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Command and control as organizational innovation in the provision of public health services

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ABSTRACT: *The Command and Control field has gone through a series of evolution in recent decades as a result of the adoption of the concepts of Network-Centered Operations Doctrine. This evolution entitles Command and Control to manage projects other than the usual one, which would be the military field. At the same time, the world faces the problem of efficiency and effectiveness in the delivery of public services, particularly in the area of health, characterized by divergences between what citizens want as users of services and what governments provide. Research has been developed seeking to elucidate the issue of the poor performance of public administration in meeting social demands. Organizational innovation presents itself as a promising area for the development of ways to maximize the provision of public services. In this context, the article presents a proposal for Organizational Innovation that applies Command and Control in the Management of Public Service Provision Operations.*

KEYWORDS: Provision of public service. Organizational innovation. Command and control. Doctrine centered on networks.

RESUMO: *A área de Comando e Controle vem sofrendo uma série de evoluções nas últimas décadas, em decorrência da adoção de conceitos de Doutrina de Operações Centradas em Redes. Essa evolução credencia a aplicação de Comando e Controle no gerenciamento de empreendimentos distintos do usual, que seria o campo militar. Paralelamente, o mundo se depara com o problema da eficiência e da eficácia na prestação dos serviços públicos, notadamente na área da saúde, caracterizado pelas divergências entre o que os cidadãos esperam, como usuários dos serviços, e o que os governos entregam. Pesquisas têm sido desenvolvidas buscando elucidar a questão do fraco desempenho da administração pública em atender às demandas sociais. A inovação organizacional se apresenta como uma área promissora para apresentar caminhos que maximizem a prestação dos serviços públicos. Neste contexto, o artigo apresenta uma proposta de Inovação Organizacional que aplica Comando e Controle no gerenciamento das Operações de Prestação de Serviços Públicos.*

PALAVRAS-CHAVE: Prestação de serviço público. Inovação organizacional. Comando e controle. Doutrina centrada em redes.

1. Introduction

This article aims to present a proposal for an innovative solution, in the form of an Organizational Innovation (OI), for the immediate treatment of failures occurring during the Provision of Public Health Services (PSP) and that contribute to unsatisfactory results, based on the concepts of Command and Control (C2) and Network Centered Operations Doctrine (DOCR), a typically military application area. This article is based on a Doctoral Thesis [1] developed at the Military Institute of Engineering (IME-RJ).

C2 has a reputation for being a mysterious subject, even for those who may be or have been a professional in the field. The words command and control, individually or together, have different meanings when used by different communities [2].

C2 techniques have undergone a series of evolution in recent decades, due to the adoption of DOCR concepts [3]. In parallel, the current perception denotes that the PSP in Brazil does not present the necessary quality to meet the needs of the population, both in scope and quality, as neither the scope nor the standard is satisfactory.

This perception is supported by research produced in the academic environment, covering various areas of PSP, such as transportation [4], health [5] [6] [7], and education [8][9], and also by evidence constantly reported in the media, ranging from lack of hot food in state schools in Rio de Janeiro [10] to a patient seen on the floor of the largest hospital in Fortaleza [11]. Numerous other press reports have evidenced similar problems [12] [13][14][15][16].

Based on this evidence, among many others reported daily, it is undeniable that the quality of public

service in Brazil is insufficient, requiring several actions to improve it. Actions to achieve the necessary improvements may consist of changes in the form of management and execution of Public Service Provision Operations (OPSP), which can be done from the implementation of OI.

In recent years, the implementation of OI in the public sector has received increasing attention, both for providing better levels of quality of public services and for influencing the capacity of the private sector to innovate [17]. While, on the one hand, news reports or scientific works emphasize the issue of problems with PSP, on the other hand, the specialized literature contains numerous publications on OI that can mitigate this problem [18][19][20].

Following this trend, the authors propose an OI in the area of health PSP that, based on the application of concepts and processes of C2 and DOCR, provides a reduction in the occurrence of failures or the reduction of their consequences. A pilot project developed between the Military Institute of Engineering (IME) and the Secretariat of Health of the State of Rio de Janeiro (SES-RJ) was implemented as part of the research process.

The purpose of the pilot project was to analyze and validate the model developed in the first cycle of action research of the research process, and its results were used in the improvement of the model, which occurred in the second cycle of action research. A summary of its implementation and the results obtained is presented at the end of the article

This article is structured as follows: the theoretical basis is presented in Section 2; Section 3 is dedicated to the description of the method used; section 4 discusses the results obtained, presenting the proposed models; and section 5 contains the summary and main results of the pilot project implementation.

2. Theoretical Foundation

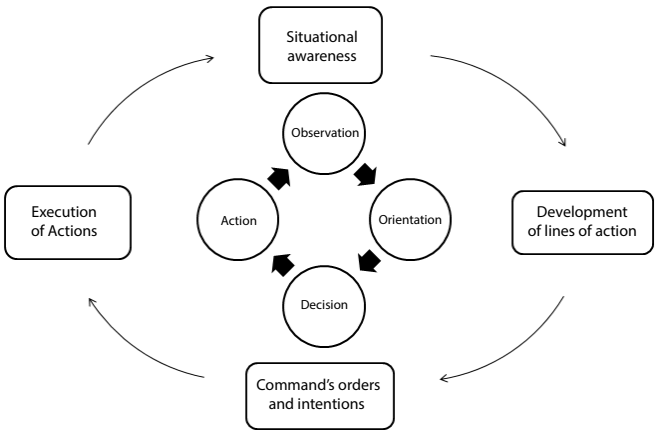
2.1 C2 and DOCR – C2

C2 is not an end in itself, but a direction for value creation, such as fulfilling a mission. Specifically, C2 centralizes efforts of several entities, individual or organizational, and resources, including information, aiming at the accomplishment of some task or objective [2].

For C2 processes to be effective, their cycle, which is the sequence in which C2 actions are performed, must unfold repeatedly and as quickly as possible in each of them, throughout the time in which the operations are necessary [21][22]. These actions are known by the acronym OODA – Observation, Orientation, Decision, Action. The concept of this cycle was introduced by John Boyd, an American military strategist active in the twentieth century [23].

The *observation* represents the continuous monitoring of the operating environment, so to detect any change in the course of events that may require an intervention. *Orientation* means the projection of the new reality to be achieved in the operating environment, the new desired situation. The *decision* corresponds to the conduct to be developed so that the new desired reality is effectively achieved. Finally, the *actions* resulting from the decision taken are implemented. A new cycle then resumes, with the resumption of observation – FIG. 1.

Fig. 1 - OODA Cycle.



Source: Adapted from [22].

The C2 functions comprise the set of activities for carrying out the PDCC – Planning, Direction, Control and Coordination – of C2 actions, which are part of the aforementioned OODA cycle [21][22]. According to [2], C2 functions are applicable not only in

military enterprises, but also in civil enterprises. Viewed as a whole, the expression C2 covers the following functions:

- Establish intention (the goal or objective);
- Determine roles, responsibilities and relationships;
- Establish rules and restrictions;
- Monitor and evaluate the situation and progress.

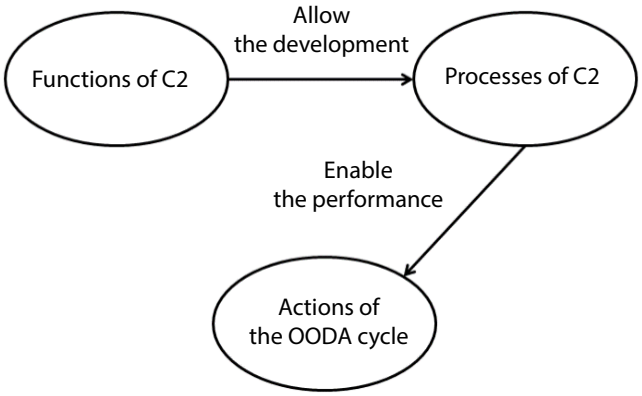
Although 'command' and 'leadership' can refer to the same person, in practice, the possibility must be allowed that these functions can be performed by different individuals or sectors. However, in view of the fact that 'command' usually refers to the figure of the leader, the following functions allow us to consider this aspect:

- Inspire, motivate, and generate confidence;
- Train and educate.

Finally, the question of the resources used in carrying out the mission cannot be overlooked. Without the necessary resources, the mission cannot be completed. Therefore, the last function considered by [2] is 'provisioning'.

The *functions* of C2 enable the development of C2 *processes*. They are what enable to carry out C2, as defined above, with the actions of the OODA cycle [21] [22]. FIG.2 illustrates this relationship.

Fig. 2 - The relationship between C2 functions, processes and actions.



For C2 processes to achieve the primary objectives, it is essential that the perception of reality and reality itself are in perfect harmony. This attunement is called *situational awareness* [21][22]. The structural framework that provides the support for all these activities and objectives to be carried out and achieved is called the C2 structure, which covers one or more – depending on the scope – C2 centers. Such centers are the operations centers designed to provide the links between the command structure with the upper and subordinate echelons [21][22].

C2 system is the set of facilities, equipment, information systems, communications, doctrine, procedures, and personnel essential for the commander to plan, direct and control the actions of their organization to achieve a certain purpose [21][22]. The initial conditions for a given mission to occur may vary over time. These are factors that need to be observed for the mission to be carried out within the desired parameters, producing the expected objectives.

Once the mission starts, objectives, rules, responsibilities, resource allocation and everything else can be changed. It is up to the 'control' component to carry out this verification: if something has changed without proper authorization, preventing the mission from being carried out, or if something needs to change. The only exception concerns the definition of objectives (intention), which is up to the 'command' component. The 'command' aims to return the mission to the path of success, based on the checks of the 'control' component [2].

2.2 C2 and DOCR – DOCR

Military organizations are, by their very nature, resistant to change, and deal with information, traditionally, in three ways: *commands*, which serve to define the specific task at hand – directives and guidelines; *intelligence*, which provides information about the environment in which the task is to be performed; and *doctrine*, which provides the rules of the game or standard operating procedures [24]

Changes, particularly changes that can affect relationships between organizations and between commanders and their subordinates, present significant risks and therefore generate considerable concern. The explosion of information-related technologies has unleashed a virtual tide of

change that profoundly affects organizations and individuals across multiple dimensions. The military is no exception [24].

Consequently, traditional military C2 has been challenged by a number of modern problems, such as environmental complexity, dynamism, new technologies and competition capable of exploiting the weaknesses of an organizational paradigm that has been dominant since the industrial revolution. The conceptual response to these challenges is a new type of C2 organization called *Network Enabled Capability* (NEC) [3], which incorporates DOCR.

Traditional military architectures have been organized in a very hierarchical way, but modern innovations in communications and computer technology provide an extensive range of other possible structures. In parallel, the emerging emphasis on operations not necessarily focused on war has required more flexible organizational structures. This new scenario requires the use of formal techniques for the evaluation of a set of possible organizational structures, and Social Network Analysis techniques are an obvious choice for such analyses [25].

In the industrial era, a period that began with the Industrial Revolution and lasted until the 20th century, interaction models were designed to ensure control from the center. Thus, the flow of information always followed the "chain of command" or the management structure of the enterprise. This pattern of interaction can be recognized in military models, in which official correspondence is addressed to unit commanders. This practice reinforces the tradition that the flow of information must follow along the command line and that all information within a unit is of interest and belongs to the unit commander. Thus, in the industrial era, communication mechanisms imitated the organizational structure of the organization [2].

The information age, also known as the computer age or digital age, is a historical period beginning in the twentieth century and characterized by the rapid change from traditional industry, which the Industrial Revolution provided, to an economy strongly based on Information Technology (IT).

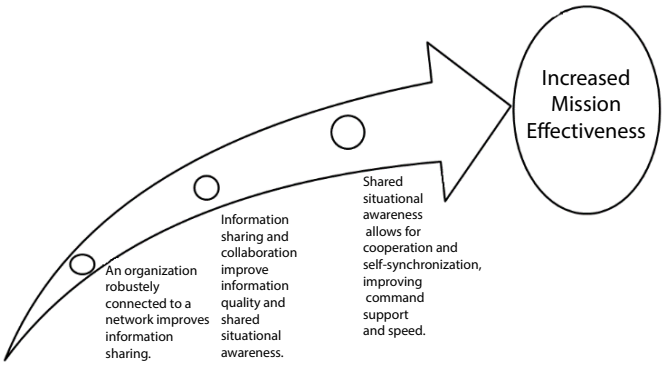
Traditional interaction patterns developed in the age of industry have undergone changes to adapt to new paradigms, transforming from centralized models to networked models. In the case of *Network Centric Warfare* (NCW) and the *Edge Organization* (a relatively new organizational form that distributes knowledge and power to its limits and allows members and organizational units to self-organize and self-synchronize their activities) [26], social networks are the ones that will be activated by any available mechanisms: mail, telephone, videoconference, local area networks, wide area networks, world wide web, etc. Social networks also depend on cooperation: the willingness to work together and collaborate when appropriate [2].

The DOCR is adopted by the U.S. Department of Defense for the implementation of its C2 systems. This doctrine has transformed and continues to transform C2 processes. It proposes the massive sharing of information through communication networks, leading to a natural self-synchronization of actions between the actuating forces and, thus, optimizing the OODA cycle and the subsequent increase in the effectiveness of the mission to be carried out [27].

According to [28], the value chain of Network Centered Operations (OCR) is reflected in a set of hypotheses that advocate, briefly, that a robustly networked force contributes to increasing mission effectiveness, according to the causal connections presented in Fig. 3. The massive sharing of information via communication networks leads to a natural self-synchronization of actions, optimizing the OODA cycle and increasing the effectiveness of the mission to be carried out [29].

This work considers that the systematic and structured observation of the complex PSP environment, based on the adapted application of the elements of C2 and DOCR, can meet the need that, according to [30], governments have to share power and be more flexible in their control mechanisms, reducing bureaucratic procedures that can impair the efficient provision of service to the public.

FIG.3 - Network-Centered Operations



Source: Made from [27] and [28].

2.3 PSP

Twenty-first-century public administration is undergoing dramatic changes, especially in advanced economies, but also in many parts of the developing world. Globalization and pluralization of service provision are the driving forces behind these changes. The political problems faced by governments are increasingly complex, perverse, and global rather than simple, linear, and nationally focused. However, the prevailing paradigms through which public sector reform is designed and implemented are relatively static and do not fully encompass the meaning or implications of these broader changes. While public sector reforms in the developing world are influenced by policy experiments and organizational practices originating in *Organisation for Economic Co-operation and Development* (OECD) countries, they tend to operate within the traditional paradigm of public administration. As a result, there is often a discrepancy between the momentum of public sector reform efforts in developing country contexts and broader changes in the nature of governance and contemporary approaches to public management based on OECD experience [31].

Contemporaneously, Public Governance (GP) has been proclaimed as a new paradigm, distinct from New Public Management (NGP) and orthodox bureaucratic public administration. It applies in new times and contexts, marked by pluralism, complexity, ambiguity, and fragmentation, unlike the contexts of the old public administration (the birth and apogee of the developmentalist welfare state) and the NGP (the neoliberal wave of the 1980s and 1990s). GP is capacity for governance; it is collaborative network governance; it is results-oriented governance [32][33][34].

An important aspect to be considered in the PSP scenario concerns the issue of efficiency and effectiveness. A reference to a quote by Peter Druker is made in [35]: the judgment of a manager's performance must be through the twin criteria of effectiveness – the ability to do the 'right' things – and efficiency – the ability to do things 'right'.

In [36] a framework is presented that discusses two general questions: whether the public administrator is 'doing the right things', that is, delivering services consistent with the needs of the citizen; and whether it is doing 'the things right', that is, providing quality services at the lowest cost. To answer these questions, in [36] two empirical tests are performed, one of effectiveness and the other of efficiency. The effectiveness test asks to what extent public programs meet established goals, while the efficiency test asks whether services are provided at the lowest possible cost.

In parallel to the process of evolution of the PSP, changes also occurred on the citizen's side. Society's pressure for quality public services is growing, and the pressure is more perceived in relation to those services related to the direct provision to the citizen. This situation became possible mainly from 1995, when the Brazilian national scenario was faced with the entry into the agenda of the reform of the State apparatus, and, within this context, of the administrative reform. With the approval of Constitutional Amendment No. 19, of June 4, 1998 [37], the adoption of the Principle of Efficiency in the Brazilian public administration was established.

PSP is an essential function of governments [30], characterized by the delivery of the product, made directly by the government or by a representative, to citizens. It can reach many stakeholders,

as it involves not only government agencies, but also inter- and intra-governmental agencies. As a consequence, there is a risk of lack of coordination and conflict of interest. Since there are many stakeholders, one needs to make an adjustment in the expectations of interactions [30].

Because it is very heterogeneous, the public sector has particular challenges in ensuring its effectiveness and efficiency. Three main dimensions can be used to classify public organizations: area (health, education, etc.), level or sphere of government (federal, state, municipal) and type of institution (policy formulation/central administration, regional agency, service provider unit) [17].

For [38], governments, especially in developing countries, do not yet have mature organizations to implement efficient public policies related to the direct provision of services to citizens. The aforementioned author reports that, in addition to politics, implementation issues can be an important focus of the research. Among the questions pointed out by [38], one is of special interest to the research aims of this study: what can be done to avoid failures or correct them more promptly?

Concern for service provision operations is also present in the work of [39]. For the author, operations management is essential to maximize the production of goods and services in the public service, while quality management ensures the satisfaction of beneficiaries beyond their expectations.

The proposal dealt with in the article seeks precisely to act on the effectiveness and efficiency of OPSP, acting on one of its variables, as seen below, through the improvement of service delivery management, in the form of an OI, positioning itself according to several publications that seek to mitigate the PSP quality problem through innovations (e.g. [19][20][40]).

Briefly, the proposed models for the application of C2 and DOCR in the PSP environment seek to: mitigate the discrepancy between the impulses of efforts for reforms and broader changes [31]; integrate with the precepts of the GP [32][33] [34]; maximize the efficiency and effectiveness of the PSP **[35]** [36] [37]; enhance interactions and reduce conflicts between those interested in the PSP [30]; manage the PSP of regional agencies and providing units of the three levels of government [17]; avoid failures and correct them more promptly [38]; and manage OPSP to maximize the production of goods and services in the SP [39].

2.4 Open OI in the Public Sector

Innovation is more than a new idea or an invention. An innovation requires implementation; that it be put to active use or made available for use by other companies, individuals, or organizations. The economic and social impacts of inventions and ideas depend on the diffusion and acceptance of related innovations [41].

According to [42], a new good, service, or process would be an innovation only if it is connected to the market. For the author, this connection means that there is no sense in innovating if there is no reflection in the market, or, in other words, if the company does not obtain an increase in sales of its products or services. Specifically in the case of public services, the increase in sales does not make sense; however, the increase in quality of service provision is still a connection with the "market".

Over time, the understanding of the process of generating innovation has deepened, showing that, on the one hand, the meaning of innovation triggers has changed, and on the other, the different phases of the innovation process have also been substantially redefined. Another novelty is the change in the understanding of the innovation process as a linear sequence of different phases for an integrated view of the process, with the replacement of simple, linear and sequential types by increasingly complex patterns. This means that the individual phases overlap and that there is feedback between them. In terms of knowledge and technology transfer, interactive models enrich both basic research and applied research and development [43].

External sources of knowledge and R&D play a central role in the development of innovation, being

complementary in companies in more technologically intense industrial areas, which usually have greater absorption capacity. In companies in low-tech industrial sectors, both strategies are effective for improving innovation performance, but the combination does not have significant effects [44].

OI, as mentioned in [45], refers to the creation or adoption of a new idea or behavior for the organization, accompanied by new processes and a new information structure, which can be caused endogenously or exogenously. This definition is consistent with the definition of the Oslo Manual [41], which defines as a minimum requirement for an innovation to be identified the existence of one or more characteristics that differ considerably from those that characterized the product or business processes previously offered or used by the company.

OI is seen as the implementation of a new organizational method in company business practices, workplace organization, or external relations. Therefore, it can be concluded that an OI has a comprehensive scope, contemplating the development of new processes and business models and the achievement of new results from the perspective of creating innovation. In addition, it includes the development of skills, as well as processes of creation and transfer of knowledge [46].

In particular, an OI is the introduction of new organizational methods for managing the business both internally and in relation to external agents [41][47], and represents one of the most important and sustainable sources of competitive advantage for companies.

An Open Innovation (IA) is a concept based on the conviction that companies can and should look for ideals and ways to create innovations not only within the limits of their structures, but also in their environment, formed by their external partners – customers, other companies, etc. [48].

The increasing complexity of products and services, coupled with rapidly changing market demands or increasing pressure from various social groups are trends that force companies to adopt new practices to remain competitive. External sources of information and integration in the context of IA is a practice that can leverage success [49].

The path to the development of new technologies and new knowledge makes companies increasingly dependent on external knowledge and technology, which may be in the public domain or belong to other companies, individuals or research institutions [50].

This study seeks, in short, to solve the issue of low efficiency and effectiveness of the PSP in Brazil, through the proposal of an open OI, which is based on the introduction of concepts and processes of C2 and DOCR in the OPSP environment.

Thus, the proposal is characterized, from the point of view of OI: as an attempt to increase the quality of service provision, representing a connection with the "market" [42]; by the application of external sources of knowledge and R&D [44]; by symbolizing the exogenous adoption of a new behavior accompanied by new processes and a new information structure [45]; by the introduction of new organizational methods for business management [41][47]; as a search to meet the growing pressure exerted by PSP's client social groups [49]; and by portraying, in the form of an open innovation [48], the application of research institution knowledge in the development of skills and practices within the public company [50].

3. Method

Two approaches were used in the development of this research. The first (general) approach concerns the scientific method related to the stages of development and validation of the research itself, which consists of identifying and studying the theoretical framework; analyzing the data; proposing a first version of the solution; in the implementation, evaluation and evolution of a pilot project; in a new round of theoretical study, due to the incorporation of a new theoretical framework; and in the formulation of a final proposal. As for the second (specific) approach, it concerns the technique and modeling tools used on the PSP environment, for

understanding the problem and developing and presenting the solution.

Regarding the first methodological approach (general), the research was developed according to the Action Research method [51][52], involving the State Department of Health of RJ (SES-RJ), in partnership with the Military Institute of Engineering (IME). SES-RJ was responsible for the role of the institution where the problem is detected and IME for the role of the holder of expertise in the area of knowledge applied in the proposal – C2 and DCR. During the development of the proposed model, a pilot project was implemented in SES-RJ. This combination of roles of the two institutions involved guided the choice of the action research method.

The development of the research had two cycles of action research. The first cycle consisted of three stages: exploratory, experimental and validation. In the exploratory stage, research related to the theoretical framework was carried out, the diagnosis of the problem and the model for the solution were developed. The experimental stage consisted of the implementation of the proposed model (pilot project) and its assisted operation. The validation stage consolidated the data from the pilot project and supported the second cycle of action research.

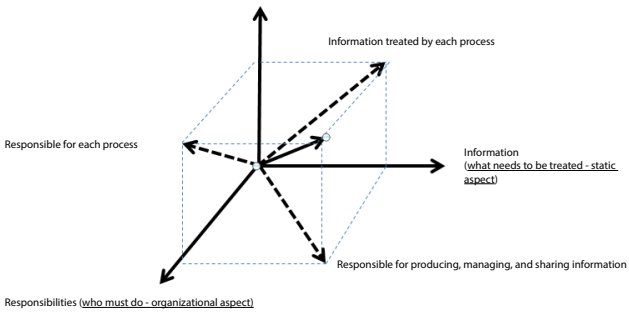
In the second cycle, only the exploratory stage was carried out and consisted of the deepening of the bibliographic review and the evolution of the proposed model. It is intended to complete the second cycle in the future, by performing a second experimental step followed by the validation step.

Regarding the second (specific) methodological approach, the modeling of the problem and the proposed solution followed a specific methodology based on the use of systems/software engineering techniques and tools [53][54]. This methodology is based on the use of diagrams representative of different views of the object studied and is also organized in cycles (conception, elaboration, construction and transition) and was used to develop the model and define the implementation of C2 and DOCR processes and concepts in the PSP environment. Throughout the steps of the two action research cycles, several modeling cycles occurred.

4. Results

The proposed OI suggests the adoption of processes, organizational structures (institutional actors with well-established responsibilities), and information structures for the incorporation of C2 and DOCR in the treatment of failures that occur during the PSP. The three dimensions covered are integrated, and the one resulting from the integration defines 'who' (actor) does 'what' (process), 'what is treated' (information) and who is responsible for the information, always related to the treatment of failures (FIG. 4 – Proposed three-dimensional model) and the use of C2 and DOCR processes and concepts.

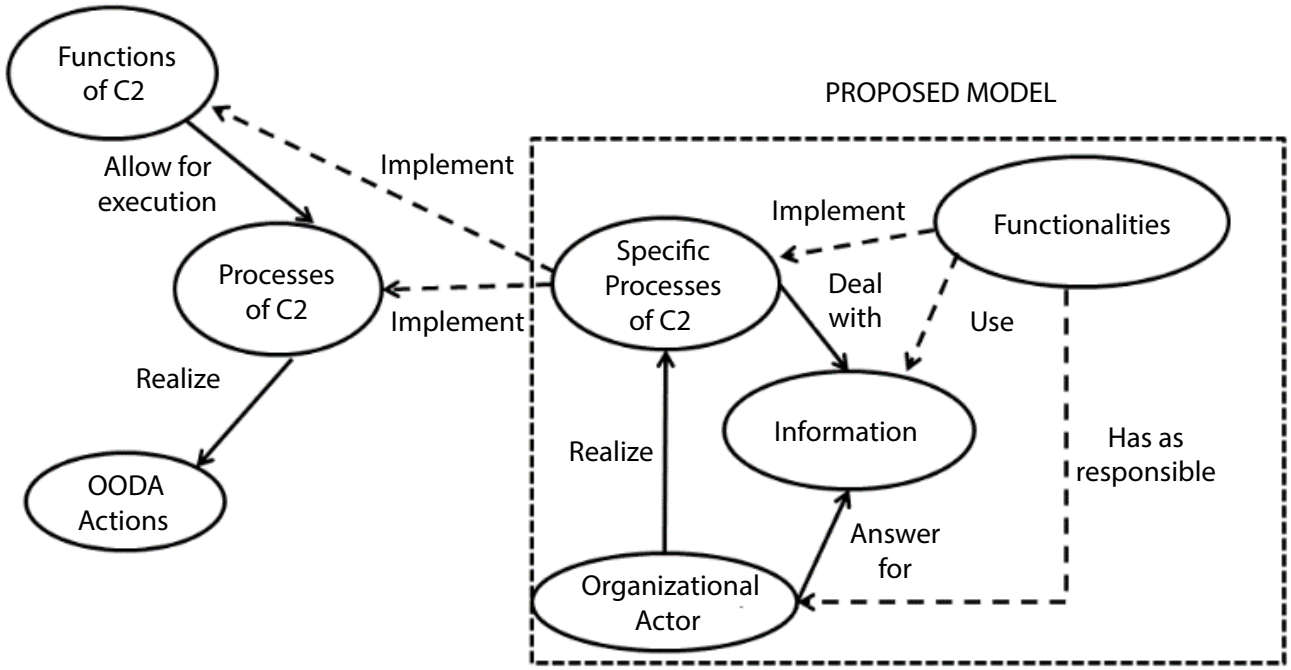
Figure 4 - Proposed three-dimensional model.



To perform the OODA cycle, C2 processes must be performed cyclically (FIG. 5). The Functions of C2 [2] [21][22] promote the framework so that the processes of C2 can be performed, as shown in FIG. 5.

Thus, the proposed model should provide specific C2 processes that implement C2 Functions and Processes, and that support the performance of the OODA cycle Actions. The execution of the specific processes of the proposed model is done by the functionalities of the system and is only possible with the proper treatment of information and the correct identification of the organizational actor responsible for the execution of the specific processes and the management of the information, as presented in FIG. 5.

Fig. 5 - Proposed model and the implementation of C2 and DOCR.



The proposed model addresses the research problem by acting on the response time elapsed between the occurrence of a failure and its total solution.

- When a failure occurs, corrective actions must be taken to resolve the problem. One variable can be identified: the response time. This variable can be divided into three parts:
- Perception time (*tp*) – time elapsed between the occurrence of the failure and its perception.
- Triggering time (*td*) – time elapsed between the perception of the failure and the triggering of the corrective action;
- Execution time (*te*) - time elapsed between the beginning of the corrective action and the complete solution.

Therefore, the response time (*tr*) is equal to *tp* + *td* + *te*.

Since efficiency is the normative measure of resource use in a given process [35], and since time is a resource used by processes, it is acceptable to assume that the *tr* used to correct a failure is a factor that inversely influences the efficiency value: the higher the *tr*, the lower the efficiency.

Since effectiveness is the normative measure of the achievement of the results of a given process [35], and since *tr* is the time interval between the moment of expectation of the result (when the failure is perceived) and the moment when the effective result is achieved, it is plausible to consider that *tr* also influences the value of effectiveness in an inversely proportional manner: the longer the time elapsed to achieve the results, the lower the value of this result.

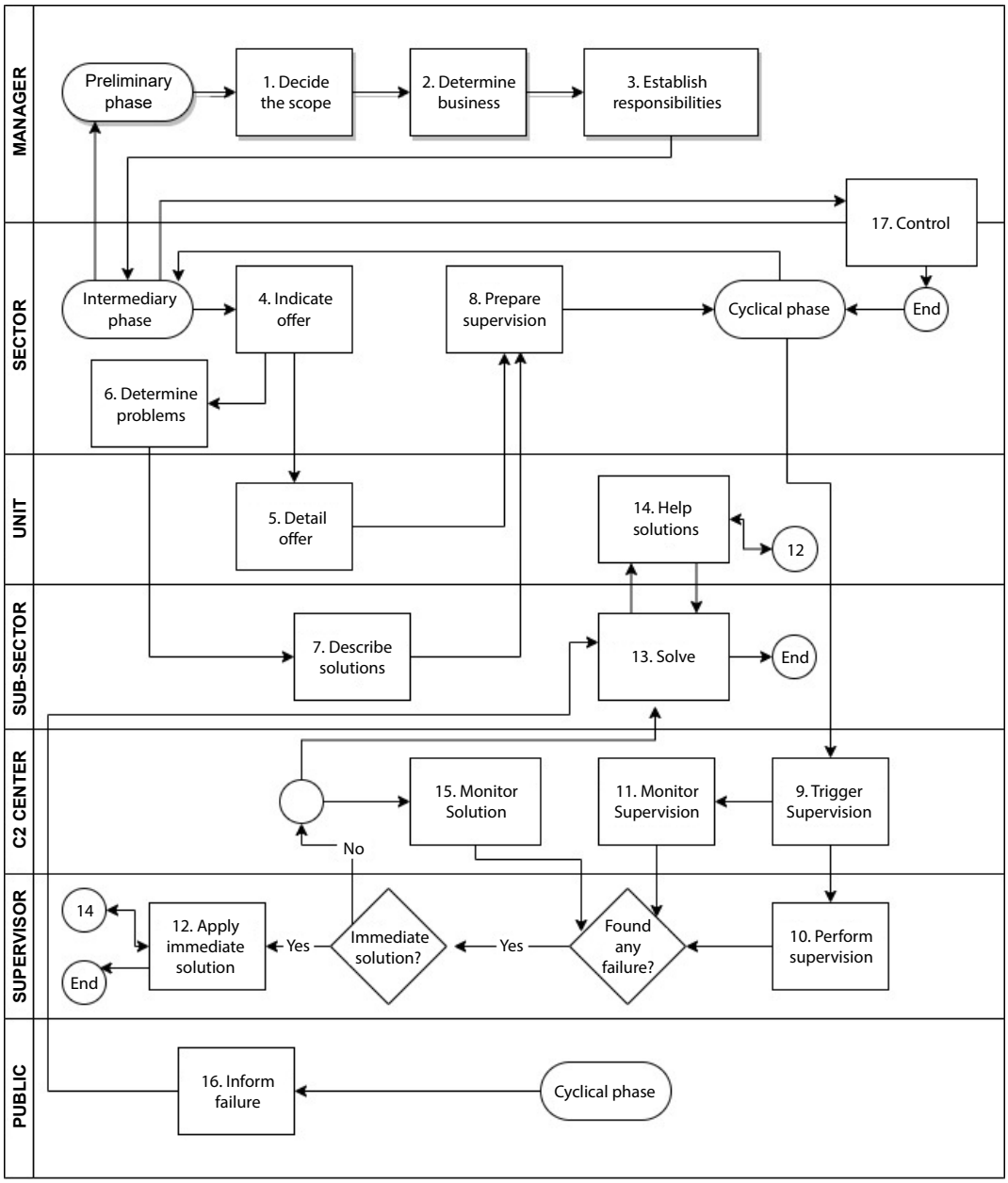
From the above, it is plausible to accept that, by acting to reduce the *tr* necessary for the treatment of a failure, one will be contributing to the improvement of the PSP's performance. It is exactly in this aspect of the PSP that the proposal acts: decreasing the *tr* for the solution of failures, acting on its components *tp*, *td* and *te*.

4.1 Procedural Model

The Business Process Flow Diagram of Figure 6 represents the proposed procedural model. The processes act on the variables related to the treatment of failures, as presented above. Processes nine, ten, eleven, and sixteen reduce the *perception time*; processes

ten, eleven, and twelve reduce the *triggering time*; and processes thirteen, fourteen, and fifteen reduce the *execution time*. Process seventeen may reduce any of the variables.

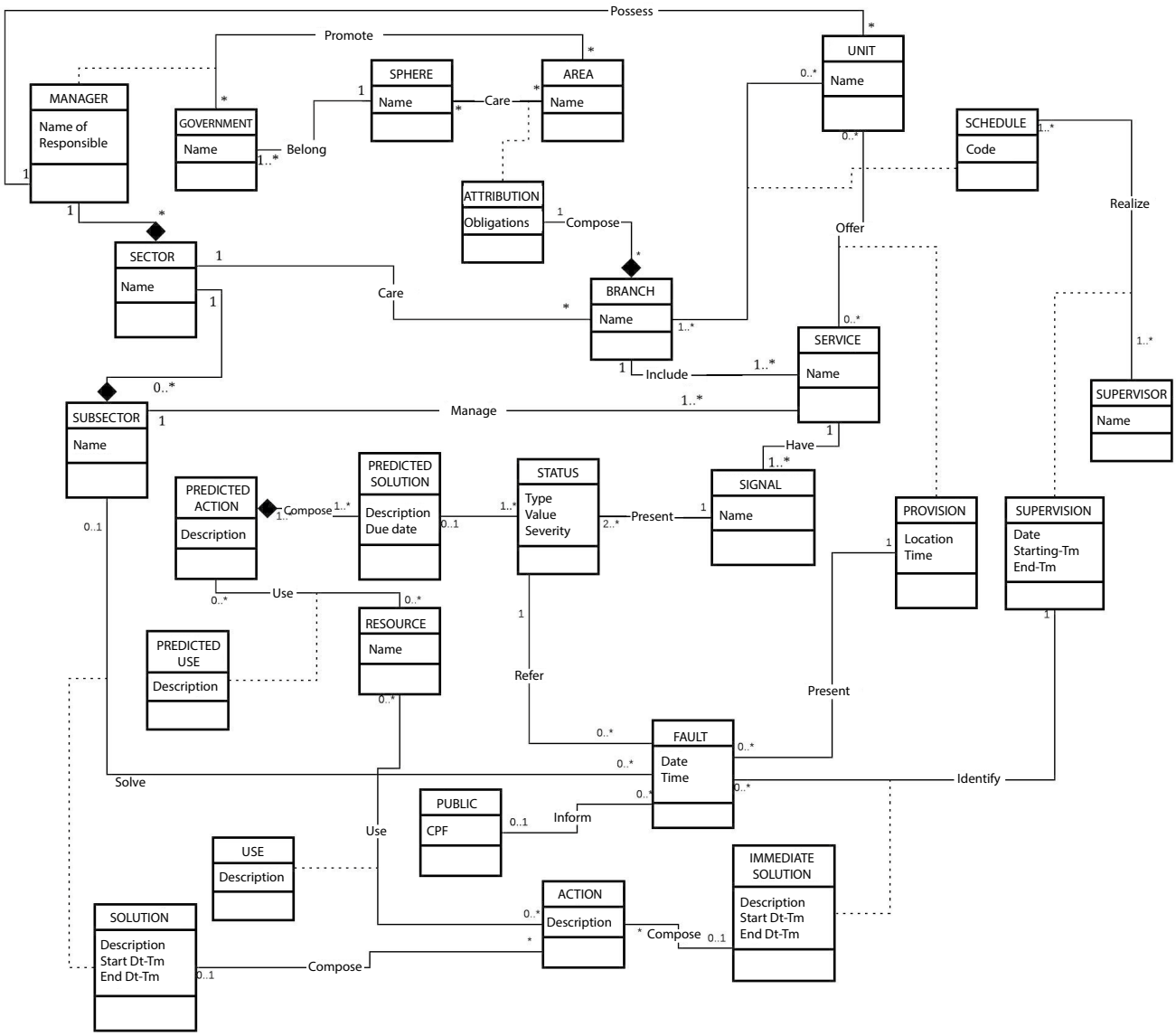
Fig. 6 - Model of C2 and DOCR Processes for the treatment of PSP failure.



4.2 Information Model and Organizational Model

The informational model contains the structure of the information necessary for the processes to be carried out, so that there is no type of ambiguity. This model contains the information elements (Sector, Fault, Solution, etc.), their main characteristics (date of the Fault, name of the Sector, description of the Solution, etc.) and the relationships between the elements (a Subsector acts on a Fault through a Solution, for example), and is presented in FIG. 7.

Fig. 7 - C2 and DOCR Information Model for the treatment of PSP failure.



The organizational model contains the generic functional structures (actors) responsible for carrying out the processes and managing the information. Some actors are pre-existing (Manager, Sector, Sub-sector, Unit, and Public), and others exist only for the treatment of faults (C3 and Supervisors). The actors are also represented in the lanes on the left side of Fig. 6 (actor responsible for the process).

In addition to the definition of the three models mentioned above, the proposal also presents the metamodel and the integration between dimensions, relating the three dimensions to each other, symbolized by the planes and the resulting graph presented in FIG. 4.

A metamodel is a model of the model. Obtaining the metamodel or meta-modeling is the analysis, construction, and development of applicable and useful representations, rules, constraints, models, and theories for modeling a predefined class of problems.

In the particular case of the research, the metamodel offers a view of how the three dimensions considered in the proposed model are organized and related. Thus, while the proposed model informs what

the elements of each of the dimensions addressed are and how the elements of each dimension relate to each other, the metamodel of the proposed model portrays the general characteristics of each dimension and how the dimensions relate to each other.

The class diagram of Fig. 8 contains the meta--model of the proposed model, whose core is formed by classes that represent the dimensions addressed: informational element, procedural element and organizational element.

Each of these classes specializes in the specific classes of each dimension. The procedural element specializes in seventeen classes representative of the processes identified in the procedural model; the organizational element, in the eight classes of the organizational model structure; and the informational element, in the twenty--six information classes of the informational model.

The associations between the meta classes representing the three dimensions provide the foundations for integration. In view of space limitations, the integration is not presented in this article, but the reader can refer to the reference dissertation [1] for further details.

Fig. 8 - Organizational Model of C2 and DOCR for the treatment of PSP failure.

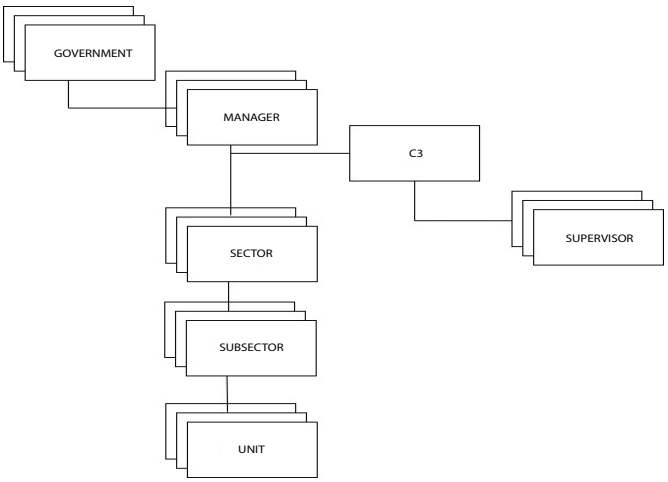
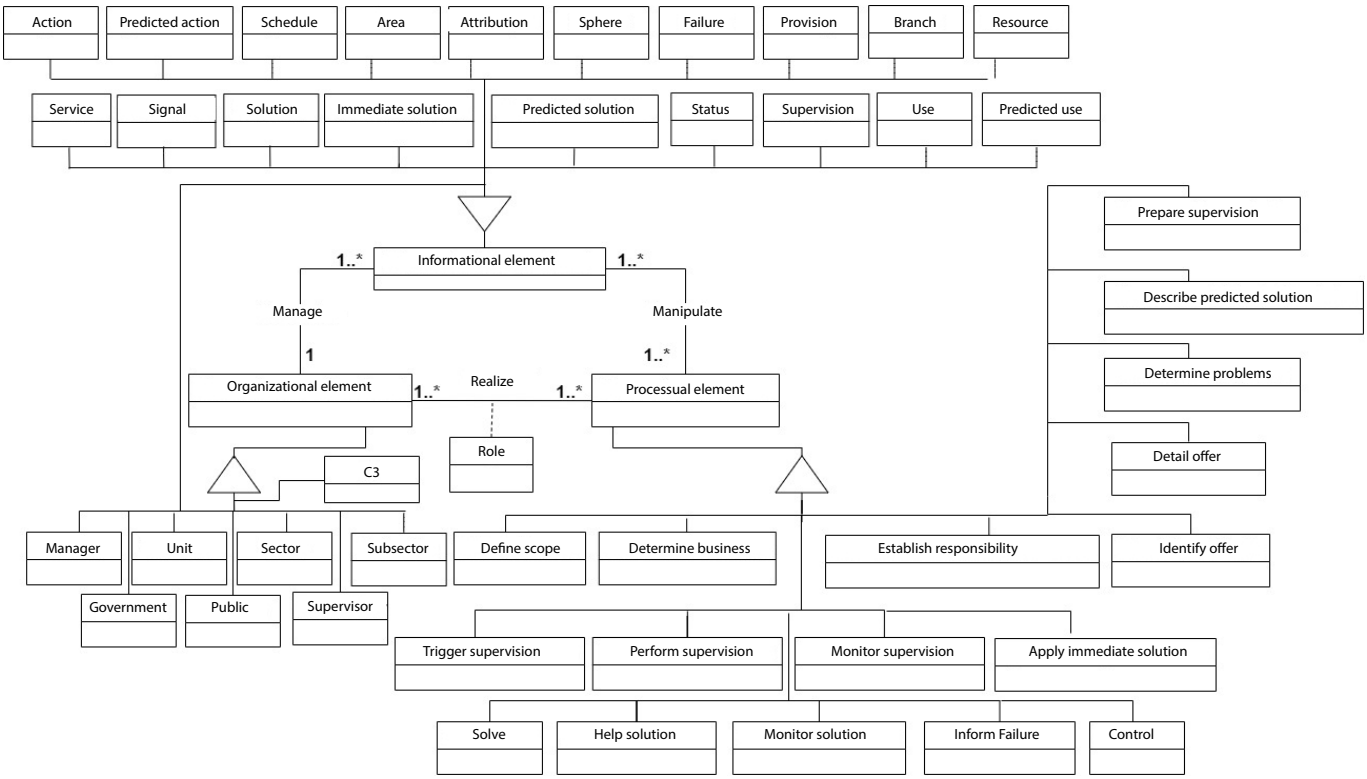


Fig. 8 - Meta-model of C2 and DOCR Information for the treatment of PSP failures.



5. Pilot Project

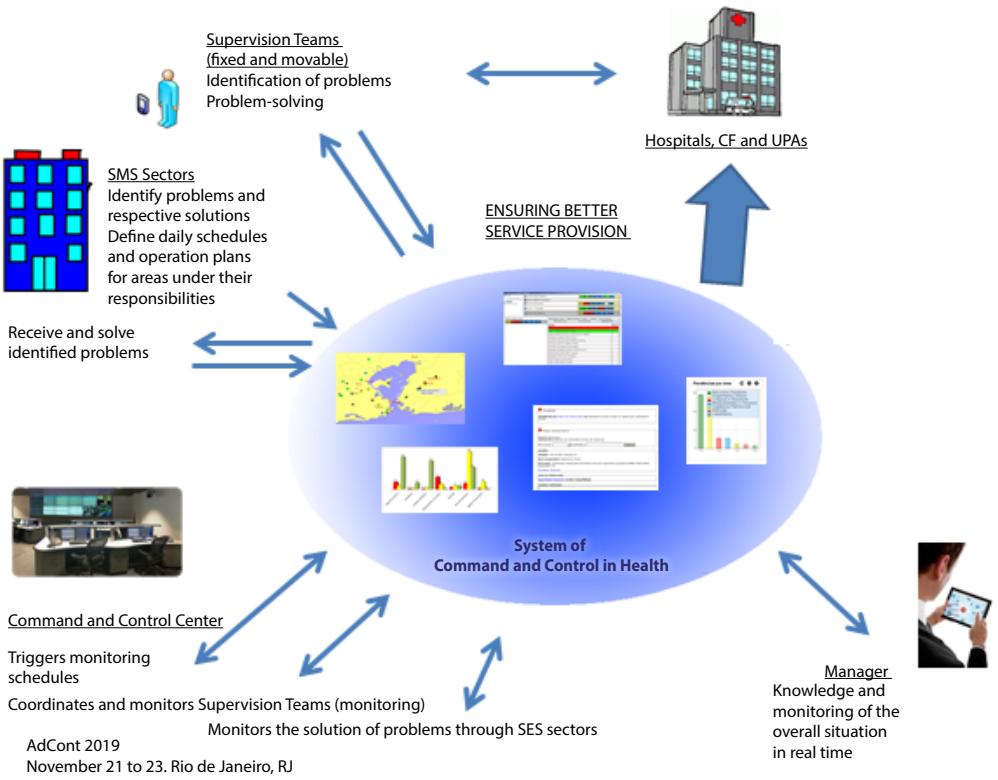
The pilot project was implemented in the period between 10/28/2013 and 03/13/2014, during the experimental and validation stages of the first cycle of action research. It was composed of the C2 Center, the supervision team, an IME team, the team of SES institutional actors involved in the treatment of failures, the monitored units (two hospitals and 28 UPAs) and the C2 computerized system (SC2). The daily operation composed of the processes of the cyclic phase of the procedural model (FIG. 6) is presented schematically in FIG. 9.

784 supervisions were performed, with 37,000 flags analyzed. 736 problems were identified, 632 of which were solved before the next supervision, as a result of the implementation of the proposal (resolution rate of approximately 86.4%).

In addition to decreasing the response time in the treatment of failures, other factors were noticed. For example, almost half of the failures identified throughout the experience (30.77%+17.48%=48.25%) presented reasonable or high severity, with more than 17% being severe. As an example of serious failure, the storage of expired drugs in doctors' offices, which were normally distributed to the public, can be mentioned.

Another finding concerns the previous perception of managers that the 'biggest problem' of SES-RJ would be related to the 'human resources' Branch (absences, delays, and shortages of professionals). It was found that the problems related to this Branch were, for the most part, of medium severity. The 'medicines and supplies' Branch, which was not the focus of greatest concern for managers, received most of the serious problems (almost 40% of all serious problems), as shown in FIG. 10. This finding means that a Branch with serious management problems in the delivery of the service was not perceived as a fragile point, thus not receiving due attention from managers. Particularly in the area of public health, the correct identification of fragile points in the PSP can represent the preservation of many lives.

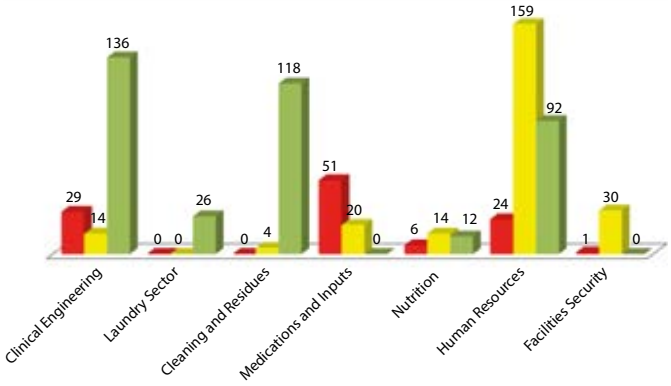
Figure 9 - Cyclical phase of the pilot project.



It was also possible to identify the institutional actors that faced the most problems, showing the need for an internal audit to seek the reasons for this behavior.

After the second cycle of the action research, based on the analysis of the results of the pilot project and a new round of research and development, the initial model was evolved into the proposed final model, which is presented in section 4 (Results). As explained in section 3 (Method), only the first cycle of the action research took place in full, and only one pilot project was implemented.

Figure 10 - Fault distribution according to severity and area. In each group of three bars, the more severe is on the left, and less severe on the right.



A second and third pilot projects are being planned at the time of writing, as part of the completion of the second cycle and the completion of a third action research cycle, which will continue the research produced during the completion of the original doctoral dissertation.

Conclusion

This study presents an open OI proposal for the implementation of C2 and DOCR in the treatment of PSP failures. The objective is to intensely reduce the consequences of failures during the provision of the service to the citizen, by reducing the times related to the solution of failures.

In view of the evolution that occurred in the exploratory stage of the second cycle of action research, the final proposal presents improvements in relation to the model implemented in the pilot project. For example, it is possible to identify how quickly the sectors solve the problems encountered and the public can participate in the treatment of failures, through process 16 (FIG. 2).

As limitations, only one complete cycle of action research can be mentioned; the lack of a mechanism for performance measurement; the impossibility of comparisons between the results of the pilot project and the previous situation, in view of the lack of a prior failure treatment mechanism; and the realization of only one pilot project. Further executions of exploratory and validation stages of the second cycle of action research tend to address these limitations.

Finally, it should be noted that the proposed model is generic, which means that it can be applied to any area of the public service (health, education, etc.), despite having been developed based on the field of public health.

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