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Features of Adaptive Complex Systems in the Management Practices of Open University in Brazil

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Abstract **— The study presented here examines management practices which influences the role of Brazilian Open University System (SiSuab) applied at University of Brasilia (UnB). In the explanatory descriptive research on the study of case, twenty-two Department Advisers on SiSuab had been interviewed in three levels of hierarchy. From the outcomes, features of Adaptive Complex Systems (ACS) had arisen: 1) aggregation – creation of a new culture of Distance Learning System (DL), which influences in-class practices; 2) autonomy – in academic management and logistic of campuses, 3) self-organization – in the alternative forms of management, 4) cooperating – in the informal interactions among campuses, 5) emergency – in the informal responsibilities and horizontal networks, 6) interaction – in forums and Moodle usage for management practices sharing. In conclusion, although SiSuab presents the features of an adaptive complex system, it is not regulated as one. Thus, the study of management practices under the lights of ACS may contribute for the expansion of understanding in the characteristics which inhibit or favor Management in complex organizations.**

Keywords **— Complex Adaptive Systems, Distance Learning Systems, Management of Complex Organizations, Open University of Brazil.**

I. INTRODUCTION

Transformation lead by technological achievements are resetting social relations and creating new forms of structuration and dynamic organization. In this context, organization environments become more complex as well as demanding on alternative forms rather than the classic managerial model.

Educational systems also have not remained immune to that transformation. Technologies related to education cause changes in teaching-learning process and emphasize Open Education and Distance Systems, in which the traditional structures such as time, space, and social interaction change deeply.

In this set, the previously established model of Open Universities has been strengthened in several countries for it had altered the organizational paradigm. For instance, the adoption of distance modality aligned with the use of Information and Communication Technologies (ICTs) have reduced time and space restriction. Another trend in higher education is the rise of partnership among institutions to increase admissions through DL modality in order to reuse existent structures, obtain a streamed economy, and reducing costs.

It is worthy to emphasize that, in a DL system, several subsystems coexist so they affect the whole system work and, at the same time, they are also affected by the central system. In this manner, the management of several systems has become complex in the same proportion. According to Rumble [1], in such a complex environment challenges are imposed to mangers since the organization conception of appropriate administrative systems for DE process. Such a situation points to a contradiction, for the scenario, which at the same time gathers a complex system, follows managerial practices related to classical administration. In the view of Agostinho [2], in order to survive and evolve, complex organizations require a rewiring of models used for theirs administration.

As facing this organization paradox, this study sought examine those managerial practices which influence working system at Uab-UnB according to the view of Coordinators in three levels of hierarchy: Perfecting Coordination of Higher Education Personnel- CAPES, University of Brasilia- UnB and In-class Support Pole. It is important to notice works with respect Management of Open and Distance Learning Systems were not found during the study. Although this perspective is yet incipient, it presents itself rich for understanding of current educational reality, which points out the relevancy of this paper.

II. THEORETICAL BACKGROUND

The classic scientific thought, according to Morin [3] was built upon three pillars: order, divisibility, and reason. However, as presented complex phenomena in postmodern perspective, classical science paradigm presented restrictions [4], which motivated part scientific community to seek alternative forms of interpretation to those phenomena. For some researcher it represented the break situation that opened the pre-paradigmatic period [5], in which the "interdisciplinary practice takes all its importance," [6].

The ideas of Theory of Complexity were pushed in the decade of 1980s. The main researcher responsible for developing the ACS theory were: Waldrop [7], Gell-Mann [8], Holland [9],Kauffman [10],and Stacey [11], [12]. In the same way, work papers on ACS were published in Europe by the scientists: Prigogine and Stengers [13]; Goodwin [14], Axelrod and Cohen [15].

The Open System concept is taken from Biology in the studies of living beings and their dependency on and adaptability to the environment [16], and it has been adopted by other knowledge areas such as Psychology, Sociology and Administration.

Organizations, as considered as Open and Complex Systems, are not described as machines or gears in a closed

system, but realized as a living organism through their actions, where several agents' adaptive interactions are brought up [17].

Thus, those concepts related to mechanic administration are not sufficient to explain phenomena and dynamics in complex organizations[4].

Jones [18]argues that organizations classified as a Complex System have risen from the differentiated viewfrom the subject Complexity with studies which analyzed organizations dynamicity upon several aspects: leadership, organizational practices, organizational behavior, team, shared management [19], [20], [21].

Although there are a variety of definition on the term Organizational Complexity, there is not an agreement upon a definition, but most researcher maintain the idea presented by Simon [22] as the formal structure composed by major and minor levels connecting to each other. That author did not defined formally the Complexity, but he stated the Complex System as a composition of a great amount single way integrated of pieces establishing several level of inter-relationship among subsystems [23].However, the rise of complex behavior cannot be only seen as result from a complex action of an individual, but also from the complex behavior of the whole, which results are shared by members of the system as well as practiced in a simple, non-linear and unforeseen manner.Clemens [24] made a model to show the dynamicfeatures found in Complex Systems as presented in Figure 1.

Ferreira [25] emphasizes that, in a system composed by many parts there are emergent components, yet such a characteristic cannot be directly inferred from its component's behavior, but from actions which rise from interaction among parts. Thus,the system may present hierarchy and self-organization produced by interaction. According to Ferreira, its suggests that the amount of different scales may indicate a Complex System, therefore, it is possible to study it as a whole stating from levels. The author concludes presenting the need of an analysis towards how Complex Systems evolve along time and how little alteration in the parameters of the system may result on a chaotic behavior, thus, understanding the organizational dynamic in Theory of Complexity.

Holland [9] classifies Adaptive Complex System as one which springs as time passes by towards a coherent form adapting and organizing itselfwithout any central control entity. Thus, ACS presents features such as multiplicity of learning agents, nonlinear interaction among agents and, therefore, self-organization of its emerging properties and coevolution in the environment [11], [26], [27]. In Addition, the environment may force new roles and norms, that is, new practices. In this dynamic realm, ACSs evolve up to the ideal state.

In the study of general working of ACS, Agostinho [2] highlights, individual gather and cooperate among them in order to obtain adaptive advantages in an autonomy context. In the study about the work routine of ACs, Agostinho [2] highlights how individuals aggregate and cooperate in order to obtain adaptive advantages in a context of autonomy. Besides, according to Agostinho [2], such a behavior "tends to be selected and reproduced, reaching the point

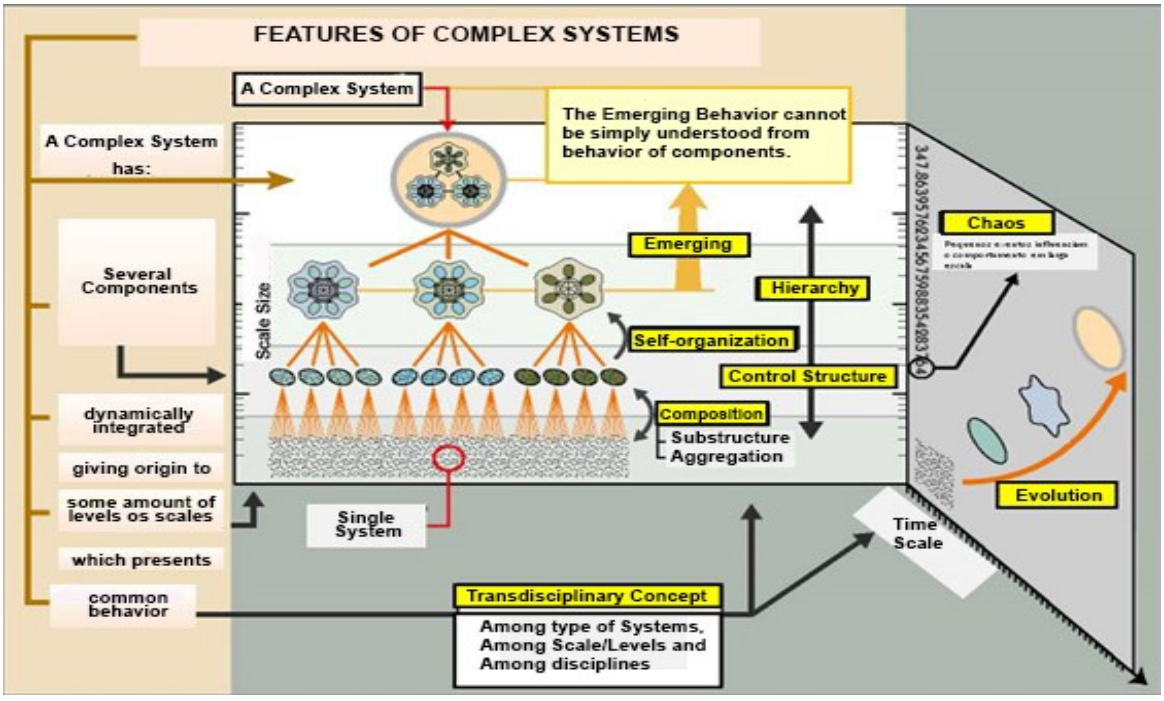

Figure 1. Figure 1. Description of general features found in Complex Systems. Adapted from Clemens [24] Available at: <www.necsi.org>. Accessed on: Aug 7. 2012.

cooperative individuals unite as an aggregation which also starts to act and a single individual and so on," (2003, p. 28). Thus, the result is a self-organization which is highlighted as one of the most interesting aspects, setting apart human social organization from other ACSs, i.e., it represents the possibility for human beings of choosing how they should perform in the practice.

III. The Complexity In Management of Distance Education System

Moore and Kearley [28] claim that extension and complexity of administrative activities should vary according to the kind of system with respect to the Program Management of DL. According to Rumble [1], management routine in Distance Educational Systems requires constant awareness of process changing; many times, it requires flexibility and adaptation avoiding situations, mainly, when one is away from decision center. The referred author alerts about this matter, once there is risk in management regarding with the action of the manager of pole and the team which may or may not influence the decisive action. Rumble [1] believes that the success of a DL system as a whole is bond to neutralization of issues among subsystems, for that reason it is important to keep the stability among them.

Higher education institution, for example, already realized the complexity involved in the Management DL System's process as they considered the goals, option for pedagogic models, target customer's profile, multiple technological ways used as evaluation in teaching and learning process and in the comprehensiveness of supply. Their practices and planning concepts suffered relevant change in the last years. For Rumble [1], centralized, linear, rigid and mandatory planning had been revealed as improper for the complexity of DL systems.

In Brazil, the Open University is set as a Network System that uses the existing structure of traditional in-class system universities which had joined the public policy of this system. According to the authors, structural organization in Uab is a mix of two models: integrated and associated, i.e., the network of integrated institutions in three federal realms: federal, state, and city. Such a network is made possible by the Technical Cooperation Agreement among the Ministry of Education and Public Universities, both federal and state's, Federal Science, Technology, and Education Institutes, state and city governments. The concept of Uab admits previously the used of academic structure in the Public Higher Education Institutes (PHEIs) combined to the structure established under the network model in the Student In-class Support Unities in several cities in the country.

The Uab System was created in 2005 by the Ministry of Education of Brazil (MEC) with the aim of articulating and integrate experiences of DLS in a National Higher Education System. It is by means a Distance Education System which integrates several agents on an inter-organizational network, a complex system [29]. SiSuab works as mediator connecting public universities, state and city government, aiming to supply higher education demandin the municipalities. Besides Public Universities, Federal Education, Science and Technology Institutes also participate of Uab System with their In-class Support Unities (Extension Campus), in several municipalities and in the Federal District. Extension Campuses for In-class Support are the operational unities for decentralized development of pedagogic and administrative activities, related to curses and distance programs offered by higher education public institutions in the Uab System and, they also work as location for face-to-face meetings.

Regarding with the model adopted by some Open Universities around the world, it is verified that most of them adhered to the principle of Open University of United Kingdom, which the junction of Open Education (accessibility) with Distance Learning System (modality). In the Brazilian case, Alves [30] highlights, Uab is not a very university, but a consortium of Public Higher Education Institutions. However, Uab System is more than a consortium; it may say its organization is mix of two models: integrated and associated, i.e., it is a network arrangement which integrates institutions in the realms of federal, state, and city government.

IV. Strategical Methodologies

This research followed the imminent, explanatory and descriptive line [31] in the context of Brazilian Open University System. The In-class Support Poles of University of Brasilia were selected as empirical units on the investigation. The research was done on the months of July and August, 2013.

In 2006, Brazilian Open University Program had been implemented at University of Brasilia (UnB) with the offer of Administration by the Economy Department, Administration, Accounting, Documentation and Information Science (FACE), with partnership of Bank of Brazil, under the title of Testing Project.

The research comprehended different participant groups involved with Uab System management in three hierarchy levels. There were twenty-one Coordinators who participated on the study, as two of them from macro level (one general Coordinator from Distance Learning Secretary, DLS) and another one responsible for national Uab Program at CAPES). From intermediary level, there were seven participants, as one of them a former General Coordinator of Uab at UnB, another one in changer of this duty at the research data collection time, one Coordinator of the Poles (or Manager of Pole), and four Department Advisers from five different department. From micron level, there twelve professors from Secretary of Education of Municipalities who had been designated to be in charge of Pole coordination. The sample was selected by convenience, based on the Coordinators' willingness and availability criteria.

Two target topics (the script) had been prepared to perform the investigation as well as aiming to support the individual and group interviews based on the theory applied on this study. Semi-structured interviews were adopted with open questions [32]. The open questions aimed to identify organizational practices, goals of each agent on the system, relationship among agents, actions for promotion and interaction of participants on the system, management troubleshoot, best practices, agents autonomy level, and the action towards improving of the system based on studied context.

Each group of mangers had been submitted to a specific set of data collection procedures as further presented. Two interview, individual and group techniques were combined [33].Individual interviews with Coordinator from macro and intermediary levels had been taken place at CAPES and UnB. Interviews from micron level took place in two different moment: group ones, through a meeting with the Managers from UnB Poles, and the individual ones, made on the phone orVoIP (Skype). All interviews had been recorded and transcripts kept for further analysis. Software NVivo 9 had been used for information analysis. It is told NVivois being used more frequently in Administration field [34], and it considered a valid tool for qualitative data analysis.

The content analysis technique was guided by methodical supposition of thematic categorical analysis proposed by Bardin [35] as: scanning of the text for content arrangement, dense reading for identification frequent themes through vocabulary records, identification of categorical themes assured by judges, and suggestion appending. It was also published in the analysis the grouping of categories according to likeness contents, logic, and penitence criterion for final analysis and interpretation on the information.

V. RESULTS AND DISCUSSION

Table 1. Features for high and low autonomy

DECLARATION PROVIDED BY COOEDINATORS	DEFINITION	
	Low Autonomy: lack of financial autonomy due to misaligned foment in the budget matrix. Decision power is limited to macro and intermediary levels. Autonomy is the speech. Decisions are taken unilaterally. There is dependency on the Policy for the University Pole operation which does not have financial autonomy.	High Autonomy: respect towards universities' autonomy will be practiced through provision of resources from the budgeting matrix, which will foment autonomy in the management of resources by the universities. The stimulation for solution of problems comes from the Departments which are able to evaluate structural situation in the University Poles. Those ones have autonomy to de define logistic according to the demand of each course and of the universities.
MACRO LEVEL	"We wish for the future for the existence of institutionalization of Open University is that all fomenting action may be done by the matrix. Thus, Uab will be able to manage the system, its Dean Support Offices and its College Committees. It will not be treated as an appendices."	"Courses have higher academic autonomy. We take the constitutional role the basic education care, respecting higher education institutions' autonomy."
INTERMEDIARY LEVEL	"I think there might be better understanding on autonomy action of the Course Department regarding with Uab. In addition, it was in the speech 'Every course is free to produce its own structure.' But it is not like so."	"University Poles have higher autonomy on their management for UnB has those courses, but Poles has not only UnB there. There are poles with eight universities installed." "We have autonomy to evaluate the offer of a course at the University Pole."
MICRON LEVEL	"I think calendar should be prepared accordingly to the Pole's reality. I consider it is made far from us which brings a lot of conflict- it leads to the thought I do not have the autonomy I wish I could have." "We have the law for creation, however we do not have any resource ratio for the pole, which means we have no financial management autonomy."	"The definition of logistic for a pole is made by the very coordination and the whole work team, considering the demand of each course and of each university." "Yes, I have some sort of autonomy, yet I need to develop it. I have the initiative to do, however, sometimes it does not work." "At UnB, we have open doors for new proposals to do the activities. It is an achievement of collective cooperation, there are bonds of confidence."

Source: Prepared by the authors

After reading the codes, a classification table was made identifying the most frequent themes and theirs vocabulary; therefore, it is the first step on the construction of categories [35]. After the analysis made by judges and admission of proposed suggestion, themes were grouped among 5 categories with respect intensity (high and low). Thus, the following features came out from analysis:autonomy, self-organization, cooperation, aggregation, interaction, and emergency stayed closed (high) or away (low) from ACSs features.

The outcomes can be found on the tables from 1 to 5 supporting records found in literature,which highlight features (autonomy, self-organization, cooperation, aggregation, and interaction) as those ones influence practices and organizational relationships[2], [36].

With respect the category of autonomy, according to Leite, Bomia and Coelho [37], this category provides consciousness of their skills, information, and possibility of performance on specific circumstances. Those authors assert that controlling is the opposite of autonomy, "which rises not as a hierarchy manifestation, but a possibility of the autonomous entity realized own limitations thus seeking evolution in the interaction (p. 36)".For the authors, the exiting formal rules, generally, the agents' actions, however, the agents provided with autonomy produce informal rules which articulates the goals of organizations with individuals.

According to Leite, Bornia and Coelho [37],autonomy is characterized by independency of the agents. Maturana and Varela [38]assert that autonomous beings cannot be limited to passively receiving information and commands coming from outside.

Regarding with low autonomy, the findings indicated that lack of financial autonomy remains in the Uab System at intermediary and micron levels. The contrary would be an evolution form in the system. Coordinators at Uab-UnBclaim that resources are not included in budget matrix of their courses and they are controlled by CAPES. With respect Poles, managers highlight such a financial dependency on the funder has negative impact, mainly in the infrastructure of Poles, even with the definition of financial dependency may be found in the Law of Creation of The Course, however it does not happen in the practice.To those who were interviewed, resources' dependency jeopardize actions. In the same manner, Perim and Filho [39] consider that such a dependency makes the organization on Inter-organizational network to be vulnerable. For that sake, it is important to specify resources and their origin in a spread out way [29]. In this manner, it attenuates dependence conflicts identified by Coordinators at Uab-UnB and at Poles. For the Coordinator at macro level (CAPES) it is clear as institutionalization of Uab System depends on its financial decentralization.

On the other hand, in the Agostinho's approach [2],autonomy goes beyond financial autonomy, once it allows an individual to set action based on own judgement. In the organizational environment, there is the possibility for inclusion for most of agents, before order receivers, now may take the charge as decision takers and practice their own judgment. Agostinho highlights the advantages on an autonomous management as the classical control structure is given up and the reduction in the number of hierarchy levels. Then, an environment for adaptability is created. In this case, relationship intensity increases as well as speed and amount of shared information, therefore. Such an environment of autonomous individuals is proper for generation of new ideas, for they are shared when tested and selected.

Another advantage noticed by Agostinho [2] is the possibility for individuals to learn as they are able to observe their own behavior unto the target goals. In addition, she highlights that autonomous individuals pass to review their own actions as dependable of others or even comparing their judgement in some cases with their peer workers so mistakes may be corrected. Such a dynamic, Agostinho asserts, itbecomes a source for learning and adaptation. According to Agostinho, in opposition to static hierarchy models, autonomy based models are able to solve conflicts locally and also it prevents conflict to spread along the network reaching out other agents, which may turn cooperation relationships more difficult.

The results from interviews about high autonomy indicate a limited autonomy in academic and pedagogic environment. Regarding with Course Advisers, this autonomy may be found in the College Committee's decision. Now the Course Advisers at the Poles, the autonomy is bound to the arrangement of services referred to courses offeredby universities.

A wide autonomy allows people to understand skills and information they have to take action on a situation, nevertheless, only autonomy does not guarantee a good systemic performance. What is being proposed in the ACS models, Agostinho argues, it is the lack of a central coordination in the organizations, yet a process of information on others' planned behavior, instead.

On the self-organization category, Serva [40] asserts it is a central concept in Complexity for it aggregates all characteristics of such an approach. Self-organization, therefore, it is the capability for adaptation on random distresses in the environment. For Serva, it is a set of behaviors which are characteristics of autonomous unities.

In the view of Agostinho [2], self-organization rises when several agents integrating a system are autonomous elements to orientate their actions according to their understanding on their internal and external interactions. For Ms. Agostinho, those agents have the freedom to do what their have learned and, thus, they may adapt to the environment.In addition, she adds, managers may create a basic structure so the system may self-organize, however, it is importantto emphasize that degrees of freedom would decrease in the system as well as necessary strategies to conduct problems which may rise in such a conditions.

Based on results fund, it worthy to mention Agostinho's assertion [2] which says that self-organization pass through opening and strengthening of communication channels in

several directions, thus it increases capability of perception to interpret and answer all sorts of feedback.

Constant declarations on Table 2 may be supported by studies conducted by Leite, Bornia and Coelho [37]. They highlight that self-organization has not interfered by a central planner in the background. Such a characteristic present on ACS rises from interaction among agents and, even without its rigidness on central rules, it is manifested on agents' mental arrangement involved by beliefs, ethic principles judgement of value and from their own organization plans.

In this meaning, Agostino [2] asserts it is necessary to respect diversity – a must in a complex environment- to stablish required qualities in the actors of an organization. When someone, with other attributes, assume a certain position, new links in the network, new relationships are createdand, consequently, more diversity is created. Such a dynamic flows when advantage is taken from self-organization in the system, as well as if conditions are created to foment that capability and also, if the prescriptive and controller management may be suspended as one can find in the answers.

On a research conduct by Sato, Hatakeyama and Dergint [36] about project based organization, for instance an ACS, it was verified that the characteristic of self-organization, in practical meanings, it has minimum requests to central coordination. This affirmation may be verified in the answers by Course Advisers from whom is the assertive about the existence of a planning change on an educational event during its development. Those authors recommended that, instead of a central coordination, it should be a cooperative coordination based on informal horizontal relationship networks among agents essentially similar to each other. In this manner, a proper real is created to apply the theoretic approach of complexity which conducts the system to its self-organization.

At Uab-UnB, self-organization category stays latent in agents' action seek alternatives in management with respect to a) adaptation in tutor model differently from the one suggested by CAPES, b) hiring personnel from private sector, c) decision take procedures in the departments, which may disturb the management dynamic; d) re-planning on actions during it development, e) availability/relocation of environments to adequate the different in person meeting agenda and, f) flexibility in chronograms aiming attend to in personscheduled by universities or by the courses.

Table 2. Features for High and Low Self-Organization.

EXPLANATION PROVIDED BY COOEDINATORS	DEFINITION	
	Low Self-organization: lack of clearness on formal communication, which triggers misinterpretation among the peers. Signing up with knowledge on the system. Lack of review on planning. Lack of open talk to Course Advisers. Reactive behavior and centralization of decisions. Lack of clear definition on responsibilities.	High Self-organization: transfer of duties and models to several context.Search for new models. Flexibility of norms. Adaptation in the DE model as well as in the model of planning. Dynamic and complex System. Solution for problems and adaptation to local demands.
MACRO LEVEL	"In the first editions, there was a failure as the universities and poles could propose their courses at their own choice.It generated a complicated situation, most of poles did not know what was DE and thought they would host the very universities."	"CAPES has duties which succeed in post-graduation and CAPES quality standard is being transferred to Distance Education.The three pillars are induction, evaluation and quality, we try to adapt the Uab System courses."
INTERMEDIARY LEVEL	"Acceptance by UnB must be rethink. It is the acceptance of an operational coordination. The coordination of Uab-UnB must be proactive; it cannot be reactive. One needs an open discussion with all Course Advisers." "I think, sometimes, the Coordination of Uab-UnB is quite decentralized, but it wants to be the control center."	"We could negotiate with CAPES,especially on tutoring.We wanted few tutors; at least a fixed one.Then, we sought for alternatives to extrapolate CAPES' model. We searched for flexibility on actions considering the differences between local and ideal reality.""DE model will certainly suffer adaptation into a Brazilian model." "Thus, sometimes, we need to adapt and adjust some demand." "With respect planning it is complicated and super complex, if planning is done, but it is changed on half-way."
MICRON LEVEL	"Schedule conflicts among universities. Yearly Calendars were not available to a pole on time. Then, in-class courses' schedule of two, three, four classes coincided, which caused tumult to our work at the pole."	"Uab Program is still on adjust phase according to the need of each university which raises along the work is done.""It is necessary, sometimes, to chance routine in order to meet parameters of each university."

Source: Prepared by the authors

Different approach may be found at Rebelo and Erdmann's studies [41] about the model for designing management strategies in Higher Education Institutes (HEIs) according to Theory of Complexity. Those authors stress that actions performed in the studied context had not been analyzed. Therefore, there was some restriction in the occurrence of self-organization. Such a limitation refers to lack of support to shared and complex learning and, it reduced possibility for agents to reviewing their action. Despite restriction, Rebelo and Erdmann's ideas are supported by findings demonstrated at Uab-UnB since agents presented two needs: a) to adapt and adjust to demands or, b) adapting the Uab model so it may become the Brazilian model. Considering those findings, Rebelo and Erdmann point that action must pass on the planning review and the agents must criticize the achievements. Without it, self-organization process remains limited to feedback task and refining strategic design process, i.e., a pure operational task.

With respect to cooperation category, Agostinho[42] asserts that it may occur among individuals from the same team, and/or among teams, and/or among institutions, and it allows knowledge flux among them, contributing, therefore, to the performance of the organization. Still according to Ms. Agostinho, such a behavior "tends to be selected and reproduced until it reaches the point where cooperative individuals gather to form an aggregation which also starts to behave as a single individual and so on." On table 3, the findings for this category are presented.

The willingness to cooperate as with peers as with the organization rises among individuals who recognizes situations which are worthy to cooperate and thus they participate without being co-opted,however by option [2].

Leite, Bornia and Coelho [38] point that, through cooperation and team coordination, an organization remains permanently seeking flexibility. In this manner, it increases complexity which is often characterized by uncertainty unpredictability degree. Those authors when they studied a

Table 3. Features for Cooperation

	DEFINITION	
EXPLANATION PROVIDED BY COOEDINATORS	Lower cooperation: regulation of procedures to promote cooperation; in practical meanings, there are few adhering of universities to the formal sharing mechanism. A perception of low cooperation among the partners and the existence of congested points to management. Institutionalization is fragmented. Cooperation varies according to the universities. Perception of diversity on attributions. Mainly political relationships, which makes it difficult to cooperation.	Higher cooperation: relation of trust among partners. Open talk among hierarchy levels. Share of informal ideas among member. Creation of proper environment for development of horizontal relations and strengthening of trust and cooperation bounds. Foment of team work with common goals. Maintaining responsibility and relation win-win should be established.
MACRO LEVEL	"Cooperation has been always the subject of discussions. The foment must be to promoted cooperation among skilled people; however, in order to make happen on reality, it must be arranged and regulated."	"Of course we trust in it, for we work with public institutions which are committed to quality. They have a name to zeal."
INTERMEDIARY LEVEL	"The environment of Uabat sharing among education institutes is not real yet. I have no idea about the best practices of the system." "I still had the illusion this system would be more cooperative." "Cooperation among individuals still must be improved significantly."	"At the Coordination Office, I establish intermediation with mangers of poles. We may exchange successful ideas. This is very interesting." "Sharing good ideas among managers of poles is the greatest gain."
MICRON LEVEL	"We have partnership with two institutions-UnB and an IHE 'X'; the second on is faulty. There are communication problems." "Relationship between the Pole and the fund institution is based on policy as it has been created by previous management. Pole is being treated as an 'illegitimate child'. The municipality argues it has not enough budget." "There is low cooperation from manager of pole in the state."	"With respect to IHE, I classify it into two types: graduation and post-graduation. Those from graduation type, in general, have more installations. Regarding with UnB, it is very good relationship; it is open with rich discussion and trust in one another." "Cooperation is given by fulfillment of one's responsibility in the partnership, as it is done, everyone wins. Thus, bounds of cooperation among partners are strengthened."

Source: Prepared by the authors

relationship network, they observed a need to establish relation such as win-win aiming to reduce uncertainty and rinks in cases where global performance interfere in the individual one and vice-versa (p. 29).

After studying the network effect in an innovation pole, Balestrin, Vargas and Fayard [43], they stressed the value of inter-organizational cooperation with the objective of promotingcomplementarity of knowledge as stressed by other authors [44],[29]. For these authors, network dynamic may turn it easy tothe complementarity of skills among participants. According to Balestrin, Vargas andFayard[43],the contribution of relationship networks among organizations may work as a mechanism to spread information and catalyzer for knowledge sharing, especially in the technological context. Such an affirmation does not meet the findings in the answers given by managers at Uab-UnB, mainly with respect toSiSuaB (Open University System of Brazil) which is the mechanism for content sharing and considered as repository for many some agents, although it is less used by agents. SiSuaB is the support platform for tasking, monitoring and process management at Uab where registration is made as well as consulting on information about institutions, poles, courses, material of study, articulation, coworkers, and funders. Another sharing tool is Uabat (Work Environment at Uab), which is restrict to its work team. It is set as a customization of virtual environment for learning (AVA) Moodle for information sharing and communication with CAPES, public universities and poles, in addition to management and discussion on target themes to development of Uab System.

Reports by Balestrin, Vargas and Fayard [43] presents the cooperation level among researched institutions, as most of them, at least, indicated some technical cooperation experience with another unity in the network. According to those authors, the analysis of a cooperation level is not a simple task as it is affected by several variables.They noticed the lack of cooperation, for example, when only one of the agents takes advantage on a situation and wastes potential of complementarity of resources which may be provided by cooperation.It may be inferred by the answers that the cooperative system is not being considered or the

Table 4. Features for high and low aggregation

EXPLANATION PROVIDED BY COOEDINATORS	DEFINITION	
	Low aggregation: lack of sharing of best practices among the universities. Sharing defined by central and higher coordination. Need of decentralization and interaction among the parts involved. Perception a system's fragmentation. Limitation on interaction of Poles in the same region. Communication with failures and differences among universities to be aggregate.	Higher aggregation: Search for process of interaction which stimulates support among the parts and sharing of best practices. Strengthening of Distance Learning culture at the institution. Spreading of ideas through informal way. Open communication at the universities' departments. Creation of bonds among courses and poles. Team work. Informal sharing of experiences among poles. Online informal communication processes.
MACRO LEVEL	"To share the best practices among the universities. I would say it had been a concern registered on documents."	"Fourteen national forums from all areas of graduation have been created to stimulate the most prepared universities so they support the less experienced ones. Reginal forums were held with pole coordinators for best practices sharing."
INTERMEDIARY LEVEL	"We had a big awareness process to make people begin to understand the difference between in-class and distance learning. What they would need to aggregate to give quality to those courses was already there at each of the Poles. They had something to contribute, but they need to work to make it." "In fact, the university has not embraced distance learning modality yet- Uab."	"Awareness of professors and the search for accession had been achieved through several meetings. It was the way of sharing some experience and strengthening it through implementation of course at the departments. The goal was creating a new culture among professors, i.e., Distance Learning culture." "As DL influenced in-class modality as it influenced DL. When they have to migrate to DL, they had to make some adaption."
MICRON LEVEL	"As the other Poles are limited only to meetings we have here at the university, aggregation becomes lower. Regarding with IHE, the relation varies accordingly with the university so that one is more present than the other one." "Relation with CAPES is based on evaluation; thus, CAPES causes us to dither, to be frightened."	"A good relationship among team members is based on: community commitment, activities planning, search for common goals, analysis of problems and shared evaluation. Pole coordination takes responsibility to organize and lead the group so the pole works accordingly with the institution's goals and with the student's needs."

Source: Prepared by the authors

lack for sharing on best routines in the system, thus, being fragmented. In the context studied by Balestrin, Vargas and Fayard [43], it was observed an effort from institutions to strengthen partnerships to complement their competencies.

The referred author still highlight the analytical perspective for meeting the differences in cooperation. For example, on resources dependency, cooperation is to cover financial lacks. It can be notice in one of the Coordinators' answer who stresses the political relation between the pole and the funder as cause of frequent interference on destined financial resources. In this case, the pole is treated by the funder as "illegitimate child." On that matter, Balestrin and Arbage [45] assert that member may influence politics through strengthening the network.

Another matter which deserves to be stressed is the difference of cooperation. A partner may be more cooperative that other in relationship network [29]. This situation could be often noticed in the answers provided which it was stressed the difficulties encountered by the manager of pole to interact with diversity of management from promoted by the universities or by courses; however, it is not a problem in the view of Balestrin and Arbage. On their studies, it was clear that networks can contribute to a higher dynamic of interaction among participants in different institutional contexts. It may occur if a knowledge environment is created in the network, for it generates significant results on organizational learning, management and technological innovation.

According to Balestrin and Arbage [45] intensity on social relations allows support for information free sharing among member in the network which foment mutual learning and innovation as one can infer from high cooperation answers. As contribution, Melo and Agostinho [46] assert that an effective cooperation requires transparency of decisions and actions, which are essential parts in the development of trust, which consequently is conquer based on credibility.

Regarding with aggregation category, Agostinho [47], [2]argues that the process occurs when a system becomes more that a gathering of parts and, a tem more than a crowd of people. At ACs, the aggregation property is shared in order to form new agents on higher level as the ones formed with aggregation on lower level. For Agostinho [2], such a situation gives more survival chance and adaption as is increases the organization level of the system.

The managers' concerning on the Uab-UnB System was initially the expansion and induction of enrollment. In this case, expansion was quick as at the universities as in the poles. At the involved universities, the concern was to make professors' team aware on working on the operation system of DL which had been less explored by those universities. According to the Advisers, UnB had not institutionalized DL yet and, Uab was not as well in the organizational environment, according to the answers given above.

Another important matter arose from the research: the fact that a pole is not considered as a university which means it is not understood as a campus, this unity however, is aggregated although it is not totally represented by the IHE. According to Agostinho [2], the aggregated one is always seeking to attract and keep components which brings complementarity of skills. Confirming it, Katzenbach and Smith [49]assert that a team is "a small group of people with complementary skills and committed to a purpose, performance goals, and common approaches by which they are mutually responsible."

Despite the need to create culture of sharing for best practices for confirmation of Uab System, such a mechanism still does not work on an effective way on its system's network. Even with the understanding on the mechanism by the agents as a form of aggregation, it is evident it does not occur in practical terms. There is an environment of sharing of practices created by CAPES – SiSuab, however, the use of this mechanism has been given by central determination, i.e., vertically. Perhaps it explains the lower accession of universities in SiSuab. There is no natural identification by the agents with the sharing system.

Considering those results, it worthy to highlight that the systems are favored by their capacity of union and hierarchical organization. According to Agostinho [2], [48], the agents use a mechanism to selective interaction possible, which mean the agent recognizes "instantly" who are those he or she may interact with to obtain mutual benefits; thus, useful interaction occur for the system's evolution [9]. Formation of boundaries among aggregate ones is defined by mechanism of labeling.

On a network Adaptive System evolution occurs constantly through learning situation and, success or failure of interactions. Through changeable dynamics, labels are tested and selected continually according theiradaption utility of systems on several organization levels [2], [47]. Ms. Agostinho argues that every moment there are labels being discarded and others being created; interactions are strengthened as others faint; agents are aggregated and disaggregated. Those agents evolve according to environment conditions, as it may be verified on reports shown on category below.

On the study developed by Sato, Hatakeyama and Dergint [37], aggregation's category had been evaluated as a group competency and how it was transferred and shared with other projects and partners. The aggregation united was found in the departments and not in the projects developed by the teams. Those authors observed missing techniques or formal tools for transference or information sharing; in many cases, it resulted on rework. A different result has been found on answers given by the research participants at Uab-UnB, in which evident that the aggregation process seek creating sharing processes of best practices through forums held by CAPES with the Coordinators at Uab, at partner universities, and Poles and courses. The answers shows that concern about aggregation also comes from departments due to interest on accession by professor to Uab System and, even on the spreading of culture of DL at the institution. According to the report, the biggest challenge for UnB is making DL a part of academic unities and part of budgeting matrix of the university. For a

number of coordinators, there is a need for stablishing a clear direction for this system.

Another worthy point for discussion is the aggregation potential mentioned by Advisers at Uab-UnB which is related to Distance Learning practices, which influence professors' experience who used to perform alone on classroom teaching modality. Now, in order to work on distance learning modality, professors had to adapt their pedagogic practices.Regarding with aggregating capacity, Agostinho [2], [47] stresses that an individual, if is part of a group, passes to present a different behavior from that when acting alone. For Ms. Agostinho, the individual begins a coevolution with other members. One's attitude influences the other's and shapes the behave pattern which feature of the group.

Sato, Hatakeyama andDergint[36] observed the methods and procedures for docking and dysfunction of learned lessons at organization are done informally. At Uab-UnB, such a practice could be noticed, however, according to those authors, on practices involving several department and partners, it was checked the aggregation aspect had been jeopardized by lack of formal process of integration. On this study, those authors stressed issues related to variable waging and missing rules more defined as barrier for aggregation which allow action sharing on relationship network. The second cause was indicated by the Advisers on low aggregation.

Rebelo and Erdmann [41] consider that the mechanism of communication stablished increases when there is information exchange on a regular and manner. According to those authors, the practice of dialogic principle faces difficulties when aggregation has lower frequency as well as limited to individual and spontaneous actions. On the study of Uab-UnB, the focus on creating bonds with poles was indicated by the Advisers aiming aggregation potential increase.For the Advisers, in-class activities done by professors and manager of pole is a practice which makes significant difference on the course administration.

With respect to results from Uab-UnB on activities plan at the pole, the local managers stress that it ideal a good relationship among team members and agents on planning phase, aiming to fulfil common goals to both ones, however, the managers of pole did not stress they participated on the action planning at the universities, which also involves the pole. The findings by Rebelo and Erdman [41]reveals the planning execution phase and the dialogic principle were prejudiced partially, as the information exchange among strategic, tactic and operational levels,

Table 5. Features for high and low interaction

EXPLANATION PROVIDED BY COOEDINATORS	DEFINITION	
	Low interaction: formal interaction processes, but with low accession by the agents involved and low (vertical and horizontal) interaction among them which may confirm the formal interaction processes.	High Interaction: creation of informal processes for promoting horizontal interaction among the agents, for example, virtual social networks. Strengthening of interactions through state forums by poles with respect to the virtual environment of learning as a strategy for sharing of management practices among poles. Half-year Face-to-face meetings promoting interaction among the diversity of agents.
MACRO LEVEL	It had not been clearly verbalized.	It had not been clearly verbalized.
INTERMEDIARY LEVEL	"CAPES often promotes meetings for managers." "We have SiSuab, which is a Communication System– a mechanism to increase the interaction. We are very good on Facebook, on SiSuab, however, we aren't."	It had not been clearly verbalized.
MICRON LEVEL	"Interaction with CAPES currently happens only through Uabatinterface; before it, interaction was more intense." "I think communication with the manager of pole, university and funder should not be so isolated. There is a missing mediation. There are fragmentation in the cases of state poles."	"Each pole has its blog and, through this resource, we share everything. I often access it in order to know what each pole is doing. It works as a reference so we may produce new ideas." "I consider the pole as a hoop between university and community." "Document Management Course on Moodle made possible the exchange of ideas among managers of poles."

Source: Prepared by the authors

which used to depend on agents who were on higher and intermediary level occupations. Those authors conclude that aggregation category requires interactivity among different hierarchy level agents, especially, if it is on a new context for most of organizational agents. Nevertheless, the execution of Strategic Formation Management Plan may become limited. In summary, it requires the agents to realize that the organization is a whole and not only parts gathered. Moreover, feedback process (positive and negative ones) conduct to adaption and to permanent re-evaluation of actions.

Inter-organizational networks point to exchange relations with a set of organizations in the environment of operation and they may affect directly the interaction working on this arrangement type. In agreement with it, Amato Neto [49] argues that inter-organizational relations for cooperation, however, are a result of a complex process, in which multiple dimensions would work as to facilitate as to difficult the interaction among the acting members of this network.With that in mind, the key points which may causedifficulties rise from the answers from the managers of the poles and from advisers at Uab-UnB, whose answers are arranged in the Low Interaction category.

Nevertheless, when interaction is mentioned on informalinteraction networks, reported by Eildelson [50], the interaction structures do not depend on a central coordination, but on an adaption among members. Interaction patterns, often times, are produced in a spontaneous way with realignment of relations, i.e., contacts are not frequent with all colleges, however with some of them, which does create a level of interdependency among individuals.

For Anderson [5], Theory of Complexity suggests that some systems, with several interactions among different agents [11], [26], may produce simple and surprising behavior on the system, thus, this feature is considered an emerging property, for it may rise or low the level of organizational aggregation. In conclusion, the characteristics of interaction and aggregation constitute a non-linear behavior base in the organizations. With that in mind, results presented through the answers given by the managers of pole, regarding with high interaction, confirms

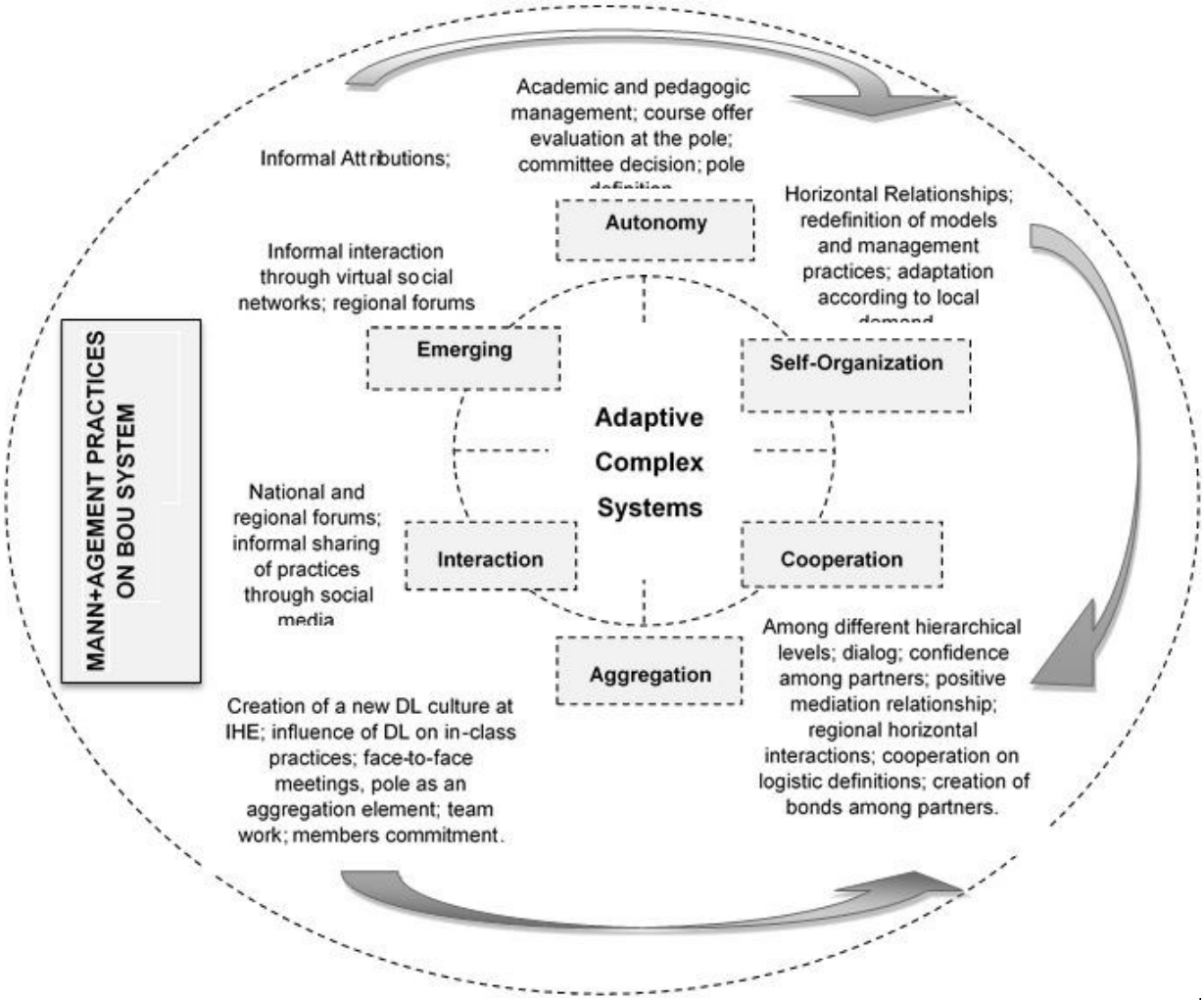

Figure 2. Summary of ACs Features of BOU-UnB Source: Prepared by the authors.

the findings no literature. In this manner, relations among the acting members may be altered through interaction of dynamic system of loop realignment.

In order to understand the aggregated complexity, Manson [51] indicates that it is necessary to explore a set of concepts inter-related which define the Complex System: relation among organizations, internal and external structure, emerging learning and behavior. Levin [52] asserts that the analysis of interaction types allows characterize the group in the system and identify inter-relations among the group properties and individual properties. Reinforcing these affirmations, Mitleton-Kelly [53] observe that the emerging property can be realized on generation of knowledge and new ideas [11], [26]. Once ideas are articulated, they become part of each individual's history, in which it also aggregated the team common history. Mr. Mitleton-Kelly stresses that this process is irreversible, for new ideas and new pieces of knowledge can be built upon the generation of other new ideas and other pieces of knowledge. Those considerations reinforce the result for high interaction given by coordinators. Figure 2 presents the summary of analysis results which stress high features, in the core and, tend towards those from ACSs according to the theoretical method of Figure 2.

According to the authors, the results from generated content analysis on the qualitative research indicate that Uab-UnB presents characteristics of ACSs, however, in this multidimensional environment [23] point to the contradictions with respect to practice's coexistence which inherent to Classic Management and to governmental bureaucracy tools. Thus, it is important to discuss how structural properties of this system require an adaption capacity and alignment of management practices with adaptive complex systems' requirements[54].

Bronzo and Honorio [55] reinforce that on informal rules and sharing knowledge. Elements from knowledge emerge and become important, for they take to aggregation of agents in the organization of an ACS. The evolving process moves constantly among micron/macro behavior and emerging structures as each one influences and recreate the other [53]. Such a structure generates learning which leads to new behavior as well as the organization adapt itself and evolve [11], [26], [27], [53], and [56].

VI. Final Considerations

The studies on management with references to complexity are few yet, and most of organizations are analyzed under Classical Management theory[23], [57]. Nevertheless, it is important to keep in mind that the evolution of organizations on networks presents complex characteristics. For this reason, there is no way to skip studying those organizations as a complex system which often converge to adaptive complex systems.

In this investigation, it has been sought to identify the differential on managerial practices according to the theoretical approach of Complexity similar to those from ACSs (Adaptive Complex Systems). It is worthy to stress that this theoretical option has been given through the inherent complexity of Distance Learning Systems, a modality operate by the Brazilian Open University System, which is naturally, a Complex System and it belongs to the core as it is a national wide public policy. According to the authors [58], literature reveals that studies related to ACSs are still limited. Considering the matter's relevance, it is understood that the complex nature related to complex organization managementis the main challenge on the studies leading on this theme.

The results of this study which emphasize features of ACS, may be found in the literature.The research brought the presence of elements que ACS features, and the possibility to extend managerial practices under ACS perspective.Thus, all reports were divided into six categories with two branches each: high and low ones. With that in mind, characteristics have been emerged\which are closer to ACSs: 1) aggregation- creation of a new DL culture at IHE which influences in-class practices and stablish a link with the pole through face-to-face meetings and team work; 2) autonomy- it is present on academic and pedagogic management, on course offer evaluation at the pole, on academic committee decisions oncampus and on the definition of logistic at the pole; 3) self-organization- in horizontal relationships, on redefinition of activities, on development of alternative models, on a varietyof management, on intern process, and in adaptation according to local demand; 4) cooperation- among different hierarchical levels, open dialog, trust among partners, positive relation of intermediation, informal interaction among poles, logistic definitions, and creation of bonds among partners; 5) emergency- informal attributions, horizontal networks, use of social media (blog and Facebook), regional forums for pole coordinators; 6) interaction- national and regional forums, informal sharing of practices through social media and the use of Moodle as management tool as well as practice sharing, however, when these practices stay distant from ACSs it turn to a significant difficultyto the pole management.

Due to complexity on the analyzed theme as it has been a study of qualitative and descriptive nature, several limitation were identified: a) the first one refers to methodological issues, b) there are limitations which describe the impossibility for application of generalization, as it is a qualitative study. Therefore, in order to overcome such a limitation, it has been suggested to analyze other contexts according to theoretical approaches; c) with respect to theoretical issues in the Brazilian national literature and foreign one, it has been evidenced another limitation switching between the inexistence of a tested theoretical model with emphasis on ACSs. With that in mind, in order to overcome this limitation, it is recommended that researchers develop future studies based on research about Complex Systems Management as in private environmentas the public environment to create a robust theoretical outline. Thus, it possible to build a model with indicator pointing towards this type of organization, so

that it may identify the aspects related to characteristics of ACSs.

It is worthy to mention that the coordinators' reflection on their management practices, whether favorable or inhibiting to the system's institutionalization may facilitate a right choice of ways of organizational development and governmental actions to execute more effective public policies which consider Distance Learning Management System due to its complexity.

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