TOWARDS AN INFORMATION SYSTEMS-DRIVEN

ORGANIZATIONAL DEVELOPMENT MODEL

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Abstract

This article discusses the main topics of interest that matter in defining a multidimensional vision capable of expanding the assessment horizons in order to deal with problem situations related to change and organizational development. In performing the descriptive and interpretive analysis of three Organizational Development (OD) projects in Brazilian public sector, based on systemic action research, it sets out a generic learning mechanism that support decision in complex scenarios. This mechanism allows decision makers to assess and diagnose problem situations in the development of their organizations through of a generic framework according to which information systems can be emerged. Most importantly, it provides a holistic and synergistic understanding of organizational functioning appropriate for the information age. Thus, the findings enabled to identify and explain four distinct dimensions that must be understood to pass from ill-structured problems to learning context until we find appropriate solutions options, which can be high-tech or low-tech.

Keywords: learning mechanism; problem structuring methods; systemic action research.

Introduction

In order to think a robust organizational development model in the current world situation, a lot of creativity and innovative spirit is necessary. In modern times, organizational development depends fundamentally on information systems. These, in turn, are intertwined in complex scenarios, especially because they involve different areas of human activity and because they suffer with the emergence of unpredictability, instability and environmental uncertainties.

Nowadays, the world is strongly characterized by the formation of networked systems and increasing objective complexity, where transdisciplinarity becomes relevant because knowledge more than permeates, it runs through the disciplines and sciences and it is among the disciplines and sciences, what makes you think in an integrative and systemic view (Garbin, 2011).

The development of systemic thinking is a circular learning process that aims at replacing a reductionist approach – restrictive, short-term, static view of the world – for a holistic – wide, long-term and dynamic view of the world – implying theories and practices to allow (re)designing policies, strategies and desirable institutionalization.

The absence of appropriate methods, models and tools to effectively manage complexity is the starting point for reflection and development of this research, which aims to address instruments typical to systemic thinking, helping to visualize, analyse, model and structure projects in complex scenarios.

Related to the central idea that serves the study under investigation, there is a definition of the general purpose of the study, that is, proposing a learning mechanism to facilitate the work of organizational decision makers, with a view to exploration and evaluation systems set up around a problem situation.

The main contribution of this study is to stimulate reflection on problem situations in complex scenarios for a more creative and innovative "make-it-happen", forming learning and information systems. It is an attempt to go beyond the organizational development exclusively with analytical approaches, by establishing other systemic approaches complementary to the traditional ones, in order to deal with the increased complexity of engineering projects and change processes, using a multidimensional and multimethodological design approaches.

The Center for Multimedia and Internet of the University of Brasília coordinated three research and technical development projects in partnership with Brazilian Public Sector Institutions. The convenience in terms of data collection, the scope of the studies, the ease of access to social actors, besides the fact that situations involving information systems were adequate for undertake the field research, allowed to design of the activities of analysis and reflective review. Therefore, the main interest of these three scenarios was to achieve theoretical knowledge based on the practice of communicative action.

The strategic design of this research is based on the confluence of the systemic approaches such as integral and systemic action-research by André Morin (2004) and Soft Systems Methodology (SSM) by Peter Checkland (1993). Likewise, the principles of the systems thinking paradigm (Gharajedaghi, 2011; Vasconcellos, 2013; Demo, 2014) and others systems practice concur to use a methodological orientation that includes the precepts of multimethodology systemic approaches, appropriating problem structuring methods and different paradigmatic conceptions (Rosenhead, 1996). All this to better portray the reality regarding the systemic complexity, communication actions and practical reflections.

The paper is structured into six sections. Following this introduction, Section 2 highlights the multimethodology approach and problem structuring methods (PSM) that guides systemic action research projects. Section 3 outlines the research strategy, which sets

forth the criteria and methodological guidance model adopted to conduct field research. After that, in Section 4 we briefly describe three field-research scenarios, methods of data collection and analysis and the intervention mode based on Morin´s anthropo-pedagogy (Morin, 2004). The analysis and synthesis of each integral and systemic action research project have broaden the horizons for assessment of the research scenario, which triggered reflexive reviews and discussions in Section 5, culminating with the proposal of a learning mechanism. The last section performs the closing remarks, pointing to future studies and development possibilities.

Multimethodology Approach Based on PSM

The methodology is a structured set of guidelines or activities that help people in conducting research or intervention (Mingers & White, 2010). You will hardly find a single methodology that can attack and deal with all aspects of complexity. The challenge is to achieve a methodology combining other methodologies able to gather knowledge that can be useful in creating solutions that work. Choosing a variety of systemic methodologies is, at the same time, theoretically adequate, and also objectively very difficult to manage in practice (Jackson, 2003).

There is an important movement within the operational research towards the concomitant use of Hard OR and Soft OR paradigms and methodologies (Jackson, 2003; Munro & Mingers, 2002). We see the use of a multimethodological approach resulted from a combination of methods and techniques with a systems approach as an important focus for the future of Soft OR and the structuring of problems robustly developed (Jackson, 2003; Seagriff & Lord, 2009).

With the emergence of soft systems methods and practices, various application possibilities of those approaches have been experienced (Jackson, 2003). From an extensive

literature review, Howick & Ackerman (2011) argue that the combination of methods with systems approach is gaining interest in structuring problems for more than two decades. However, little has been produced on the combination of methods in practice.

In spite of several published cases employing multiple systems approaches, Howick & Ackerman (2011) warn that there is a wide variety of combination methods. However, they point out the lack of well-defined criteria or a paradigm of how and why to use different methods in operational research.

When it comes to putting together several methods available in systems approach, there are few empirical studies that really show how they can be combined and put into practice. Still, multimethodological approach facilitates in structuring problems and analyzing alternative designs and processes to specify the implementation of system solutions (Small & Wainwright, 2014).

Additionally, Mingers, & Blocklesby (1997, p. 492) present four arguments in favour of a multimethodological approach: (i) the real-world problem situations are inevitably complex and multidimensional, (ii) an intervention is usually not a single event and discreet, but a process that typically occurs through internships, (iii) further analysis of the philosophical and theoretical aspects of multimethodological approach is timely, since many people are combining methodologies in practice, and (iv) arguments of a postmodern perspective also support pluralism in methodology.

There are generally three stages in the selection of a multimethodological approach: (i) creativity – initial exploration of the situation; (ii) selection – the selection of one or more specific methodologies; and (iii) implementation – putting the methodologies in practice (Jackson, 2003). According to Mingers & White (2010), understanding the strengths and weaknesses of different methods that make up each methodology is an important step, as is

the need to reflect on the interests that are being developed in the interventions and be prepared to use them together.

Multiple systems approaches provide adopting a variety of methods which differ in both complexity and in content. Among these methods, Martinelli & Ventura (2006) highlight: action research, cybernetics methodology, inquiring systems, interactive planning, SAST (Strategic Assumption Surfacing and Testing), development and analysis of strategic options, critical heuristic for the social thought, CSH (Critical Systems Heuristics), Evolutionary Administration, SSM and VSM (Viable Systems Model).

Small and Wainwright´s (2014) research shows that through the use of action research and the development of a contextualized multimethodological approach, the different players within the organization can participate in the design of new systems and adopt faster technologies to address the operational problems posed by the parties in a more systemic and innovative way.

The essence of a multimethodological approach is the association of different parties from the participating methodologies, combined by juxtaposition or by agglutination. Mingers & Blocklesby (1997) propose a framework that combines the decomposed parts of SSM Peter Checkland, with CSH Werner Ulrich and VSM Stafford Beer, and computational tools.

Professor Ion Georgiou proposes a multimethodological approach based on a combination of SODA and the SSM map. A SODA map can enrich the SSM, providing a methodological resource for structuring a large number of transformations. The map helps to identify the relationships between system transformations, their hierarchies and priorities, epicentres of problems and starting points for intervention – which serve to inform the manner in which such interventions can be performed (Georgiou, 2012).

Some examples of the application of multimethodological approaches can be found in Mingers & Rosenhead (2004). Among the reported cases, they highlight the development of an IT strategy for a supermarket chain – adopting, in combination, the SODA methods, SSM and SCA. The authors also present a list of dozens of works, gathered from the literature, with various experiences applying multimethodological approaches. In over 80% of the disclosed application, the SSM method is adopted.

Research Strategy

Feasibility of a research project involves the definition of research strategy, based on the definition of a methodological guidance capable of supporting the development stages of a research built under constructivist design, communicational and interventionist actions, and capable of incorporating prospecting and systemic analysis methods.
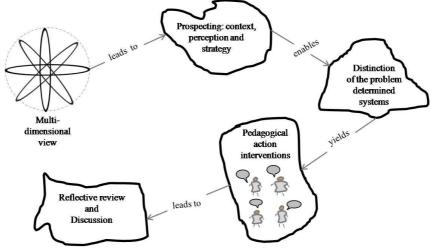
In order to determine the research plan, Morin (2004) posits on the appropriate model to deal with complex problem situations. He admits that a dynamic model better represents the idiosyncrasies of individuals and groups participating in the action research. Using a spiral, he represents such a model, noting that the base is wider when the complexity of the context is perceived from the start in the definition of the problem due to the use of a systemic, comprehensive and holistic approach. The perception of the problem will become clearer and the accuracy of the interactions will realize unknown meanings.

With a view to discover the motivations that lead to the characterization of a research problem and its texture, the methodological orientation adopted in this investigation prescribes an attitude of objectification and discussibility, instead of seeking criteria of objectivity and relations of cause and effect. The methodologist Peter Demo warns that the pursuit of objectivity is a great utopia of science, since, from a formal point of view, you

want to know the reality as it is, the more perfect picture, the most analytical explanation possible, which is so characteristic of the positivist conception (Demo, 2014).

The principle of multidimensionality of Gharajedaghi (2011), combined with the learning perspective of Checkland & Holwell (1998) information systems, with the anthropo-pedagogy approach by Morin (2004) and with the conceptual foundations of Aun, Vasconcellos, & Coelho (2012) methodology, triggered the formation of the methodological orientation of this study.

It is therefore a proposal for a methodological framework that stretches the development of the activities of prospecting, data collection, descriptive and interpretative analysis, including discussions and reflective assessment – depicted in Figure 1.

Figure1. Methodological guidance based on integral and systemic research (Lima, 2015)

Peter Checkland proposed the Soft Systems Methodology (SSM) as a very simple methodology to deal with complex problem situations (Jackson, 2003), in order to more adequately appropriate the diversity found in a particular research setting, allowing the collection of different views of interested parties through a closer representation possible to the real world and of systems thinking.

Field Research Scenarios

Aiming at performing the steps and procedures for this research, special attention was paid to contextual conditions and circumstances of the research scenarios that suggest new courses of action, depending on the dynamics inherent in the analysis of context and the changes taking place.

Action-research allows the social actors and researchers to build theories and strategies that emerge from the field and then they are validated, confronted, challenged within the field, carrying desirable changes to better solve or question a problematic situation (Morin, 2004; Thiollent, 2011), involving, for example, the development of information systems (Baskerville, 1999).

Imbued with the challenge of experimenting situations with problems associated with organizational development in practice, so that the assumptions taken in this study could be instigated through action research (Thiollent, 2011), the starting point was the definition of the field research project.

This study based on three field research scenarios developed on the Brazilian Public Sector and Military Force over the years 2012 to 2016. For more information please visit Lima (2015).

The first field research project, called Project Alpha, is the result of an organizational change project of a Military Unit of Brazilian Air Force. This Military Unit operates in the implementation of planning, preparation, employment, control and surveillance of the operations of the Brazilian Air Force.

The second field research project, called *Bravo Project*, is the result of a RTD project, claimed by an IT Department belonging to the Brazilian National Ministry of Integration, in partnership with the Center for Multimedia and Internet. The RTD project is focused on process improvement and project management and information technology governance from

the IT Department. The main objective of this project is the technical and methodological support for the implementation of policies and strategic plans for information technology.

The third field research project, called *Charlie Project*, is the result of a RTD project, claimed by a Creative Economy Department belonging to the Brazilian Culture Ministry, in partnership with the Center for Multimedia and Internet. The RTD project faces processes and projects of technical and methodological support to the implementation of an articulated network of creative economy offices in Brazil.

Data collection and analysis methods

We see data analysis as a technique that contributes to the viability of the research, enabling the interpretation of the data collected and subsequent practical implications that may arise. To handle large volumes of data, inherent feature of the approach taken, the researcher should ask how to analyse them to get to write a report, respecting the object of research and acquiring the credibility of assistance in practical knowledge (Morin, 2004).

Unlike quantitative methods that seek an instrumental and exhaustive treatment in order to achieve a mathematical quantity that can be explained later by statistical or probabilistic techniques, in this study, the data analysis is the development of techniques associated with the comprehensive and systems approach, combining the instruments of soft systems methodology, action research and ethnographic study, which are purely qualitative. The interest is focused on the description of the nature and the organization and structure of objects and their inter-relations, under the inter-subjective views of the social actors and researchers involved.

Based on the assumptions made for the definition of a research plan in the doctoral thesis of Lima (2015), the methods and tools were defined in order to consider the level of coverage and specificity of methodological approaches – depicted in Table 1.

Intervention Mode

At this stage, we seek to equalize the desired changes and the viability of systems against the real world model, then negotiate and develop improvement interventions in the human activity systems linked to each project. The intervention mode is classified as pedagogical action that follows the assumptions of the anthropo-pedagogical approach by Professor André Morin. The starting point is the definition of a structure for the discussion on action research and the suggestion of several tools of observation, recording, interpretation and collective writing. The purpose, therefore, is to undertake projects with possibilities of adapting to desired and viable changes, with a wide range of development opportunities.

Table 1. Data collection, Descriptive and Interpretative Analysis Approaches (Lima, 2015)

Project	Sources & Resources	Data Collection & Analysis Method	Frequency / Average duration	Descriptive and Interpretive Tools
Alpha	*Workshop*: Commander, Generals and Division Chiefs, as well as process analysts.	- participant observation	5 sections of 30min	Descriptive Tools - Script to start system studies (Checkland, 1993) - Aspects of Boundary Analysis(Ulrich, 1987) - Prospecting of the network typology (van Waarden, 1992) - Diagnosis of system performance capacity (Morgan, 2005) - Evaluation categories of boundary judgment (Ulrich, 1987) Interpretative Tools: - Policy Delphi sections - Social Network Analysis (van Waarden, 1992) - Viable Systems Model (Beer, 1984)
	Conference (planned action): - Generals and Division Chiefs, - process analysts	- participant observation - discourse analysis	10 sections of 1h30min	
	Digital Library: - rules and regulations - Institutional and sectorial plans	- content analysis	-	
Bravo	Conference: - Coordinators and IT Analysts - Researchers	- unstructured interview - discourse analysis	24 sections of 30min	
	Collective Interview: - Coordinators and IT Analysts - Researchers	- unstructured interview - participant observation	21 sections of 1h30	
	Planned action: - Coordinators and IT Analysts - Coordinators and business Analysts - Researchers	- participant observation	3 sections 2h00min	
	Repository: - rules and regulations - Institutional and sectorial plans	- content analysis	-	
Charlie	Ethnografic Research:	- participant observation	4 visitations of 3 days	
		- unstructured interview - discourse analysis	8 sections of 1h30min	
		- unstructured interview	8 sections of 1h30min	
	Reflective review: - Researchers	- unstructured interview	10 sections of 1h30min	
	Conference (planned action):	- participant	4 sections of	

Project	Sources & Resources	Data Collection & Analysis Method	Frequency / Average duration	Descriptive and Interpretive Tools
	- Technical coordinators and business support staff - Cultural agents and eventual public managers	observation	3h00	
	Repository: - rules and regulations - Institutional and sectorial plans	- content analysis	-	

The anthropo-pedagogical question that Morin (2004) refers to consists in the application and adaptation of methods of informative anthropological observation and principles of open pedagogy, which are based on the autonomy of social actors, updating emancipating organizational proposals.

In short, the pedagogical actions outcomes reflect the collective decisions taken by social actors and researchers involved, as can be seen in Table 2.

Table 2. Summary of pedagogical actions outcomes (Lima, 2015)

Topics	Outcomes	
	Alpha Project	
Scheduled actions & implemented actions	Implementation of awareness and activation workshops to sector managers.	Research actors received and assimilated satisfactorily.
	Implementation of the mapping methodology of business processes and work.	Actors shown many difficulties in the use of methodology, due to: new concepts, reluctance and unwillingness.
	Mapping and modeling of business processes and work.	First version of the mapped work processes. Low productivity and little involvement.

Achieved benefits	*Enhanced internal discussion on the workflows of the organization sectors.*
	Allowed to reflect on anomalies:
	    - Resources misused in some activities.
	    - Communication between adjacent truncated activities of the same process, performed by different sectors.
	    - Inability to set goals and indicators for the processes.
	Inclusion of mapping processes as an appendix to the operational norms.	

Difficulties	Low maturity in terms of employment of rating process mapping.
	    - Mapped process inconsistent with the actual process.
	    - Logic based on functional structure.
	    - Organization focus restricts based reasoning process view.
	    - Reduced team of process analysts.
	    - Requires appropriate preparation to conduct support specialists.
	    - Macro processes covert.
	    - Limited perception of processes, restricted by functional vision (Regiments and Operational Procedures).	

Bravo Project		
Scheduled actions & implemented actions	Implementation of awareness and activation workshops to IT coordinators and analysts.	Intense exchanges of knowledge and perceptions between social actors and researchers involved.
	Diagnosis and evaluation of IT subsystem with systems approach.	Challenges and opportunities arising from the communicative and appreciative action of experienced reality; low systemic consciousness essentially analytical view.
	Proposal for a strategic IT plan.	Involvement of business areas in the formation of a strategic IT plan;
Achieved benefits	*Possibilities for broadening the horizon of evaluation of typical problem situations to the level of IT system. Allowed reflect on anomalies:* - Addressing of problems with poor or hasty solutions. - Unfavorable factors drifting action targets. - Growth limited blockage. Roadmap to include actions to develop in the short term.	
Difficulties	*Solutions of problem situations make the problems chronic, pushing prospects for fundamental solutions:* - Tendency to always take the fastest and most economical solution, symptomatic solution. *Lack of an IT governance policy:* - Absence of policies, guidelines and procedures for orientation and coercion.	
Charlie Project		
Scheduled actions & implemented actions	Implementation of media and networking workshops	Understanding the fundamentals for the construction of a concept of creative economy in Brazil. Public policy proposals involving the creative economy. Plan of the Secretariat of the Creative Economy. Territories, cities, Centers and Creative Basins.
	Proposed management model and governance of the creative economy offices	Feasibility of decision-makers based on the committees-manager and executive and advisory councils. Projects and current operations broken down into work packages.
	Technical and methodological support for the implementation of creative economy offices	Ethnographic studies with social groups involved in local ecosystems of creative economy in Brazil. Social network analysis of the ecosystem of the creative economy.
Achieved benefits	*Construction of a shared management model, enhancing the co-construction of the consensus, with:* - Purposes around a theme. - Priority to dialogue on teamwork. - Belief and valuing people / institutions involved in the process. - Consideration, recognition, validation of the particularities of each one. - Perseverance in order to prioritize the dialogue context.	
Difficulties	Lack of a platform for dialogue and interaction with partners and funding agencies. Difficulty in finding experts with systemic consciousness prepared to guide and train creative professionals in the context of the creative economy.	

Reflective Review

The reality observed in each research field landscape and because of the holistic understanding of the problem-situations triggered both by the dynamics of human activity systems as interventionist actions favoured the assimilation of instruments and disciplinary mechanisms necessary to seek resolution for any particular problem.

However, only after the system distinction set around the main problem situations, linked to each project, and the perception of linguistic domains present in each scenario investigated, it was possible to prospect methods and technological approaches to make realizable each pled solutions. In the end, the whole process of communication and systemic evaluation contributed to the adoption of measures by managers and other individuals with leadership role in their respective projects.

Social phenomena permeate the work of professionals implying their ways and leading work fronts. Be by the need for ideas and tasks in an orderly, consistent and thorough manner, or by chaining tasks and use of resources, the coordination function is present (Aun, Vasconcellos & Coelho, 2012). Although there is an active coordination to soften and harmonize human activity systems that are around the work areas, the systemic complexity goes beyond this dimension of analysis.

After the interpretative analysis carried out individually on each of the three field research projects, we can identify important vestiges that revealed the main difficulties and successes obtained with the pedagogical intervention actions undertaken – Table 2. Systemic analysis allowed scaling the conditions and performance restrictions in functional, behavioral, procedural and institutional terms. Over the next sections we will discuss specific aspects and keys that led to reflective review.

A Proposal for a Learning Mechanism to Support Decision

Complexity is multidimensional and therefore requires different approaches to address its different aspects (Jackson, 2003). To cope with the complexity of human activity systems, one of the most powerful features is the ability to think the systems from various perspectives or through multiple dimensions of evaluation. Indeed, the achievement of those dimensions requires moments of reflection and communicative action between participants that must have a coordinator who can be the interlocutor of the linguistic domains and enable the interconnection of knowledge networks to minimize the effects of "knowledge islands" which are generally formed by different social groups.

For each dimension there is a set of proposed assessment tools to deal with problem situations, expressed in human activity systems, leading to the formation of social learning information systems. As a result, the organizational development model is outlined based on the new assimilation of the flow of discoveries and insights in terms of strengths and gaps of the current reality and context of the expected situation.

The perceived social reality in each context of field research is consistent with the political, cultural and technological manifestations prevalent to form a complex scenario, but at the same time symbiotic. In addition to the conditions and environmental constraints, Liker, Haddad, & Karlin (1999) argue that social reality itself of technology implementation is highly complex. This is because different technologies are appropriate to different social contexts for different reasons, which often can trigger adverse effects. Therefore, they conclude that we needed complex theories that recognize the emergency and the social construction of technology.

In order to form the learning mechanism for decision support in complex scenarios, the argumentation strategies were employed along, as they were advancing the

implementation of projects and the results emerging from research undertaken, which allows sketching the texture of the desired mechanism.

In the theoretical arena, the mechanism proposal is based on principles that were drafted by Russell Ackoff, C. West Churchmann, Edgar Morin, Humberto Maturana, Jürgen Habermas and Werner Ulrich. Also considered as a source of inspiration are authors such as Peter Checkland, André Morin, James Gharajedaghi, Mike Jackson, Peter Senge and many other specialists in systems thinking, complex systems and Systemic Practice and Action Research.
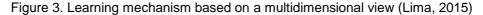
In order to gather in a single inquiring system the above aspects, so that it can deal with chaos and complexity from different perspectives assessment, a multidimensional learning mechanism was set up to deal with problems in scenarios that present unpredictable situations, unstable and with a high degree of uncertainty, from the participation of many different stakeholders.
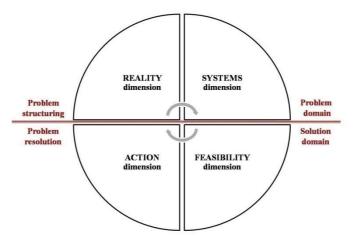
Studies prospecting context, the distinction of the relevant system around the problem situation, the descriptions of the organization and facilitation structure and solution alternatives for intervention actions, involved the following formation of learning objects:

- **real world dimensions:** ill (little) structured problem-situation, inaccessible or inappropriate reality, with multiple linguistic areas;

- **systems of interest dimensions:** system distinction (language) defined around the problem situation, system of systems of interest (SoS) distinction or relevant system;

- **viability and resilience dimensions:** context of autonomy, in search of the solution of the problem situation, description of the organization (ontology) and the structure (architecture) of the resolution system;

- **action and decisions dimension:** decision depends on multiple criteria and/or multiple objectives and may involve collegial decision, depending on the structural coupling of their makers.

Faced with the possibility of building learning systems from multiple dimensions of evaluation parameters, a new perspective emerges with regard to the way that you can use the mechanism. Considering that the first two dimensions – reality and systems thinking – are oriented to the problem domain and the problems in this scenario are typically unstructured and difficult to understand, the Soft OR methods are best suited for structuring effect. Moreover, the dimensions of feasibility and action are oriented to the solution of the problem. Under these conditions, considering that the problem is already better structured and that the systems model is better recognized and understood, the Hard OR methods can best be used, as shown in Figure 3.

Figure 3. Learning mechanism based on a multidimensional view (Lima, 2015)

Although it has a set of enlightening circumstances on the problem situation, there is no perfect decision because they cannot examine all the alternatives and all the consequences of the action. By opting for an alternative, Pereira and Fonseca (2009, p. 45) remindus that we must discard the other, and it always generates a sense of loss, even when the decision is effective, since any decision is an absolutely individual act and non-transferable.

Discussion

In short, the learning mechanism is focused on the definition of multiple dimensions of evaluation of the problem situation and the system built around it for decision support in complex scenarios. Therefore, linking the coordinator role to all engineers or IT professionals is a response to the complexity of human activity under conditions of uncertainty, difficulties, and environmental constraints.

Therefore, it is a dynamic and evolving process as the coordinator interacts with the information system and advances in the construction process in search for concepts and values, which begins with the formation of a problem and culminates with the taking of conscience and revelation of possible ideations.

In practical terms, the mechanism constitutes a body of knowledge that will serve as inspiration and learning for the coordinators of any human activity system, in so far as it traces the contours of the problem situation that emerges from complex scenarios, enabling autonomy (emancipation) of interested and affected parties in the intervention process of reality. The dimensions evaluated act as catalysts vectors, increasing the opportunities for analysis and synthesis of facilitating the decision-making process through the information systems architecture.

Given the methodological approach proposed to support the mechanism of learning, it is a participatory social mechanism. In a social learning system, competence is historically and socially defined (Wenger, 2014), a direct consequence of Humberto Maturana´s structural coupling. A perspective synthesizing the four dimensions of learning mechanism is illustrated in Figure 4.

In order for an action to take place, we first assess the viability of the desired changes in the context of human activity systems – parties involved and affected. Before that, you

need to be aware of the similarities and differences between the actual existence of a problem situation and the distinction of the linguistic system defined in its surroundings.

Figure 4. Learning Mechanism general perspective (Lima, 2015)

REAL WORLD DIMENSIONS

Issues
- Which reality we are talking about ?
- There is only one reality or there are various realities that emerged?
- What reality does it matter?

Evaluation parameters
- Prospecting of ill(little) structured problem situation
- Not accessible or inappropriate reality
- Reality perceived, felt and stage for changes
- Existence of multiple linguistic domains

Approaches and Methods
- PSM and Soft OR Methods
- SSM – 1 and 2 phases
- SODA – Cognitive mapping
- Ethnographic research

SYSTEMS OF INTEREST DIMENSIONS

Issues
- What is the system of interest, recognizing the existence of SoS?
- What references should be considered when evaluating a system?
- What is important to consider the system distinction set around a problem?

Evaluation parameters
- Role of Systemic Thinkers
- Abstraction Moment (holons)
- System Distinction set around the problem situation
- SoS – System of interest (relevant system)

Approaches and Methods
- Conceptual modelling
- Social network analysis
- Boundary critical judgment
- SSM - 3 and 4 phases
- System Distinction (single) language

development cycle

ACTION AND DECISION DIMENSIONS

Issues
- Can you always take the right decision in a problem-solving system?
- How to evaluate alternatives and make the best decision for action?
- What are the measures of value considered important for making na ecological decision?

Evaluation parameters
- Deciding Moment
- Decision depends on multiple criteria and / or multiple objectives (MCDA/MCDM)
- Single or collegiate decision cicles
- Decision support IS formation
- Dependence of the structural coupling of the decision maker
- Coordination System Performance

Approaches and Methods
- Ackoff's interactive systems
- Multicriterion analysis methods
  - American school – AHP/ANP (Saat)
  - European school – Electre and Prométhée
- Strategic and tactic scopes
- Time horizon (short, medium and long term)

VIABILITY AND RESILIENCY DIMENSIONS

Issues
- What can / must be done to solve the problem situation?
- What you need to consider to facilitate the resolution of system problem?
- What are the necessary steps to make feasible the desired solution?
- How to describe the organization and structure of an information system to solve the problem?

Evaluation parameter:
- Autonomy Context
- Performance Specialists
- Modeling Moment

Approaches and Methods
- Churchman's inquiring systems
- Beer's Viable Systems Model
- SSM – 5, 6 and 7 phases
- System organization description (ontology description)
- System structure description (architectural domain)
- Tradicional engineering methods and technologies (systems engineering)
- booleana/fuzzy rationale

In the midst of this assessment, there is a need to describe the organization of the problem situation resolution system through ontology in order to describe its organizational

structure, using architecture domains. Therefore, it was necessary to discuss the establishment of information systems from the perspective of architectures and ontologies, preceded by the application of PSM. More information can be found in Lima (2015) research.

Conclusion

Facing complex scenarios, problems are unstructured and difficult to resolve. Despite the adoption of methods, techniques and tools – traditionally applied by engineering, operations research and management sciences – to solve problems in deterministic and controlled conditions, the same resolution capability is not observed in the problems encountered in turbulent environments, unstable, unpredictable, with multiple objectives, with a high degree of uncertainty and complexity. One way to deal with complexity is assimilating the principle of multidimensionality to absorb it. To apprehend this notion, we must discuss the faces of systemic complexity in light of the theoretical framework presented in the approaches of systems thinking and complexity sciences.

In such scenarios, any individual or collective decision should be preceded by a broad or narrow scope of review, depending on the degree of understanding of the reality and the relevant system to solve the problem. When it comes to complex scenarios, there are several possibilities of decision, either because there are multiple evaluation criteria, either because the relevant system has multiple objectives due to the collegiality of the decision. One can reach such discernment after discussing the faces of decision-making based on the theoretical framework that underlies decision making in complex scenarios.

The organizational development process, prospected in the three field studies, rarely takes into account the distinction between the social aspect and the technological aspect, although it is common to find ways to think about such organizations beyond the operation mode. So it is not unusual to find a lot of approaches, models, methods and prescriptive tools applied to this type of organization, conditioning the way organizations act, without thereby

observing the provision of these human activity systems. Its conduction is performed by governance and management processes that formed intentionally or not, are structured and segregated.

We do not intend to generalize the relevance of the learning mechanism for decision support to all organizational contexts, even though the main purpose is to apply it in complex scenarios in particular. The evaluation parameters contained in the proposed dimensions may be appropriate and passed on environmental contexts and systems formed around the problem situations of each research project undertaken here, or at most similar scenarios. Otherwise, there is no guarantee that the results obtained are the same.

As future work suggestion, the practical bias, as traditionally developed in the training of engineers, can facilitate the implementation of Problem Based Learning (PBL) approaches. Given this possibility, and in view of the applicability of the learning mechanism with methodological guidance, we envision an original study to propose its use as a reference framework for engineering in field research.

Another possibility is to conduct field research under the methodological guidance of the full and systemic action-research approach, in order to reflect the key issues, the main problems and pitfalls encountered in management and operation of information technology in complex public organizations, and to enable its resilient and sustainable performance. Resilient organizations can self-organize in response to changes that cannot be predicted in advance.

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