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AN ANTIFRAGILITY MANAGEMENT MODEL FOR ORGANIZATIONS AN

ANTIFRAGILITY MANAGEMENT MODEL FOR ORGANIZATIONS

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Summary. In the current scenario, economic changes, technological innovations and competitive rivalries constantly redefine the environment of organizations that develop at increasingly higher levels of complexity and uncertainty. In this context, resilience has gone from being a desirable factor to an indispensable one in organizations; however, antifragility is positioned as a superior paradigm in terms of long-term benefits, as it prepares organizations to take advantage of changes.

This study addresses the problem of identifying the management variables that are crucial for developing antifragile responses in organizations in the face of environmental variability. The hypothesis posed suggests that, to foster antifragility, organizations should focus on three key areas: structures and processes, organizational culture, and managerial behavior. In addition, they should apply strategies for regulating variability based on negative and positive feedback, concepts central to the cybernetic approach in systems theory.

As a main result, it was found that the proposed management model offers useful guidelines for the application of multiple methodologies by systematizing its elements in two phases: first, attenuating variability through negative path strategies that make the system robust and reduce its exposure to risk, and then, expanding variability through positive path strategies that make it possible to explore opportunities with benefits potentially greater than the losses, which characterizes an anti-fragile response.

Keywords: *antifragility, business management, resilience, organizational learning, cybernetic approach.*

Abstract. In today's landscape, economic changes, technological innovations, and competitive rivalries constantly redefine the environment of organizations, which are evolving in increasingly complex and uncertain contexts. In this setting, resilience has shifted from being a desirable trait to an indispensable one for organizations. However, antifragility emerges as a superior paradigm in terms of long-term benefits, as it prepares organizations to capitalize on change.

This study addresses the challenge of identifying key management variables crucial for developing antifragile responses in organizations facing environmental variability. The proposed hypothesis suggests that to foster antifragility, organizations should focus on three key areas: structures and processes, organizational culture, and managerial behavior. Additionally, they should apply variability regulation strategies based on negative and positive feedback, which are central concepts in the cybernetic approach of systems theory.

The main finding is that the proposed management model offers useful guidelines for the application of multiple methodologies by systematizing their elements into two phases: first, mitigating variability through negative pathway strategies that strengthen the system and reduce its exposure to risk, and then expanding variability through positive pathway strategies that enable the exploration of opportunities with potentially greater benefits than losses, which characterizes an antifragile response.

Keywords: *antifragility, business management, resilience, organizational learning, cybernetic approach.*

INTRODUCTION

Antifragility in the systems approach

The concept of antifragility, proposed by Taleb [1] in his work "Antifragile: Things that Benefit from Disorder," refers to the property of systems to thrive, benefit, or improve when confronted with volatility, disorder, *shocks*, and change, in general. Taleb points out that, although there is a definition of *fragility*, in Western language there is no well-recognized meaning for its opposite. Thus, antifragility is often confused with well-known terms such as *resilience*, *evolution*, *flexibility* or *adaptability*; however, none of these definitions succeeds in describing the qualities of antifragility [2].

The clearest way to understand this concept is to consider its contrast with fragility. Fragile objects require stable conditions to maintain their properties and are damaged outside these conditions. In contrast, an antifragile system not only withstands perturbations, but is strengthened by them and actively seeks to meet new challenges in order to improve. Taleb [1] illustrates this with the myth of the Hydra, a mythological being that every time it lost a head, it grew two more. Another tangible, everyday example is muscles: when exercising, muscle fibers are broken, which, when repaired, become stronger and able to withstand greater efforts.

This ability to change, and to change for the better, when experiencing stressors is an exhibition of antifragility. These stressors or "stressors" can be conceptualized in a variety of ways, which Taleb [1] names *the disorder family*: uncertainty, variability, incomplete knowledge, chance, chaos, volatility, disorder, entropy, time, the unknown, randomness, error, disruption, and dispersion of outcomes. Taleb also coined the term *black swans* for events that are unpredictable, but which, when they happen, have an imponderable impact that can only be explained after the fact.

Figure 1. The family of disorder.
Source. Own elaboration based on Taleb (2013*).*

Antifragility is a property of complex dynamical systems with nonlinear responses [1,3]. However, its study within the field of complex adaptive systems has not yet been widely established. Nevertheless, it is commonly accepted that its definition goes beyond the traditional concept of the *adaptability* or *agility* [4]. Kennon *et al*. [5] point out that adaptability is the ability to make internal adjustments to external changes. In this context, being adaptive has two levels: *1)* the ability to self-regulate in a deterministic and structured way (resultant response) and *2)* having emergent properties that allow it to transform and evolve (emergent response).

In addition to fulfilling the properties of adaptability, antifragile systems have the peculiarity of performing better in variability than in order. For this reason, antifragility is considered as resilience 2.0 or *supraresilience*. Also, this approach offers multiple simple but powerful principles for application in organizations; for example, Taleb [1] postulates that "it is easier to know if something is fragile than to predict an event that might damage it." This approach brings new ways of approaching innovation, sustainability and risk management, through elements of knowledge management such as learning by failure, productive errors, controlled experiments and the process of "learning by doing" [4].

Response of systems to disorder

Taleb [1] clearly distinguishes between three categories of systems according to their response to the "family of disorder": fragility, robustness and antifragility. These categories are placed on a continuum that helps to understand how each responds to stress. In this framework, resilience lies at the intersection between robustness and antifragility (see Figure 2), as it combines the ability to resist perturbations (robustness) with the ability to adapt to new environments (antifragility). Taleb calls these categories *the triad*, which is briefly described below.

1. Fragile: Requires stable conditions to maintain itself and is damaged when exposed to disorder. It has a low capacity to absorb variability.
2. Robust: It remains unchanged in the face of variability and disorder. If it also has the capacity to self-repair in the face of damage, it is considered resilient.
3. Antifragile: It is that which is strengthened by disorder and actively seeks changes that benefit it.

Figure 2. The fragile, robust and antifragile triad.
Source. Own elaboration based on Taleb (2013).

To understand these differences from a formal perspective, separate from subjective notions such as risk aversion, Taleb *et al.* [6] provide a mathematical definition of the nonlinear responses exhibited by systems. These responses can be modeled as a function (Figure 3) where the behavior of a system over time (x-axis), as its exposure to stressors increases, affects the performance of the system, its benefits and losses (y-axis).

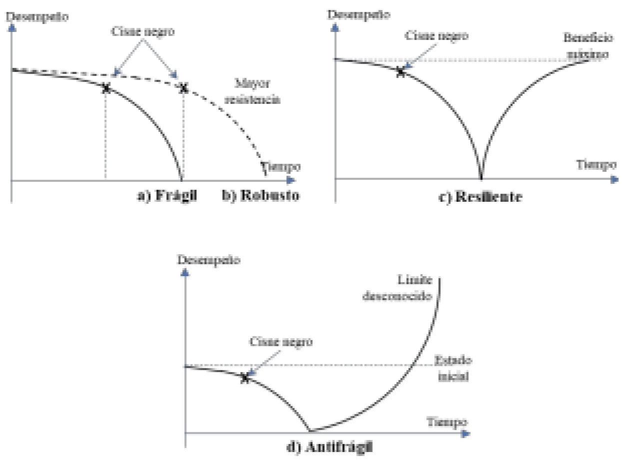

Figure 3. Types of system response.
Source. Based on Taleb et al. (2012) and Botjes (2020).

Figure 3 shows the behavior of systems when subjected to a black swan or to stress levels outside their operating parameters. On the left, a fragile behavior a) is represented, whose graph has a concave curvature, indicating that the system is limited in its advantages, but unlimited in its disadvantages when it goes from a stable state to an unexpected one [5]. Similarly, in a robustness state b), which is illustrated superimposed on the fragility plot, it is observed that the system is concave, with the difference that it is able to resist or absorb a greater amount of stress. In other words, it is fragile on a higher magnitude scale.

In illustration c), one can observe the fundamental nature of resilience, which is the ability of systems to recover from sudden *shocks* through absorption and adaptation [4]. The system "rolls back" to its steady state by means of a concave function, i.e., it returns to its normal performance, but without improvement. This means that whatever damaged it can affect it again. Finally, in the illustration on the right (d), the convex behavior of antifragility is shown, in which, after an unusual event, the system takes advantage of it as an opportunity and obtains increasing and unanticipated benefits with respect to its original level.

Another way to express antifragility, as well as fragility and robustness, in a graphical way is by means of a probabilistic risk distribution model, where the possible states that the system can have oscillate between favorable and unfavorable, which consequently generates "benefits" or "losses" for the system [3]. This view allows assuming three types of probability distribution, where the horizontal axis represents outcomes and the vertical axis the frequency of each of them, as shown in Figure 4.

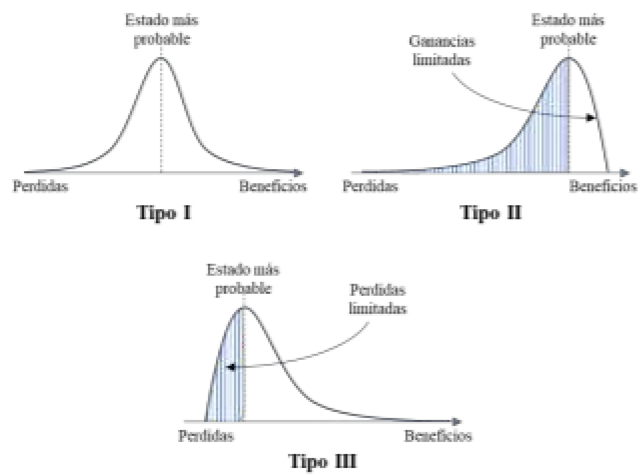

Figure 4. Types of risk distribution in systems.
Source. Based on Taleb (2013) and Gorgeon (2015).

The first graph (Type I) shows the generalized conception of system performance under "ideal" conditions, where contexts with equally probable positive or negative disturbances with a Gaussian distribution are assumed; in this sense, the robustness of the system is sought by considering the occurrence of the most probable scenarios on both sides of the mean or "stable" point. However, as Taleb [1] points out, this behavior is very infrequent and responds more to a simplification of reality.

In contrast, in empirical settings, asymmetric probability distribution types are observed in which the dispersion is more concentrated towards one side of the curve. In these settings, systems are considered to be fragile (Type II), when they operate under conditions in which possible favorable outcomes are much less likely the larger they are expected to be, while unfavorable and large outcomes (which are often hidden or ignored) are much more likely. In , antifragile systems (Type III) are a mirror image of the fragile model, operating in scenarios where severe losses are unlikely.

and, on the other hand, there are more opportunities for large profits.

In short, a system that has been designed to be stable and efficient in the face of certain scenarios may appear robust in the short or even medium term, because it has been exposed only to normally distributed randomness, as planned. However, in the long term it will suffer, because in an increasingly interconnected and complex world, driven by globalization, randomness will inevitably push organizations towards extremes of higher risks and lower returns.

Problem statement

Having established the importance for organizations to move beyond robustness and resilience, states in which the system returns to its initial state after an unusual event but does not improve, antifragility is positioned as a superior paradigm in terms of long-term benefits. However, to date, most of the work on antifragility in SMEs (small and medium-sized enterprises) is largely descriptive and relies on repeated empirical observations of performance outcomes [7]; likewise, Grassi [8] points out that theoretical and empirical research on resilience and antifragility in the SME sector is necessary to understand the concept in a comprehensive manner.

In this regard, Van Daalen [9] states that one of the fundamental questions is whether antifragility can be considered an intrinsic property of a system or whether a system exhibits antifragile behavior only in certain situations. To address this question, Taleb [1] points out that the terms *fragile* and *antifragile* are relative. The same object of study can be fragile in one sense (e.g., a person's physical complexion) and, at the same time, antifragile in another (possessing a strong personality). Therefore, as a starting point it can be assumed that antifragility is a set of "state variables", the sense that, depending on the internal configuration of a system, it will show a predisposition to be antifragile, robust or fragile in the face of certain stimuli.

In this context, the research question focuses on identifying the key aspects or management variables that allow organizations to develop antifragile responses to the variability of their environment. Therefore, the research objective is to develop a management model that allows understanding which areas of an organization are relevant to enhance its antifragility, as well as the way in which the concepts proposed by Taleb [1] can be applied to them, in order to achieve antifragility in the widest possible range of circumstances.

Hypothesis

The hypothesis of this study is that the key management areas to be influenced to develop antifragile responses in organizations are *1)* structures and processes, *2)* organizational culture, and *3)* managerial behavior (Figure 5). Furthermore, it is proposed that, in accordance with the cybernetic systems , when negative pathway strategies (variety attenuators) and subsequently positive pathway strategies (variety amplifiers) are applied, they will facilitate the ability of organizations to be antifragile.

Figure 5. Research model.
Source. Own elaboration.

Research strategy

The research strategy focused on a theoretical exploration of the approaches that explain resilience, adaptability and innovation in organizations, with the objective of identifying their key elements and their relationship with the postulates of antifragility in order to integrate them into a management model based on the general theory of systems. The theoretical validation of the proposed model was carried out by means of a non-experimental documentary design. An exhaustive review of primary and secondary sources was carried out, without the direct intervention of the researcher in a specific case, with the objective of identifying guidelines that support the viability of the model.

Toric frame of reference

Organizational behavior model

To develop a management model within the framework of general systems theory, a robust approach is required to analyze organizations in their fundamental dimensions. In this context, Hoogervorst, as cited in Botjes [10], proposes a model of organizational behavior based on three key aspects. Hoogervorst points out that it is essential to consider human behavior, both in its managerial dimension, which guides the organization, and in its collective dimension, which shapes the organizational culture. Secondly, it is necessary to recognize the correlation between these elements and the structures and processes of the business [10]. The integration of these components is illustrated in Figure 6.

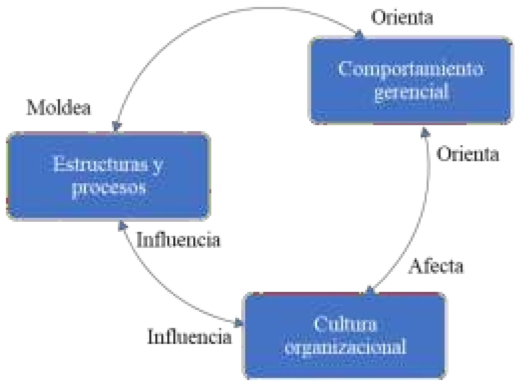

Figure 6. Organizational behavior model.
Source. Taken from Botjes (2020).

Hoogervorst's model of organizational behavior is ideal for classifying the variables of antifragility, since its factors facilitate the transition from a static approach, based on traditional production factors (labor, raw materials and financial capital), to the management of intangible or intellectual capital, which is key to improving organizational performance and promoting innovation and learning [11]. Recent studies have identified that the structural, human and relational components of organizations' intangible capital are determinants of proactive resilience [12], and innovative activity [13]. The relationship between the components of intellectual capital and the organizational behavior model is described below:

1. Managerial behavior: This component is directly related to human capital. According to Felicio *et al*. cited in Magdaleno *et al*. [13], it encompasses both talent and the capabilities developed by individuals through their training and experience. It is closely related to productivity and organizational development. It includes qualitative aspects involved in the performance of work, such as leadership, creativity, proactivity.

2. Organizational culture: This component is directly related to relational capital. It refers to the potential of formal and informal relationships within and outside the organization. According to Marín, cited in Magdaleno *et al.* [13], the longer these relationships last, the greater the exchange of knowledge, flexibility, learning and negotiation capacity. Relational capital within the organization facilitates the generation and transfer of knowledge and fosters a culture of innovation.

3. Structures and processes: According to Sánchez, cited in Magdaleno *et al*. [13], this component is directly related to structural capital and encompasses the departments, processes, systems, procedures, programs, methods and models developed and used by employees to be productive and effective. It includes all the elements that remain in the organization after employees leave and that enable value creation.

Regulatory mechanisms of the cybernetic approach

In his study on the operationalization of antifragility in inventories, Größler [14] concludes that to overcome the difficulty of implementing the concepts in a simulation, greater importance should be given to the analysis of communication between coupled subsystems -but separated from decision making-, to the choice of indicators consistent with the concept of adaptability, and to the influence of feedback on performance. Considering these conclusions, it was determined necessary for this study to incorporate elements of the systems control theory or cybernetic approach into the model of organizational behavior.

Viable Systems Theory was developed by Stafford Beer in the 1970s. It is based on concepts from cybernetics and general systems theory to create a practical framework for the management and design of organizations. The theory proposes the minimum conditions necessary for an organization to be functionally viable, that is, to be able to survive, adapt and evolve. This capability is given by the presence of five elementary subsystems that are designed to provide constant feedback, both positive and negative, allowing the system to adapt and correct its course of action [15].

A viable system is closely related to the principles of cybernetics, which conceives the response of a self-regulating system as a feedback mechanism in which the output of the system adjusts according to the deviation from the desired state while affecting its initial conditions [16]. In terms of information, a viable system obeys the Law of Required Variety (Ashby's Law), which states that only variety can absorb variety, i.e., it interacts with its environment using negative feedback or attenuators to reduce complexity, and positive feedback or amplifiers to increase amplitude or diversity in the system's response [15].

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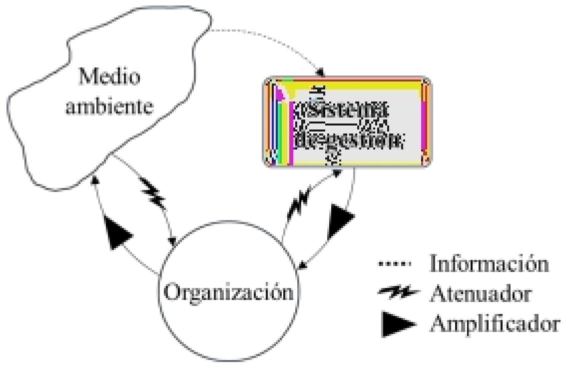

Figure 7. Basic model of a viable system.
Source. Adapted from Beer (1985, cited in Salinas- Reyes et al., 2018).

Positive and negative path strategies
Consistent with the concept of attenuators and amplifiers, Taleb [1] suggests that antifragility involves two approaches to action: a "negative pathway" that consists of eliminating factors that create fragility and an opposite or "positive" pathway that takes risks in search of benefits. Likewise, Munoz, Todres, and Rook [17] point out that this dual-track classification can be considered in a temporal dimension, where decisions can be made in advance or after an event. In this context, negative pathway is identified as proactive, aimed at reducing exposure to risk, while the positive pathway is reactive, focusing on mitigating impacts and seeking alternative solutions after an event occurs.

Botjes [10] highlights the relationship between the antifragility strategies proposed by Taleb and the negative and positive feedback responses within the framework of viable systems. In his work, Botjes classifies as attenuators those strategies that reduce uncertainty and risk exposure of the system, and as amplifiers those oriented to intervene in the system, generating randomness and subjecting it to controlled stress in expectation of potential benefits. Table 1 below shows a grouping of the strategies identified by Botjes [10] and Gorgeon [3], according to the positive and negative path criteria.

Table 1. Positive and negative pathway strategies.

Atenuadores de variabilidad	Amplificadores de variabilidad
Mando y control descendente: Tener cadenas de mando bien definidos permite que las decisiones se tomen y ejecuten rápidamente.	**Opcionalidad:** Puede ser vista como el origen de la flexibilidad. Consiste en la capacidad de cambiar de dirección y tener alternativas.
Micro gestión: Un sistema requiere equilibrio entre restricciones y grados de libertad. La supervisión sobre tareas de alta responsabilidad reduce la probabilidad de errores y accidentes.	**No monotonía:** Usar la nueva información que generan los errores y fracasos para aprender y desafiar las ideas preconcebidas y mejorar enfoques y tareas.
Intervenciones ingenuas: No intervenir impulsivamente, actuar con prudencia, tratando de ampliar el punto de vista de la situación.	**Fallar rápido:** Consiste en experimentar y aprender de los errores hasta encontrar el tipo "correcto" de errores.
Sencillez: La simplicidad en los métodos, vista como la eliminación de lo innecesario, puede mejorar la resistencia y eficiencia de los sistemas.	**Insertar aleatoriedad:** Incrementar la variedad de los elementos internos de un sistema para aumentar sus propiedades emergentes y capacidad de innovación.
Redundancia: Consiste en la duplicación de componentes críticos para aumentar la fiabilidad aun a costa de los gastos adicionales.	**Conexiones de red:** Cuantas más conexiones haya, mayor será el potencial para nuevas construcciones y funcionalidades adicionales.
Modularidad: Consiste en dividir un sistema en partes independientes con tareas bien definidas que pueden ser aisladas o sustituidas en caso de fallas.	**Estrategia de la haltera:** Apostar a la par por extremos opuestos en lugar de optar únicamente por una opción o por un término medio.
Ahorros: Tener un fondo de reserva de capital o recursos disponibles para afrontar crisis o aprovechar oportunidades inesperadas.	**Piel en el juego:** Asegurarse que quienes toman decisiones y llevan a cabo el trabajo tengan una relación directa con el riesgo y los beneficios.
Acoplamiento débil: Minimizar la dependencia entre los elementos de un sistema. Los componentes pueden ser modificados con la mínima repercusión en el sistema.	**Insertar bajo nivel de estrés:** Se centra en la exposición de manera constante a pequeños estresores para para probar la resistencia y capacidad de recuperación del sistema.

Source: Adapted from Botjes (2020) and Gorgeon (2015).

DEVELOPMENT

Proposal: Two-way management model
The development of the management model is based on an interrelation between two conceptual frameworks within the systems paradigm: the organizational behavior model and the attenuators and amplifiers approach of the cybernetic model variety. This approach will make it possible to study the relationship between the type of response (fragile, robust, resilient or anti-fragile) of a system depending on the type of strategy (negative or positive pathway) implemented in the key areas of the organization.

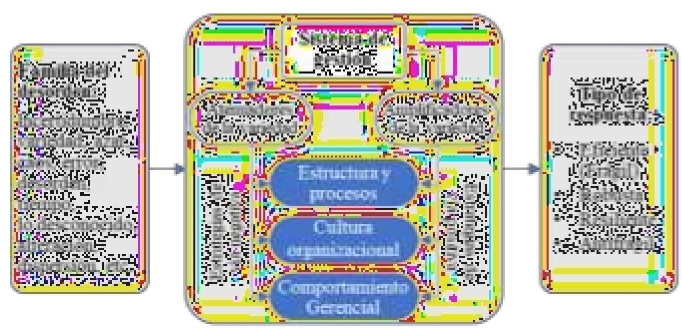

Figure 8. Systemic approach to the management model.
Source. Own elaboration.

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Figure 8 shows that the system performs a transformation process where the environmental stimuli are considered as elements of the disorder family, and the output is the type of response to that stimulus, which is processed by a management system that mitigates the threats and explores how the potential of each situation could be exploited.

Relationship between dual-track strategies and the type of system response.

It is proposed that a management system that effectively generates antifragile responses requires the systematic combination of negative and positive feedback starting from the negative pathway as a prerequisite for the positive pathway. That is, the negative pathway provides the conditions for robustness, while the positive pathway leads to antifragility. This idea is confirmed by Größler [14], who points out that antifragility encompasses robustness since the system must first absorb *shocks* (be robust) and then explore and take advantage of opportunities (be antifragile). Figure 9 shows the systematization of both approaches.

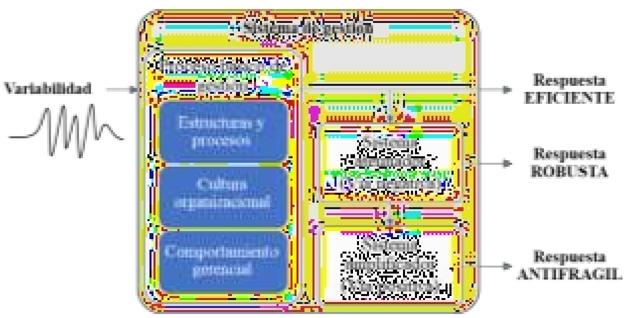

Figure 9. Two-way strategies in the management model.
Source: Own elaboration.

The above management model provides interesting conclusions for analyzing the response of a system, which can be classified into three types depending on the level of "processing" within the organization. Each type of response is described below:

1. Efficient response: It is the response that arises from a basic management process, i.e., when decision making is based on deterministic reasoning, well-defined theories, resource optimization, and predictability of the future. In this approach, efficiency is obtained at the expense of increased damage potential in the face of the randomness of the environment [10]. This approach will be fragile in the medium to long term.
2. Robust response: This response arises from the incorporation of a negative path approach. The system allocates efforts to reduce the potential for system failure at the cost of resources with no further immediate functionality or use [10]. It increases prevention, supervision, reinforcement of critical points and threat monitoring. Although this may make the system less efficient, it allows it to become more robust.
3. Anti-fragile response: Arises from a proactive stance to change, preceded by an approach that considers potential risks. Paradoxically, antifragile systems rely on the fragility of their components, without which they would be merely robust. Under stress, these fragile subcomponents break down, allowing the system to improve [10]. This approach of amplifying stress allows the firm to venture into innovations and new scenarios, with the possibility of discovering contingent benefits with limited losses, which characterizes an antifragile response.

Relationship between key areas of the organization and the type of system response

In this phase of the analysis, we examined how each area of organizational behavior (structure and processes, organizational culture and managerial behavior) influences the proposed management model to foster prevention, resilience and innovation. It is then shown how the management of each of these areas determines the ability to cope with problems and take advantage of opportunities and, consequently, their relationship with the specific types of responses: robust, resilient and antifragile.

Figure 10. Anti-fragile management model.
Source: Own elaboration.

Structures and processes

The institutionalization of roles, responsibilities, procedures and systems within an organization makes work routines more efficient and controlled, which reduces errors while giving workers the opportunity to make mistakes with minimal impact on company performance [13], since their activities are kept within established standards.

By formalizing the long-lasting elements of structural capital, an organization effectively aligns its material and human resources with its strategic goals. This ensures continuity of operations and value creation, which strengthens and creates competitive advantages [12]. Therefore, it can be established that the structures and processes dimension has a positive impact mainly on the type of robust response by providing stability to the organization.

Organizational culture.

It constitutes the values, beliefs, customs and norms shared by people within an organization. A strong and positive organizational culture teamwork and improves communication among employees, facilitating interaction and mutual support. In addition, personal connections within the company are fundamental, as they favor learning and the ability of employees to generate new ideas and the confidence to transmit them [13].

Corvello *et al.* [12] emphasize the importance of a culture oriented towards knowledge management and communication to favor the adaptation of employees to change, and to improve their ability to exploit shared resources and promote innovation. In this sense, a well-managed organizational culture has a significant impact on resilience, as it improves the ability of workers to adapt to change and participate in the generation of creative solutions to challenges.

Management behavior

Organizations with strong human capital are better prepared to face sudden disruptive events. Decision-makers with high knowledge and experience can facilitate a quick recovery of the company from any crisis, and efficiently adapt to new market conditions [12]. Having management positions that possess coordination skills allows companies to have a high commitment from their staff and manage knowledge to obtain initiatives that mitigate the effects of a crisis and thus overcome the negative consequences in the long term.

In addition, human capital, seen in its leadership dimension, acts as a source of strategic vision and renewal, either in the implementation of improvement projects or in the reinforcement of commitment and motivation [13]. It can then be established that managerial behavior has a significant impact mainly on the type of antifragile response, since decision-making based on the vision of leaders, institutional support for new proposals and expert knowledge, allows new scenarios to be explored to take advantage of opportunities.

DISCUSSION AND ANALYSIS OF RESULTS

The proposed management model was based on the three dimensions described in Hoogervorst's model of organizational behavior (Structure and Processes, Organizational Culture and Managerial Behavior). This research extends the scope of this model by relating it to recent studies on intellectual capital by Corvello [12] and Magdaleno [13]. This approach allowed its contextualization in the SME sector and to establish a direct relationship with Structural Capital, Relational Capital and Human Capital, key factors to understand the emergence of responses such as creativity, resilience, learning and innovation.

Likewise, this research is based on Stafford Beer's Viable Systems Theory, with a particular focus on the concepts of attenuator and amplifier of the cybernetic approach, to describe the role of constant feedback in the management model. Based on the work of Botjes [10] and Salinas-Reyes [15], an approach is proposed that represents a conceptual advance to operationalize these concepts in organizations through a systematization of two phases: first, a precautionary phase that acts as a variability reducer, and, secondly, an exploratory phase that amplifies variability.

A significant contribution of the proposed management model, based on the findings of Botjes [10] and Gorgeon [3], is the grouping of 16 antifragility strategies according to the attenuators and amplifiers approach. This approach provides a heuristic criterion to adapt various methods already available in engineering such as Quality Management, Knowledge Management, Scenario Planning, Process Reengineering, Change Management or New Product Launch (see example in Figure 11) by means of an analysis that divides its components either as elements to reduce fragilities (negative way) or to take advantage of opportunities (positive way).

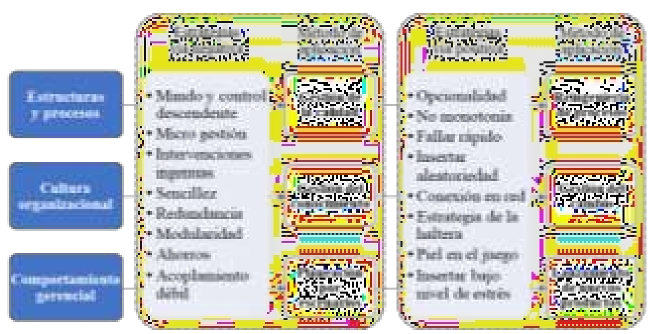

Figure 11. Anti-fragile management model: Example of application with different methodologies.
Source: Own elaboration.

CONCLUSIONS

The present study has allowed us to clearly classify the types of response that complex systems can exhibit when exposed to elements of the family of disorder and black swans. Using the systems , elements of organizational behavior, the cybernetic approach and the antifragility principles identified by Taleb (2013) were integrated into a management model. This approach, using the variability regulation concepts of the cybernetic approach, defines two courses of action that allow the application of 16 generic antifragility strategies in three key areas of the organization: structures and processes, organizational culture and managerial behavior.

The main finding is that the proposed model allows generating guidelines to understand, adapt and improve the implementation of multiple methods commonly studied in industrial engineering by systematizing their application in two stages: First attenuating variability and making the system robust (negative path) and then amplifying it in search of opportunities (positive path strategies). This approach is the basis for continuing future lines of research in which the relevance of each particular method within the model is analyzed, as well as the characterization of the positive and negative path strategies they apply.

Another important line of future research is to deepen the understanding of innovation processes from the perspective of antifragility. In this sense, the proposed management model could be used to determine the role of leadership, structure and culture in designing "organizations that discover and innovate". This approach could complement existing studies that do not prioritize the reduction of internal fragilities as a basis for identifying opportunities, as well as for anticipating and mitigating the risks inherent in experiments and mistakes on the road to innovation.

Ultimately, it is stressed that the antifragility paradigm provides a strong critique of the convention that greater control and meticulous planning always lead to better results, given that the larger, more efficient and specialized systems become, the more sensitive they are to variability. Likewise, due to the complex nature of the environment and the limitations in predicting the sources of change, it is necessary to adopt an anti-fragile management that allows organizations not only to withstand crises, but also to learn and act effectively in the face of challenges. In Taleb's words, thanks to antifragility, to a large extent, we are better at acting than thinking.

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