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The application of the Cynefin framework in disaster risk management: Predictive approaches for enhancing practices and adaptive approaches to address complexity and uncertainty

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ABSTRACT
Effective disaster management is critical to ensuring the safety and well-being of communities. In this context, this work aimed to analyze the importance of Cynefin as a tool that can improve the response to natural disasters, addressing the different dimensions that the Cynefin framework offers from the gaps identified in the simulations carried out in the state civil defense of Rio de Janeiro. To achieve this objective, a methodological approach was used that involved the analysis of the simulations, the application of the Cynefin framework and interviews with the participants. The results obtained revealed some gaps in the organization of the simulations, in the communication between the participants and in the evaluation of the results. The use of the Cynefin framework proved to be an adaptive and guiding approach that contributed to dealing with the complexity and uncertainty of disasters. From the analysis carried out, practices were identified that can be adopted to improve the organization, such as the implementation of the Deming cycle for the predictive domain, the approach and the Snowden approach for the adaptive domain.. In summary, this work presents valuable insights and practical directions to improve disaster management practices, aiming at the safety and well-being of the population.

Keywords: Civil Defense, SEDEC, ICTDEC, CEPEDEC.

1 INTRODUCTION

(MCENTIRE, 2014)In the context of natural disasters, effective response capacity plays a key role in mitigating harm and protecting human lives. The complexity and uncertainty inherent in these situations require adaptive approaches that can adjust to ever-changing conditions. (CILLIERS, 1998)

The Cynefin method, devised by Snowden (2007) recognizes that natural disasters are not isolated and simplistic events, but rather complex systems, composed of dynamic interactions between several factors. By applying Cynefin in disaster management, it is possible to gain a deeper understanding of the complexity involved, allowing practitioners and decision makers to identify the appropriate domains for each specific situation.

Cynefin's approach classifies problems into different domains: clear, complicated, complex, and chaotic. In the clear domain, cause-and-effect relationships are predictable and well-understood, allowing for responses based on established best practices. In the complicated domain, there are a

variety of possible solutions, but expert analysis is needed to identify the most appropriate approach. In the complex domain, cause-and-effect relationships are emergent and unpredictable, requiring an adaptive approach and experimentation to find effective solutions. Finally, in the chaotic realm, there are no discernible patterns, requiring immediate action to restore stability. (SNOWDEN e BOONE, 2007)

The application of Cynefin in disaster response allows for more informed and adaptive decision-making, taking into account the specific characteristics of each situation. By understanding the complex nature of disasters and using the appropriate approaches according to the identified domain, practitioners can improve the effectiveness of disaster risk management and disaster management. (SNOWDEN e BOONE, 2007)

Therefore, the use of Cynefin framework (MCLEOD e CHILDS, 2013) Responding to natural disasters offers significant benefits, including an in-depth understanding of the complexity involved, informed decision making, adaptive approaches, and identification of good practices. The application of this approach can lead to a more effective and efficient response, contributing to the protection of affected communities and accelerating recovery from the complex and uncertain challenges presented by natural disasters (Tricco et al., 2018).

In the specific context of the State of Rio de Janeiro, the application of the Cynefin framework in coping with natural disasters gains relevance given its characteristic of dealing with uncertainty. In this scenario, the region faces a series of challenges related to events such as floods, landslides and storms, which occur frequently and negatively impact the population and local infrastructure (Ávila et al., 2016). This approach can assist in identifying adaptive solutions, resilience, and minimizing the impacts caused by natural disasters (Hayes et. al., 2019).

In the context of disaster management, the challenge arises of how to effectively employ the Cynefin framework (BECK, 2009) to deal with the complexity and uncertainty inherent in these situations;;. Disaster management involves a number of crucial decision-making, ranging from preparedness, response, recovery, prevention, and even mitigation (Vegt (SNOWDEN e BOONE, 2007) (GIDDENS, 1990)et al., 2015). When using the Cynefin, disaster management professionals can classify problems into different domains, identify appropriate strategies, and direct resources more efficiently. (MCLEOD e CHILDS, 2013)

In addressing the application of the Cynefin framework in disaster management, several studies emphasize the importance of an adaptive approach. As mentioned by Hayes (2019); McLeod (2013), Cynefin allows us to understand the complexity and uncertainty of disasters and offers guidelines for effective decision-making. In this sense, the author makes it clear that Cynefin assists in identifying the appropriate domains for each situation and promotes an adaptive mindset, recognizing the need for continuous adjustments.

In addition, McLeod (2013); Berwick (2016) highlight the importance of applying Cynefin in disaster planning and response, pointing out that the model-based adaptive approach allows adjusting strategies based on evolving conditions and the unpredictability of cause-and-effect relationships. These approaches reinforce the relevance of Cynefin as a tool to face the complexity and uncertainty of disasters, aiming at a more effective and adaptive management.

The objective of this article is to analyze the importance of Cynefin as a tool that can improve the response to natural disasters, addressing the different dimensions that the Cynefin framework can offer from the gaps identified in the simulations carried out in the state civil defense of Rio de Janeiro. By applying Cynefin to disaster management, practitioners and decision makers can gain a deeper understanding of the complexity involved, identify appropriate domains for each situation, and adopt more effective strategies for comprehensive disaster risk management.

The motivation to deal with the topic "Cynefin (BECK, 2009) in the context of uncertainties" arises from the need to develop effective approaches to deal with the complexity and uncertainty that permeate various aspects of society, including disaster management; Uncertainty is an intrinsic feature of catastrophic events and presents significant challenges for civil defense professionals and crisis managers. Understand and apply the framework (VALÊNCIO, 2010)Cynefin In this context it can offer a valuable conceptual framework and adaptive strategies to address uncertainty and improve decision-making.

The importance of this for society and, more specifically, for civil defense professionals lies in the need to improve disaster response practices and minimize negative impacts on affected communities. Ultimately, the utility of exploring the topic "Cynefin in the context of uncertainties" is to empower civil defense professionals with a robust tool to deal with the complexity of disasters and make decisions based on a deep understanding of the dynamics involved.

To carry out the research, data collection, direct observations will be made during the participation in simulated exercises of the state civil defense in the years 2021 and 2022, acting as evaluator of these simulations. The results obtained will be recorded in reports, contemplating relevant aspects related to disaster management, without the use of the Cynefin framework. This approach will allow you to gain a comprehensive view of current disaster response practices and identify areas that could benefit from applying Cynefin.

In the treatment of the data, the analysis will be qualitative, using the technique of content analysis. The reports will be scrutinized thoroughly to identify patterns and categorize observed practices according to Cynefin domains. This approach will allow you to identify which framework domains are most frequently applied and which may be underutilized in disaster management. Categorizing the patterns according to Cynefin's domains will provide a deeper understanding of how

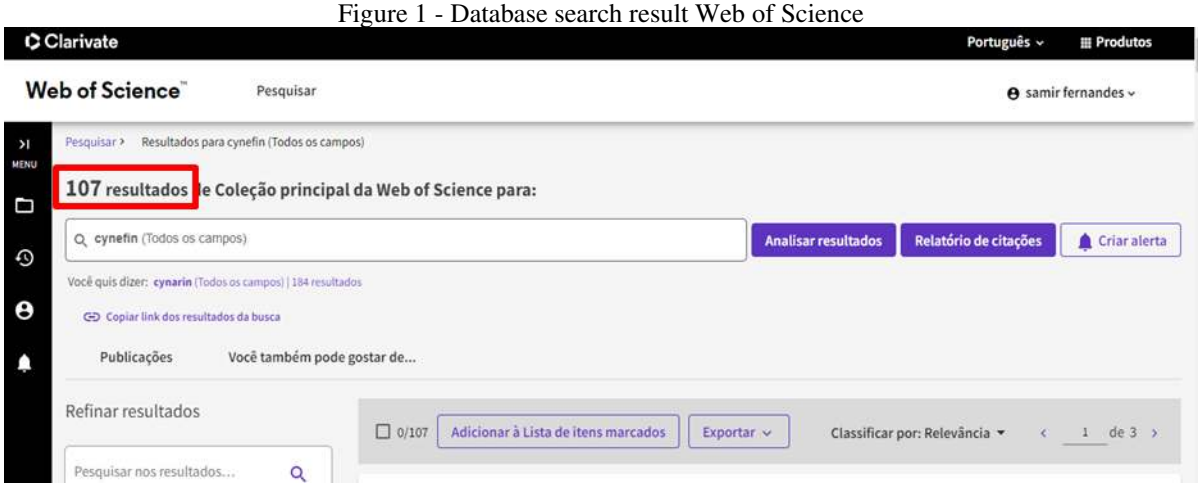
the adaptive and predictive approach can be implemented effectively in disaster risk management and disaster management.

Thus, data collection will be performed through direct observation in previous simulated exercises, while data treatment will occur through qualitative content analysis, categorizing the patterns according to the Cynefin domains. This methodology will allow to obtain valuable insights into the application of the framework in disaster management and will provide subsidies for informed decision-making in research. To develop the work, soon after the introduction, the theoretical framework was approached, followed by a section of materials and methods, moving to a section of discussion of the results and conclusion.

2 THEORETICAL FRAMEWORK

For the elaboration of the theoretical framework, the Web of Science search platform was used with the search of the term "Cynefin", resulting in a return of 107 results.

Figure 1 - Database search result Web of Science

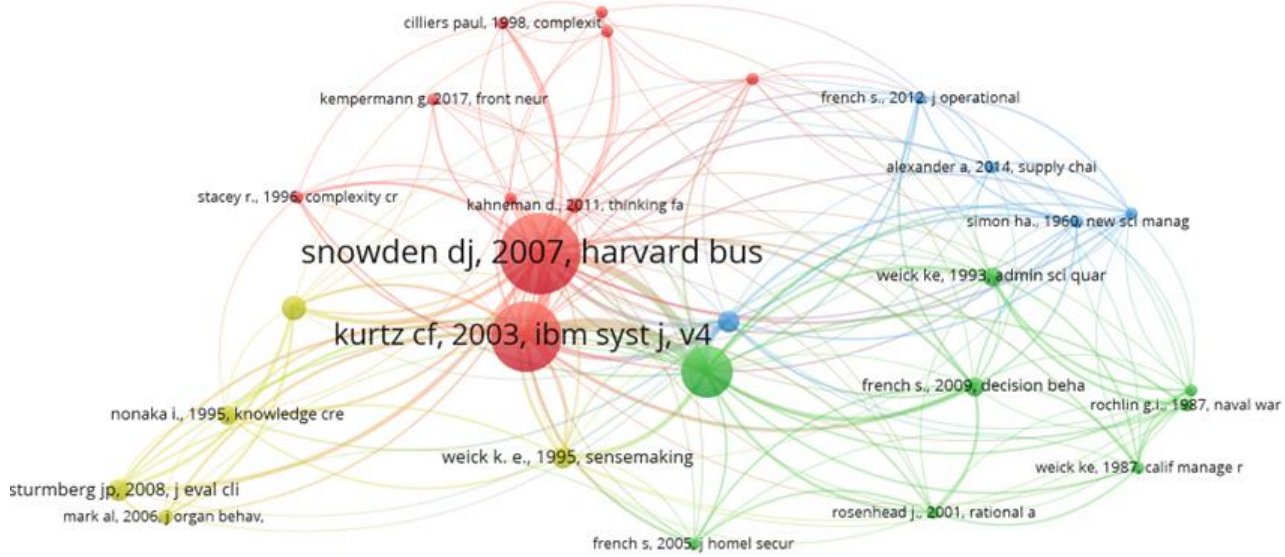


Source: The Authors (2023)

The author Snowden (2007), creator of the Cynefin framework, presented the highest number of citations, followed by Kurtz (2003), as shown in Figure 1. To obtain the results presented in Figures 2 and 3, the VOSviewer software was used, creating a map based on bibliographic data that were exported from the Web of Science research using the full counting method to analyze the co-citation between the authors in Figure 2, and the co-occurrence analysis to examine the words in Figure 3.

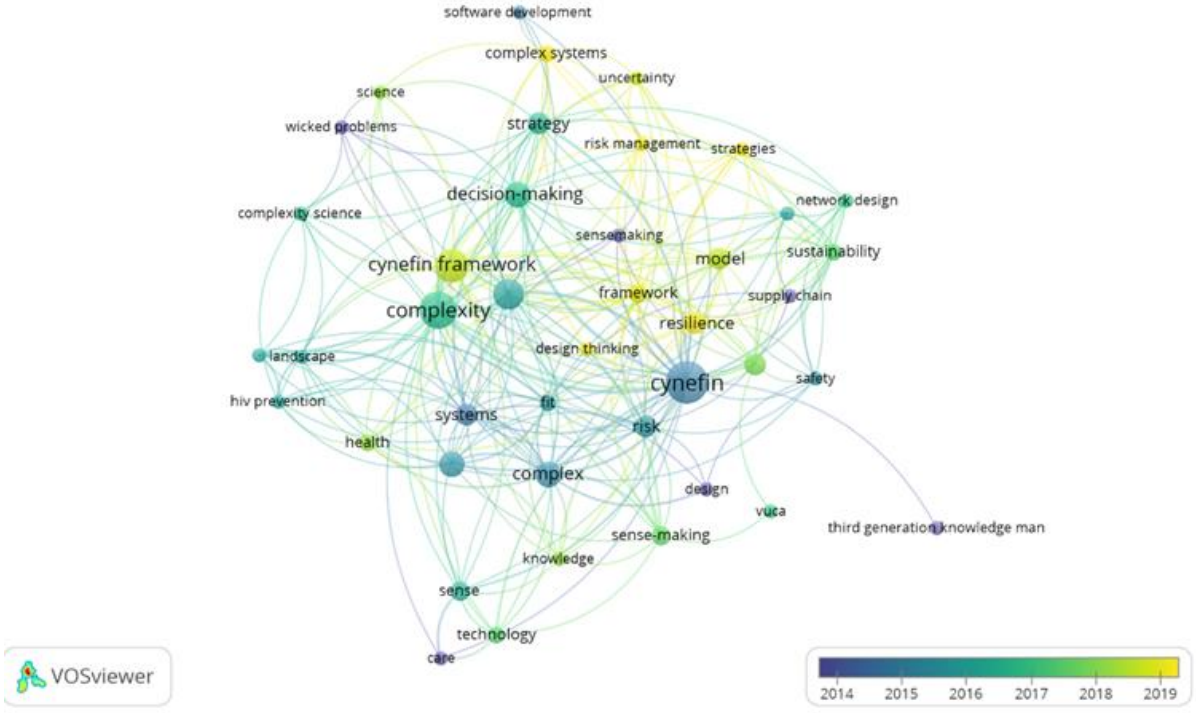
Figure 3 analyzes the frequencies of the most cited words of the selected works and their connections. The highest number of occurrences of the words was grouped by year. In this way, words such as complex systems, framework, resilience and cynefin framework and risk management appear more frequently after the year 2019.

Figure 2 - Graph analysis with the relationships of the authors and the selected works



Source: The Authors (2023)

Figure 3 - Graph analysis with the relationships of authors and words associated with Cynefin



Source: The Authors (2023)

The research of the theoretical framework was conducted in a systematic manner and using a reliable database, such as the Web of Science platform, in order to identify the main contributions and approaches related to the Cynefin framework. Snowden's quotes were considered relevant to support the theoretical foundation of this research , and the use of the VOSviewer software allowed to visualize and analyze the relationships between the authors and the keywords, enriching the understanding of the field of study.

Thus, the analysis of the frequencies of the words in Figure 2 contributes to the delimitation of the scope of the research, highlighting the most relevant concepts and terms that permeate the current literature on Cynefin in the context of disaster management. It was possible to observe that there are few works on the subject because it is a relatively new theme associated with disasters. This information will support the in-depth investigation and interpretation of the results obtained throughout the research.

Figure 3 analyzes the frequencies of the most cited words in the selected works, as well as their interconnections. The occurrences of the words were grouped by year, evidencing the highest number of occurrences over time. Thus, words such as "complex systems", "framework", "resilience", "Cynefin framework" and "risk management" appear more frequently from the year 2019.

This analysis allows us to observe the evolution of the use of these keywords and their growing importance in the context of research on Cynefin and its application in disaster management. The words identified are indicative of the trends and recurring themes in the selected publications, providing valuable insights for understanding the field of study.

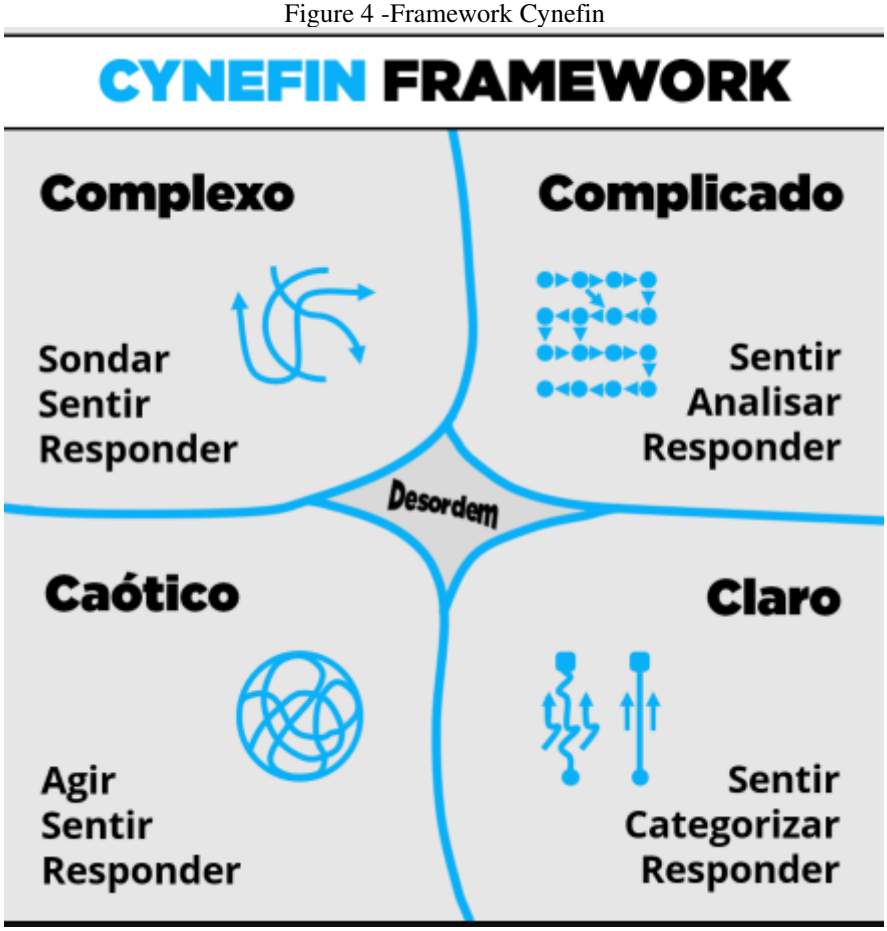
In conclusion, the theoretical framework carried out in this study used a systematic and reliable approach, employing the Web of Science search platform to identify the main contributions and approaches related to the Cynefin framework. The analysis of the citations of the authors Snowden and Kurtz demonstrated their relevance in the field of study. In addition, the use of the VOSviewer software allowed a detailed visualization and analysis of the relationships between authors and keywords, revealing the evolution and growing importance of terms such as "complex systems", "framework", "resilience", "Cynefin framework" and "risk management".

2.1 THE CYNEFIN FRAMEWORK

Cynefin Framework was developed by David J. Snowden (2007) as a tool for decision making. Its origin lies in the field of knowledge management, but it has since been applied in many other contexts, including disaster risk management and disaster management.

Cynefin is a model that helps organizations navigate complexity by providing a "lens" to understand the nature of different types of systems and problems. The word "Cynefin" (pronounced ku-ne-vin) is a Welsh word meaning "place of multiple belonging". This name was chosen to reflect the idea that our understanding of the world around us is shaped by our past experiences, our context, and our ability to interpret patterns.

Figure 4 -Framework Cynefin



Source: MERITHU(2023)

The Cynefin model categorizes problems into four main domains: clear (formerly known as simple), complicated, complex, and chaotic. In addition, there is the confused state or disorder that is not exactly a domain but the representation of more than one domain or the difficulty of classifying the belonging of the problem to a specific domain. Each of these domains represents a different type of system or problem, and requires a different approach to decision making:

Figure 5 - Framework Cynefin for the clear domain

Source: Gino Terentin(2023)

2.1.1 Clear Domain:

• Knowledge production: In this field, the problems are familiar and the solutions are clear. There is a direct and understood relationship between cause and effect. Past problems are well understood and previous solutions can be safely applied to the present and probably to the future. Knowledge in this domain is often codified in established procedures and practices. In this domain, the Deming cycle (P,D,C,A) is used.

• Number of people acting in the resolution of a problem: In a social context in which the relationships and interactions are well established and predictable, the group of people involved is in the known domain. The social norms and rules of engagement are clear and understood, and the group can function according to these "best practices." In this domain, Dunbar's Theory (2010) suggests that an individual would have a clear understanding of each person in their social circle and would be able to maintain stable relationships with up to about 150 people.

• Leadership: In this domain, situations are predictable and repeatable. Leaders tend to focus on efficiency and implementing "best practices." Communication is usually top-down, with the leader giving clear instructions to those led. It is an environment in which hierarchy plays an important role and decision-making is often centralized.

• Metrics: Metrics can be established easily and accurately. Metrics often focus on the efficiency and effectiveness of "best practices." For example, full compliance in the routine

of a Civil Defense as the check-list of verification of the condition of a vehicle or in the filling in the caution of the exit or entry of material.

• Approach: In this domain, the relationship between cause and effect is clear, and situations are predictable and repeatable. The proper approach here is mostly predictive. The appropriate action is to "feel" the situation, "categorize" according to known best practices, and "respond" accordingly. In this domain, the Deming cycle (P,D,C,A) is used.

Figure 6 - Framework Cynefin for the complicated domain

Source: Gino Terentin(2023)

2.1.2 Complicated Domain:

• Knowledge production: In this domain, problems are understandable, but require some analysis or expertise to understand the relationship between cause and effect. Past problems provide useful guidance, but solutions may need to be adapted to meet current or future circumstances. Knowledge in this domain often emerges through analysis or research.

• As the group grows beyond Dunbar's size or when an individual finds themselves in a new or changing social environment, social relationships may become more complex and less predictable, but they are still knowable. The individual may need to make a conscious effort to understand group dynamics and social relationships. In this domain, Dunbar's theory suggests that an individual may maintain less stable relationships with a larger number of people, but this would require more cognitive and social effort. In this situation

the individual would be able to maintain meaningful connections with up to 50 people. (2010)

• Leadership: In this domain, although cause and effect are not immediately apparent, they can be determined with analysis or investigation. Leaders should consult with experts and make use of "best practices." Leadership here is more about facilitating understanding and learning, and less about providing definitive answers. Decision-making can start to be more decentralized.

• Metrics: Cause and effect can be determined with analysis or investigation, so metrics may still be applicable, but may need more nuance. The metrics here can be more oriented towards learning and innovation, focused on improving understanding and the ability to deal with complexity. For example, the recommendation of a certain structural intervention, after a technical inspection.

• Approach: In this domain, cause and effect are still related, but need analysis or investigation to be understood. The proper approach here is a mix of predictive and adaptive. Actions involve "feeling" the situation, "analyzing" to understand cause-and-effect relationships, and then "responding." The evaluation can focus on the quality of the analysis and the effectiveness of the response. In this domain, the Deming cycle (P,D,C,A) is used.

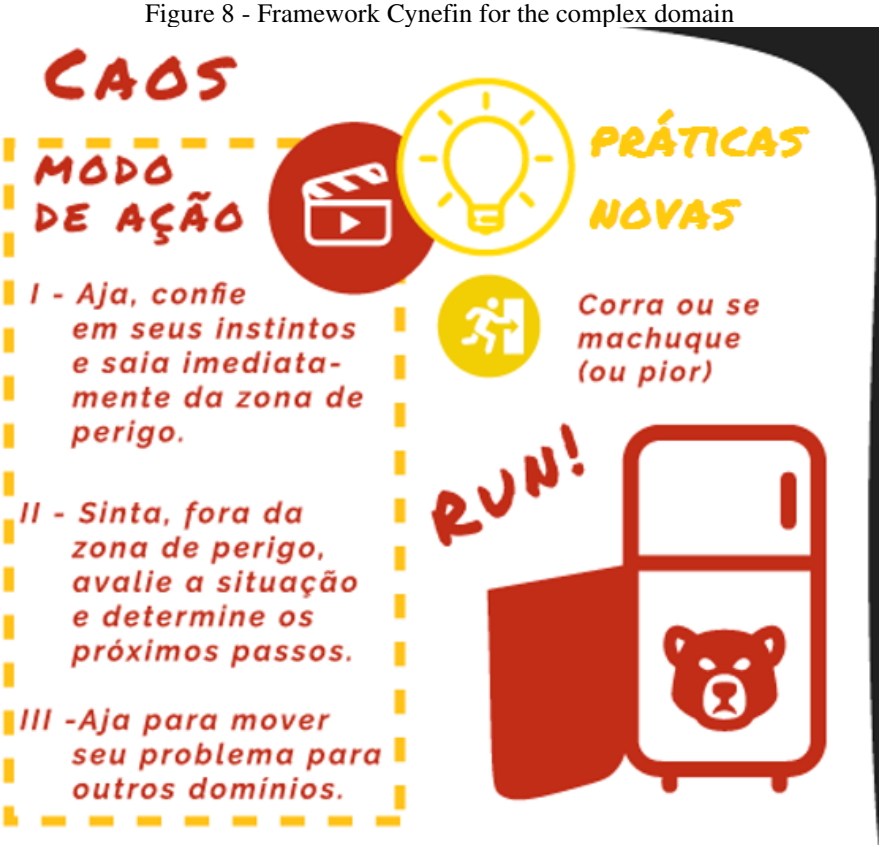
Figure 7 - Framework Cynefin for the complex domain

Source: Gino Terentin(2023)

2.1.3 Complex Domain:

- Knowledge production: In this domain, the relationship between cause and effect can only be perceived in retrospect. Past problems may not offer much guidance for current or future problems. Knowledge emerges in often unpredictable ways and depends on patterns that can be difficult to discern.
- Number of people acting in the resolution of a problem: In very large social groups or in highly dynamic and complex social situations, social relationships can be so complex that the relationship between individual actions and social outcomes can only be understood in hindsight. In this domain, Dunbar's theory suggests that an individual may be able to recognize faces or names of a much larger number of people, but social relationships will not be stable and group dynamics will be difficult to predict, suggesting a group of no more than 15 people with a strong connection between them.
- Leadership: In this domain, cause and effect can only be identified retrospectively. Leaders must facilitate the emergence of patterns and learn from them. They need to create an environment that allows for experimentation and innovation. The leadership here is more distributed and collaborative. Communication is often networked and decision-making is often decentralized and dependent on local experience.
- Metrics: The metrics here can be difficult to define due to the emerging nature of the problems. However, it's still important to measure and learn, and metrics can be more focused on adaptability, resilience, and the ability to respond to change. For example, one can measure the capacity of lessons learned post-event and recorded in events such as dashboards. Eventually, complex domains may emerge as good practices that will serve as metrics for both clear and complicated domains.
- Approach: In this domain, cause and effect can only be understood retrospectively. The proper approach here is adaptive, requiring a mindset of learning and experimentation. Actions involve "feeling" the situation, "experimenting" with different approaches, and then "responding" based on the results. The assessment is based on adaptability, resilience and the ability to learn and respond to change. As this domain is adaptive, it is not recommended to use the Deming cycle (P,D,C,A).

Figure 8 - Framework Cynefin for the complex domain



Source: Gino Terentin(2023)

2.1.4 Chaotic Domain:

- Knowledge production: In this domain, there is no discernible relationship between cause and effect. Past problems offer little or no guidance for present or future problems. Knowledge may emerge quickly and unexpectedly, or it may not emerge at all.
- Number of people working to solve a problem: In crisis or conflict situations, or in extremely large groups, social relationships can become so complex that there is no discernible relationship between actions and outcomes. In this domain, Dunbar's theory suggests that an individual may feel overwhelmed and unable to maintain stable social relationships. The recommended approach in this area is to act to stabilise the situation and try to move the social dynamics back to one of the other domains. In this case the group reduces to a maximum of 5 people who have extremely strong ties to each other.
- Leadership: In this domain, cause and effect are not discernible. Leaders need to act quickly and decisively to stabilize the situation. They need to be able to give clear orders and make quick decisions amid uncertainty. Leadership in this domain often requires decision-making under pressure and the ability to quickly mobilize resources and people.
- Metrics: In this domain, cause and effect are not discernible, and the situation requires immediate action. The metrics here may not be practical or useful during the crisis itself.

However, once the situation has been stabilized and moved to one of the other domains, retrospective evaluation can be useful to learn and prepare for future crises.

- Approach: In this domain, there is no discernible relationship between cause and effect, and immediate action is required. The proper approach here is adaptive and focused on stabilizing the situation. Actions involve "acting" to stabilize, "feeling" how the situation is changing, and then "responding." The assessment is made based on the effectiveness of the action to bring the situation back under control. As this domain is adaptive, it is not recommended to use the Deming cycle (P,D,C,A).

3 MATERIALS AND METHODS

The research, as conceptualized in the document by Tricco et al (2018) . , is a systematic process for mapping evidence on a topic, identifying key concepts, theories, and sources, and determining where the gaps lie. Research can be useful for examining the extent, variety, and characteristics of the evidence on a topic or issue; summarize findings from a body of knowledge that is heterogeneous in terms of methods or discipline; or identify gaps in the literature to assist in planning and commissioning future research. (ELM, ALTMAN, et al., 2008)

The research adopted a qualitative approach, because according to Merriam, the qualitative approach is adequate when seeking a rich and contextualized understanding of the events and perspectives of the individuals involved. In addition, to analyze the collected data, the technique of documentary content analysis was used. As highlighted by Bardin, content analysis is a method of investigation that aims to identify patterns, themes and meanings present in documentary data. This analysis approach allows a deeper understanding of the elements present in the reports and documents related to disaster management, contributing to the categorization of the patterns identified according to the domains of the (2009)(2016)Cynefin.

The classification adopted for this research was exploratory, with the objective of investigating and comprehensively understanding the application of the framework Cynefin in disaster management. According to Gil, exploratory research is carried out when the topic is little explored or there is not enough prior knowledge on the subject. Exploratory research provides an initial and exploratory view of the problem, allowing to delimit issues, identify gaps and guide further investigation. (2002)

Exploratory research, according to Gil, "(2002)aims to provide greater familiarity with the problem, with a view to making it more explicit or to construct hypotheses". In this sense, we seek to obtain an initial knowledge on the subject and deepen the understanding of the relationships between the framework Cynefin and disaster management. This classification allows a broad and comprehensive investigation, making it possible to identify new insights, explore diverse perspectives and support the definition of future research in the area. Exploratory research is fundamental to

establish a solid base of knowledge on the subject, providing an adequate theoretical basis for the development of the research in question.

The instrument used for data collection in this research was direct observation, combined with the analysis of institutional records and consultation of relevant articles. This combination of approaches proves ideal for research due to the scarcity of specific literature addressing Cynefin associated with disaster management. By performing direct observation, I was able to actively participate in the phenomena studied, experiencing the complexity and uncertainty inherent in disasters. The analysis of institutional records, in turn, allowed access to documented information on disaster management practices. In addition, the consultation of relevant scientific articles enriched the research, providing solid insights and theoretical foundation. Thus, the combination of these data collection instruments allowed a comprehensive and contextualized approach to explore the application of Cynefin in disaster management, even in the face of the limitation of existing literature on the subject.

The research was conducted from a trajectory that involved active participation in simulated exercises passed in Civil Defense between the years 2021 and 2022, playing the role of evaluator of these simulations. During this process, there was the dissemination of the results obtained, the preparation of reports and articles, and the careful analysis of the recommendations provided by the participants involved in the simulations. It was in this context that the perception arose that the application of the Cynefin framework could contribute significantly to disaster management.

Given this insight, a search was conducted in the Web of Science database to identify relevant studies that addressed Cynefin in the context of disasters or risks. In total, 107 literatures were found, from which those that directly addressed Cynefin in the context of disaster management were selected. Based on these literatures, it was possible to adapt Cynefin's domains for disaster management, establishing a solid connection between the framework and response and mitigation practices.

Thus, the research was developed from a practical experience and the search for theoretical basis in specialized literature, allowing to explore comprehensively the application of Cynefin in disaster management and identify its contributions in the specific context.

The textual analysis of the collected documents allowed us to identify the existing bottlenecks in the state management of civil defense, in which Cynefin can offer significant contributions by establishing adaptive solutions to these issues. Thus, the methodology chosen was fundamental to achieve the objective of the research, allowing to explore the application of Cynefin in disaster management through appropriate procedures and a qualitative approach.

4 RESULTS AND DISCUSSION

The purpose of this work was to investigate the application of the Cynefin framework in disaster management and disaster risk management, seeking a deeper understanding of the complexity and uncertainty inherent in these events with an adaptive approach to deal with the complexity of natural disasters, considering their different domains and principles. In this sense, the underlying theory is that Cynefin offers a conceptual framework that assists in understanding the complex dynamics of disasters and identifying effective management practices. The study thus sought to contribute to the advancement of knowledge about the use of Cynefin in disaster management, providing insights and recommendations that can improve response strategies and risk reduction.

Snowden makes it clear that the application of the (2007)Cynefin framework In disaster management it can provide a deeper understanding of the complexity and uncertainty of these events, allowing the adaptation of response strategies and actions. In this sense, as a logical argument, it is worth noting that the Cynefin recognizes the complex and unpredictable nature of disasters, providing a theoretical and practical framework for dealing with these situations. According to Ramaswamy et al., " (2018)Cynefin offers a framework that assists in understanding the complexity of problems and in selecting appropriate approaches to deal with them". Therefore, by adopting the Cynefin As a basis for disaster management, it is possible to promote a more adaptive and efficient response to the adversities and uncertainties present in these events.

Between 2021 and 2022, two simulations were conducted in the state civil defense of Rio de Janeiro that generated two publications (article and technical report). This material served as a study to evaluate the hypotheses listed in the research. The analysis of the simulations was grouped into the following themes: (1) Organization; (2) methodology; (3) Number of people involved; (4) communication and (5) evaluation metrics.

Organization of the simulated – In 2021, the exercise was organized in a simulated way and gradual in intensity. Participants were established in predetermined locations and began their activities in response to messages assigning responsibilities to the bodies to which they belong. The demands were gradually inserted, consolidating the dynamics of the simulated activities. In 2022, although it was mentioned that there was an evolution in the organization of the simulated, some practices were taught moments before the exercise, such as filling out the table to exchange information.

Methodology – As for the methodology, in 2021 Kaizen was used, which is a continuous improvement approach based on processes. The methodology involved the active participation of the professionals involved, with the objective of identifying problems, analyzing root causes and implementing solutions to improve processes. In 2022 it used a methodology that sought to present a comparison in relation to 2021. The form was a strategic tool allowing a longitudinal analysis in the

future. Therefore, there was in 2021 the use of Kaizen and in 2022 a comparative analysis for an intervention based on the historical series.

Number of people – The number of people involved in the simulation was not specified in 2021 or 2022, but in 2021 it was mentioned that the event was attended by several state and municipal agencies, as well as experts in risk and disaster management. Professionals from the areas of health, public safety, civil defense, environment, among others, were involved. In 2022 there was the massive participation of a sector (General Department of Civil Defense). When consulting event attendees at the time, it is certain to ensure that more than 15 and less than 150 professionals participated in both 2021 and 2022.

Communication between participants – Communication between participants in 2021 took place through an instant messaging group on the WhatsApp app. All participants were present in the group and information and guidance about the exercise were shared in this environment. During the simulation, the professionals interacted with each other through this group, assigning responsibilities to the organs to which they belonged and consolidating the dynamics of the simulated activities. In addition, only information and clarification of doubts about the use of the spreadsheet used were prescribed, avoiding interference in the activities of the organs involved.

Evaluation metrics – In 2021, a qualitative research was used through a semi-structured form in an Excel spreadsheet, sent to the participants of the event, to evaluate the scope of the simulated and identify positive or negative points. There were seventeen (17) fields of completion, and among these, there were questions about the perceptions of the participants about the simulated. In addition, considering the use of WhatsApp message groups among the participants for insertion and visualization regarding disaster management in the respective sectors of those involved, we worked on the responses of the 46 participants who responded to the qualitative research on the simulated. The research revealed information with potential for improvements, such as having another tool for entering the data other than the WhatsApp application. Therefore, the evaluation of the simulated was carried out through qualitative research and analysis of the responses of the participants. In 2022 the general perception of the result of the simulation was positive. The participants evaluated the simulation as excellent, well structured, very productive and an excellent training for future events. Although there were some suggestions for improvement, the overall assessment was quite positive.

One of the gaps identified is related to the organization of the simulations. Although there was an evolution in the organization of the simulation in 2022, some practices were still taught moments before the exercise. From Cynefin's perspective, disaster is a unique event, so the domain to which it belongs is the complex, chaotic, or confusing. In this context it is possible that a good practice emerges after a disaster as a lesson learned, but it should be noted that disasters belong to the adaptive field and in this field a strong interaction between the team can promote a more appropriate response than

autocratic decisions, because the disaster belongs to an unknown field and there are no answers in the past that will help in the solution of the problem of the present.

It is worth mentioning that a gap was detected in the good or best practices of the predictive field because, in the domains of the clear and complicated, there is a limitation in the structure of civil defense in Brazil. Because there are protocols, general rules of action, checklist, etc. for the actions of the simple domain, however there is a gap in the field of specialists typically or exclusively of civil defense. This is because there is no field of knowledge applied to the professional working in civil defense, that is, there is no science of disasters serving as a theoretical reference for civil defense agents. This means that the agents who work in civil defense emerge from various fields of knowledge without a theoretical leveling in civil defense. This is more evident when observed the turnover of professionals in civil defense and it is necessary to teach "from scratch", but with aggravating that what is taught is limited to legislation or legal framework or knowledge of the domain of the simple.

As a consequence, the technological innovation that is in the domain of specialists are not implemented by civil defense agents but in a transversal way by other areas that have theoretical reference and field of production such as engineering, geology, meteorology, etc..

Another gap identified concerns the communication between the participants and the number of participants directly involved in the exercise. Although the use of the WhatsApp application facilitated communication during the simulations, the need to have another tool for data entry was mentioned. Cynefin can assist in identifying more effective communication approaches, taking into account the number of people and the complexity of the interaction between participants so that there is clear and agile communication.

Through the analysis of the clear domain of Cynefin, it is possible to identify best communication practices that promote the exchange of information efficiently and avoid interference in the activities of the agencies involved, however the gap is more complex than the exchange of the communication tool. As mentioned earlier, the doctrinal gap seems to be the biggest obstacle in operations. In addition, a greater number of participants in an event will not necessarily translate into a response gain, because according to Dunbar (2010) it is necessary that we have a significant memory of the qualities and potentials of the professionals who work with us. Dunbar's proposal gains more prominence since in the absence of a theoretical leveling what remains is the personal capacity of each professional to solve problems.

In communication, Cynefin can also contribute because in its structure the vertical relationship between leadership and led or horizontal led with led changes according to the domain. In the domain of the simple the led do not need to interact much with each other for the task to be executed, because it is already well known. The difficulty increases in the other domains, because the execution of the

task will require greater communication between those led, to emerge the best solution. For example, when a group of doctors meet to discuss the best intervention in a complicated or complex case.

In the absence of a theoretical framework, civil defense agents, faced with a problem that they do not know the solution, the problem leaves the simple domain and goes straight to the complex or chaotic. Therefore, the absence of mapping of competencies by sectors, the adequacy of the professional profile and educational leveling, through a doctrine based on scientific evidence in the training of agents in protection and civil defense will have these leaps between the domain of the clear to the complex.

In addition, the analysis of the simulations highlighted the importance of communication evaluation metrics. We can highlight the use of the Deming cycle in the clear and complicated domains and Snowden's approach to the other domains. In which in the predictive domains the metrics such as quality, efficiency, effectiveness make logic and in the adaptive domains the metric is the lesson learned.

From the interpretation of the results presented in the previous blocks, it is evident that the use of the Cynefin framework can bring significant benefits to disaster management. The application of this adaptive and guiding approach can fill the gaps identified in the simulations, both in terms of organization and communication. By providing a deeper understanding of the complexity and uncertainty of disasters, Cynefin offers guidelines and best practices for more effective management. These results reinforce the relevance of this framework as an indispensable tool to deal with complex and unpredictable situations, for example.

As explained above, the analysis of the simulations performed by the state civil defense highlights the importance of the Cynefin framework in disaster management. Through the use of this adaptive and guiding approach, it was possible to identify gaps in the areas of organization, communication and evaluation of the simulated. When considering the guidelines provided by Cynefin it was possible to consider as an essential tool to deal with the complexity and uncertainty of disasters

5 CONCLUSION

The present work allowed us to analyze the importance of Cynefin as a tool that can improve the response to natural disasters, addressing the different dimensions that the Cynefin framework can offer from the gaps identified in the simulations carried out in the state civil defense of Rio de Janeiro. By applying Cynefin in disaster management, practitioners and decision makers will have a deeper understanding of the complexity involved, identifying the appropriate domains for each situation and adopting more effective strategies for comprehensive disaster risk management. In short, this work has contributed to a deeper understanding of disaster management and to the proposition of strategies that can significantly improve disaster response and mitigation in the future.

The results obtained in this study demonstrated the importance of the Cynefin framework in disaster management. The analysis of the simulations carried out by the state civil defense revealed gaps and areas of improvement in the different stages of the knowledge management process, such as organization, methodology, communication and evaluation metrics. The application of Cynefin as an adaptive approach provided a deeper understanding of the complexity and uncertainty of disasters, allowing the adoption of more structured and planned strategies. This has contributed to improving the effectiveness of management, making it more agile, efficient and results-oriented. These findings provide valuable insights to enhance comprehensive disaster risk management to mitigate impacts and protect the lives and heritage of affected communities.

Based on the results found, it is possible to suggest some measures to improve the integral management of disaster risks and address the identified gaps. To improve disaster management, it is recommended to invest in the production of knowledge in civil defense, that is, the genealogy of thinking knowledge in Civil Defense, the mapping of sectoral competencies, the identification of the professional profiles necessary to act in Civil Defense and from this, an educational leveling, through a doctrine based on scientific evidence. Finally, it is recommended to continue the application of the Cynefin framework as a guiding approach to deal with the complexity of disasters, further exploring its guidelines and adapting them to the specific needs of simulated management.

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