization, in this context, performs a key role because it is linked to the executables that generate output to the exterior, representing the added value and allowing it to achieve measurable objectives.

To attain its purposes, the organization manages entities acting on business processes that, in turn, are used by other business processes. These processes are essential for ensuring the availability of resources for proper organization functioning. As processes increase in complexity, being used by more actors and other processes, each with a set of constraints, it becomes more difficult to manage the organization, almost in real time, in its many dimensions and configurations. Therefore, it is necessary to create and adapt transformation mechanisms, that reducing complexity, are able to maintain the necessary balance for the operation to succeed.

In this context, it is therefore essential to identify, given the complexity of procedures, what is the relationship between the operational component (generator of value) and the support component and, also, how to draw, organize and manage an organization, in the human and material resources domain, considering i) multiple restrictions ii); critical needs of real time iii); various configurations.

This paper shows how the Portuguese Air Force initiated a change process, using coherent principles of Organizational and Design Engineering (ODE), taking as tools proven concepts associated to flying (like the organizational cockpit), towards situational awareness.

The main objective, however, is not to describe the change process but, instead, to present some of its results in terms of organization artifacts that are helping the Air Force to improve its situational awareness.

Due to the size of the paper, it is not possible to describe, in detail, all the artifacts and their real impact in the Air Force life. Therefore, the aim is to explain briefly:

- What the overall objective is;
- The purpose of each artifact, and
- How the flying concepts helped to discipline actions taken.

Section 2 presents the concepts associated with change: General Systems Theory, ODE, Business Motivation Model, Self-awareness, Flexibility, Agility and Change. Section 3 describes some principles and concepts associated with flying such as personnel and mission preparation. Section 4 briefly introduces the change process (that is not the core objective of this paper), and Section 5 presents the core objective of this paper as it describes concept application to the Organization. Section 6 presents the conclusion.

2 Literature Review

In order to understand some of the organizational paradigms, this paragraph is divided into several sections. Each of the sections addresses an important related organizational issue.

New forms of designing and engineering the organization are presented by communities that struggle to transform enterprise engineering into a steady and robust science.

Thus, in order to try to get an idea of the work done in areas of interest, the related research is structured in the following way:

- General Systems Theory. Describes important elements related to system's simple forms and basic relations.
- Organizational and Design Engineering. Presents theoretical foundations for the organization self-awareness taking in consideration technical and social aspects.
- Enterprise Architecture. Processes, Skills and Views of the Organization, defines a set of items necessary to understand the organization's business, particularly those that contribute to the identification of the Information Systems Architecture (ISA), the architectural sub-components, models and views of the organization.
- Enterprise Governance. A recent term that introduces the governance perspective, which includes the strategic and operational performance with focus on compliance and performance concerns.
- Business Motivation Model. Provides a scheme or structure for developing, communicating, and managing business plans in an organized manner. This paragraph describes the model's concepts and relations.
- Self-awareness, Flexibility and Change. Key factors in any organization, which drive the ability to identify and store the organization's knowledge are presented as decisive for attaining situation awareness and near time reaction, thus providing competitive advantage.
- Changing the Organization. To become self-aware, once understood all the concepts behind adaptability and flexibility the organization must delineate a path to find the TO BE. Change theories provide known forms of achieving change.

2.1 General Systems Theory

The General Systems Theory (GST) is based on three basic premises: i) systems exist within systems; ii) systems are opened; iii) systems functions depend on its structure.

Fredrick Hegel (1770-1831) formulated four statements concerning the nature of systems, stating that:

- The whole is more than the sum of the parts.
- The whole defines the nature of the parts.
- The parts cannot be understood by studying the whole.
- The parts are dynamically interrelated or interdependent.

In what concerns its constitution, systems can be concrete, conceptual, abstract or unperceivable. The concrete system (living or non-living) is real in the dimensions of space and time and is defined as consisting of at least two units or objects. A standard biological definition uses the following characteristics: Self-regulation; Organization; Metabolism and Growth; Reaction Capacity; Adaptability; Reproduction Capability and Development Capability.

Complex, organized and open systems are also characterized by its capacity for autopoiesis, a theory created by H. Maturana and V. Varela (1974) [1], which means "self-renewing" allowing living systems to be autonomous.

Today, there is a near total agreement on which associated properties together comprise a general systems theory of open systems. Ludvig von Bertalanffy (1955) [2], Joseph Litterer (1969) and other distinguished people have formulated the

hallmarks of such a theory. The list below sums up their efforts in identifying principles for characterizing relations between systems.

- *Interrelationship and interdependence* of objects and their attributes: Unrelated and independent elements can never constitute a system.
- *Holism*: Holistic properties not possible to detect by analysis should be possible to define in the system.
- *Goal seeking*: Systemic interaction must result in some goal or final state to be reached, or some equilibrium point being approached.
- *Transformation process*: All systems, if they are to attain their goal, must transform inputs into outputs. In living systems, this transformation is mainly of a cyclical nature.
- *Inputs and outputs*: In a closed system, the inputs are determined once and for all; in an open system additional inputs are admitted from its environment.
- *Entropy*: This is the amount of disorder or randomness present in any system. All non-living systems tend toward disorder; left alone they will eventually lose all motion and degenerate into an inert mass. When this permanent stage is reached and no events occur, maximum entropy is attained.
- *Regulation*: The interrelated objects constituting the system must be regulated in some fashion, so that its goals can be accomplished. Regulation implies that necessary deviations will be detected and corrected. Feedback is therefore a requisite of effective control. Typical of surviving open systems is a stable state of dynamic equilibrium.
- *Hierarchy*: Systems are generally complex wholes made up of smaller subsystems. This nesting of systems within other systems is what is implied by hierarchy.
- *Differentiation*: In complex systems, specialized units perform specialized functions. This is a characteristic of all complex systems and may be called specialization or division of labor.
- *Equifinality and multifinality*: Open systems have equally valid alternative ways of attaining the same objectives from different initial conditions (convergence) or, from a given initial state, obtain different, and mutually exclusive, objectives (divergence).

2.2 Organizational and Design Engineering

Universities and Institutes in the civilian world are currently going deep into investigating the integration of knowledge coming from different fields and paradigms. One of these fields of interest is Organizational Design and Engineering (ODE), a multidisciplinary research project born at the Department of Computer Science and Engineering of the Instituto Superior Técnico in Lisboa, Portugal, and now established at the Centre for Organizational Design and Engineering (CODE).

ODE is defined as "the application of social science and computer science research and practice to the study and implementation of new organizational designs, including the integrated structuring, modeling, development and deployment of artifacts and people" and its "*mission is to help organizations make better use of existing human, information and computer-based resources in order to build up the organization's knowledge and intelligence in a sustainable fashion*" [3].

ODE describes organizations as complex adaptive systems whose components are networks of people, processes, machines and other organizations. This has numerous implications:

1. The first implication is that a clear assumption is made that it is possible to apply principles of decomposition to the organization (system classification);
2. The second implication is that it is assumed that these systems change and are self-managing (the adaptive classification); and
3. Other implications come from classifying enterprises as social and complex: this means that enterprises will have particular properties namely: (1) ***System Properties*** such as *scalability*, *flexibility*, *stability*, *accuracy*, *robustness*, among others, which may be selectively targeted and most of the time imply the favoring of certain aspects over others (tradeoffs); and (2) ***Emergent Values*** or ***Soft Properties*** that are related to categories of social systems and result from the human dimension inherent to any enterprise.

ODE talks about properties such as *trust*, *motivation, loyalty, dedication,* and others. The last matter of relevance about ODE positioning, and that cannot be directly inferred by its ontological position is that a clear assumption is made that it is possible to apply the rigour of engineering sciences to approach organizational problems such as design and change [4].

Without having the tools to do so, organizations have to adapt to external and internal changes almost on a daily basis. Hence, today's organizations – profit-making and not-for-profit – have to develop new capabilities for continuous sensing, learning and adapting to ever-changing environments [3].

The mission of ODE is to, based on ODE principles (see Figure 1), help organizations make better use of existing human, information and computer-based resources in order to build up the organization's knowledge and intelligence in a sustainable fashion [3]. In this environment "Intelligence" is the term usually referring to a general mental capability to reason, solve problems, think abstractly, understand new information, learn from past experience and adjust to new situations [3].

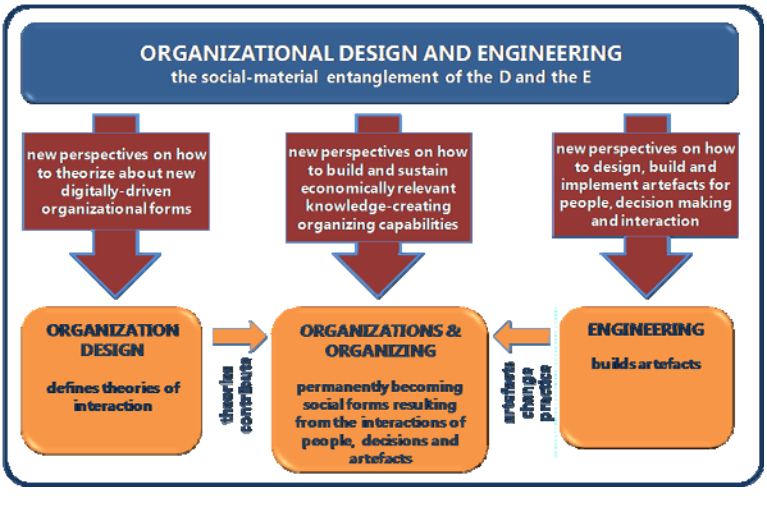

Fig. 1. Organizational Design and Engineering Entanglement of the D and the E [Source: [3]]

When applied to organizational settings, the representational technologies that Youngjin et al (2006) [5] talk about are crucial sources of self-awareness. Organizational self-awareness is part of the organization's knowledge creation process. It comprises a number of capabilities that jointly give the organization greater power to know itself. Self-awareness is of course a human capability, which can be greatly enhanced or diminished by the existing organizational designs combined with the existing computer-based artifacts [6]. The concept is obviously important because the larger the degree of self-awareness of any organization, the more cohesive it will become and the readier it will be at reacting to environmental change (external or internal). Organizational self-awareness and organizational agility go hand-in-hand.

The discipline of ODE is different from the traditional disciplines of Organizational Engineering because it tries to combine knowledge of social sciences with engineering sciences, enabling that the design of the social component of the organization (individuals, groups, values, culture, etc.) is combined to the rigour and the tools of the engineering disciplines [4].

Using the computer in the organization, as an essential tool to achieving strategy and managing own information and decision support elements, requires the determination of ISA, which consists of five sub-models [7].

- Enterprise Architecture (EA). Deals with aspects of the organization that are not directly related to the specific business and its operations, such as 'Mission', 'Vision', 'Strategy', and 'Organizational Goals';
- Business Architecture (BA). Relates with the materialization of the business strategy, implemented by business processes, representing the objects 'business process' and 'business purpose';
- Information Architecture (IA). Focus on what is that the organization needs to know to perform the operations, as defined in BA, characterized in EA and provides an abstraction of the organization's information needs, regardless of technology; it contemplates the objects 'feature', 'actor', 'observable state 'and 'activity';
- Application Architecture (AA). Deals with the needs of applications in data management and support of business, being independent of the software used to implement the different systems and includes the objects 'component SI' ('block IS') and 'service';
- Technological Architecture (TA). Handles all the technology behind the implementation of the applications as defined in the AA, as well as the necessary infrastructure for the production of support systems, business processes, and it considers concepts such as 'Information Technologies (IT) component', ('IT block') and 'IT service'.

One of the ISA components encompasses the definition of Business Processes, which can be defined as the "*set of interrelated and inter-performing activities that transform inputs into outputs*" [8]. The Business Process embody the generation of value-added businesses and is decomposed into activities that require a set of resources, human and material, in a defined time, which could contribute to their achievement.

The inability to run the processes, depending on its nature, leads to impairment of the success of an organization resulting in a set of incalculable damage that may even lead to loss of competitiveness and consequent market exit.

2.3 Enterprise Architecture and Enterprise Governance

"Architecture" when applied to the enterprise is denominated by Enterprise Architecture (EA). Within this context is also important to define what an enterprise is and what enterprise architecture is. Enterprise can be defined as "*any collection of organizations that has a common set of goals and/or a single bottom line*" [9].

While enterprise architecture provides a holistic view and captures the essentials of the business, and its evolution is very helpful in keeping the essentials of the business, so allowing for maximal flexibility and adaptability towards business success, good enterprise architecture provides the insight needed to balance these requirements and facilitates the translation from corporate strategy to daily operations [10].

A definition of EA can be "*a coherent set of descriptions, covering a regulations-oriented, design-oriented and patterns-oriented perspective on an enterprise, which provides indicators and controls that enable the informed governance of the enterprise's evolution and success*" [11].

Theories exist, today, to help to develop the Architecture. For instances, the Enterprise Ontology, can be defined "*as the realization and implementation independent essence of an enterprise, in short, as the deep structure behind its observable surface structure*" [12].

Enterprise Governance is a recent term that introduces the governance perspective that includes the strategic and operational performance with focus on compliance and performance concerns [13]. Enterprise governance is considered as "*the set of responsibilities and practices exercised by the board and executive management with the goal of providing strategic direction, ensuring that objectives are achieved, ascertaining that risks are managed appropriately and verifying that the organization's resources are used responsibly*" [13].

2.4 The Business Motivation Model (BMM)

The Business Motivation Model (BMM) [14] is a framework to develop the architecture of the Business in an organized way. The BMM has five major distinct areas: "Ends", "Means", "Influencers", "SWOT" and "Potential Impact". "Ends", which states what the organization wants to achieve, is composed by "Vision", "Goals" and "Objectives"; "Means", the way the organization uses to achieve its "Ends" includes the "Course of Action" and within this, "Strategy", "Tactics", "Business Policies " and "Business Rules"; Internal and external "Influencers" perform actions that could significantly impact both the "Ends" and the "Means". The "Strength, Weakness, Opportunities and Threats (SWOT) Analysis" lets one to know what impact these influencers have in the "Means" and in the "Ends"; "Potential Impact" can limit or jeopardize the activities of the organization.

Although it is a model revealing the behavior of the organization pursuing what it wants to be achieved, and how it will be accomplished, the BMM intends to motivate the components of the organization. Through this model, the elements understand the desired outcomes of the organization and how they are achieved, so there is a greater motivation on the part of its constituents.

"Mission" indicates the main activities of the organization, while "Vision" indicates the state that is sought and amplified by "Goals" and "Objectives".

"Course of Action" includes both "Strategy" and "Tactics". "Strategy" means the right approach to achieve the "Goals"; "Tactics", in turn, in relation to "Strategy", tend to fill in a shorter period of time, and have a more narrow perspective. "Tactics" are the tool for the achievement of defined "Objectives".

Directives, in any organization, serve to rule the "Course of Action". "Business Policies" are, in comparison with the "Business Rules", less structured, less discrete and not so small. On the other hand, "Business Rules" are highly structured, very thorough, presenting the standard vocabulary of the business, authorizing, restricting or guiding the work of the organization in specific areas.

The "External Influences" are those that stand outside the organization and create an impact on the application of "Means" or achievement of "Ends". The "Internal Influences" come from within the organization and have an impact on employment of "Means" and in the achievement of "Ends".

A SWOT analysis, according to the BMM, is a judgment on an Influencer, which affects the organization in its work to implement its "Means" or achieve its "Ends", that is, an analysis of strengths and weaknesses, opportunities and threats.

With the development of the SWOT analysis the "Potential Impact" can be anticipated, that is, to anticipate what impact the "Influencers" will have on "Means" or "Ends", positively or negatively. While negative influencers present a high Risk to the activity of the organization, positive influencers could, in turn, be used as a way to potential reward.

Risk arises from negative impacts indicating the probability of loss; naturally, without an analysis on the influencers, one cannot know the risk associated. The potential reward comes from positive results, indicating the winning probability. Like in the risk, in the absence of an analysis on "Influencers" the organization will not know what benefit could draw from them.

2.5 Self-Awareness, Flexibility, Agility and Change

There are numerous methodologies and methods related to the change of the organization which involves the establishment and articulation of the assumptions needed to start manufacturing processes and analyze and report how those really changed the organization.

Concepts related to the transformation and innovation, as self-awareness, flexibility and agility, are treated by various disciplines, including ODE, which experiments, analyzes and concludes about how concept application has effectively produced change in the organization.

This section describes and relates the principles of ODE to concepts applied to the transformation and innovation in the organization, placing them in the midst of change strategies advocated by modern scientists such as John Kotter (1996) [15].

In the context of change, it is also important to define a good strategy that encompasses solutions on the way to deal with resources in the process, including how to lead and avoid errors that may occur.

Concepts Associated with Transformation Processes and Innovation

In organizations in which there is the need to create deep changes, the concepts Transformation and Innovation are totally related [16].

Transformation means a continuous process, not having a specific end. Transformations are used to create or anticipate the future, raising ways of leading with the co-evolution of concepts, processes, organizations and technology. Change, in any of these areas, implies change of all [17].

Innovation means an introduction of something "new and uncommon", and it is the "heart" of any transformation [17]. It can also be defined as the development of new products, services, technology, work processes, markets and organizational structures [18].

Transformation and innovation increase, when certain important aspects of organization performance, such as self-awareness, flexibility and agility, are well succeeded.

Awareness consists of being conscious of the current moment, and it is important to the knowledge of how the world presents itself and to the adequacy of the actions to the reality [19].

The agility of an organization consists on its ability to move fast, decisive and effectively in anticipating, initiating and obtaining advantages from the change [16].

Flexibility is the capability of reaching success in different ways.

Change

Usually, change happens to adapt the organization to its strategy, and being the human resources the most valuable asset, they are also the ones that help to aid or hinder the process of change. The type of leadership can also make possible, help or difficult the happening of the change process. There are methods to initiate change and to determine problems that may arise in its implementation.

This section briefly discusses all the factors outlined above, describing the need for a strategy to implement change, to increase and demonstrate the feasibility of this complex process.

Strategy

Change, to be achieved, must be properly planned and balanced in order to be consistent. Thus, it is crucial that there is a strategy to implement change, to increase and demonstrate the feasibility of this complex process.

The Balanced Score Card is a Strategic Management methodology, composed of four different perspectives: financial, customer, internal processes, learning and growing [20][21].

Human Resources in Change

The success of the change processes in organizations depends on their human resources, which sometimes tends to create resistance to change. It is therefore essential to adopt a strategy for change that ensures that, by the human resources, acceptance, membership and involvement in change.

For this, it is important to know the best way to bring human resources to perform the desired actions. In this context, who is leading the change may take several options in what concerns his/her leadership:

- Education and communication;
- Participation and involvement;
- Slackening and support;
- Negotiation and agreement;
- Manipulation and cooptation;
- Explicit and implicit coercion.

According to the situation, the leader may choose one or more leadership styles mentioned above. They all have advantages and disadvantages, with consequences that must be carefully considered.

Driving Change

The changes need to be properly led to be successfully completed, so it is necessary to know how to properly target a transformation. According to John Kotter (1996) [15] there are eight processes which make possible to change in order to minimize the deviations from the transformation process implementation. These eight processes are:

- To establish a sense of urgency. It is essential to obtain the necessary cooperation and bring together a group with enough power and credibility to guide the effort or to convince key people to spend time to create and communicate a vision of change.
- To create a guiding coalition. In a process of change it is always necessary a strong guiding coalition, with the proper composition, levels of trust and common goals.
- To develop vision and strategy. Vision is constituted as an image of the future. In a process of change, an adequate vision allows to achieve three important aspects: first, to clarify the general direction of change, saying it is necessary to move in and out of the current situation; secondly, to motivate people to take action in the desired direction; and finally, to coordinate the actions of many people quickly and efficiently.
- To communicate the vision of change. The real power of vision is only triggered when the majority of people involved in the change have a common understanding of the objectives and direction. This can help to motivate and coordinate the types of actions that create the change.
- To empower broad-based action. This phase is to train employees about the actions that must occur.
- To generate short-term victories. Short-term victories are important because they make the change last. The statement “short-term victories” consolidates the actions and allows the identification of the “next step”. Short-term victories must: i) be highly visible in order to allow a large number of people to find that the results are real, ii) be unambiguous and iii) clearly associated to change.
- To consolidate gains and produce more change. After reaching the objectives above, it is necessary to consolidate these gains. Moreover, it is profitable to organizations to continue to produce more change in order to profit and justify what has been done in the past. This is a step that can last for years, the more profound is the change, the more interdependent systems are changed.

– To anchor new approaches in the culture. After the desired change is finally implemented, it is necessary to anchor it in the organizational culture. Organization culture is a very powerful factor: individuals are selected and indoctrinated accordingly with the existing culture; it is exercised through hundreds or thousands of persons and most of the times become difficult to challenge or even discuss.

3 Flying

Ron Person (2008) in his book [22], states that leading a business in the current high-speed world is not that different from flying a high-speed jet. An objective metaphor was set by a conversation between a possible passenger, boarding an aircraft, and the pilot.

– "You: "What is our destination?"
– Pilot: "The crew got together and talked about a destination. We couldn't come to an exact agreement, so we decided to go somewhere out West. If something better comes up while we're en route, we might change direction."
– You: "What route will we be taking?" (Maybe I'll still go. It sounds adventurous, although it could be a waste of time and fuel. It shouldn't be too dangerous.)
– Pilot: "Well, we aren't sure about the exact route, but I've been that general direction before, so I don't need maps. I'm experienced."
– You: "I notice that your cockpit dashboard seems a bit sparse. There aren't any flight instruments — just stacks of paper. How will you monitor the flight?" (This is starting to sound a bit iffy. The pilot may be experienced, but how will he communicate his experience to the copilot, the flight engineer, the steward, the ground crew, other aircraft, and the Federal Aviation Administration?)
– Pilot: "Well, we're comfortable with the detail of printed reports. While we're in flight, I can request a short stack of printed reports that give me airspeed, altitude, attitude, and heading. The copilot gets a larger stack with operational data about radio settings, fuel, hydraulics, and technical details. We have to ask for the data, but it only takes a few minutes to get new reports — so we're in pretty good shape as long as everything stays stable and we don't have mechanical, weather, or crew problems.""

Flying is exactly the opposite of what is described in the metaphor. Flying is all about planning, become aware of every factor that affects not only the flight but also the flying environment.

Common errors, in the flying business, usually cost lives. Flying is all about planning, detail, awareness, precision, learning, controlling, analyzing and reporting in real time trying to forecast and mitigate exceptions that can result in error.

Comparing the standard organization to the flying organizations is an interesting exercise since most of the principles are common. The main difference is, perhaps, the cost of errors is immediately visible. Flying organizations have a very own culture that can be taken to the organizations in general.

Flying, itself, is a science of proven success. The several concepts associated with flying can also be taken to the organizations in a way that can create added value and situational awareness.

Thinking the organization as an aircraft can be surprising. Flying culture implies complying with strict rules on every component. Since this paper refers the operational and support components of an organization, a description of the Flying Culture effects will be described on both components.

This chapter presents several principles and concepts associated with the flying culture, on the architecture, personnel and material components.

3.1 Operational Crew Preparation

Flying implies a set of pre-requirements in several areas. If an actor (pilot, navigator, other) wants to occupy one flying position he or she has to follow a specific path comprehending four phases: i) health and psychological check; ii) environment courses; iii) aircraft training; iv) operational [23].

- Health and psychological check:
  - Health and body condition. First of all the candidate has to go a strict and very demanding set of tests. Extremely good eye vision and accuracy, spinal straighten is also mandatory.
  - Psychological. A good psychological condition is also essential. The candidate has to go through extensive testing and be present, at least once, on an interview with a psychologist.
- Environment courses:
  - Physiological course. A full physiological course is given where the candidate learns how to deal with problems that may arise within the air environment.
  - Water and land survival courses. Full water and land survival courses are given where the candidate learns how to deal with problems that may arise within the sea and land environment.
- Aircraft training:
  - Aircraft theoretical course. A very detailed and extensive aircraft course is given comprehending detailed information about essential systems, emergency procedures and emergency maneuvers.
  - Ground training. Comprehends aircraft systems training on the ground inside the cockpit. Emergency situations are taught and simulated to the possible extent.
  - Aircraft simulator. Simulator sessions are very intensive and are intended to simulate aircraft systems malfunction and the expected reaction from the crew.
  - Flight training. Trains the pilot on flying the aircraft and perform the basic flying procedures.
- Operational training:
  - Operational qualification. Provides operational qualification using aircraft capabilities.

Once the operational qualification is attained, the crew member regularly performs refresh courses and is submitted to semester testing, not only on the aircraft systems but also on the operational components. Pilots perform simulator training at least once a year.

3.2 Maintenance Crew

Aircraft Maintenance is the most important piece of support to the aeronautical business. Maintenance assures the aircrafts' continuing airworthiness, performing scheduled and non-schedule inspections and getting them ready and mission equipped to fly.

Maintenance personnel has to be trained to comply with high standards. Each person working on an airplane needs to have his or her technical formation, then needs to go on extensive courses about aircraft maintenance, and finally needs to obtain a qualification for performing a certain task on the airplane.

Every work is to be performed, in accordance with the published maintenance publications, by the worker and a supervisor and upon completeness, needs to be certified by an inspector granting that it has been done according to all the approved publications, norms, qualility standards and inspection instructions.

3.3 Mission Planning

In the air there is little time for reasoning. Decisions must be made quickly and accurately; therefore, careful planning is essential to every flight. A smooth, successful mission requires a step-by-step plan which can be followed from take-off to landing. The main steps taken for mission planning are the following [24]:

- Select the destination and get all the information available;
- Select the route and map it;
- Flight Plan (time and resources);
- Fly;
- Stay on course, speed, altitude and planned fuel consumption;
- Check indicators permanently;
- Update en-route communications, navigation aids and alternate aerodromes;
- Debrief;

Due to its importance on the creation of self-awareness about all phases of flight, including en route and destination the next paragraphs describe with some detail the phases identified previously.

3.4 Destination Selection

A typical mission planning includes, after the destination is selected, consulting a extensive set of publications in order to get the necessary situational awareness of all the factors that can affect the mission en route and on the destination (Air Navigation, 2001):

- Flight information publications (FLIP). Complete aeronautical information concerning air traffic systems is published in FLIP.
- General planning (GP). This document is revised every 32 weeks with planning change notices (PCN) issued at the 16-week midpoint. Urgent change notices (UCN) are issued as required. The FLIP *GP* document contains information that is applicable worldwide. It is supplemented by the information published in seven Area Publication Sections.

- Area planning (AP). Located behind GP in the FLIP Planning document binder, contain planning and procedure information for a specific geographical area. The document is amplified by publications that contain a tabulation of all prohibited, restricted, danger, warning, and alert areas. In addition, they contain intensive student jet training areas, military training areas, and known parachute jumping areas within their specific geographical area.
- Planning change notices (PCN). These are in textual form and are used to update the FLIP.
- Flight information handbook (FIH). The FIH contains information for in-flight use. Sections include emergency procedures, national and international flight data and procedures, meteorological information, conversion tables and frequency pairings, standard time signals, and FLIP/NOTAM abbreviations and codes.
- FLIP En route charts. Charts portray airway systems, radio aids to navigation, airports, airspace divisions and other aeronautical data for IFR operations
- FLIP En route supplements (ERS). One is published for each geographical area. Each supplement contains an airport or facility directory, enroute procedures, special notices, and other textual data required to support FLIP *En Route Charts.* Airport sketch details include airport identification, city name, distance, direction, and elevation, as well as a diagram of each airport.
- Area and terminal area charts. These charts are large-scale graphics of selected terminal areas.
- Approach and departure procedures. Departure Procedures (DP) and terminal instrument approach procedures contain the approved departure and instrument approach procedures. Each instrument approach procedure shows an airport sketch, with additional data if necessary, for an approach under IFR conditions.
- Terminal change notices (TCN). TCN contains revisions to approach procedures and are published normally at the midpoint of the FLIP terminal booklets.
- Standard terminal arrival route (STAR). STAR contain preplanned IFR air traffic control arrival routes and are published in graphic and/or textual form. STAR provide transition from the en route structure to a fix or point from which an approach can be made.
- Notice to airman (NOTAM). A NOTAM is a message requiring expeditious and wide dissemination by telecommunication means. NOTAM provides information that is essential to all personnel concerned with flight operations. NOTAM information is normally in the form of abbreviations or a NOTAM code. The *FIH* contains an alphabetical list of these abbreviations.

Upon destination selection, all the information about the destination should be retrieved. Knowing all the information concerning the destination is essential to route selection.

3.5 Route Selection and Mapping

When planning a route to be flown, many factors enter into consideration. The route may be dictated by operational requirements of the mission; it may be a preplanned route, or the navigator may have the prerogative of selecting the route to be flown. In any case, definite factors affect route selection and the navigator must be aware of them.

In most cases, a direct route is usually best because it saves both time and fuel. Such things as airways, routing, high terrain, and bad weather, however, can affect this. The direction of prevailing winds can affect route selection because the proper use of a jet stream often decreases total flying time, even though a direct route is not flown.

Once a route is established, navigation charts appropriated to the intended flight path should be selected. Correct selection depends on distance to be flown, airspeeds, methods of navigation, and chart accuracy.

A great circle is the shortest distance between two points. One can save considerable distance by flying a great circle course, particularly on long-range missions in polar latitudes. A straight line on a gnomonic chart represents a great circle course. One way to flight plan a great circle course is to plot the entire route on a minor detail chart, and then transfer coordinates to charts more suitable for navigation. Select coordinates at intervals of approximately 300 nautical miles (NM). Once the route is plotted, record true courses and distances for each leg of the mission on the flight plan.

The method of navigation is determined by mission requirements and the flight mission area. Select charts for the mission which are best suited to the navigational techniques chosen (for example, radar missions require charts with representative terrain and cultural returns for precision fixing and grid missions require charts with a grid overlay). Once the route is selected and drawn the following information has to be retrieved:

- Alternate Airfield. An alternate airfield is where an aircraft intends to land if weather conditions prevent landing at a scheduled destination. Occasionally, an airfield may also be identified as an alternate for takeoff purposes. This procedure is at the direction of a major command that authorizes the use of lower minimums for takeoff than for landing.
- Emergency Airfields. During flight planning, select certain airfields along the planned flight route as possible emergency landing areas and then annotate these airfields on the charts for quick reference. Consider the following factors when selecting an emergency airfield: type of aircraft, weather conditions, runway length, runway weight-bearing capacity, runway lighting, and radio NAVAIDs. The NOTAMs for these airfields should be checked prior to flight.
- Highest Obstruction. After the route has been determined, the navigator should study the area surrounding the planned route and annotate the highest obstruction (terrain or cultural). The distance within which the highest obstruction will be annotated is IAW governing or local directives. The highest obstruction will be taken into consideration when determining the minimum en route altitude (MEA) and in emergency procedures discussion.
- Special Use Airspace. When determining the flight plan route, the locations of special use airspace will have to be considered. The best way to find the locations of the areas is by checking an en route chart. After the route is determined, any special use airspace that may be close enough to the route of flight to cause concern (as per governing directives) should be annotated on the chart with pertinent information. Annotate time and days of operation, effective altitudes, and any restriction applicable to that area. These areas, when annotated on the chart, will assist the navigator with in-flight mission changes and prevent planning a route of flight that cannot be flown.

4 Mission: Changing the Air Force

Based on a set of measures approved by the Air Force Chief-of-Staff, framed in his Vision, and in order to improve the relationship between the Organization's strategy with its information systems, it has been developed an action plan with three phases that that have started in March 2009 [25].

The first phase, using concepts depicted in Sections 2.1 to 2.5 (the initiative was launched following the rules depicted in Section 2.5), intended to determine the Organization AS IS by performing the actions identified below. The second stage intends to consolidate all the activities and lay down the basis for the TO BE planning (stage 3).

This plan of action, still ongoing, was intended to be a catalyst for change by identifying several areas of action, as defined below:

- Development of cross-organization doctrine (concepts, procedures), establishing a building of publications for operation and maintenance;
- Modeling of Processes and Activities of the maintenance and operation;
- Establishment of metrics and indicators for decision support in the information systems;
- Standardization of repositories of information (operational, maintenance, personnel);
- Integration of the articles to record activity of operational and maintenance components;
- Control mechanisms establishment.

Before the start of the process, Air Force has developed/updated business rules that allowed the framework of information systems in:

- Mission of the Air Units to reflect the changes expressed in the Strategic Concept of National Defense and the Military Strategic Concept, aligning the elements of the mission with NATO doctrine and defining the mechanisms required to obtain indicators related to air activity [26].
- The definition of dynamic and flexible mechanisms that would keep the amount of personnel needed for the operation and maintenance of weapons systems [27] for the purpose of:
  - Automatically calculating, by the given the assumptions, the amount of personnel (operation and maintenance) for the various Air Units.
  - Assessing the existing information on weapons systems and, if necessary, the methodology and verification of information integration, correcting methods and procedures.
  - Quantifying variations caused by specific features of the Air Units.
  - Comparing the existing workforce to the current regime of effort of the staff planned.
  - Defining and establishing appropriate planning and management planning, integrating information from different systems prevailing in each fleet, within the information system of the Air Force.

– The legal publications for operation and maintenance, constitute the building of Air Force operational publications, defining the responsible entities for their development and update. It underpins all the actions proposed by the plan in order to implement the change in the doctrine.

The doctrine, military term similar to business rules, based on experience, best practices and lessons learned [28], defines how it is expected to employ existing capabilities in a particular operation. The military doctrine is also the basis for future thought, integrating new technology and new capabilities [28]. The building of operating and maintenance publications, creating a doctrinal framework, aims to standardize and align it with the strategy across the Organization.

The approach to the process organization represents a new paradigm. While the doctrine says how to do, the survey process says exactly what it is done in reality.

The creation of metrics and mechanisms for decision support presupposes the existence and definition of goals and objectives enabling the monitoring and acquisition.

The standardization of repositories and integration of articles of information register forms are elements of dematerialization of essential tools for knowledge of the Organization itself.

The creation of control mechanisms allows the definition of the control points necessary to achieve the objectives.

To make the recommended actions operational it was created an implementation plan, spread over thirteen months, and to create organizational knowledge there were two different repositories for exchanging ideas: a directory on the internal network for staff directly involved and a forum in Internet that allows global access to information needed for the discussion.

The change also includes other acts such as the spread of organizational engineering at the Academy and at the various Promotion Courses.

Up to now fifty business policy and business rules manuals were produced, 470 business processes and key performance indicators were identified and 12 master thesis were developed (six are already completed).

In addition, the Air Force improved substantially its self-awareness. Chapter 5 presents some of the artifacts created and the associated concepts.

5 Flying the Organization or the Organization as an Airplane

All the flying vocabulary can be applied to the organization and enterprise concepts with minor adjustment. In fact, when looking at several concepts they seem alike and they seem to elaborate on the GST principles shown in Section 2.1. Table 1 shows some of the concepts and their counterparts.

Crew concepts include crew identification, which explains what they do, how they do it, and how they behave in respect to the outside world. In organizations that can be shown by a business model.

The next paragraphs discuss the enterprise vocabulary and its application to the Air Force.

Table 1. Concepts using Enterprise Vocabulary versus Flying Vocabulary

Enterprise Vocabulary	Flying Vocabulary	Mission Planning (Section 3.3)
Mission	Mission	Mission
Vision	Destination	Select Destination
Goals	Route	Select Route and map it
Objectives	Waypoints	
Strategy	Flight Plan	
Tactics	Flight Level, Speed	
Business Policy	Flight Policy	
Business Rules	Flight Rules	
Internal Influencers	Crew, aircraft status	
External Influencers	Weather, Airports, Flight Condition	Flight Planning
SWOT	Route Choosing, alternates, communications, country authorizations, equipment	
Potential Impact	Capability to fly and attain destination	
Business Processes	Aircraft Processes	Fly
Performance Indicators	Instruments	On course on time
Performance Dashboard	Cockpit indicators	Check & Update Debrief

5.1 Crew Identification or Who Are We?

One very important aspect of organization is that every human member understands what he or she is contributing with his or her individual work.

A survey was done by the Portuguese Air Force Academy students in which they enquired a selected set of people about if they knew what the contribution was of the work that they were developing to a greater achievement. In general, the selected people, working in the strategic and operational level knew what they were working for in terms of strategic objectives. However, when asked about if they knew everything that the Air Force was doing, the answer was negative.

Answering questions such as: "Who are we?", "What do we do?", "What are our values?" is done by the Business Model [29, 30, 31, 32]. Therefore, it became important to complement the Business Architecture Concepts by adding information about the organization itself. The Air Force Business Model development had to follow specific requirements:

1. To appeal to patriotism, given the highly patriotic nature of armed forces;
2. To be made into an easy and readable symbol, an image easy to understand;
3. To be able to represent any level of the Organization;
4. To represent the Organizational Structure;
5. To show the corporate values and mission;
6. To reflect areas (local) of employment;

Figure 2 shows the generic model for the PoAF Business Model [33, 34].

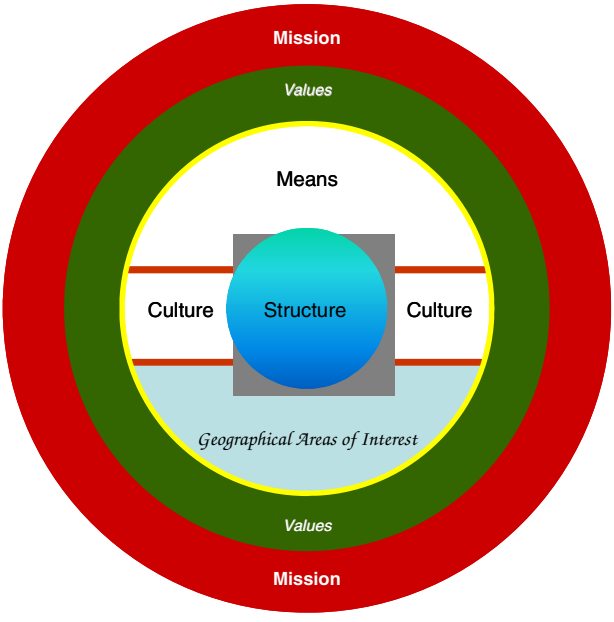

Fig. 2. POAF's Generic Business Model

While developing the Business Model for the Air Force, the necessary articles were included to meet the above requirements: the description of the operational means, actions, values, organizational structure and the sites where it operates. Figure 3 shows the model for the Air Force itself. The detail is described below.

The Portuguese Air Force is a branch of the Armed Forces that, in the operational area, operates different weapon systems that can be characterized by high specialization, such as, for example, speed, mobility, range and flexibility of employment in any type of theater. Integrating the system of national forces, the Air Force's Mission, among others, cooperates in an integrated way, in defense of the Republic, through execution of air operations and air defense of the national space [35].

The structure of the Organization consists of the following: at the strategic level of the hierarchy is the Air Force Chief of Staff (CEMFA), which is supported by the Air Force Staff (EMFA), the Inspector-General of the Air Force (IGFA), the Directorate of Finance (DFFA), by the Culture Organs (ONC) and by the Council Organs. These are followed by the operational level composed by four functional commands, the Logistics Command (CLAFA), the Air Command (CA), the Personnel Command of the Air Force (CPESFA) and the Education and Training Command (CIFFA). At the tactical level stand the Air Bases and the Air Units that operate the weapon systems.

In its normal activity the Air Force relates to the various entities including:

- The Portuguese Government, a regulatory element that ensures also a financial component;
- Other State Organs, such as the Presidency and the various Ministries and the Regional Governments;
- The military, for example, the General Staff of the Armed Forces, Army, Navy;

- The Portuguese Official Language's African Countries (PALOP);
- International Organizations such as the European Union and NATO;
- Other entities such as Universities, Media, Hospitals and Cultural organisms.

As part of its Mission, the Organization provides a range of services to the entities described above, being the most relevant: the defense of national airspace, air transport operations, patrol, search and rescue, maritime surveillance and medical evacuation, education (university and professional formation), research and development, health, courses of command and leadership and usage of the wind tunnel for aerodynamic tests.

The Air Force is a military institution that practices noble values, such as the following: ”Do well to well serve“, ”Ethics of Rigor“, “Responsibility“, ”Demand“, ”Culture of Merit“, "Integrity", "Dedication", "Competence", "Justice", ”Permanent availability“, ”Honesty“, “Leadership“ and ”Discipline” [36].

In carrying out its specific Mission, the Organization operates around the Globe especially in Portugal, Main Land and Islands, the area of influence of NATO, the European Union and the Western European Union and also within the Community of Portuguese Speaking Countries, having recently participated in several national and international operations of which stands out Afghanistan.

In a clear reference to patriotism and the highest values of the Nation, the colors of the National Flag can be observed in the two outer circles and in the small inner circle.

In the center there is the organizational structure of the Air Force and various images. On left there are shown the students of the Air Force Academy, representing the essential training for any organization and on the right the F-16 fighter aircraft personnel, representing the operational field.

Also in the center, at the bottom, there are the local activities of that organization, at the top are the operational means of the Air Force, in a setting that highlights the fact that the Air Force flies in all ways and directions.

In the green circle are listed the values of all the Portuguese Air Force and in the red circle there are the various actions that the Air Force plays in civil and military components, in strict compliance with its Mission.

The Business Model enhanced the personnel situation awareness towards the Organization. One of the visible “things” is the broad scope of services provided and the relation with a multitude of external entities.

5.2 Concept Application

The following lines describe the Concepts identified in Table 1. As the change process is still happening, the Organization is still working on some of the areas. Nevertheless, a note has to be made to the fact that most of the described concepts are resulting from change and the shared effort between organization components with the aim of attaining goals and objectives while maintaining situational awareness.

Mission and Vision (select destination) or What do We Want?
The Air Force Mission is published by the Government on the Law of the Air Force Organization [35].

The destination was set with the Vision published by the General Chief-of-Staff (GCOS): *"In the multi-faceted coverage of the Mission, I envision an Air Force with a highly deployable nature, while maintaining a high degree of interoperability with*

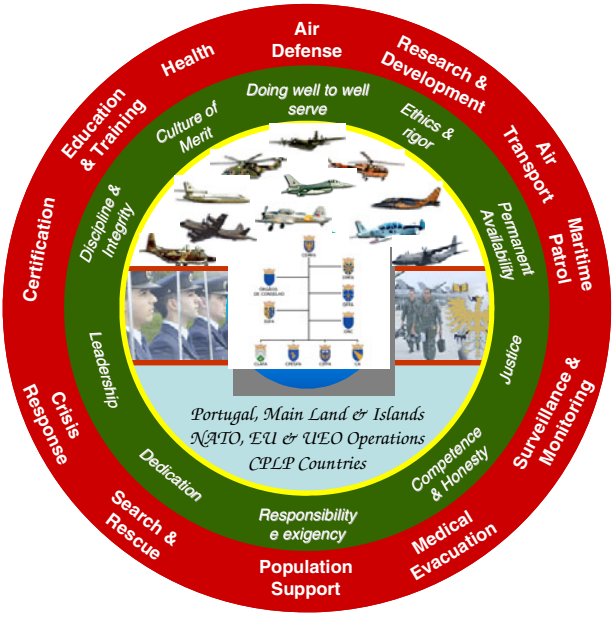

Fig. 3. Graphic representation of the Business Model for the Portuguese Air Force [33, 34]

other national and multinational forces, supported by the use of equipment that incorporate new technologies, served by a deployable command and control that enables operation in different environments, and a streamlined logistics, based on a modular structure, that eases expedited activation process. " [37].

It is important to mention that flying concepts depicted in Sections 3.3 to 3.5, when put together with concepts like the ones described in sections 2.1 to 2.5, provide a very useful insight in allying discipline of operating airplanes with scientific artifacts.

Naturally, before selecting the Vision (destination) a good analysis has to be performed (like the ones in mission planning, destination selection and route selection and mapping).

Goals & Objectives (Route & waypoints)

A model (shown in Figure 4) for aligning goals and objectives is being developed. The model was used to the definition of the management objectives for the year of 2010.

The model takes in consideration goals and the corresponding objectives. Priorities are a very important issue since the Organization relies heavily on external stakeholders for financial aspects that are crucial for objective definition.

Since the government funding scheme entails funding at several moments during the fiscal year, the Organization setup requires multiple configurations in order to be able to react to budget cuts by identifying impacts on the goals and corresponding objectives.

The model considers Goals (and priorities), key factors (number of hours flown) that will be affected by attaining the objective, organizational components (that will have to adequate own objectives) and business procceses (that attain objectives) which have to be accounted for while defining objectives.

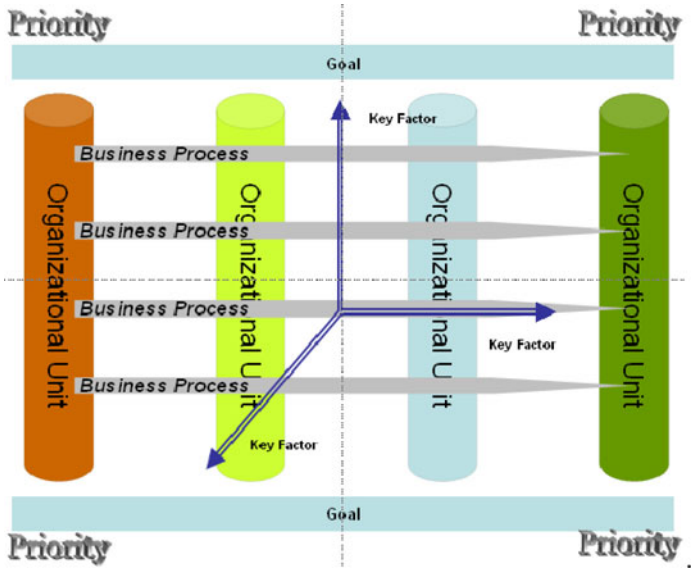

Fig. 4. Designing Objectives Model

An example can be shown.

- Goal: improving crew personnel draft in the next three years;
- Objective: improve drafting for navigators and pilots;
- Key factors: number of flying hours has to be increased;
- Business processes envolved: operational, training, image management (only to mention a few);
- Organizational components or units objectives (acronym description in section 5.3): EMFA, defining the number of personnel to be drafted; CIFFA, plan draft and courses; CA, fly demo sorties on specific areas; Public Relations, define a marketing campaign, DFFA, calculates the budget, etc...

By using the Model the Air Force makes sure that there is consistency betwen the several objectives in the Organization and also that, if a new configuration enters in place, due to financional constraints, what will be the objective to eliminate or reduce and what the financial impact will be.

Strategy & Tactics

A non-profit organization exists primarily to bring about changes in individuals and in society, and there is not the figure of "profit". Typically, these organizations exist to perform righteous or moral acts or causes to serve. However, like in profitable organizations, they should optimize their resources in order to add efficiency and effectiveness to their processes.

Strategy implementation in this type of organization differs from the others. While the Strategy in a profitable organization leads to produce the maximum profit as a result of its operation, Strategy in the nonprofit organization is merely a means of maximizing resources.

Currently the Air Force is developing a strategy map that can adequate to the organization's specifics and yet, represent the best way to achieve Goals and Objectives.

Business Policy & Business Rules

Business Policy and Business Rules are key orientations to strategy execution since they can define rules that restrict or expand the organization acts. In addition, they are the basis for development of the several configurations that drive adaptability in the Organization improving self-awareness and reaction times and easing the communications with external entities.

In the military, business policy and business rules tend to take either the form of directives issued by different levels or the form of doctrine.

On this subject, a hierarchy of manuals directive (example in Figure 5) was approved by the GCOS that intends to build doctrine at the different levels in a consistent manner [38].

As an example, the strategic level developed a concept of operations for each weapon system, which led to the development of two consistent manuals at the operational level: the concept of operational employment from the Air Command, and the concept of logistics support to operations from the Logistics Command.

At the tactical level, following the same principles, a set of rules and policies are also being developed.

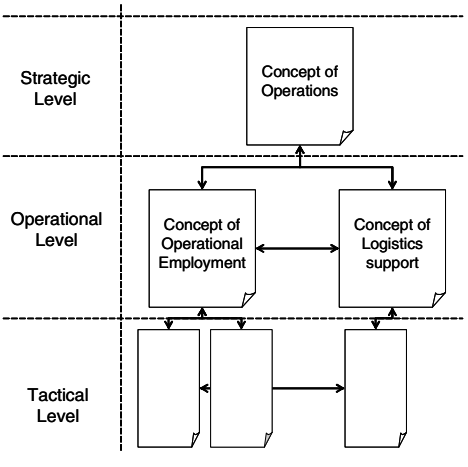

Fig. 5. Business Policy and Business Rules hierarchy

Internal & External Influencers, SWOT and Potential Impact

Internal and external influencers are directly connected to everything that the organization does. Externally influencers can produce enterprise governance artifacts and other type of negative and positive constraints. One example of an external influencer that produces governance on the Air Force is the Portuguese Government, which is also responsible for all the funding. The Portuguese Government also plays a customer role because it requests missions from the Organization.

Internal influencers act on all the definition of the organization artifacts. They are resources used by business processes; they can also act as internal governance creators in the form of business policy and business rules; they are also directly linked to goals, objectives, strategy formulation and to the SWOT and potential impact analysis.

The work created by the Air Force, as previously said, entails different configurations in order to allow situational awareness and rapid reaction times.

The research done by the Air Force Academy for the study and development of a strategy map considers, for each strategic action, the associated goals to fulfill, the corresponding business policies and rules, the related processes and the SWOT and Potential Impact analysis.

Business Processes

Since the business process is used to attain business objectives, Process Architecture can be understood as structuring the processes in management lines and value chain defining the required levels. Therefore, it is essential to find if the business processes attain the corresponding business objectives.

With this in mind, since the Air Force is identifying its business processes, a master thesis was conducted to establish the link to business objectives. The resulting work is now being used as a method for adding consistency between the two concepts. Figure 6 shows a picture of the scope [39, 40].

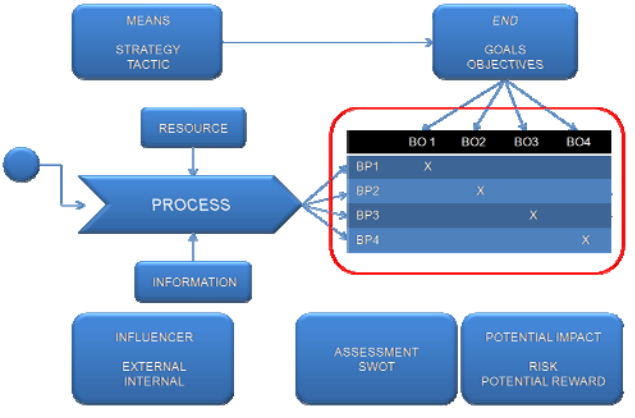

Fig. 6. Business Policy and Business Rules hierarchy [39, 40]

Performance Indicators & Dashboard

The importance of controlling parameters is vital to the functioning of any organization. Its importance becomes exponentially crucial when addressing large and complex organizations. Expertise on the analytical use of indicators and dashboards of the Portuguese Air Force was developed in another master thesis [41].

However, like in an airplane, to know what to control is vital. The work done was made around the Organization Key Factors (see section 5.2.2) in order to assist in the control, management and decision making process in a way benefiting organizational self-awareness and rapid reaction times. Using ODE principles and theories, basic

artifacts were created. Examples are the missions performed by each weapon system, the number of people associated and the reification of the Organization Key Factors into tangible values.

Figure 7 shows a part of the organizational cockpit created showing indicators for different organization levels.

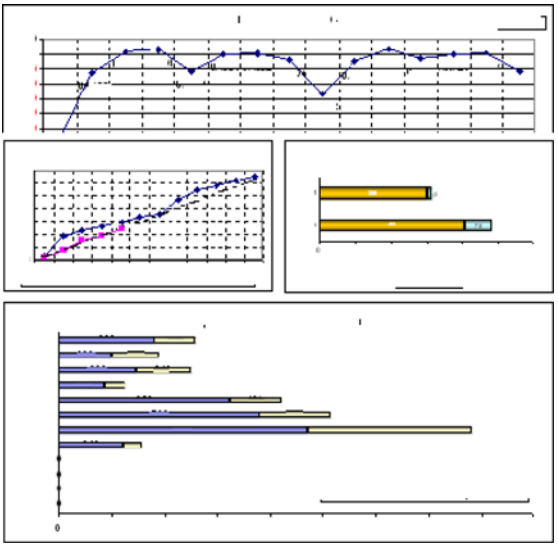

Fig. 7. A sample of the Air Force Organizational Cockpit

The formulation and definition of key factors brought along the need to measure efficiency and effectiveness that led to the creation of one number concept. Global effectiveness is given by one number and a scale of graduation. If needed, the concept provides the ability to drill down into the hierarchy and examine individual values.

5.3 Structuring the Air Force

Structuring well the organization in order to attain the goals is an essential step to success. In every organization, people should know what they have to do and therefore is essential to have track of people's functions, abilities and competences.

In addition, on the path to the business process oriented organization, it is very important to be able to compare what the people have to do, in the organization publications with what people actually do, in the business processes.

An analysis of the existing information in the organization's manuals and the way it was organized revealed some problems:

– Inexistent agreed semantics. There is no formal agreed terminology. However, tacit knowledge across the organization accepts that there are organizational entities (that have competencies) and job positions (that have functions and qualifications).

- Low consistency. Inexistence of horizontal and vertical verification of activities and competences (the first level organizational entity can have a competency that is not on the immediate level) with repetitions with a different text (for example: "participate in working groups" and "integrate working groups" or "produce reports" and "write reports")
- Regulations on paper. Paper regulations are very heavy, with a lot of sheets, little flexibility, hard to read, expensive due to the heavy spending of ink and paper, with high economical and environmental impacts.
- Induced inefficiency. Paper distribution limits the desired dematerialization, essential to smooth flow and process facilitation.
- Slow access to documents. Access to regulations is difficult and slow.
- Metrics inexistence. Inability to know the working hours associated to Job positions.
- Organization based on people. Hard maintenance based on people instead of Job positions.
- Difficult and expensive upgrades. Organization changes imply changing manuals, printing and distributing numerous copies.

Although the Air Force has its Information Technology (IT) System with some information about people that are occupying a certain Position, the EMFA, itself, has no electronic database that can act as a repository of information allowing for rapid query of some important issues like:

- What are the agreed upon semantics for the Organization? (Inexistent);
- What is the representation of the Organization? (Drawn on paper);
- Who works for whom? (Available on paper, does not answer to matrix groups that are created inside the organization with specific, time-limited tasks);
- What are the requirements, essential and desirable needed to occupy a job position? (Information exists on paper, however it lacks consistency between entities);
- What is the relevant information that one has to know about each job position (like, telephone number, job code, hierarchal dependency)? (Inexistent);
- What are the competencies needed to occupy a job position? (Information exists on paper, however it lacks consistency between entities);
- What are the functions of each job position? (Information exists on paper, however it lacks consistency between entities);
- What are the subjects that each job position deals with? (Available on the job position only with a very limited sentence);
- Who deals with a specific subject? (Available, but time consuming).

Developing an ontology, based on existing ontologies and theories [12] seemed to be a correct approach to establish an electronic repository of information accessible to all, while providing answers to the previous questions.

The concept has come to reality. It was developed in three phases and is one of the key items to be inserted in the new IS structure.

The idea behind is to apply to organizational positions the same concept that is currently applied to aircraft positions. If people cannot fly an airplane without going through the preparation depicted in Section 3.1, what would be the preparation necessary to "fly" an organizational position?

5.4 Shaping IT

IT shaping was one of the main objectives of the change process. An IT change plan [42] was prepared and the actions to identify the AS IS comprehended software acquisition to model business architecture and specification, information architecture.

The following phase will determine the TO BE and the design of a new architecture, using service-oriented architecture (SOA).

IT is also playing an essential role on personnel training and the setup of an internal directory and an Internet Forum where, upon registration, people could consult the "things" that have been done and provide feedback.

5.5 Back to the Basis or Assuring Knowledge

One of the essential aspects for maintaining knowledge is to involve the new generations. One of the key items in the Change process was to involve deeply the Academy and the Staff College in contributing to the development of concepts, theories, models and methods.

The Air Force Academy, with the Technical University of Lisboa, is contributing with the following master thesis:

- "A Business Model for the Air Force" [33, 34], completed;
- "Added Value Matrix representation for consistency between business objectives and business processes" [39, 40], completed;
- "Identification of Decision Support Indicators of Strategic Nature for the Portuguese Air Force" [41], completed;
- "Modeling the Effort Regime for the Air Force" [43, 44], completed;
- "Modeling the Flight Hour Cost for the Air Force" [45, 46], completed;
- "The Air Force Transformation Process" [47], completed;
- "A Strategy Map applied to a Military Organization", ongoing;
- "Two level (strategic and operational) objective definition", ongoing;
- "Modeling the Air Force Effort Regime Analysis Component", ongoing;
- "Business Rules alignment at different organizational levels", ongoing;
- "Changing the Air Force – Part II, conclusions" , ongoing;
- "Organizational and Design Engineering: Modeling the Flight Hour Cost for the Air Force using the Defence IS"; ongoing;

The Staff College contributed with five thesis on the promotion courses to senior officer.

6 Conclusion

The subject of maintaining self-awareness in an organization is discussed in this paper. How to draw, organize and manage an organization, in the human and material resources domains, considering i) multiple restrictions ii) critical needs of real time iii) various configurations is the key problem to be solved.

Concepts based on solid theories help the organization to stay self-aware and to know itself. Considering the organization to be a system, the general systems theory establishes a set of relations between two systems (or system and its exterior) that are expanded by other theories related to the organization like Organizational and Design Engineering, Enterprise Architecture and Enterprise Governance, the Business Motivation Model and self-awareness, agility and change.

To answer the questions above, the Portuguese Air Force Chief-of-Staff determined that the Air Force would conduct a holistic approach to the problem and a change process was initiated. The change process evolved three main items and had the objective of aligning IT with the strategy:

- Development of cross-organization doctrine (concepts, procedures), establishing a building of publications for operation and maintenance;
- Modeling of Processes and Activities of the maintenance and operation;
- Establishment of metrics and indicators for decision support in information systems.

Change included a strong support by the scientific community and comprehended master thesis development at the Air Force Academy.

Up to now fifty business policy and business rules manuals (at the different levels were produced, 470 business processes and key performance indicators were identified and 12 master thesis were developed (six are already complete).

As the discipline of flying deals with the same problems, the flying concepts were applied to the business. Personal preparation, mission, cockpit are being translated into their business counterparts.

As a result, the Air Force is identifying critical factors while studying and applying new concepts and resulting artifacts, such as:

- The business model (to enhance internal understanding);
- The business objectives selection model (to guarantee consistency between Vision, goals and business processes);
- The business rules hierarchy model (to hold consistency between the business rules at different organization levels);
- The business objectives/business processes consistency model (to hold consistency between the business objectives and the business processes);
- The organizational cockpit model (to verify strategy execution and that the organization is reaching the defined goals).
- The online organization (to verify what the organization's best structure is and to provide a set of best practices in organizational and personnel competencies).

Considering i) multiple restrictions, ii) critical needs of real time, iii) various configurations, entail a set of actions. Conclusions are:

- Since the Air Force is highly affected in its operation by external influencers, planning is an essential tool;
- Self-awareness comes together with the need of knowing exactly what the Vision (destination) is, and the corresponding goals and objectives (route and waypoints). Alternate selection is also a key point to attaining rapid response to environment changes;

- Strategy (route and waypoints), together with the business policies and business rules, play an essential role in how to achieve the objectives;
- Business processes and business objectives must be well aligned;
- IT plays an important role in Enterprise Architecture since it stands as the facilitating actor.

Taking in consideration what has been said before, one possible solution to attain operational effectiveness in a multiple restriction environment is to consider multiple configurations settings with a configuration manager.

Configuration entails a set of business concepts with different objectives and different rules.

The configuration manager holds the key to change configurations, in near real time, as a result of changes in the organizational world, caused either by internal or external influencers.

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