

Design Of The Organizational Structure And Coordination Of An Observatory Based On Collective Intelligence

Diseño de la estructura organizacional y de coordinación de un observatorio basado en inteligencia colectiva

Desenho da estrutura organizacional e coordenação de um observatório baseado em inteligência coletiva

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Abstract

Introduction: This article is the product of research developed within the framework of the Emple-ap Project, throughout 2019 at the School of Industrial Engineering, Universidad Distrital Francisco Jose de Caldas.

Problem: Limitations in the use of traditional hierarchical structures for the management of organizations based on control hierarchies, due to their difficulty in operating efficiently in human social systems (HSS).

Objective: To generate a general proposal to understand the structure and organizational management for the observatory of employability of the Pacific Alliance (PA) supported by collective intelligence (CI) and high reliability organization (HRO).

Methodology: The methodology for the development of the proposal is supported on grounded theory, in which the design emerges from the statements made in previous research.

Results: Based on the results of the review, it presents a proposal for organizational structure for the observatory, emphasizing the alternatives to divide and coordinate the work and the important characteristics of the structure to facilitate the exploitation of available resources.

Conclusion: The CI and reliable organizations, are a different and decentralized way of management in organizations that allow you to create more flexible and robust systems. This study creates a general outline of the characteristics and main preconditions that must have a system based on CI.

Originality: The main contribution of this research lies in the design of an organizational structure, different from the traditional hierarchical structure, supported by CI for the management of an entire organization.

Limitations: Currently, there are no great advances with respect to organizational structures or alternatives to the traditional hierarchies of control, despite limitations in information processing and the impact that has on performance.

Keywords: Observatory, Collective Intelligence, Reliable Organizations, Knowledge Manager.

Resumen

Introducción: El presente artículo es producto de una investigación desarrollada en el marco del proyecto Emple-ap, a lo largo del 2019 en la escuela de ingeniería Industrial, Universidad Distrital Francisco José de Caldas.

Problema: Limitaciones en el uso de las estructuras jerárquicas tradicionales para la gestión de las organizaciones basadas en jerarquías de control, por su dificultad para operar eficientemente en Sistemas Sociales Humanos (SSH).

Objetivo: Generar una propuesta general que comprenda la estructura y gestión organizacional para el observatorio de empleabilidad de la alianza del pacífico (AP) soportado en inteligencia colectiva (IC) y en organizaciones de alta confiabilidad.

Metodología: La metodología para el desarrollo de la propuesta se soporta en teoría fundamentada, en el que el diseño emerge a partir de los planteamientos realizados en investigaciones previas.

Resultados: A partir de los resultados de la revisión, se presenta la propuesta de estructura organizacional para el observatorio, enfatizando las alternativas para dividir y coordinar el trabajo, y las características importantes de la estructura para facilitar el aprovechamiento de los recursos disponibles en el medio.

Conclusiones: La IC y las organizaciones fiables, son una forma diferente y descentralizada de gestión en las organizaciones que permite crear sistemas más flexibles y robustos, este estudio crea un esquema general de las características y precondiciones principales que debe tener un sistema basado en IC.

Originalidad: El principal aporte de la presente investigación radica en el diseño de una estructura organizacional diferente a la estructura jerárquica tradicional, soportada en IC para la gestión de toda una organización.

Limitaciones: Actualmente no existen grandes avances respecto a estructuras organizacionales alternativas a las tradicionales jerarquías de control a pesar de sus limitaciones en el procesamiento de información y en la incidencia que tendrían en su desempeño.

Palabras clave: Observatorio, Inteligencia Colectiva, Organizaciones Fiables, Gestor de conocimiento.

Resumo

Introdução: este artigo é o produto de uma pesquisa realizada no âmbito do projeto Empla-ap, ao longo de 2019 na Escola de Engenharia Industrial da Universidade Distrital Francisco José de Caldas.

Problema: Limitações no uso de estruturas hierárquicas tradicionais para o gerenciamento de organizações baseadas em hierarquias de controle, devido à dificuldade de operar eficientemente nos Sistemas Sociais Humanos (SSH).

Objetivo: Gerar uma proposta geral que inclua a estrutura organizacional e o gerenciamento do observatório da empregabilidade da Aliança do Pacífico (PA) apoiado em inteligência coletiva (CI) e em organizações de alta confiabilidade.

Metodologia: A metodologia para o desenvolvimento da proposta é apoiada pela teoria fundamentada, na qual o design emerge das abordagens feitas em pesquisas anteriores.

Resultados: Com base nos resultados da revisão, é apresentada a estrutura organizacional proposta para o observatório, enfatizando as alternativas para dividir e coordenar o trabalho e as características importantes da estrutura para facilitar o uso dos recursos disponíveis no ambiente .

Conclusões: O IC e as organizações confiáveis são uma forma diferente e descentralizada de gerenciamento nas organizações que permite criar sistemas mais flexíveis e robustos. Este estudo cria um esquema geral das principais características e pré-condições que um sistema baseado em IC deve ter.

Originalidade: A principal contribuição desta pesquisa está no desenho de uma estrutura organizacional diferente da estrutura hierárquica tradicional, apoiada pelo CI para o gerenciamento de uma organização inteira.

Limitações: Atualmente, não há grandes avanços em relação às estruturas organizacionais alternativas às hierarquias de controle tradicionais, apesar de suas limitações no processamento de informações e do impacto que elas teriam no desempenho.

Palavras-chave: Observatório, Inteligência Coletiva, Organizações Confiáveis, Gerente de Conhecimento.

1. INTRODUCTION

Empla-ap is an international cooperation project that has as one of its objectives, the creation of an observatory of employability and labor insertion for the countries of the Pacific Alliance (PA). It arose thanks to the Erasmus+ program of the European Union, and nowadays is composed of 10 higher education institutions of the PA, and 4 of the European Union [1]. The relevance of this work lies in the fact that it addresses one of the central problems in the human organization design; the configuration of the organizational structure is understood as the division of labor and coordination

mechanism that shows the formal pattern of interactions that allow for problem-solving and decision-making.

Nowadays, there are many investigations that show, in part, the relevance of organizational structure and coordination mechanisms in the success and sustainability of organizations [2]. They also show the importance of flexible structure design which facilitates the adaptable exchange of information, and that this exceeds the restrictions of hierarchical structures and coordination mechanisms based on supervision and standardization [3]. However, there is little research in terms of the impact of the structure in the design of observatories, and in particular on intensive observatories and generators of knowledge [4].

Traditionally the organizational structure has been defined as a formal pattern of relationships and activities between parts of an organization. They show who depends on who and how to divide such activities [5] [6] [7]. Daft points out that "the structure also includes the design of systems to ensure communication, coordination and effective integration of efforts between departments." [8, p.90]. Franklin, Benjamin, & Fincowsky highlighted that the organizations "require a framework of action to operate. This framework is the organizational structure, which is nothing but an orderly and systematic division of their units of work in response to their creation purpose" [9, p.65].

The coordination by its side has been understood as the integration of functional units of an organization in pursuit of their goals, where the crucial tool is the synchronization of efforts [10] [11] [12]. Malone & Crowston [13] define the theory of coordination as the set of principles on how the actors can work together in harmony. Castillo, Gómez, & Bohorquez [14] warn of the importance of coordination mechanisms set up in conjunction with the organizational structure.

Mintzberg asserts that: "All organized human activity raises two fundamental requirements and opposites: the division of labor when performing many tasks and the coordination of these tasks to carry out the activity" [2, p.116]. He also posits some coordination mechanisms that describe fundamental ways in which organizations coordinate their work: mutual adaptation, direct supervision, standardization of processes, standardization of results, skills standardization and standardization of rules, raised from most to least important, depending on the complexity of the work [2].

Nowadays, the dominant structure in the organizational context has been the hierarchy of control, which is dominated by mechanisms of coordination based on supervision and standardization, however, in complex environments, hierarchies manifest great precariousness in the processing of information, due to limited connections between nodes and vertical and horizontal flows. It generates excessive dependence

and fragility, since it limits the information that members can have access to along with slowness in decision-making processes, and a high probability of failure; a product of the huge manipulation of information between levels of hierarchy [3].

The growing complexity of the environment has led to the traditional paradigms being insufficient at the time of giving a timely response [15]. The rigidity of the hierarchies limits the interaction and diversity of individuals, tending to a static balance and decreasing the creativity and ability to adapt to the environment. On the other hand, the complex networks can overcome the limitations of the hierarchies of classical control, being characterized by high robustness and information processing capacity [3], to the approach of a proposal that is capable of behaving similarly; the CI as an alternative of coordination in organizations.

The CI facilitates a quick information transfer, with flows that may occur in any direction, the product of a high level of interaction, distributing the load of information as evenly as possible, thus avoiding delays and overloads in the network [16]. Angulo [17] highlights the observatories as catalysts of CI in facilitating the interaction of multiple agents to generate value, but also acknowledges difficulty in the transition of rigid hierarchies to CI, due to feelings of power loss and questioning of the legitimacy of the organization. Beyond this, there is no evidence of a clear organizational structure or observatory that supports its management in CI.

Regarding the labor division, the CI alone is insufficient. Its implementation is given to specific purposes and not to the management of an entire organization. Malone, Friedrich-heinrich & Dellarocas indicate the need for a "Gene Hierarchy" [18, p.26] for management when conditions are not met in order to work with crowds. Angulo [17] argues the difficulty of giving precise functions and responsible actors in an observatory. Highly reliable or reliable organizations, could be constituted as an appropriate framework for the division of labor [9] by establishing clearly defined roles that can be assumed by any qualified member [19], providing sufficient flexibility to allow the emergence of CI.

In this sense, the contribution of this research is to propose an outline of organizational structure and coordination in order to define how to operate the observatory of employability and labor insertion of the PA, to take advantage of the knowledge available in the environment, be agile in decision-making despite being geographically distributed, facilitate their adaptation and comprehensively overcome the limitations of traditional hierarchical structure.

2. MATERIALS AND METHODS

The present investigation is supported on grounded theory as a methodology for the knowledge of a social phenomenon. Grounded theory emerges as a qualitative method of research in social groups and organizations, is based on the study of data obtained directly from the field of study, for the construction of concepts, hypotheses, theories or the deepening of a topic in question [20]. It is developed in fields such as management, information systems and business creation. It can provide a variety of details and processes for the creation of an organizational system based on CI.

In [21] it is pointed out that certain actions must be performed to conduct a systematic design of grounded theory. The main phases of this investigation are presented in Figure 1.

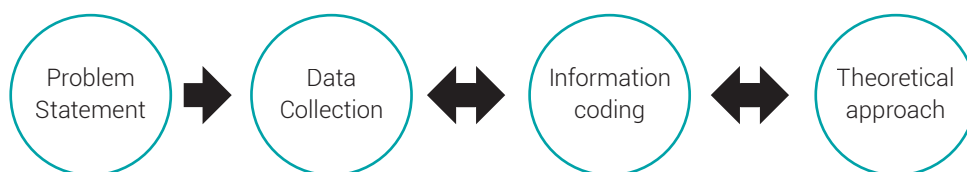


Figure 1. Phases of the investigation

Source: own work

Table 1 presents the stages of this research. The resources used were based both on searches of specialized databases and books, for the collection and classification of information and observation of its impact in addition to joint participation in groups such as Complex UD, interviews and consultations within the framework of the Emple-ap project for contextualization and development.

Table 1. Stages of the methodology

Phase	Stage	Definition
Problem Statement	S0	Identification of the particular conditions of the PA employability and labor insertion observatory and the limitations of traditional organizational structures.
Data collection	S1	Literature review on CI. Literature review of the CI in HSS (With emphasis on how coordination occurs).
	S2	Collection of information about HRO and observatories (With emphasis on how the division of labor occurs).
Information coding: open, axial and selective	S3	Identification of the preconditions and characteristics that the different models that apply CI in HSS have in common.
	S4	Comparison of the characteristics of the CI models in HSS identified in S3, to recognize differences and similarities.

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Phase	Stage	Definition
Theoretical approach	S5	Structuring CI levels: common approaches and characteristics that facilitate the understanding and use of CI in HSS.
	S6	Structuring roles in the context of the observatory and the basic means through which the actors connect and coordinate.

Source: own work

The following describes how each of these stages were performed:

S0: The starting point of this research is to recognize the disadvantages and limitations of the control hierarchies, and how inconvenient a traditional approach to the employability observatory would be. This is also projected as a knowledge-intensive organization, distributed geographically and made up of agents representing organizations; also knowledge intensive.

S1: Focuses on the search for alternative coordination mechanisms to the traditional ones. In the first instance, emphasis is placed on CI and its application in HSS, due to previous knowledge of the high levels of coordination that characterize these systems. This stage is then based on extensive searches in different databases. Table 2 presents some search criteria and relevant authors.

Table 2. Classification of the review

Keywords	Databases	Journals	Author and year of publication
Collective Intelligence	Access Engineering	Centro Nacional de Información de Ciencias Médicas (INFOMED).	P. Lévy (1997)
	IEEE Xplore, Science-Direct		T. Atlee y G. Pór (2000)
	Scopus	Dissertation Abstracts International Section A: Humanities and Social Sciences.	K. McHugh (2016)
	Jstor	MIT Sloan Management Review.	T. Malone (2010) Bonabeau, Eric (2009) G. Pór (1995)
Using Collective Intelligence in...	Access Engineering	Royal Society Open Science.	A. Camacho, M. Merayo, M. Núñez (2017).
	IEEE Xplore, Science-Direct	Journal of Intelligent and Fuzzy Systems.	G. Hernández, A. Rodríguez, G. Alor, J. M. Gómez, M. A. Mayer, and R. Posada (2012).
	Scopus	Journal of Medical Systems.	M. Mačiulienė, A. Skaržauskienė (2016).
	Jstor	Journal of Business Research.	M. Gea, R. Soldado, V. Gámiz (2011).
		International Conference on Information Society.	G. Fauville <i>et al</i> (2018).
		Journal of Literacy and Technology Intelligence.	

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Keywords	Databases	Journals	Author and year of publication
Crowdsourcing	Access Engineering IEEE Xplore, Science-Direct Scopus Jstor	Medical Teacher. Procedia Computer Science. PLOS ONE. Leonardo Music Journal. Science. Expert Systems with Applications.	S. Tackett, S. Gaglani, J. Heilman, A. Azzam (2018). M. dos Santos (2017). A. Brown, D. Allison (2014). D. Casal (2011). L. Von Ahn, B. Maurer, C. McMillen D. Abraham, M. Blum (2013). Y. Yu, J. Kim, K. Shin, G. Jo (2009).

Source: own work

S2: Subsequently, complementary searches are aimed at establishing how the definition of tasks and their division can be given for the particular case of the Employability Observatory. In the first instance, information is collected about organizations capable of performing efficiently in complex environments (HRO). In the second instance, information is collected about observatories of different dynamics, mainly identifying tasks and activities.

S3 and S4: Based on the results of S1, the analysis of the obtained information is developed through the critical study of the most important characteristics and features of the CI (self-organization, robustness and flexibility).

Open coding: Concepts relevant to the case study are identified based on questions such as: What does it do and how does it work?, What are the necessary conditions for the CI?, What characteristics do the actors exhibit?. Table 3 exemplifies the treatment of each consulted model.

Table 3. CI-based models

Title	What does it do and how does it work?	Necessary conditions (Preconditions)	Characteristics of the Actors
Using the collective intelligence for inventive problem solving: A computer Aided Innovation [22]	An agent proposes and shares a project through a platform with the other registered users. The system provides a list of possible collaborators. Through asynchronous collaboration, a collective solution is generated.	Asynchronous digital collaboration platform. Common language to facilitate user participation. List of possible collaborators according to their affinity with the theme of the project.	Participants with knowledge in different areas of interest.

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Title	What does it do and how does it work?	Necessary conditions (Preconditions)	Characteristics of the Actors
Collective Intelligence Meets Medical Decision-Making: The Collective Outperforms the Best Radiologist [23]	A diagnosis (good / bad) is issued applying CI rules, which may include: the vote of each specialist, the average rate of true and false positives, or the individual accuracy of each radiologist.	Mammography database. Participant radiologists.	Specialized participants a specific area of interest.
reCAPTCHA: Human-Based Character Recognition via Web Security Measures [24]	Digitization of old printed material. The contribution of users who solve a hood is channeled verifying that they are human, to digitize and validate a word that an optical recognition system cannot understand.	Digital platforms that use hood. Database in which the responses obtained are stored and validated. Internet users.	Participants with basic knowledge in literacy and Internet use.

Source: own work

Axial coding: Table 4 shows the general scheme of axial coding for CI-based models.

Table 4. General scheme of axial coding

Phenomenon	CI emergency.
Causal conditions	Preconditions for a CI: Actors, Knowledge and TIC.
Context	HSS.
Intervening conditions	Interaction between actors / individual participation.
Strategies	Variation in the composition of actors the type and quantity.
Consequences	Change of focus in a CI.

Source: own work

Selective coding: The concept "Level" is proposed to refer to a particular configuration of CI, defined by the composition of the group of actors in variables such as the degree of specialty, diversity and quantity. CI models at a certain level generally have a particular focus. The above is illustrated in Figure 2.

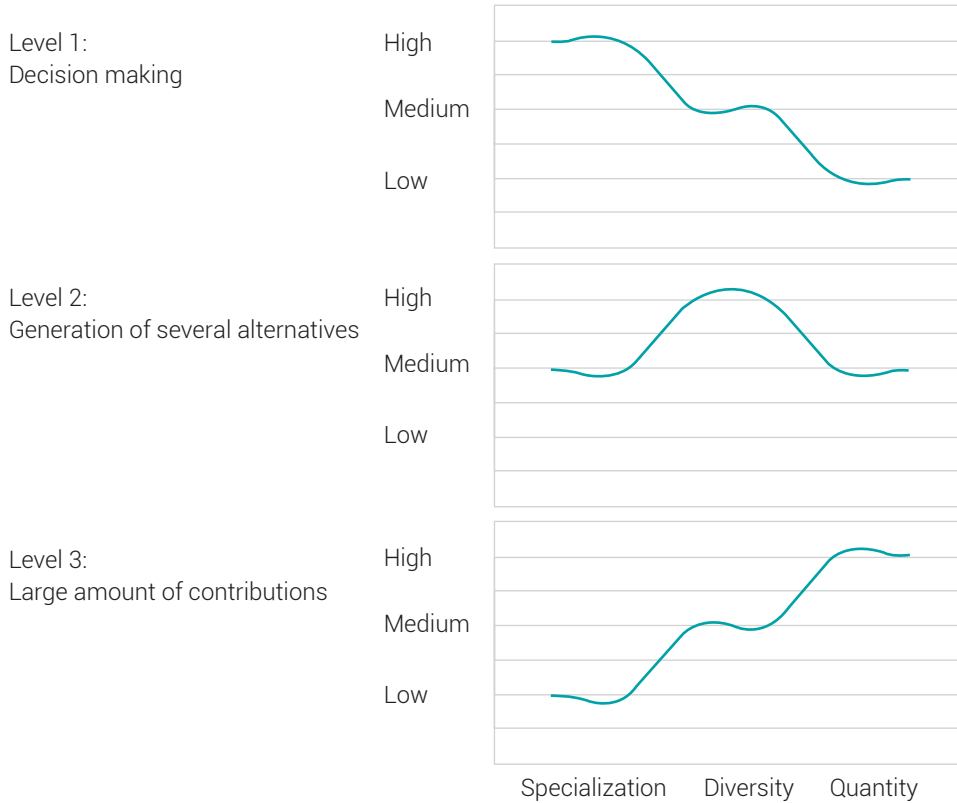


Figure 2. Overall grade exhibited by CI models, depending on their approach
 Source: own work

S5 and S6: Finally, these stages include the theoretical modeling of the proposal, based on the previous stages.

2.1. Literature review

A systematic review of scientific articles is carried out as a technique of exploration and analysis of information. In the first instance the search focused on the term "Collective Intelligence". Highlighting authors such as: Levy, Atlee and Pór, Malone and Bonabeau. Through Google Scholar and databases such as: Access Engineering, IEEE Xplore, ScienceDirect, Scopus, the first relevant or most cited articles in this area were found. Some of the journals found in this review were: Centro Nacional de Información de Ciencias Médicas (INFOMED), Technological Forecasting and Social Change, Journal of Business Research, Leadership Quarterly, among others.

An investigation of models based on CI was made, however, non-related content was found according to the need of search. According to this, using an alternative

strategy with terms and phrases such as "Using Collective Intelligence", or "Collective Intelligence" and through secondary sources such as [18] and [25], it was possible to find the necessary references to locate the sources of early models or applications of CI in human social systems (HSS) and words related to the topic such as "Crowdsourcing" or "Collective Intelligence and Crowdsourcing". This gave rise to some examples of the use of CI in specific areas such as: medical cases, the web or the Internet (reCAPTCHA, Wikipedia, Google, linux), specialized digital platforms (DuoLingo, m-learning, eHealth, iPixel, Galen and DDtrac), applications (mashup) and some ways of using CI to solve social, environmental or educational problems.

22 models of CI in articles published in the year 2008 were collected, using the following selection criterion for the articles: the clarity and CI management in the study case, the journal or database used and the year of publication. In this search, specialized search engines were used such as: Google academic and institutional databases such as the library system of the Universidad Distrital F.J.C., the Universidad de los Andes, and the Universidad Militar Nueva Granada. The most important journals used were: MIT Sloan Management Review, Cultura y Educacion, Expert Systems with Applications, Journal of Intelligent and Fuzzy Systems, Royal Society Open Science, among others.

2.1.1. Collective Intelligence

Pór [26] makes an analogy of a CI with a nervous system that coordinates actions and learns from its own experience. Levy explains CI as: "A distributed intelligence everywhere, constantly valued, coordinated in real time, which leads to an effective mobilization of competences" [21, p.7]. Atlee & Pór [28] argue that a CI will be even more evolved to the extent that it may successfully deal with greater complexity. Malone exposes the CI as: "groups of individuals who do things collectively that seem smart" [23, p.1]. Bonabeau [30] affirms that the technological developments enable you to take advantage of the power of the group to expand the traditional group of work and achieve a state of balance between diversity and expertise. Glenn [31] points out that the CI arises from the constant interaction between people, information and technology.

Malone *et al.* [18] expose how the CI has been successfully applied to different purposes, such as decision-making processes, solutions research, collection of contributions or links and utilization of resources available in the environment (information, materials, capital, etc.).

In collective decision-making, some research propose how to take into account the ability of individual members of a group, increasing the accuracy and quality of the decisions [23] [32]. Some models of CI raised platforms of interconnection for specialists in health sciences, oriented to generate and share diagnoses, clinical decision-making, recommendation of other specialists and the creation and intelligent management of medical knowledge bases [33] [34] [35] [36] [37].

More accessible models propose digital platforms, that manage information and connect to individuals at any time and place, which are not necessarily experts on a specific topic. Its purpose is usually to take advantage of diversity to generate structured discussions, looking for ideas, alternatives, solutions and creating projects to split large problems in smaller, more manageable problems [22] [32] [38] [39] [40] [41] [42].

Some others recognize the need to continually educate a population to identify barriers [43] [44], Or to improve the quality of the contributions received, where the interaction also promotes a knowledge construction in a collaborative manner, for example: Education and generating ideas for energy conservation [45], The effort of users who learn languages on the internet in order to translate the Web [46], Or the improvement of the quality of articles of health topics in Wikipedia, to incorporate your edition as a methodology of higher education [47].

There are also models with a simpler approach, oriented to the collection and use of large amounts of individual contributions, for the generation of value [24] [48] [49] [50].

2.2. High Reliability Organizations

High reliability organizations are those which exist in such dangerous environments where the consequences of mistakes are high, but the occurrence of these is extremely low [51]. They are distinguished by features such as hyper, understood as the extreme diversity of components, systems and levels; a large number of decision-makers in complex communication networks, characterized by the redundancy in the control systems and information; degrees of responsibility, which do not exist in most organizations; the high frequency of immediate feedback on decisions, among other aspects [52].

The structure of the reliable organizations is characterized by having clearly defined roles that may be occupied by different members of the organization, according to the circumstances of the environment. Nogara [19] points to the case of a volunteer firefighting department, under a method of management, incident management,

hereinafter referred to as the Incident Command System (ICS), where a series of roles called C-FLOP (command, finance, logistics, operations and planning) are borne by any qualified member depending on the situation. That is, the roles are semi-to be set, but not assigned to a particular person, and can be developed by any of them.

The model of operation of these organizations is characterized, among other things, by the permanent creation of emergency situations, constant processes of training, which may be interdisciplinary and that encourage the transfer of knowledge [53]. The interaction is very important as it allows the knowledge of the powers and limitations of individual and collective action among all members of the team [19]. Jobidon, Labrecque, Turcotte, Rousseau, & Tremblay [54] argue that, although the computers that do not have formal assignment of roles are more flexible, teams with defined roles and functions are able to adapt effectively and more quickly to unexpected events.

2.3. Observatories

An observatory is a form of organization that analyzes and provides follow-up to a phenomenon of interest, in order to know the state and evolution of a problem [4] [55]. The observatories can assume functions such as: collection, classification, codification, categorization and creation of databases. They also perform analysis, diagnosis, systematization, standardization, formulation of scenarios or advance as a function of their prospective. Other duties include scientific dissemination, networking, formulation, adaptation and/or development of policies, among others. [56] [57] [58] [59].

Angulo [17] Notes that many of the functions of the observatories refer to the conversion of data and information into useful knowledge. It also presents to the observatories a framework of knowledge management and identifies key roles, providing access in a timely manner to the knowledge available. The National Institute of Public Administration A.C. [56] warns of the impossibility in the operation of the observatories without new information and communication technologies or (TIC).

3. RESULTS

For the observatory of employability of the PA, a proposal for a structure based on reliable organizations with semi-formal roles is modeled, coordinated through mechanisms of CI, developed from the review of models of CI. Internally the observatory was formed by members of higher education institutions linked to the project: researchers, teachers, graduates and students; externally aiming to link to state organizations, private companies and society in general. It raises and argues for a knowledge manager

(KM) that not only ensures the reliable and timely access to the knowledge available, but allows for the connection between any agent in the system.

3.1. Modeling

Table 5 adapts the concept of CI level, to the context of the observatory, identifying at what level the actors involved could operate according to the degree of specialization, the diversity of the group and the amount of individual contributions and exemplifying what type of contribution could be exploited by the Observatory. The management of the observatory would then operate at level 1, while levels 2 and 3 would create links with the environment, in order to take advantage of its resources.

Table 5. Characterization of the levels of CI

Level	Characteristics	Actors	Resources
1	High degree of specialization. Small and homogeneous groups. There are decision-making processes. Creation of networks of specialists. Generation and Validation of knowledge. Creation of knowledge bases.	Officials of the observatory: researchers, teachers, students.	Specialized inputs: Research and/or generation of projects of any kind.
2	The average level of competence. High degree of diversity. Creation of open networks. Interaction and search for a greater variety of options, through the division of big problems into smaller ones.	Users linked to the network: students, graduates, external organizations.	Various inputs: Personal data, labor offers, ideas, options, approaches, among others.
3	Minimum level of competence. Use of the Web. Collection of large volumes of simple inputs, and independent.	Members of the society in general.	Simple inputs: Data and others.

Source: own work

3.2. Organizational Structure

As to the division of labor for the actors at level 1, the organizational structure is supported by reliable organizations for its robustness, flexibility and agility. Based on the roles of the ICS, Table 6 proposes similarly semi-formal roles adapted to the context of the observatory.

Table 6. Roles and activities identified for the model

Internal Role	Activities
Direction (D)	To assess situations and identify the approach must be the same [19], Given the social, political, economic, etc. Make decisions [60], [61]. Be the representative image of the observatory and create strategic alliances [19]. Intervene in the resolution of problems [16].
Sustainability (S)	Identifying sources of funding [4]. Managing the budget, cost structure and creation of financing plans [19].
Logistics (L)	Organization of events (seminars, meetings, congresses and other related actions) [55] [22]. Coordination of training events that require it (courses, workshops, diplomas, etc.) for the articulation of actors. Keep track in real time [14].
Research and development (R)	Data collection, analysis and dissemination of information [55]. Creation of processes of innovation, research and development [17]. Training and continuous training of the actors [17]. Creation and management of information systems and platforms [62]. Creation of indicators and results dissemination [17].
Planning/ strategy (P)	Development of reports and evaluation techniques [54]. Strategic alliances [19]. Planning of training events (workshops, courses, diplomas, etc) and training methods and training to members [55], [19].

Source: own work

3.3. Knowledge Manager

A common point between the three levels of CI raised in Table 5, is that it always includes three elements: actors, technology and knowledge. It is inferred that a CI can occur, if and only if they are present. In the review of CI, the technological element is permanent, either as Web sites, open digital platforms, specialized applications or knowledge bases. The review of observatories concludes that this type of organization depends to a large extent on TIC, to the point of the impossibility of operation in his absence.

A proposal, that integrates all levels of CI, is that the more the requirement in the handling of information implies an observatory and its technological dependence, the greater the absolute need for a system described by By (1995) in your analogy, which expresses the global capabilities to: interconnect to all its members, collect your

data and inputs, and facilitate a rapid exchange and processing of information in the absence of a central controller.¹

The system called Knowledge Manager (KM), in addition to the above, shall among other things: be accessible and geared towards simplicity of interactions [45]; Ensure reliable and timely access to available knowledge [17]; Have constantly updated knowledge about powers, limitations and evolution of the actors of level 1, in order to generate recommendations regarding the role that can assumed, in addition to constantly promoting and enabling training processes [17] [19].

For the exploitation of resources, the system should collect data, information and contributions of actors in levels 2 and 3. It is crucial to the elimination of language barriers in raising platforms that are in line with the abilities of the social group [45]. The system will also be able to take advantage of other platforms of greater use such as social networks or debate forums for data acquisition, dissemination of results or promotion of non-formal learning [39] in order to generate a greater social impact.

3.4. Coordination Mechanisms

Making use of interconnected platforms according to the skills of the members, in a manner similar to social networks, each actor must build a profile. This is fed with personal data, skills, areas of interest, academic and labor resupplied with experience, results, participation within the observatory, among others.

It is intended to present relevant information in a personalized way. The members must be able to gain access at any time and place to: your profile and trajectory in the observatory; the state and evolution a particular project; custom suggestions about discussions, events, online training and other content of interest in a simple and attractive manner.

The platforms will be linked to the KM in a manner that makes it possible to provide actors of level 1 real-time access to accurate and relevant information to enable them to decide quickly and in an organized manner. An actor of level 1 with relevant information in a framework for action and time will be able to: assume a role in the organization, be trained in areas of interest, be linked to a project or propose their own, share it and get a list of potential partners, open it to the public, structure discussions, as well as disseminate results, needs, future lines of work, educational content or content of general interest.

Similar to the ICS, the observatory can have different approaches in time. At a given point in your approach, you may be oriented towards the search for economic

¹ The nervous system of an organization.

resources and in another, towards the dissemination of results, depending on your goals, emergencies, and the conditions of the environment that need to be faced. Table 7 proposes activities and criteria by which actors could be organized, thanks to the technological support of the KM in providing relevant and timely information.

Table 7. Activities and coordination criteria identified for the model

Activity	Criteria	Description
Selecting Roles	Need. Competencies.	Given an approach, based on the competences of the actors, the KM makes suggestions tailored to each about what roles could be assumed.
Training Continues	Need. Competencies.	Given an approach, based on the competences of the actors, the KM makes suggestions tailored to each one of those who should be trained.
Generation of projects	Need. Impact.	Once arisen, they are approved and managed with support in the KM according to the situation or focus of the observatory.
Selection and invitation of contributors to a project	Proximity to the project. Competition. Participation	The KM generates suggestions of collaborators for a specific project from the relevance that have criteria such as: the proximity of the project, the degree of competition and the history of the participation of actors.
Dissemination of results	Scope. Powers of the public.	Based on the scope of a project, and the skills of the target audience, the KM gives suggestions of how and where the results should be presented.

Source: own work

In collective decision-making it is important to take into account the individual capacity of each member in a particular situation, recognizing that all actors are not equally valuable in all situations. Given the theoretical modeling developed so far, the decision-making is presented as a process that consists of the identification of needs, the generation of alternatives and the selection of one or more depending on the case. To illustrate it, a voting system, based on weighted averages where every participant has a weight defined by their ability to provide decision making actions in a situation is proposed; setting out criteria for assessing the ability of an individual to respond, i.e. the weight of each actor in the vote.

Firstly, depending on the approach or particular needs of the situation, the actors involved assign a relative weight to each criterion (WC_i), where the sum of these is equal to one. Secondly, the KM, based on information in the personal profile of each actor in the group, will generate a relative score (P_i) in a range from zero to one for each criterion. The weight (W) of each actor in a collective decision-making process is the sum of the relative weight of the i^{th} criteria by which the relative score of that criterion is calculated, as expressed in (1):

$$W = \sum_{i=1}^n (WC_i \times P_i) \quad (1)$$

In a simple process, each member selects an alternative and chooses the one that has greater average weight. Table 8 proposes basic criteria for an example where the problem to be addressed is the educational needs in Colombia.

Table 8. Criteria for assessment of actors in a particular situation, identified for the model

	Criteria	Description
Relative Weight	Proximity to the project= 0.4	The context of the problem makes criteria such as proximity and level of competence to be of more relevance than participation.
	Competition= 0.5	
	Participation= 0.1	
Actor Score: Director of the observatory	Proximity to the project= 1.0	For each criterion, the score is calculated on the basis of the information of all members of the group that makes the decision.
	Competition= 0.9	
	Participation= 0.8	

Source: own work

In the previous case, a sum-product is finally made between the criteria of the relative weight (depending on the situation) and the actor's score in this situation, granting a weight of 0.93 to the actor to make a decision. This score will be averaged with the weights and decisions of the other participating actors.

4. DISCUSSION AND CONCLUSIONS

The success of this research lies in the creation of an organizational structure and coordination that overcomes the limitations of the traditional paradigm. In this model, the actors involved in a framework of CI (levels of CI) that sets the type of linkage and/or participation in the observatory are defined. On the other hand, the basic roles that describe and group the functions and/or basic processes necessary for the operation of the Organization in its context have been established. The role and functions of the KM as an element active articulator of the highest importance has also been defined. Finally, mechanisms for coordination, for which it is essential that each actor has access to relevant information in a timely manner, have been established.

Based on the above, the observatory has features such as agility, robustness and adaptation necessary for its functionality and sustainability over time. To date, the modeling presented here is based on grounded theory, however, validation of the same is still under development by means of an agent-based simulation and is expected to present the results of their performance and effectiveness shortly.

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