

STRUCTURING, ANALYSING AND MONITORING PROBLEMS AND DECISION MAKING PROCESSES AT CIVIL AIR NAVIGATION SETS OF A PUBLIC ORGANIZATION

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This article presents the partial application of a post-graduation doctoral study developed in the Production Engineering Program of Rio de Janeiro Federal University (UFRJ – Universidade Federal do Rio de Janeiro), at the following civil Air Navigation operational sets of a public organization: Tower; APP – Approach; and AIS - Aeronautical Information System Room. Its main goal is to demonstrate how Multi-methodologies and Concept Maps were used to subsidize PSM - Problem Structuring Methods, for structuring, analyzing and monitoring problems and decision making processes to: promote System and Rational Thinking, by interdisciplinary interactions and interactions; reduce Self-deception and increase Metacognition; encourage Metagovernance and Situational Leadership; and enable possible improvements. Its main purpose is to consolidate a predictive culture on Operational Safety Management, focusing on Human Factors, according to aeronautical requirements, for the continuously emergence of hidden threats, considering the complexity, variability, dynamics, unpredictability and minimum acceptable risk control of Complex Systems.

Introduction

The search of human being for modern technologies in response to social and organizational demands represents a challenge. Nevertheless, there is a reductionist tend towards quantifying information with standardized models, putting a risk into its reflection and effectiveness. Therefore, is required to complement this approach with a more refined analysis to explicit knowledge for better deal with unexpected situations and future foresee. Therefore, it were used Multi-methodologies (MINGERS, 2006) and Concept Maps (ESTELLITA, 2010; ARÊAS, 2009) in this study, basing the main subject of this article, that is structuring, analyzing and monitoring problems and decision making processes in Complex Systems.

I. Conceptual Base

Multi-methodologies (MINGERS, 2006) consist of a number of new methodologies used to address problems involving material, social and individual qualitative aspects, once just one methodology is not complete enough for this. This study used Multi-methodologies (MINGERS, 2006) and Concept Maps (ESTELLITA, 2010; ARÊAS, 2009) as complementary instruments to subsidize PSM - Problem Structuring Method (ESTELLITA, 2010; ROSENHEAD and MINGERS, 2001), encouraging the practice of thinking in group in order to create a space out of work routine to provide reflection, and enlarge the chances of better understanding its strengths and limits.

Concept Maps (ESTELLITA, 2010; ARÊAS, 2009), then, were used in complementation of Multi-methodologies (MINGERS, 2006), as an instrument of SODA - Strategic Options and Development Analysis, in SOR - Soft-Operational Research, to promote the reflection about different and conflicted perceptions of the same problems, for better understanding the reality. In a similar way, Cognitive Maps provide mental representations about the reality, but they were not used in this study.

This study found on System Thinking (GHARAJEDAGHI, 2011) and Rational Thinking (SENGE, 2008) a form to define more precisely problems, solutions and possible qualitative changes, based on: power dimensions; knowledge; well-being; beauty; values; and desire. For this, it is necessary successive “iterative loopings” (interactions) involving human behavior and continuous interactions among different actors, providing new alternatives and desirable objectives for the future (GHARAJEDAGHI, 2011), what was possible with the use of Concept Maps (ESTELLITA, 2010; ARÊAS, 2009), for a better understanding about the reality of the work stations studied.

According to Metacognition Theory (FLAVELL, 1976), the state of mind depends on: knowledge dimensions - propositional, experimental, representative and epistemological, that interfere on perception; alternatives to deal with the levels of consciousness; elements analysis for the construction of references to pass from the subjective to the inter-subjective attribute; characterization and measurement of the relevant subjective attributes for decision making process (MINGERS, 2006). Also, the “Unknown Unknowns” (YAMIN, 1286-1368) shows how people choose for Self-deception to be accepted by a group, by fear of going against the status-quo, assuming bad attitudes on disrespect of others instead of promoting positive changes to maintain their integrity. This study demonstrates how Metacognition (FLAVELL, 1976) may help and Self-deception (YAMIN, 1286-1368) may harm the commitment to face problems.

Governance is the transcendence of an isolated part of an integrated whole, by interactions among various organizations in order to regulate what they have in common, emphasizing the centralization or the localization of the organizational power. Metagovernance (JESSOP, 2002) assumes the interdependence of relations and question hierarchic coordination values of all levels (top-down / bottom-up) for a more reflexive organization, by the commitment with effectiveness of: economic controls; collective objectives; and associated values. As participants of this study, as the operators and their heads, including supervisors, coordinators and managers, adopt a free communication channel with dialogue (“requisite variety”), which enables to analyze the same situation from different perspectives. If not opened to other level’s points of view, the failures of the high levels of the organization hierarchy will remain static.

Situational Leadership (HERSEY & BLANCHARD, 1986) describes two kinds of maturity for the operator’s heads deal with the staff at work: psychological maturity, involving relationship; and task maturity, involving knowledge, ability and experience. This study associates Situational Leadership to Metacognition (FLAVELL, 1976) and Metagovernance (JESSOP, 2002), to better deal with reality.

Complexity is one of the main Complex System’s characteristics (ESTELLITA, 2010), as retreated in the Air Navigation sets of the public organization studied, and it is not consistent because of the main paradoxes that involve these kind of systems, as follows: individual and collective object; isolated and global interdependent parts; centralized and distributed information; individual and multiple observers; conservation and transcendence of processes. This will be commented in this article.

II. Method

The method of this study focused on:

2.1. Scenario – Operational work stations (Tower, APP – Approach, AIS - Aeronautical Information System Room) of six Civil Air Navigation sets of a public organization, and one will be commented here.

2.2. Participants – Operators of Air Traffic Control (Tower and APP – Approach); AIS - Aeronautical Information System, Meteorology and Air Navigation Communication (AIS Room); and operators’ heads (supervisors, coordinators, managers).

2.3. Study Focus – Structure, analyze and monitor problems and decision making processes in Air Navigation Complex Systems.

III. Methodology

Multi-methodologies (MINGERS, 2006) and Concept Maps (ESTELLITA, 2010; ARÊAS, 2009) were applied during this study to subsidize PSM - Problem Structuring Methods (ESTELLITA, 2010; ROSENHEAD and MINGERS, 2001), what embodied four phases, as follows:

3.1. 1st. Phase / 2011 - Problems Representation: In the year of 2011, a group exercise was conducted and, after the preliminary definition of a representative for each group, constituted by complementary Multi-methodologies (MINGERS, 2006), as follows:

3.1.1. Brainstorm – Each group was asked to select a problem of the addressing operational set and, by the use of brainstorm, register, randomly, the ideas associated, on one side of a poster paper, with a pilot pen. This Multi-methodology (MINGERS, 2006) is characterized by an “iterative looping” (interaction) and an interaction (GHARAJEDAGHI, 2011).

3.1.2. Symbolization – Each group was asked to analyze the ideas linked to the problem selected and register, now with symbols (map, flowchart, tree-diagram, bubble, design, image etc.), its characteristics, effects, possible solutions and necessary interventions, from a systemic point of view, on the other side of the same poster paper already used, with a pilot pen. This Multi-methodology (MINGERS, 2006) is characterized by an “iterative looping” (interaction) and an interaction (GHARAJEDAGHI, 2011).

3.1.3. Simulation – Each group was asked to simulate a real situation involving the problem selected and debated (brainstorm / symbolization), to demonstrate it, in practice, what, after approval, was filmed.

3.1.4. Oral presentation – Each group was asked to make an oral presentation of the problem selected and debated (brainstorm / symbolization), and its implications, based on the stages above, with a conclusion.

3.2. 2nd. Phase / 2011 - Problems Consolidation: It was consolidated all the problems and implications in a Concept Map (ESTELLITA, 2010; ARÊAS, 2009), based on the Multi-methodologies (MINGERS, 2006) used on the 1st. Phase / 2011 - Problems Representation, and succeeded by other Multi-methodologies (MINGERS, 2006), as follows:

3.2.1. First Concept Map (ESTELLITA, 2010; ARÊAS, 2009) – The First Concept Map (ESTELLITA, 2010; ARÊAS, 2009) was elaborated for each operational set, containing the consolidation of all the problems once addressed, based on the Multi-methodologies (MINGERS, 2006) used during the 1st. Phase / 2011 - Problems Representation.

3.2.2. First report – A written report was elaborated for each operational set, containing the problems once addressed during the 1st. Phase / 2011 - Problems Representation, and the suggestions of interventions, what was sent to each local operators' heads and the higher levels of managers. This is another Multi-methodology (MINGERS, 2006) used in this study.

3.2.3. Debriefing – An oral debriefing about the results (First Concept Map - ESTELLITA, 2010; ARÊAS, 2009 / First Report) was conducted to the local operators' heads and the higher levels of managers. This is another Multi-methodology (MINGERS, 2006) used in this study.

3.3. 3rd. Phase / 2012 - Problems Representation Update: Another group exercise was conducted, based on the First Concept Map (ESTELLITA, 2010; ARÊAS, 2009), elaborated during the 1st. Phase / 2011 - Problems Representation, and, after the preliminary definition of a representative for each group, other Multi-methodologies (MINGERS, 2006) were used, as follows:

3.3.1. Debate – A debate followed by a written update of the First Concept Map (ESTELLITA, 2010; ARÊAS, 2009) was accomplished, constituting another “iterative looping” (iteration) and an interaction (GHARAJEDAGHI, 2011) used in this study.

3.3.2. Oral presentation - Each group was asked to make an oral presentation with a conclusion, based on the debate above.

3.4. 4th. Phase / 2012 - Problems Consolidation Update: It was consolidated all the problems' update and their implications in another Concept Map (ESTELLITA, 2010; ARÊAS, 2009), based on the Multi-methodologies (MINGERS, 2006) used on the 3rd. Phase / 2012 - Problems Representation Update, and succeeded by other Multi-methodologies (MINGERS, 2006), as follows:

3.4.1. Second Concept Map (ESTELLITA, 2010; ARÊAS, 2009) - The Second Concept Map (ESTELLITA, 2010; ARÊAS, 2009) was elaborated for each operational set, containing the consolidation of all the problems addressed before, based on the Multi-methodologies (MINGERS, 2006) used during the 3rd. Phase / 2012 – Problems Representation Update.

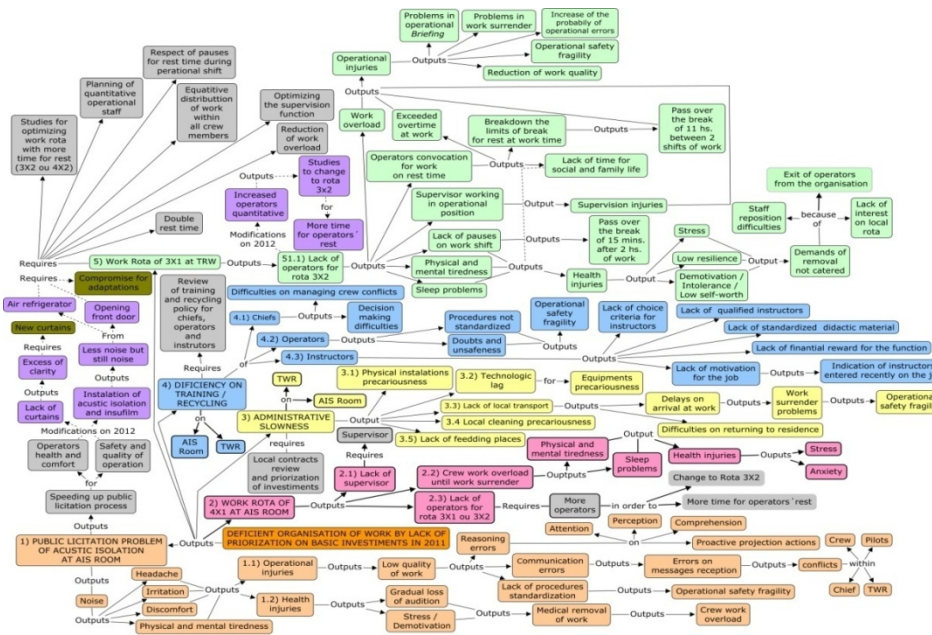
3.4.2. Second report – A written report was elaborated for each operational set, containing the problems addressed before during the 3rd. Phase / 2012 – Problems Representation Update, and the suggestions of interventions, what was sent to each local operators' heads and the higher levels of managers. This is another Multi-methodology (MINGERS, 2006) used in this study.

This article is restricted to comment the 1st. Phase / 2011 - Problems Representation and the 2nd. Phase / 2012 - Problems Consolidation of only one operational set studied, leaving the 3rd. Phase / 2012 - Problems Representation Update and the 4th. Phase / 2012 - Problems Consolidation Update for the future.

IV. Analysis

“Figure 1” shows the First Concept Map (ESTELLITA, 2010; ARÊAS, 2009) for one operational set, related to the 2nd. Phase / 2012 - Problems Consolidation.

“Figure 1”: First Concept Map (ESTELLITA, 2010; ARÉAS, 2009) with the problems consolidation in one operational set



According to “Figure” 1, this First Concept Map (ESTELLITA, 2010; ARÉAS, 2009) content, related to the 2nd. Phase / 2012 – Problems Consolidation, begins with a central problem – “Deficient Organization of Work by Lack of Prioritization in Basic Investments in 2011”, with five main developments:

- (1) **Public Licitiation of Acoustic Isolation** – The Law 8666 / 1993 - Licitiation for Public Organizations, prescribes that the winner company of a licitation is the one that presents the lowest price for the service, what may damage its quality. The current licitation of acoustic isolation for AIS Room lasted too much time in consequence of an unsuccessful licitation involving an uncompleted service by the company first licitated, what obliged to open a new licitation. On the other hand, this law represents a protection for not accepting any company to do the services needed without licitation, and this exemplifies one of the many paradoxes of Complex System (ESTELLITA, 2010) we can find in the public organization studied, equivalent to the need of conservation this process, but also to transcend it for the necessary improvements.
- (2) **Work Rota of 4x1 at AIS Room** – This problem involves: lack of supervisor; crew work overload until work surrender; and lack of operators for rota 3 x1 or 3 x2. It indicates that some operational staff was transferred to other operational sets without reposition. There was also less operational staff because of medical removals, vacations, absences, without having enough agility in personal reposition or mechanisms to minimize the negative impacts of this reality. These causes of staff reduction may be minimized for short periods of time, but it is a Self-deception (YAMIN, 1286-1368) to deny the real demand for more operators. The plan for calculating operators quantification must include this type of occurrences, but public organizations, as the one studied, tend towards presenting bureaucratic routines, retarding the solutions for this problem, what is an obstacle to change work rota, so this aspect needs to be improved.
- (3) **Administrative slowness (AIS Room and Tower)** – Slow and bureaucratic processes involving; physical installations precariousness; technologic lag; lack of local transport; local cleaning precariousness; lack of feeding places etc., demonstrate that public organizations, as the one studied, are not generated enough to prepare themselves to make the necessary interactions to attend common objectives. This characterizes another paradox of Complex System involving isolated and global interdependent parts (ESTELLITA, 2010): these processes need to be addressed as a global interdependent part of a whole, to have the agility enough to be solved, and not to remain only as an isolated part separate of the whole. Therefore, they remain slow and bureaucratic faced to real demands, so this aspect also needs to be improved.
- (4) **Deficiency on Training / Recycling (AIS Room and Tower)** – This problem embodies the lack of a career plan including a periodicity of defined courses for each operational function (AIS Room and Tower), operators’ heads and instructors, restraining them to up-grad towards the advance of aeronautic technology.

The training plan is restricted to formative courses, although there was an investment on recycling courses (English Language and Operational Safety), what increased the staff knowledge. This represents another paradox of Complex System involving centralized and distributed information (ESTELLITA, 2010), where the lack of training indicates a trend towards centralized information and the investment on training indicates a trend towards distributed information, once even more information people get, more knowledge and safety they have, what is the base for an aimed predictive culture (CANADA, 2006, 2010, 2012).

(5) Work Rota of 3x1 at Tower – This problem involves the lack of operators for rota 3 x 2, indicating a trend towards: work overload; operators convocation for work on rest time; supervisor working on operational position; lack of pauses on work shift; physical and mental tiredness; and sleep problems. See the same considerations of problem (2), aggravated by the stressful activity of air traffic control at Tower.

The problems described above have their respective subdevelopments showed in “Figure 1”. In general, public organizations have difficulty to prioritize solutions in response to the existent demands and, in consequence, do not succeed on making continuous qualitative changes required by Complex System’s characteristics, as complexity, variability, dynamics, unpredictability and acceptable risk control, in complement to normative prescription (CANADA, 2006, 2010, 2012). Therefore, in one year (2011 - 2012), there were neither the necessary improvements for the problems addressed, nor the necessary predictions of new problems to appear, for all the operational sets, not attending the expectation of more agility on this.

Nevertheless, both of the group exercises conducted during the study, either the first one, related to the 1st. Phase / 2011 - Problems Representation, or the second one, related to the 3rd. Phase / 2012 - Problems Representation Update, were considered useful by a majority of participants, what demonstrates the significance sequence of the Multi-methodologies (MINGERS, 2006), and “iterative loopings” (iterations) (GHARAJEDAGHI, 2011) used in this study, enabling the elaboration of the Concept Maps (ESTELLITA, 2010; ARÊAS, 2009) with the problems addressed. Besides, both exercises provided the opportunity to make interactions (GHARAJEDAGHI, 2011) and treat conflicts among different professional formations of different hierarchical levels, what enlarged the chances to: minimize Self-deception (YAMIN, 1286-1368); enhance Metacognition (FLAVELL, 1976); put into practice Systemic Thinking (GHARAJEDAGHI, 2011) and Rational Thinking (SENSE, 2008); apply Metagovernance (JESSOP, 2002) and Situational Leadership (HERSEY & BLANCHARD, 1986); and increase the understanding about Complex System and its characteristics involving complexity (ESTELLITA, 2010), and the commitment of each person and groups with the appropriate management of problems and their risks. Comparing both exercises, we have: during the first one, related to the 1st. Phase / 2011 – Problems Representation, a majority of participants from all hierarchic levels demonstrated a certain motivation to face problems and hope to solve them; but during the second one, related to the 3rd. Phase / 2012 – Problems Representation Update, the participants evoked a certain frustration for the slowness of problems conduction and resolution, although unintentionally.

Also, there is a prevalence of bureaucratic characteristics (CANADA, 2006, 2010, 2012) in the organization studied, what, through Complex System’s (ESTELLITA, 2010) point of view, indicates the relevance to understand them for making them treatable. Related to the dynamics of the paradoxes of Complex System (ESTELLITA, 2010), we have that: anyone’s individual objects show up more than everyone’s collective common objects, although these last ones are desirable, for enabling to situate the organization members in different contexts; isolated parts are more evident than the interdependent whole, characterized by multifunctional ambiguity in different areas of knowledge, once different sectors of the same operational set and different operational sets lean towards functioning in a separated and independent way, not having the habit to consider the necessities among each other or to supply them interactively; power centralization is more present than the necessary systemic distribution of information among different observers, based on an integrated vision of the whole, in which the communication among different operational sets, sectors and hierarchical levels, not always has the same priority; individual unity is emphasized in relation to multiplicity of different observers, what requires a continuous observation of reality, from different points of view, in diverse, similar, conflicted or complementary activities, instead of a shy knowledge exchange about internal and external occurrences, as observed in the study; processes preservation are prevalent in relation to their transcendence, what could bring continuous and permanent evolutions, subjected to emergent properties of Complex System’s self-organization, once there is a trend towards the routine preservation, based on the current regulations, and not on their constant update.

In reference to Metagovernance (JESSOP, 2002), it is reinforced a reciprocal interdependence of crescent and frequent interactions - intra and inter-organizational, intra and inter-sectional, and national and

international. But the partial results of this study show that there are evidences of a confuse, distant and slow communication in the organizational hierarchy, that needs to be continuously treatable and improved for its safety, based on the concepts of Complexity (ESTELLITA, 2010). Related to Situational Leadership (HERSEY & BLANCHARD, 1986), there is a trend of the operators' heads towards not making a difference between the task maturity and the psychological maturity in their operational performance, what may difficult the appropriate management of the staff in their work stations, deviating from the main focus on people to the focus on processes management, what contributes to the extension of Self-deception (YAMIN, 1286-1368) instead of Metacognition (FLAVELL, 1976). This suggests to intensify the necessary continuation of "iterative loopings" (interactions) and interactions (GHARAJEDAGHI, 2011) by the use of Concept Maps (ESTELLITA, 2010; ARÊAS, 2009); and to stimulate Metagovernance (JESSOP, 2002) and Situational Leadership (HERSEY & BLANCHARD, 1986), to improve communication and better cope with reality.

V. Study Application

The present study is still being developed in its 4th. Phase / 2012 - Problems Consolidation Update, and have resulted into this article and another poster presentation at SHE – Sustainability, Health and Education Conference / 2012, by UFRJ – Rio de Janeiro Federal University: "A Qualitative Methodology for Problems Structuring, Analyzing and Monitoring Applied to a Complex Public Organization".

VI. Conclusion

This study demonstrates that is possible to structure, analyze and monitor problems and decision making processes, using Multi-methodologies (MINGERS, 2006) and Concept Maps (ESTELLITA, 2010; ARÊAS, 2009) for PSM - Problem Structuring Methods (ESTELLITA, 2010; ROSENHEAD and MINGERS, 2001), based on: Systemic Thinking (GHARAJEDAGHI, 2011) and Rational Thinking (SENGE, 2008); Metacognition (FLAVELL, 1976) and Self-deception (YAMIN, 1286-1368); Metagovernance (JESSOP, 2002); Situational Leadership (HERSEY & BLANCHARD, 1986); Complexity and Complex System (ESTELLITA, 2010). Therefore, it aims at contributing for transforming the organizational culture in a more predictive and generative one to improve the effectiveness of Operational Safety Management (CANADA, 2006, 2010, 2012).

VII. Future Prospective

It is intended to be written more literature about this study theme and, in the future, advance from the application of Concept Map to Cognitive Map, as Thinking Map (ESTELLITA, 2010; ARÊAS, 2009).

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