Organizational Features in Disaster Risk Management Systems

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Abstract. In recent years, the fields of humanitarian logistics and attention to natural disasters have been focused on identifying the needs of the communities that go through some type of crisis, with the purpose of optimizing mitigation, prevention and response to emergencies processes. Today, problems have become more frequent and devastating; globalization, environmental damage and climate change have made our planet vulnerable. The social, economic and even political impact that have generated these events, has placed them in the crosshairs of governs. This article aims to conduct a systematic review of the literature about systems that address natural disasters and emergencies; its structures and structural features that characterize them. The structure includes, but is not limited to aspects such as the distribution of information, interaction patterns between the parties, the roles played by team members, among others. In this way we seek to highlight how the decision-making processes are carried out, and how these factors affect the outcome of the emergency. As a research proposal in the first part, the review process carried out and the definition of important terms are described. Then, some cases of emergency care are identified and selected, in which the stages from the declaration of the emergency to the results obtained can be recognized and the definition of four common structural elements in each situation can be defined: coordination mechanisms; information flows; structural flexibility; and roles and authority within the organization.

Keywords: Disaster Risk Management Systems, Structural features, Decision making process, Coordination, Natural disasters.

1 First Section

An emergency could be understood from the perspective of L. N. Van Wassenhove [1], who define it as "a disruption that physically affects a system as a whole and threatens its priorities and goals", discontinuities, breaking of symmetries, and overall changes from one state to another [2]. Cozzolino (2012) suggest that an emergency come from two main causes, (natural hazards or man-made) and their onset can be slow or sudden. The Table 1 shows the relationship between cause and onset of an emergency.

According to the type of emergency that teams face, different resources will be demanded and the level of response will change. For those events with a sudden-onset,

the effort of mobilization and attention must be greater than for slow-onset emergencies.

Table 1. Types of emergency [3]

Cause	Onset	Example
Natural	Sudden	Earthquake
Natural	Slow	Famines
Man-Made	Sudden	Terrorist Attack
Man-Made	Slow	Armed conflict

The attention of a natural emergency requires the participation of different institutions, forcing them to coordinate their efforts and resources to reduce the impact of an event of this magnitude. The field of humanitarian logistics has for many years studied the optimal way to carry out the processes of planning, control and mobilization of resources for helping the affected communities. [4]. Optimization of these processes occurs through effective performance in the coordination and integration of all the inter-organizational actors involved. In this way, it seeks to eliminate repetitive and/or unnecessary tasks, and maximize efficiency at each stage of the supply chain [3].

The multiple interactions that can occur in the attention of an emergency and the different configurations that the response system presents, lead to modifications in the structure of the team. The team structure refer to how individuals in companies are organized to facilitate coordination and work division. The aforementioned includes some aspects such as the distribution of information, patterns of interaction among parties, the allocation of decision-making rights, roles taken by the team members among others. However, this is not its only focus [5-7].

At present, there are several research papers that support the relevance of the structure in decision-making processes mainly due to the rise of crisis derived from the interdependence among different systems. Phenomena such as globalization and technological breakthroughs facilitate this condition [8, 9]. Regardless of their magnitude, these elements demand of corporate organizations to take efficient decisions to use the environment complexity to boost organizations performance.

Within systems that involve inter-institutional relations, the constituent element in the design of organizational structures is the prevalence of hierarchies of control. The relevance of those type of structures is related to the theory of transaction cost and the theory of the signature. From that point of view, the hierarchy of control is the mechanism that allow diminishing the risks and the costs derived from the limited rational in the agent-agency dynamics. However, despite to these advantages, there are numerous researchers that show the lack of resources that have in order to act in environments of crises and even more in complex ones [10 – 13].

The limitations of hierarchies of control and the importance that teams structure must respond to emergencies had caused that from different fields of study be developed extensive research works. Some of these are the attention of natural disasters (earthquakes, avalanches, etc.), attention and management of crisis situations (man-made sudden-onset emergencies.), emergency management in hospitals, as well

as the organization of teams in the fields of battle. The focus of the above-mentioned is the study of the structures and their features that increase or explain the team's capacity to respond nimbly (with speed, accuracy, effectiveness, and efficiency) in highly changeable environments.

In view of the foregoing, we would like to address in this paperwork, based on the literature review, the structural features that underline organizations whose focus is dealing with emergency situations, regardless of where they occur, and what causes their rate of success or failure.

This paper is organized into three sections: the first will report the methodology followed to review the literature; the second will describe the structural features that emerged from the revision display the different teams focused on the attention and management of crisis situations; finally, we will tackle the debate and outline the future lines of research.

2 Methodology

The methodology employed in this paper is based on the Kitchenham [14] proposal of a systematic and generic review process that is developed through three phases (Fig. 1). The first phase allowed us to identify the possible cases to be considered for the review. To this end, we search on academic databases such as SPRINGER (www.springer.com/la), Elsevier (www.elsevier.com) and JSTOR (www.jstor.org).

There were used the following keywords for the search: crisis response organizations, disaster risk management, DRM organization, disaster response, emergency. The use of abbreviations such as DRM or terms like emergency response expanded the list of useful research papers, in comparison to those using terms in Spanish like emergency response (respuesta de emergencias) or disaster management (manejo de desastres). The main priority in the initial search was the identification of cases in which the crisis, regardless of the type of the event, the date or the place, was presented unexpectedly and required a scheme of attention and management. In the literature review, there were included some situations of crises such as natural disasters, fires, floods, and hospital emergency care among others.

The second phase focused on the selection of articles dealing with some aspects related to the structure or structural features of the team in charge of caring and managing the situation of crises. To this purpose, the search of keywords in the articles like structure; hierarchy; self-organization; coordination; command and control; communication, information flows; roles; decision-making process, and social system structures was essential. Once more the choice of terminology in English was preferred due to the depth and amount of studies related to the structure of systems written in this language. Also, it was evident a remarkable difference in the results of the searches made with terms like systems, in comparison to the type of results collected using terminology in English. The reason is that the results derived from this were not coherent with the topic of research or the number of results was very limited.

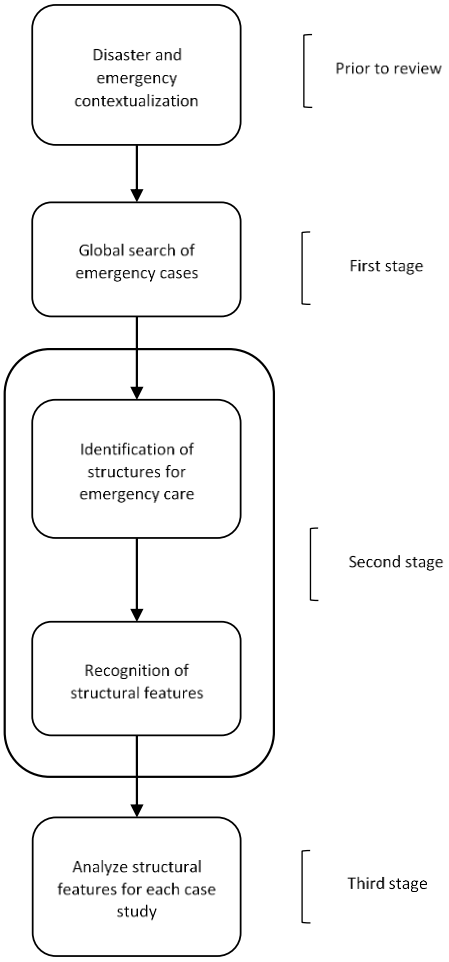

Fig. 1. Flow diagram of the review methodology

The search in this phase begins with the identification of structures already formalized like is the case of ICS (Incident Command System). The aforementioned is established to select as a leader to the person who had the first approach to the situation of crisis. However, this leadership may vary depending on the evolution or the disturbances within the system or the environment; a characteristic also found when self-organization is defined as an organizational structure. These situations force the change of the structures and thus, sets a common ground among the variety of structures that will be described later on.

It was also allowed identifying that crises have been addressed in the literature from two perspectives of analysis. The first aims at studying disasters in general without deepening into particular cases. And the second, whose focus was specific cases of

study for its analysis; this perspective formed the 23.84% of the investigations founded [15].

The third phase focuses on understanding the structure and or identifying the structural features that underlie the team in charge of caring and managing the crisis. Although the organizations involved may have individually acquired exemplary know-how in many previous experiences, they still have difficulties to work quickly together in the field.[34] For the development of this stage, it was made a complete and detailed reading of the articles selected in phase two. The comprehension of the structure and or the identification of the structural features was done mainly considering the following criteria:

- Mechanisms of coordination, which refers to how agents interact in teams to the development of collective behavior.
- Channels and information flow focus on identifying the mechanisms used by organizations to distribute and share information. In this way, it can be identified what is the route and the process that follows inside and outside the structure.
- Flexibility refers to the recognition of variations in the structural level assumed by organizations according to the type of crisis attended. In this manner, can be generated changes in responsibilities (individual and group) and in decision-making processes.
- Roles within the system refer to the way responsibilities are assigned to the team, as well as how they change in order to respond to the environment.

In the research in the journals, the focal themes of the research were: Contingencies and Crisis Management, Disaster Risk Science, Disaster Risk Redution, Humanitarian Logistic, Risk Management. As evidenced on the Figure 2.

Fig. 2. Diagram of relationship main issues with number of articles reviewed

Humanitarian emergencies have increased noticeably in recent years, as consequence, they have become an issue of local and global relevance as indicated [15]. Some disasters such as the earthquake in Haiti [16] and the tsunami in Japan (2011) have increased the concern of governments and communities regarding prevention and

mitigation. However, there is not enough research work that concentrates its attention on the organizational structure of the teams in charge of responding to emergencies. This will be confirmed later with some cases that have been considered relevant.

3 Structures and Structural Features

A system represents a whole that can be undivided into independent parts. The behavior of each part depends on itself and the influence of others elements. And the general performance of the system obtains the result of the possible interactions among all of them [17]. Therefore, the effective management of a system entails an adequate managing of the interactions of its parts granting to the previous explanation. In addition, given a social system interacts with its environment, it also demands the proper management function effectively.

It is common for systems to be immersed in dynamic environments, in which their constituent elements interact over time and exchange internal and external information. Sudden changes within the organization and in the environment, require organizations to adapt to new scenarios. This is why systems must readjust the functions of individuals, their position within the structure and the most effective mechanisms to deal with emerging situations.

The structure of the system expresses how its components are organized and how the work is divided [17] to fulfill its function in the environment [18]. When facing an event, the definition of a specific structure can have a direct impact on the results obtained, and on whence future situations will be addressed. Likewise, in many cases the schemes that a system adopts must be defined based on the individual and collective aptitudes of the components; the degree of freedom that each of them has to make decisions; and the information and coordination demands in space-time. In many cases, systems must reorder their components to cope with the changes presented by the environment. Therefore, the change in the structure remains a fundamental resource that systems use to adapt and consequently face abrupt variations over time.

Systems frequently create new structures, which represent new interactions that can be made by its components to establish higher-level organizations, developing patterns of behavior and communication between the parties [6]. The reference [19] points out that these organizations have three essential characteristics; the creation of spatiotemporal structures, the possibility of establishing multiple interactions and access to other parallel processing systems, where their components carry out simultaneous activities; and the ability to adapt to the environment of origin.

The criteria under which organizations modify their structures to face the changes support previous categorizations made. These have been made to identify the kind adopted by the systems depending on their objectives and the elements that constitute them. The reference [20] defines five categories that an institution can assume according to the leading coordination mechanism, the core part of the organization and the type of decentralization: simple structure, machine bureaucracy, professional bureaucracy, divisional form, and Adhocracy [21].

On the other part, [17] analyzes the behavior of the structure to define four types of systems. The passive, which maintains the same construction and function in all environments; the reactive, that assumes various types and functions in diverse circumstances; the receptive, that adopts sundry structures, but the same objective in unalike environments; and the active (proactive), with various structures and functions depending on the diversity of the settings.

To date, some numerous investigations propose features that can characterize the design of the organizational structure. The reference [5] raises three features: first, the distribution of information which refers to the mechanisms that the systems have to regulate, monitor and control the flow of data. This is done to guarantee its relevance and clarity. Second, the interaction patterns that aim to identify and establish the degree of participation that individuals demonstrate according to the complexity of the activities developed and their respective specialization; and third, the assignment of decision rights. The prior concerns about the centralization of authority and the autonomy that a system can achieve in consonance the specialization of the individuals or the entities that shape it.

The more these factors are seized, the more can grasp the "edge" of control and the direction of the organization. The dynamics of the organizations that work through this tripartite relationship require a clever use of information channels and an adequate flow of it. What this implies is that the parties involved must efficiently coordinate their individual and group knowledge. The consequence of such is the establishment of processes that could generate supplementary information and respond adequately to the needs of the system and its settings.

Due to all the possible interactions that may occur in a system [6] is necessary that mechanisms and effective processes of information exchange be defined. These become more difficult in the case of organization members that manage interdependent chains of command; when their interests vary considerably; and or by reason of the change of perceptions in a situation differs from person to person [5]. For this reason, feedback reduces these harmful effects when it comes to communication and decision making. For its part, Boyd [22] proposes a feedback mechanism through the "ODDA" loop, a process in which the direction and control of an organization are represented in four stages: observe, guide, decide and act.

In the decision-making process, the system as a whole must be understood. At the same time recognize that each individual represents an influential element that can contribute their knowledge and skills in that process. Therefore, knowing how to develop the cognitive abilities of people, enhancing their ability to transmit ideas, and encouraging self-synchronization when facing emergency scenarios develops shared awareness of the system [23]. In this way, information flows efficiently through the diverse nodes of the network, speeding up the response of the organization [24].

In addition to coordination, information flows and the way in which decisions are made, it is also necessary to identify responsibilities. This is essential to define what would do each of the components of a system in a specific structure; this assignment of specific activities is known as roles. Further, they can change according to the event to be faced, the environment of the system and the individual capacities of its components [25]. Due to the unlikeness to know the role that each individual will occupy within an

organization in complex and dynamic environments, it is necessary to establish the aforementioned feedback. As [26] suggested, these processes are implemented to evaluate performance in past events, collective effectiveness, interactions among members, and the results obtained. When occurs, it is said that a network has been trained by the inputs and will respond to others based on this experience [7].

3.1 Structures and structural features present in human social systems focused on crisis care and management.

From the approaches made by authors studied in the previous section, this research identifies four structural features in organizations. These will facilitate the study and understanding of the ways in which work teams of human social systems focused on crisis management and care function. First, we find the coordination mechanisms that refer to the way in which the agents interact in the teams for the development of collective behaviors. Second, to channels and information flows focused on identifying the mechanisms used by organizations to distribute and share data. In this way, the route and the flow that follows inside and outside the structure are recognized. Third, flexibility, which refers to the recognition of changes at the structural level assumed by organizations according to the type of crisis served. As a consequence, this generates changes in responsibilities (individual and group) and in the decision-making processes. And fourth, the roles within the system, which are how responsibilities are assigned to the team and the way this last change to respond to the environment.

Charts I to VII present the analysis of each of the structural features in the selected cases.

Charts I. Case 1: An Institutional Model for Collaborative Disaster Risk Management in the Southern African (2016) [27].

Case description	This case collects information from interviews conducted with people involved in disaster relief. In this way, the procedures under which emergency care has been carried out are identified, the basic principles that govern its structure and the advantages thereof. It assumes a structure of three levels; include the African Union (AU), the CDSA, and each of the 15 member states of this institution. The success of the model's operations depends internally on different aspects coming up next. These are the management of the Development Community and externally of the African Union; the work of each member state; the role of the international institutions concerned; and the eventual participation of state and non-state institutions (ex. Civil Society) as support in disaster risk reduction (DRR).
REPRESENTATION OF THE STRUCTURAL ELEMENTS	
Coordination Mechanisms	The agencies that intervene in emergency care belong to interdisciplinary institutions with different interests, however, they work under the collaborative model of DRM (Disaster Risk Management). This model involves processes aimed at sharing knowledge, locally and among the members of the African Union. In addition, it includes the power granted to the CDSA to allocate funding resources and support programs for each of its units.

Informa-tion flows	The case study suggests the need for information exchange between the units and organizations involved. Even so, it does not establish the mechanisms used to transmit the information.
Structural flexibility	The structure of this system is divided into three levels, denoted as A, B, and C, representing the institutions in charge of the African Union, the Regional Development Community and the SADC member states respectively. These levels have the following relationship and association properties: • Information report relationships • Regional nuclei within the system • Functional relationships • Focal areas associated with a particular function. These associations can be given within the same level or between them.
Roles and authority	There is no evidence of how the activities are divided among the individuals that make up the system. It is recognized that authority always falls on the African Union or the Development Community, limiting decision-making to the higher levels of the organization.

Charts II. Case 2: Territorial Accessibility and Decision-Making Structure Related to Debris Flow Impacts on Roads in the French Alpes (2016) [28].

Case description	On the morning of June 4, 2012, there was a debris fall in the RifBlanc basin, followed by rainy days in the Guisane Valley, located north of the "High Alps" (a region of the French Alps). The sediments extended for 94 meters along the D1091 road, causing its blockage. The damage caused was close to US$ 30,000, generating the blockade of the highway for 8 hours. Many of these events caused by landslides or avalanches can cause critical damages in infrastructure and transport networks. Depending on the situation within the region, situations with a strong economic and social impact can occur. It is recognized a hierarchical structure led mainly by two organisms: the governmental administrative and security entity; and the municipal administration. In these two, decisions and action plans are made. In the research process and through the interviews conducted, clear differences between the theoretical model and the practical model in this situation can be determined.
REPRESENTATION OF THE STRUCTURAL ELEMENTS	
Coordination Mechanisms	The service agencies formed by the fire and mountain guard unit work together under the same procedure protocol, divided into four stages: intervention, communication, action, and normalization of activities. In addition, relationships are established with particular purposes, either only to report information, to make decisions or to execute an action.
Information flows	Within the structure recognized in practice, information flows are established that do not have a defined direction between levels or types of organization. This is transmitted in a bidirectional way between the organizations according to the pertinence that represents for the diverse actors, contributing and improving the taking of decisions.

Structural flexibility	Two structures are differentiated: the first, established as the formal structure in which there is a hierarchical distinction according to the levels of administration. These come from the government as an actor responsible for the safety of individuals to the units in charge of giving attention to the crisis (Fire and Rescue Department, Police or security body). The care agencies mentioned are controlled by a departmental operations center that responds to the direction of rescue operations, and so on. Under these parameters, decision-making is assumed at the highest levels of the structure. The second emergency structure lies on the immediate decisions of the two last-mentioned groups. They are the first to be informed of the situation and are responsible for attending and making the relevant decisions in the scene. They intervene on the roads, report the event through the Internet, organize the corresponding detours, remove the debris and allow the return to the initial conditions. In this structure the pyramid scheme is eliminated, the actors responsible for decision-making are defined, and the tasks to be executed are established in temporary stages. There are also information flows and procedures that involve not only two actors, but all those considered relevant to address the crisis. Generally, the inclusion occurs from stages 2 and 3, initial communication of the emergency and initial decision making respectively. What allows this behavior to be evident is that the "formal" or recognized structure changes according to the needs of the emergency, focusing on making assertive decisions.
Roles and authority	Each organization involved knows in which aspect of the situation should intervene. Therefore, decision-making processes rely on each one of them. In addition, the roles for everyone are defined considering the functions of the other players. This requires a permanent communication of the actions to be performed, and not generate a conflict of interest.

Charts III. Case 3. Response to a high-altitude earthquake: The Yushu Earthquake (2011) [29].

Case escription	On April 14, 2010, the territory of Yushu in Qinghai Province (China) was shaken by an earthquake of magnitude 7.1. The central government defined six main response mechanisms for the event: disaster emergency response; issuing disaster information; reservation of relief material; early warning of disasters; early consultation and information exchange; coordi nation for the rescue and mitigation of major disasters; and social mobilization for disaster emergency response [29]. Local governments at different levels also established relevant mechanisms for earthquake response and disaster mitigation known as the "2 + 1" model. This consists on: (1) statistical data on losses reported by the local government of a disaster area; (2) professional surveys and evaluation at the earthquake site; and (3) the intervention of the local government and its disaster management department.

Case escription	This latter included the collective consultation of other relevant departments to verify the disaster losses of the final earthquake. The system mentioned was modified to a "3 + 1" model where a remote sensing analysis was added for the conditions of the area. Thusly, the efficiency of the rescue was significantly improved and the transition from attention to recovery and reconstruction accelerated.
REPRESENTATION OF THE STRUCTURAL ELEMENTS	
Coordination Mechanisms	Each participating institution was located in one of the six centers, either to go directly to the event occurred, transmit the information, took charge of the logistic process of channeling resources (material and economic); or social mobilization. By using the so-called effective model of partner assistance, the institutions of rescue worked efficiently with other private organizations altogether with civilians. The transmission of accurate information was essential for the Chinese government to plan the recovery of the area. Thus, the NCDR (National Commission for Disaster Reduction) selected an expert team to carry out a field evaluation and provide with support the reading and interpretation of data. The national, provincial and prefectures headquarters altogether with the headquarters of the army and the armed police force were assigned to different tasks, but always operating in close cooperation and coordination with each other and with local authorities and institutions. The recovery and construction processes were developed altogether with the attention to care.
Information flows	The ease to access information in real time of the situation without further costs allowed to gather a large amount of evidence. This was essential to evaluate the most affected areas and define the necessary actions to address the situation. These results were validated with the retrieval of fieldwork data. We would like to highlight the speed in the transmission of information by each organization involved. In addition, small media is identified as the most important source of information due to its transparency and clarity of spreading
Structural flexibility	It was not possible to determine a structure for the attention because different control entities were included in the process. In each one, the structure established as an organization is maintained and intervened according to the relevance of the activities or identified needs. A multi-institutional functioning is recognized where each organization had the criteria to determine the relevant individuals for the situation. All the parties involved took a human-oriented approach. Based on the rapid preliminary assessment of the disaster situation, the Chinese government quickly shifted its focus from work to recovery and reconstruction.
Roles and authority	The organizations involved assume a defined responsibility within a response mechanism, depending on the skills they have as an institution and according to the need of the event. The participation of each organism was developed in different proportions. However, it was possible to divide the tasks in order to focus efforts and quickly mitigate the impacts of the emergency. The authority depends on the structural model that each organization possesses within the system and the response mechanism to which it is assigned.

Charts IV. Case 4. The Incident Command System High-Reliability Organizing for Complex and Volatile Task (2001) [25].

Case description	This study is based on interviews conducted with the United States Department of Fire and emergency response models. This research identifies that the work within the ICS is specialized, based on standardized routines and requires special training. There is a hierarchical organization in which every position relates to each other on the basis of formal authority [25]. The personnel that attends the emergency is divided into four sections mainly: operations, planning, logistics and financial-administrative. In each of them, there is a boss in charge. This type of organization seeks to respond continuously to the variety required by the situation. Like this pretends to expand or contract according to the situation; changing strategic orientation; or modifying or changing tactics throughout the development of the incident.
REPRESENTATION OF THE STRUCTURAL ELEMENTS	
Coordination Mechanisms	The degree of effectiveness in the coordination of individuals depends to a large extent on the capacity they might have to build and maintain understandings of their own organization. These understandings represent the basic cognitive infrastructure that allows individuals and groups to effectively integrate their behaviors with those of others as an incident develops and evolves. This knowledge can be developed by the activities carried out in a certain situation, communicated among the members of the organization or through the change of roles. That is when a task is assigned to a person and this does not generate a viable operational representation is relegated to another person. Usually, to whom is in a better organizational position and has sufficient cognitive resources to build and maintain an understanding of the activities of the system. There is also the knowledge imparted through the grown in the lines of authority.
Information flows	The information flows through the structure from the moment in which the unit that attends the emergency communicates the event to the rest of the organization. Moreover, there are established within the organization some communication commands in addition to systems of efficient exchange of information with the population that participates in the care of the event.
Structural flexibility	The head of the unit that attends the emergency assumes the position of "Incident commander" (IC). This is the one who makes the decisions and assigns the functions of the other members. This unit is the one that first arrives at the scene, reports the conditions and determines the resources to be used. This position is held until an individual arrives with a higher rank and has the faculties to take control of the situation. In the event in which the first structure demonstrates inefficiency or the incident becomes more complicated than expected, the IC can completely dismantle the organization, redirect it and or reconfigure it.

Roles and authority	The initial role of the individuals who attend the emergency is assigned by the IC. Some of their positions are deactivated when the situation no longer requires them, and it is even allowed to reassign personnel within the organization. Individuals can improvise when they are attending the incident but are limited by the tools provided: the rules defined by the IC and the routines established by the organization. Bear in mind that the higher degree of expertise, training, and knowledge the person possesses, the more autonomous the decisions can be made to improve the conditions of the situation. If the specialized knowledge of the individuals in the organization is used efficiently, the authority can be handed over to those who overcome particular problems. This in the case of an incident that requires something different. At this point, authority relationships and informal decision making can also change.

Charts V. Case 5. Team Scaffolds: How Meso-Level Structures Support Role-based Coordination in Temporary Groups (2014) [30].

Case description	It involves the application of a model of a particular structure for an emergency service of a hospital that operates 24/7. The working shifts operate with a dynamic of staff rotation and the need for coordination between temporary groups. It is necessary to define the characteristics and the number of professionals required to assemble the temporary groups. In this way, they would know their responsibilities and consequently would work fluidly. This dynamic is based on the technique of limited positions under the theory of roles and shared responsibilities. The way of work is based on roles or positions that can be assumed by anyone with the skills and or the necessary capabilities This is the case when it is necessary to cope with emergencies with the following work patterns: • An independent and team-based organizational work is scheduled. In other words, is a team with a task assigned that demands that multiple specialties work together. Moreover, is required it has a diversity of knowledge, efficiency, satisfaction, and synergy. • Role-based work. Roles must be well-defined, so any trained person can do it, but there must be limits and accountability. • Teamwork. Interaction must be generated among the members. The team must know the skills and experiences of each member. The stability of the members of the team is considered to evaluate their effectiveness as well as the ability to take advantage of their expertise and knowledge. When this is done, their performance is promoted allowing them to coordinate activities, anticipate and offer appropriate responses even when the system is moving. While working in temporary groups there must be a feedback channel between the people who are laboring collaboratively. It is also necessary to be able to ask for anything verbally, review requests, and confirm if there has been any activity. This allows communicating the constant changes of priorities directly.

REPRESENTATION OF THE STRUCTURAL ELEMENTS	
Coordination Mechanisms	The requirement of the environment where the crisis develops acknowledges the need for interrelations and permanent collaborative work. There, the participation of a variety of professionals who interact efficiently regardless of the change of teamwork and a constant rotation of individuals is highlighted. Once you become a member of a team, you assume a collective responsibility. These sorts of structures aim to prioritize each other's efforts, update each other's progress, the assumption of responsibilities, and foster the help within each other.
Information flows	The groups formed are small, so stepwise communication is unallowed. Conversely, it is always direct and precise, guaranteeing the team has the confidence to communicate directly with any of the members (The distinction of professions is forgotten.). There are no intermediaries in the exchange of information, so the whole team must know what happens during the day. In this way, reprocesses or non-pertinent activities would not occur. All the considered relevant information for the next assigned group must be registered and clear. Groups function as teams when they collectively experience the consequences of their work. These are constructive processes where there is active communication, knowledge exchange and problem-solving.
Structural flexibility	Initially, the characteristics of the individuals that should remain part of the team-work are established; however, hierarchical positions are not defined but team responsibilities. People must react with flexibility in the case of structures that suffer high action potential in response to chaotic events. Also to the changing environments and a restricted improvisation in the case of the convergence in time of composition and the execution. The team-work has: limitation, who is on the team and who is not. Stability: the same group of individuals that makes up the team over time; independence, working jointly for some common purpose for which they assume collective responsibility; effective coordination: happens when they know each other well and adapt to each other's strengths and weaknesses. This allows each other to anticipate the facts.
Roles and authority	It is based on the definition of roles; Any individual who has the skills, knowledge and defined attitudes can assume the position and be part of a team if it has the criticality of the situation. The decision making is not focused on a person, the solution is determined by the team as a whole. Thus, the actors involved are defined directly and indirectly, and the activities that each one will develop taking advantage of their expertise.

Charts VI. Case 6. The Common Operational Picture as Collective Sensemaking (2013) [23].

Case description	Ten possible incidents are generated: Collision in the sea, gas explosion, railway accident, road accident, hostage situation in a school, an accident of a helicopter in a water treatment plant. The exercises have the specific objective of improving the quality of multidisciplinary collaboration.

Case description	Although the incidents were fictitious, the officers were confronted with the pressure of time, information overload and interaction with professionals from organizations other than their own. The set is based on Dutch system that has an Emergency Response Center that has predefined protocols to call the officers in charge of these organizations to the scene of the incident. Each officer is responsible for commanding their own operational units onstage. 1. ***"Are a hundred meters enough? Discussions about safety during an explosion".*** A man is attempting suicide by manipulating a gas valve with the intention of causing an explosion. An operator receives the call and considers it is pertinent to send a fire truck. However, when evaluating the situation, it asks for the help of a team of professionals specialized in assistance care that determines that the objective is to protect the first people who arrived on the scene in addition to those around them. The officers in the different response organizations are always referred to as a whole, regardless of their organizational origin. 2. ***"Dangerous material on board a ship".*** The priority is to save the crew and the crew and ensure the care and transfer of all those affected. Officials negotiate their interests and in turn value mutual dependence on safety standards and operational capacity with other emergency agencies. 3. ***"Children caught in a gunfight. How old are the children?"***. It was necessary to prioritize the rescue and then evaluate the relevance of the ages. However, it was considered that it could be counterproductive to forget the ages due to the variety of care. The COP is treated as a solution to a difficulty of incomplete information so that the best and most accessible data solves the problem in question.
REPRESENTATION OF THE STRUCTURAL ELEMENTS	
Coordination Mechanisms	In the scene are involved the police, the firemen, the paramedics, and a bomb squad among others. The situation is assumed from the moment in which the event is identified to the transfer of victims to the emergency room. In there, they were also considered as actors in the process. The first approach will always be on the part of the team considered relevant for care. However, depending on how the situation evolves the participation of new organizations is determined. In this way, a central decision table is established, from which the activities to be carried out are determined. The operational level of the other groups is always considered so that the activities do not overlap and the response is unobstructed. The negotiations between the participants are crucial to reaching an agreement that includes the possible scenarios and where the experience of each one of them is evaluated. A common understanding of the situation develops.

Information flows	Two key parameters for the management of information are established. First, you must have a detailed database of the situation. The lack of it can generate deficiency in the management of the crisis. Subsequently, the process and mechanisms with which the organizations involved exchange and share information pertinent to the situation must be defined. Failure in the process can alter the expected result. It is based on an "information store" perspective which implies that information can be captured, collected, classified and exchanged in an accessible and unambiguous manner. In other words, professionals interpret similar information differently. Therefore, it focuses on how the people who attended the emergency developed the collective sense of information. This understanding is created where the implications of managing shared information are evaluated.
Structural flexibility	A constant relationship between different organisms is managed, capable of yielding the leadership of the operation if the situation requires it. A negotiation table is established where the members of each agency are together to analyze the requirements to effectively deal with the crisis. They evaluate all the possible implications and thus determine the participation of new determining actors to control the situation
Structural flexibility	All the parties understand the limitations of each one and the different scenarios in which they offer their collaboration. Also, how to support themselves under a given set of conditions.[31]. Decision making is always focused on guaranteeing the safety of the team present in the crisis area and of the people at risk. Furthermore, the participation of the agencies will depend on the expertise and skills of each team. In accordance with these skills, the leader of the situation is determined, and the priority
Roles and authority	Furthermore, the participation of the agencies will depend on the expertise and skills of each team. In accordance with these skills, the leader of the situation is determined, and the priority actions are defined.

Charts VII. Case 7 Haiti 2010 Earthquake—How to Explain Such Huge Losses? (2011) [16].

Case description	On January 12, 2010, a magnitude 7.0 earthquake hit the surface of Haiti, leaving close to 316,000 dead and more than 350,000 injured, one of the most devastating catastrophes in recent years worldwide. Many of the human losses were due to the socio-economic conditions of the country and the deficiency in the attention of the emergency. In this type of emergency, the response in the first 72 hours is crucial for the rescue of the victims and the mitigation of the impacts, since from this period the possibility of finding people with life decreases considerably. It is mainly attributed to the slowness on the part of the Haitian government and the late arrival of the American military forces, a large part of the failure to respond to the situation. In addition, the little autonomy of the police force in the country (only 57% of the police in the affected area responded to the government's call) to attend the emergency made it difficult to reduce the impact of the same.

Case description	In addition, the little autonomy of the police force in the country (only 57% of the police in the affected area responded to the government's call) to attend the emergency made it difficult to reduce the impact of the same. The participation and initiative of the citizens was a fundamental element to save many lives, but there was no efficient coordination between the rescue agencies and the citizens who decided to help. In addition, there were cases in which rescued people had to wait a long time to receive medical assistance, deteriorating their condition.
REPRESENTATION OF THE STRUCTURAL ELEMENTS	
Coordination Mechanisms	There were four key entities, the Haitian State, the United Nations, the US military and international NGOs. However, the actors present in the field demonstrated a delayed response to the magnitude of the emergency, as well as external agents who did not consider it appropriate to intervene despite the situation. On the contrary, the NGOs acted quickly, which was not enough since they depended on the actions of other groups that did not react with the same efficiency; thus, there were many shortcomings in coordination that worsened the situation of the entire population.
Information flows	Since the declaration of the emergency, the leaders showed shortcomings in communicating the status of the situation, delayed the actions of agencies and did not timely recognize the need for the support of other organizations. The crisis itself caused a collapse of the entire infrastructure, causing the interruption of telephone and radio communications, which slowed the dissemination of information about the disaster.
Structural flexibility	No structure is identified before or during the crisis, which is recognized as a failure of coordination and efficiency.
Roles and authority	Prior to the crisis, no tasks and responsibilities were defined to address this type of emergency, so there was no control over the individuals involved and the activities that were being developed.

4 Discussion and Future Lines of Research

The following is an analysis of the structural features that have characterized human social systems focused on the management and attention of crisis situations. It is possible to see the predominance of formal hierarchical structures that show the ways in which work is divided in the system. However, this hierarchical structure does not represent the ways in which the system is coordinated for decision making.

For example, the information in the Yushu earthquake response system as well as in South African disaster management flows easily. This allows intuiting the coexistence of formal hierarchical structures with informal and absent structures from the hierarchy.

These last ones allow the agents involved generate knowledge that results in the handling and attention of the crisis from the free exchange of information. Therefore, the present investigation suggests they be called structures of information and knowledge.

As well, the plural of the expression "information and knowledge structures" arises because in these human systems information flows freely and in non-pre-established ways. Each crisis and each situation that occurs can generate different information and knowledge structure proving that are emerging structures.

Moreover, the coexistence of hierarchical structures and structures of information and knowledge in human systems focused on crisis management and attention gives birth to two understandings. On one side, the number of levels of flexibility that are held by a system. And on the other, the dynamics of the roles and authority within.

Flexibility is understood as the ability to adapt agilely to situations that are difficult to predict and control is manifested in cases like ICS, COP, and Temporary Groups.

In addition, the dynamics of roles and authority show that these are not assigned to specific individuals but are likely to change depending on the circumstances. For example, in the case of the ICS, individuals can change their activities within the system as the situation progresses. This situation highlights the relevance of the free flow of information within the system. There must be a wide level of knowledge between the parties to allow the roles and the authority of the structure to be emerging (for example, knowledge of competencies, previous experiences, or individual traits among others).

The flexibility of the aforementioned makes it possible to state that the structures that characterize them allow to absorb higher levels of environmental uncertainty, and thus deal with the increasing complexity. However, the application of this approach in the business context requires projecting important lines of research. For example, the research is scarce regarding the relationship of the hierarchical structure or the structures of information and knowledge with the uncertainty of the environment. Nevertheless, some studies such as [32][33] have shown that high technological uncertainty hinders the generation of consensus and promotes the emergence of conflicts, which could affect business performance.

Also, the coexistence of the hierarchical structure with information and knowledge structures is notoriously different from the dominant paradigm approach for the management of organizations. This occurs as well with the dynamics of roles and authority. In the dominant paradigm, the existence of a single hierarchical structure is generally recognized. This explains both the division of labor and the way in which the system is coordinated. In addition, the paradigm and the authority are assigned to specific people. However, the apex of the hierarchical structure or the person holding that role can determine a possible change. In other words, in the dominant paradigm, the structure and the system are liable to change. The issue relies on the fact that it does not do it with the agility presented by the systems focused on crisis management and care.

To date, some investigations have shown the relevance of the structure of the team in business performance. Mainly due to the capacity this can give to the system in order to adapt to changing environmental conditions. However, until now the research has focused on the design of structures that respond to the search of optimal results. But not in the design of organizations in which members are immersed in parallel systems of hierarchical structures. Nor in structures of information and knowledge that respond to

topologies different from free scale hierarchies (it means each individual can interact with a non-predetermined number of co-workers.)

The conclusions found in this research also suggest another critical line of work in organizational engineering research which regards is the understanding and design of business structures as information processing systems. This is based on the premise that information and knowledge flows give organizations the flexibility to adapt to changing environmental conditions.

Finally, the understanding of the business organization as an information processing system would allow rethinking the structure of the system from remarkably diverse perspectives. For example, computer science, network science, swarm intelligence, among other fields in which the agility in information processing explains the elevated levels of robustness and flexibility of the system. In these, the research in this regard has advanced in a superior way in comparison with the results achieved in the same subject in business management.

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