Near Real Time System for Operational Management

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Abstract

Current organizations integrate different social realities which result in a complex intersection of people, processes and technologies. Since people are the only agents endowed with the necessary autonomy to make decisions, and considering that the timeliness of information affects, overwhelmingly, the effectiveness of decision making, it is necessary to provide these same people a robust Self-Awareness. Indeed, in the current constantly changing environment, it is a great advantage for organizations to recognize uncertainty as an important factor to consider in its operation. Thus, like the aircrafts, the organizations require Near Real Time mechanisms that allow them to be ahead of the organizational environment, i.e., to know, at any given moment, the real status of its means and resources. Based on the principles of Organizational Engineering, this paper proposes a Near Real Time Model for the Portuguese Air Force. Considering its core business, the air defense of the Republic, the main objective of this investigation is to provide the Air Force’s operational component with the necessary Near Real Time mechanisms. Although this model is based on a particular set of requirements, its conclusions and principles might be considered a reference for the entire organization and, furthermore, for modern enterprises.

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1. Introduction

Organizations face, nowadays, new paradigms at various levels, in a hostile and fast changing environment. Such reality requires a new approach to the organizational structure as an open system in constant communication, not only with external entities, but also, internally. In fact, in the current constantly changing environment, the greatest advantage for organizations is to recognize “that uncertainty itself is a basic feature of organizational environments” [1]. Therefore, similarly to aircrafts, the organizations require management tools in Near Real Time which allow them to improve their performance through constant monitoring. It has been witnessed, over the last few years, an astronomical technological development that allowed companies to abolish physical barriers. Therefore, it is possible for organizational actors placed in different geographical positions, to know “where” the different others actors are, and “what they are doing”. However, in order to accomplish such goal, it is mandatory that the information system is fed with information that, at any given moment, is representative of the reality of the organization. Such state of Self-Awareness will allow a convenient alignment between the organization’s goals and the organizational actors’ decisions, resulting in an improvement of effectiveness and efficiency.

The Portuguese Air Force (PRT AF), despite being a military organization, is currently facing a complex situation arising from technological developments and new paradigms in the field of national defense. Having as its prime mission, the air defense of the republic, embodied in the projection of its airpower, it must have an information system that is able to represent the reality of its means and operational resources. During this investigation, it was detected that the Near Real Time mechanisms within the Information System responsible for the Operational Management of PRT AF, the Operational Management Module (MGO), where insufficient. This problem is characterized by several aspects, namely:

- Organizational Self-Awareness: the operational information is concentrated in a particular set of organizational units, that do not share it with the different hierarchical levels;
- Squadron’s Internal Management: the current MGO does not allow, in an automatic and proactive way, the allocation of available resources to fulfill a mission;
- Integration and correction of information: existence of operational information replicated in several information systems, leading to different realities for different entities;
- Command and Control (C2): the different organs of C2 do not have access to the actualized planning of air activities in Near Real Time through MGO, not knowing which resources are involved on the missions;
- Support to Operations: impossibility from the Air Base (AB) to provide an effective support to the crew in mission, as for example, medical assistance, food, based on the information registered in the system.

Considering the items identified, the authors developed a model that could solve the problem presented. Having in mind the specificities of a military organization, such as the PRT AF, when compared with similar civilian Institutions, a comparison with other models was not established for this purpose. The study was conducted over an existing system, developed according to the organization’s specific requirements.

This article is structured as follows: section 2 goes through the necessary literature related with Near Real Time; section 3 focuses on the Near Real Time Model for PRT AF; section 4 presents the conclusions.

2. Concepts and Applications

This section presents the most significant concepts and principles that support the Model presented on section 3.

2.1. Organizational Design and Engineering

As organizations develop and grow, with the introduction of new technologies and processes, so does the complexity of relationships between individuals, which results on an increase of difficulty in the organizations management.

Organizational Engineering (OE) results in a “body of knowledge, principles, and practices having to do with the analysis, design, implementation and operation of an enterprise” [2], and addresses a fundamental question: “how to
design and improve all elements associated with the total enterprise through the use of engineering and analysis methods and tools to more effectively achieve its goals and objectives” [2].

But OE itself can’t provide the necessary mechanisms to answer to this process of constant adaptation. Therefore, Organizational Design intends to provide the manager the ability to implement decisions, with technical and economical quality, in a timely manner [3], affecting the efficiency, the effectiveness and the competitiveness of the organization [3].

Both approaches should be addressed as the two faces of a coin, once “while design defines, recommends or uncovers the interactions between organizational actors (human and non-human), in an intertwined fashion engineering improves, streamlines, monitors or changes the nature of such interactions” [4], trough distribution of resources, authority and information [3].

2.2. Organizational Self-Awareness

Human beings are, naturally, self-aware. This capability allows us to know who we are, how we do things and what we are doing at a particular moment. Although this capacity is innate in individuals, when referring to organizations, it results in a complex web of interactions between different individuals.

According to Vicente [5], Organizational Self-Awareness (OSA) can be divided in two dimensions: the individual and the organizational. The individual dimension is related with the capacity of an individual to answer questions such as: “Who am I in this organization?”, “How do things get done?”, “What is he organization, as a whole, doing right now?”. The organizational dimension concerns questions as “Who are my members”, “How do they do things” and “What are they doing now”. An organization is Self-Aware when these two dimensions are aligned.

This subject is of an utmost importance, once human resources are the only actors capable of sense making, i.e., have the ability of “structuring unknown contexts and/or actions and assigning them with meaning” [6]. Therefore, human resources are the main responibles for the organization performance.

2.3. Adaptability, Flexibility and Agility

Adaptability consists on the “ability to alter force organization and work processes when necessary as the situation and/or environment changes” [7]. In other words, it consists on the ability of an organization to mold itself to the environment.

Flexibility is the “ability for achieving success in different ways” and is based on the cognitive capacity of the human resources [7]. This concept implies the creation of multiple scenarios, according with several parameters that might affect business processes, and alternative ways, as well as detection mechanisms, that will allow the organization to respond rapidly to environment changes.

Agility is related with the quality of moving with ease and promptness. But, for an organization to be agile, it requires it to be flexible and adaptable. It also implies a correct harmonization between human resources, processes and technologies.

One common fact to these three principles, adaptability, flexibility and agility (AFA), is that OSA leverages their advantages to the organization. So, for an organization to predict multiple scenarios, to be able to modify its processes and to be able to move easily, it requires individuals to know the reality of the organization and what is the best choice to take.

2.4. The Zachman Framework

Zachman [8] proposes a Framework classification, designated Zachman Framework, for describing complex ideas. It is considered the fundamental structure for Enterprise Architecture, once it is an ontology, ie, a structured set of terms and concepts for classification. It intersects two historical classifications: the fundamentals of communication and the reification or, “the transformation of an abstract idea into an instantiation” [8]. While the first can be found in the primitive interrogatives “What, How, When, Who, Where, and Why” [8], the second one is labeled as “Identification, Definition, Representation, Specification, Configuration and Instantiation” [8].
Therefore, the Framework describes and defines the Enterprise Architecture according to six levels of abstraction allowing different stakeholders, with different points of views, to see different perspectives of one same complex thing.

2.5. Near Real Time

Recognizing the fast changing markets, and comparing the concept of flying an aircraft with flying an organization, Páscoa and Tribolet [9] created the concept “Flying the Organization”. According to these authors, flying is an exact science of proven success, based on planning, detail, knowledge, precision, learning, monitoring, analysis and report in real time, with the objective of being ahead of the aircraft and being able to predict exceptions that may lead to errors. Therefore, organizations need near real time mechanisms that allow them to be ahead. To accomplish such goal, it is necessary a process of constant monitoring, strict discipline and proactive attitude.

Páscoa [1] defines a near real time system, as one in which the activities completion times or responsiveness, when measured against wall clock time, are important aspects of system quality. That means that the time between data being available and one organizational actor seeing it, is negligible.

The difference between “real time” and “near real time” relies on the precision and magnitude of the time constraints: while real-time specifies the precision of time constraints, near real-time is not precisely articulated, implying a narrower range of magnitudes.

2.6. The Latency and Value of Data

Hackatorn [10] argues that the value of data decreases as it ages and so, low latency data has more value for an organization than high latency data. Therefore, the referred author proposes a model that applies latency to data warehousing and to the value lost for the organization, identifying three kinds of latency: data latency, analysis latency and decision latency.

While data latency is “the length of time between when an event occurs and when the associated data is stored in the data warehouse” [10], the analysis latency consists in “the time between when the data is stored and when it is analyzed and made available to applications and users” [10]. Decision latency is the next phase and is related with the time from when information is available until someone takes an action in order to minimize the impact on the organization. All three kinds of latency are additive and result in total latency.

On this paper, and once MGO’s Technological Architecture enables a low analysis latency, and decision latency is related with the action after the information is delivered, only data latency will be discussed. Reducing this vector depends primarily on technological solutions and procedures in providing fresh data.

2.7. Concepts: Operational Triad, Type of Mission, Modality of Action, Air Unit and Air Base

The Operational Triad [11] establishes the three High Level Information Entities of PRT AF: “Mission”, “Aircraft” and “Crew”. These entities are related in the sense that a crew uses an aircraft to fulfill a mission. All are planned annually in the flying regime definition [12, 13] using simulation [14, 15], key performance indicators [16, 17] and an operational effectiveness index [18].

The “Type of Mission” establishes the capacities of each Squadron, according to North Atlantic Treaty Organization (NATO) doctrine [19].

“Modality of Action Type” defines if the mission is Operational, Training Qualification, Maintenance Qualification Training, Uniformization Training or Instruction [19].

An Air Unit, or Squadron, is the nuclear element of PRT AF for constitution and projection of Air Power. It is equipped with the appropriated human resources and materials and has a set of capacities, aligned with NATO Air Doctrine [19].

An Air Base is an aeronautical infrastructure where one or more Air Units are, or could be, settled, and has all the resources to support Air Operations [20]. Air Bases are typically divided into Operational Group and Support Group: the first one is responsible for controlling and executing the air activity, for example, the Air Tower and the
Meteorology Center; the Support Group is responsible to provide all the assistance required to the Air Activity and to the personnel of the Air Base, for example, health center and canteen.

2.8. PRT AF As Is

Considering the three types of latency referred by Páscoa and Tribolet [9], it is important to analyze the organizational As Is of each component. In this case, and since the aim of this study is to provide near real time mechanisms, decision latency won’t be discussed once it comprehends the action after information being delivered. Therefore, it is only necessary to examine data latency and analysis latency, which are the main factors that influence the timeliness of information. Applying these two concepts on the field, it is important to examine the procedures in the collection and sharing of information (data latency) and evaluate the technological architecture of MGO (analysis latency).

Regarding to procedures, three case studies were performed in three different Squadrons: Squadron 201, Squadron 501 and Squadron 504. In all cases, it was clear that Squadrons only use and insert data in MGO after the mission is completed and, sometimes, largely after. MGO is treated as a statistic management tool for controlling the cost of flight hour and organizational control. In all cases, the interviewees assumed the usage and sharing of spreadsheets made with office tools, revealing a lack of standardization on data collecting. One interesting fact is that Squadron 201 has its own information system, based on spreadsheets, available on the Air Base private network: each organ of the Air Base has the responsibility to manage a particular set of information on its own spreadsheet, that is automatically shared to the other users, according to their points of view, information necessities and security access grants.

In relation to Technological Architecture, it must be referred that MGO is a specific module of the Portuguese Air Force Information System. It can be accessed via intranet and enables the user to manage and consult operational information. It is connected with other modules, as Human Resources and Maintenance Module, allowing MGO to compile information that is needed for Operational Management. Any PRT AF organ, through a system of individual and specific logging for each module, has access to the information presented by the different applications.

MGO Architecture consists in a central database that can be accessed and operated from any PRT AF Air Base. Therefore, the time between data insertion in one Air Base, and its availability to the remaining PRT AF organs, is negligible, contributing to low analysis latency. This architecture allows the time between data insertion and its availability to all organs being negligible. Thus, it contributes to low analysis latency and near real time communication between different actors.

3. Near Real Time Model for PRT AF Operational Component

This section intends to explain the logic behind the Near Real Time Model, the Model itself, and the validation mechanisms that answered the problems previously stated in section 1.

3.1. Model Development

In order to build a Near Real-Time Model for the PRT AF Operational component, a “To Be” vision must be settled. Applying the Zachman Framework [8], figure 1 highlights the differences between As Is and To Be.
Mission Requirements: specification of a set of a Squadron’s needs for fulfilling a mission. When the Squadron gets an “air tasking order”, the mission requirements are evaluated and an information is sent to the Air Operations Center (AOC), which will decide if the mission is executable or not.

Air Task Order (ATO): the AOC, after deciding that the mission “is a go”, emits an ATO. This consists in a code that designates the mission. After being emitted, the Squadron allocates crews and aircrafts. This information is classified and requires a secure network to share for being shared and processed.

Aircraft: the aircraft readiness depends on its operational status. The current MGO does not allow the organization to know the real status of their aircraft. This problem can be promptly solved with mechanisms that allow the MGO to read the “prevision of aircraft readiness” from the Maintenance Information System. Thereby, none of the aircraft that are not operational can be allocated to a mission before it is cleared from the Maintenance Group. Besides, it was detected during the interviews, that Ready and Incomplete (RI) status isn’t valuable to the user once it doesn’t show if a RI aircraft can accomplish a certain mission with safety. This subject is currently being revised by the responsible organs. Normatives will be written on the possible configurations of each aircraft and which missions can be accomplished with each configuration. These two mechanisms should be integrated on MGO in order to allow the user, in a proactive and automatic way, to verify which aircrafts are ready to fulfill the mission.

Crews: the crew’s readiness depends on two subjects: qualifications and availability to air service. This subject is currently being revised by Dias [21].

Mission Report (MisRep): This is the last activity of a mission process and consists on flight data insertion on MGO. This report offers to higher levels of decision the access to a particular set of flight information such as alternative landing locals and problems occurred during the mission.

Status of the Organs of Support: The air activity is a road of two ways: as support organs need to know the planning of air missions, in order to adequate their support resources, so does the Squadron need to know if the air base has the minimum requirements for supporting the air activity. The interviews allowed the authors to highlight some requirements, as the fuel available at the AB, the medical personnel and the assistance means available status.

Comparing the current MGO with the requirements of the Operational Component, it is clear that none of the requirements is accomplished: although MGO presents all the crews and aircrafts, it does not provide their real status. Besides, it can only generate the tasking code, and not the complete ATO.
3.2. Model

As stated previously, the Operational Management is not a sealed process: it requires constant updated with information that represents the reality of the operational means and resources. Therefore, it is necessary that the information system is constantly updated with up to date information.

For this model to correctly work, it is necessary that the different organs responsible for managing the information related to the requirements, insert up to date information. In this way, when executing the planning process, the system can alert the user about the available means and resources (figure 2).

![Diagram](image)

Fig. 2. MGO as a tool for improving OSA and AFA (source: authors).

The Modality of Action has an important role on the model, once it defines which organ starts the process: if it is an operational mission, Air Command (AC) fills in all the information of its responsibility on the system; if it is another modality, it is up to the Squadron to start the process. It must be referred that the allocation of crews and aircraft is a Squadron responsibility: the AC just needs to see, when it gets an air tasking order, if the concerned Squadron has the necessary means and the AB has the necessary organs of support. Therefore, and if AC wants to provide important information about the mission, as for example, the block of time to execute the mission, or other kind of information, it should insert it on the “Observations” field. After planning has been made, and if changes occur to the plan, the responsible organ should insert the information in the system in order for other organs to change the planning, if it is necessary.

Another important topic to be referred is the status of a mission, for the different organs of the organization to know if the aircraft is already airborne or landed. Therefore, and once it is the Control Tower that witnesses the aircraft’s take-off and landing, this entity should be responsible for inserting the Actual Time of Departure (ATD) and the Actual Time of Arrival (ATA) in the system. Considering the time spent on supporting the exit or entry of the aircraft on the circuit with safety, this information should be inserted in MGO, at maximum, 60 seconds after departure, giving the air controller enough time to safely support the aircraft.

After the mission is over, and once most of the information has already been inserted in the system, the responsible entities only have to elaborate the MisRep, filling in the remaining fields. Therefore, the presented model allows all users, at all times, to see the real statues of PRT AF resources and mission operations (Figure 3).
3.3. Model Validation

The model was subject to an instantiation, based on three particular case studies. This allowed the authors to validate the integration of this model into PRT AF reality, although it didn’t solve all the problems identified on section 1.

The first point that should be referred is the allocation of crew and aircraft. The model allows the user, when identifying the necessary resources to fulfill a mission, to see if they are available according to their status. However, if they are already involved in a mission at the same time, they can be allocated either way. Therefore, the system should have mechanisms to make the user aware that such resources are already compromised. This can also be solved with an alert mechanism that allows the user to know that mean is already planned for other mission.

Other point that is not totally solved is C2. Although the present model shows the real status of the mission, it has a hiatus during the mission execution: it does not show the exact position of the aircraft when the mission is being executed, which is a must for the operational component. Currently this information is managed by a NATO Information System, situation that leads to a problem of information integration. Therefore, the authors recommend a future study on this subject.

3.4. Model Implementation

Although this model allows the necessary information sharing for PRT AF’s Operational component, it represents a change in the business processes of the organization and, therefore, it will face resistance to change by individuals. Thus, for the model to be correctly implemented, there is a set of measures that should be taken in order to smooth this transition.

The first one is to create more user-friendly views for the users. The current views in windows format do not provide the users the understanding of the “big picture”. All the unofficial tools used currently have a characteristic in common: all of them are made with spreadsheets. This upgrade should allow the user’s to insert information on the system directly on the spreadsheets.

The second one is to elaborate a new MGO’s manual and distribute it through the different organs of the Operational component. It should describe the different functions of each organ and how to work with the system.

The third measure relies on the creation of courses on the system to be ministered to users from the organs that are responsible for feeding it with information, similarly with what happens nowadays with the maintenance information system.

The last, and maybe the most important measure, it is to implement a secure network to support MGO. Once ATO and MisRep deal with classified information, MGO needs to run over a secure network in order to protect its data. Besides, it should be configurable in order to allow or restrict users to read specific operational information.

All measures referred, besides contributing to establish doctrine, at a medium and long range, among the organization, will "soften" the process of change, contributing to a more self-aware, effective and efficient PRT AF.
4. Conclusion

As previously stated, change is part of every organizations’ quotidian. Thus, and as natural in any organization, there is always a resistance to change by people. For that reason, it is necessary to involve every individual in the process. As a matter of fact, people are the most important element of an organization. Therefore, it is necessary to give them the abilities to accomplish their functions. Near Real Time mechanisms are a possible answer that could lead organizations to success. However, to accomplish such goal, a correct harmonization between people and technologies is required.

According to the interviews, the authors conclude that the critics that have been made on MGO about its outdated information are not valid once it is not fed with up to date information. However, it is clear that the system itself is not correctly aligned with the processes of the organization. Although in the Model Development the authors presented requirements for the information system, it should not be considered as an exhaustive and limitative set of requirements but as examples of features that the system should allow to the different users. Although the model didn’t solve all problems stated on section 1, it allowed the organization to become more self-aware, agile and so, more effective and efficient.

To conclude, the authors stress that the most valorous contribute of this research is the correct harmonization between process requirements and doctrine: one without the other will lead to the failure of the organization once, if people want the system to have up to date information, they should feed it with information every time there is change on the organization, that is, an event occurs. Although this research was based on PRT AF Operational Component, considering the specific requirements implied, the conclusion that the concepts and principles referred can be applied to any other component of PRT AF, as well as any other modern enterprise, is unavoidable.

References