ORGANIZATIONAL MANAGEMENT: PROPOSAL OF AN EVALUATION METHOD FROM THE PERSPECTIVE OF THE ORGANIZATIONAL ENTROPY CONCEPT

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ABSTRACT

The evolution of scientific knowledge for centuries increasingly enables the integration of the exact sciences and humanities for a single purpose. The application of the principles of thermodynamics in open systems brings the understanding of organizational management closer to the essence of the systems and allows inference about their dynamic functioning. This research aimed to develop an evaluation method to raise the level of understanding of management practices, from the perspective of entropy in open systems to provide managers with an overview of the internal and external environment of the organization in its context. A survey was conducted by means of convenience sampling in a population of business consultant specialists who work in national and international private entities of small, medium and large size, as well as autonomous professionals who work in the provision of business consulting services, focusing on organizational management, organizational strategy, leadership, business processes, organizational development, innovation, and sustainability in the state of Rio de Janeiro. Through the proposed method it will be possible to understand the intrinsic factors of management that generate greater or lesser energy gain or loss, which may contribute to decision making, creating a fertile environment for change.

Keywords: Entropy; Leadership, Strategy; Management.

1. INTRODUCTION

The use of the fundamentals of thermodynamics in the social sciences should be carried out avoiding the imprecise or mistaken application of its concepts, which may generate ambiguities, as well as allowing the utilization of knowledge from one area of science in another. It must respect the original concept and contemplate a weighted analogy, although, in the case of entropy, the state of the art must be maintained, explaining the typology used as Clausius' thermodynamic entropy, in which the energy of the universe remains constant while the entropy of the universe at all times moves towards the maximum.

Negative entropy or negentropy can be defined as the specific entropy deficit of a subsystem in relation to the surrounding chaos. Negative entropy is used in theoretical information to measure the distance to normality. It measures the difference in entropy between a given distribution and the Gaussian distribution, which is the one with the highest entropy (Santamaría-bonfil et al., 2016).

The concept of Bruyn et al. (2014) will be used as the basis of this research, according to which entropy, as expressed in the second law of thermodynamics, is a fundamental principle in traditional engineering sciences and although many versions exist, it basically has the intention of expressing the growing amount of complexity, uncertainty (lack of information), and the tendency of particles to interact within a system.

Understanding the dynamics of social systems makes it possible to forecast and model the future state of the organizational system with a smaller margin of error. In the 21st century, geographical demarcations have lost importance, requiring a differentiated approach from those applied in the last century. Business leaders need to improve their capabilities to manage in an unstable and unpredictable environment (Olyaiy, 2015).

In the globalized environment, top management and average levels of command must direct their actions based on reliable information and data. People represent the link between the strategies defined and the base that supports them. The efficiency and effectiveness of decisions depend on how well people understand and operationalize the processes of an organization, as well as they deal with the interfaces of their environments, internally and externally.

Organizations, as open systems, suffer the same transformations that occur in mechanical systems. The amount of energy leaving an organization (value-added work) is equal to the amount of energy you put in, minus the amount of energy required to keep the organization running (Barrett, 2010b). Thus, it is paramount that leaders, as agents

of change, know the factors that impact the organization, knowing them and considering them in their decision-making. From this approach, it becomes important to understand corporate entropy.

Nevertheless, it is recurrent that organizations have strategies that are not properly clarified and discussed and do not reach all levels. Such factors can lead to inconsistent decisions for business success. The analysis of organizational performance based merely on quantitative models does not provide a complete picture of the situation of the management system and its business processes (McAuley et al., 2013).

This study is supported by the scientific postulates of exact sciences and their applications in humanities, with the purpose of satisfying the premise in which strategic management in organizations is in an open system. Organizations are directly impacted by the laws that govern the universe and therefore should consider them in their decision-making. The scope of systemic thinking within the organizational context and its inter-relationships with the internal and external environment generate interactions that can be positive or negative, so that it can affect and be affected in their decisions.

This research aimed to develop an evaluation method to raise the level of understanding of management practices from the perspective of entropy in open systems, in order to understand the main factors that impact organizational entropy. The goal was to demonstrate how organizations can adopt the principles of entropy in organizational strategies and identify factors intrinsic to management, which generate more or less gain or loss of energy, corroborating the achievement of the proposed goal.

2. THEORETICAL BACKGROUND

The economic process consists materially in a transformation from low to high entropy, that is, in losses. Since this transformation is irrevocable, resources must necessarily represent a notion of value, whether economic or otherwise. Since the management process is a set of needs and expectations, the actions of all agents, human or material, are related to the environment and society, which allows us to highlight the differences between management systems that fail and others that prosper over the years, or even businesses that are maintained over the centuries (Gray, 2013).

Entropy law makes it possible to capture the evolution and consequences generated by an organization's operational and strategic actions due to pressures from its stakeholders (society, government, suppliers, shareholders, administrative boards, employees and non-governmental organizations) and everyone who feels affected internally

or externally. An organization is the rational coordination of the activities of several people for the fulfillment of an implicit or explicit objective, through the division of work or function, as well as through a hierarchy of authority and responsibility.

For McAuley et al. (2013), many contemporary writers suggest that in any typical modern organization there is an elite of managers and professionals who can use their intellect and rationality in the pursuit of their work, in addition to supporting employees, for whom work is essentially the source of survival. The treatment given to organizations as a system allows approaching the management science with the natural science, enabling them to establish methods and techniques of engineering for organizational control from principles, as understood by the authors McAuley et al. (2013).

> Systems Theory provides a rich opportunity to develop an understanding of the principles that apply to all organizations. It provides an intellectually rigorous framework for the exploration of organizations. When we get to the Open Systems Theory, we can explore the relationship between the organization and its external environment. This provides a rational structure to deal with the uncertainties that a fickle fate throws at organizations (McAuley et al., 2013, p. 104).

The organization is a set of people who influence the energy level of the system, and some of these factors are inherent to each individual, which are parts of the whole.

Thus, all those involved are aware of individual aspirations and goals within the organization, making integration between the various levels and positions inevitable in order to achieve what is planned or defined by the higher levels. This process is called latency, that is, the way they are generated, guaranteed and maintained, thus generating the organizational culture (McAuley et al., 2013). In addition, the organization can change according to its needs to maintain balance or follow another path in order to become even more balanced.

The studies of sociologists Anselm Strauss and Barney Glaser (1967) describe "the 'management' processes of patients who have chronic diseases as they go through the stages of recovery, such as that which occurs in organizations of high entropy, i.e., an evolution". These studies have found applications in several areas of knowledge, such as in organizations. Based on this principle, within the organization, the "path of change" (Figure 1) can be understood and analyzed according to the different stages that people, groups and organizations experience in the process of change (McAuley et al., 2013).
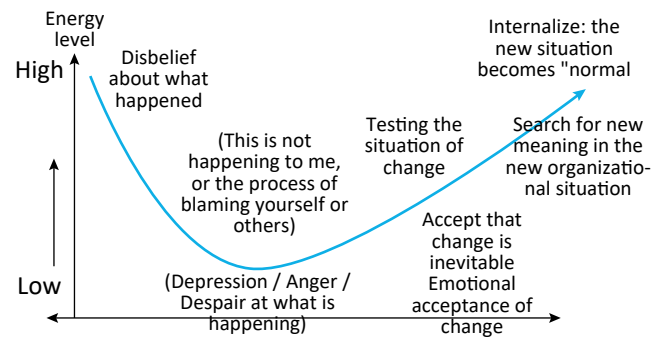

Figure 1. Trajectory of change and energy level
Source: McAuley et al. (2013, p. 31)

Entropy is the essence and mass dependent: two kilos of any substance have exactly twice as much entropy as one kilogram of the same substance under the same thermodynamic conditions. Intangible elements have no entropy (either positive or negative). Jing (2011) highlights three points to be considered interrelated and non-transferable in organizational management, in the aspect of entropy:

Entropy of the company scale: as an organizational system, its factors have a different hierarchy and functional structure. There are several relationships between these factors, that is, the business system is uncertain. Together with the expansion of the business scale, the factors become more and more challenging. The number of factors that make up the corporate system, i.e., the scale of the company, affects entropy.

The capacity of the company's entropy: it consists of the survival skills of the market and of the management operation, which are the structure, extension and strength of the core capacity. With the constant growth, the external information and the factors of the corporate system become better and better.

Entropy of company speed: the development of the company can be considered as absorption and merger of all types of information, finance, affairs, and employees. When the company grows rapidly, all kinds of phenomena occur, such as the number of employees, finances, sales performance, and growth.

When organizational capabilities are weak, entropy has an inverted U-curve relationship with corporate entrepreneurship, and when organizational capabilities are strong, the relationship between entropy and corporate entrepreneurship is significantly positive (Gohil; Deshpande, 2014).

The efficiency and functionality of a management system can be reflected using management entropy. Taking this as a precondition, the interpretation of the management of the

second law of thermodynamics can be described as the stability of the requirements of the system elements, such as structure or other factors, which will result in the delay of the system in relation to the external environment, which determines a gradual failure of the administration functionality, because the reactions of the system cannot respond immediately to changes in its environment. Therefore, entropy increases (Ali et al., 2017).

The external environment of an organization can be divided into specific and general environment. The specific environment directly influences the decision and action of managers and is directly relevant to the achievement of organizational objectives (Chun et al., 2013).

3. METHODOLOGY

The respondents were selected from the convenience of the authors, focusing on the areas of activity of the respondents, allowing their experiences to contribute in a more significant way to the survey, aiming to standardize the sample as much as possible. Twenty-six respondents were selected from various areas of knowledge related to business management. The geographic diversity of the respondents can be verified by their locations, as well as the type of companies in which they operate, with 46% of professionals influencing small, medium and large companies; 31% consisting of consultant-auditors-entrepreneurs; and 23% of independent/autonomous consultants, who work in government organization supporting the business.

The respondents were distributed as follows: 31% in the city of Rio de Janeiro; 19% in Araruama; 12% in Volta Redonda; 12% in Niterói; 11% in Campos dos Goytacazes; 11% in Macaé; and 4% in Petrópolis. All municipalities are from Rio de Janeiro State, according to Figure 2.

Figure 2. Location of respondents by city in the state of Rio de Janeiro
Source: elaborated by the authors (2020).

In terms of academic background: 85% have a master's degree or are master students; 8% are doctoral or doctoral candidates; and 8% only have a degree. Concerning the gender profile: 38% are women and 62% are men. Figure 3

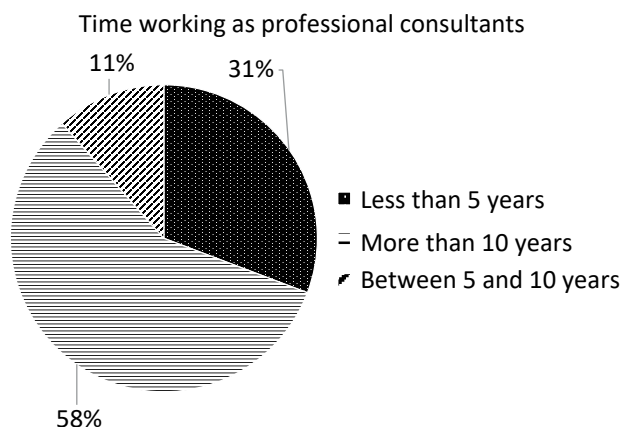shows the professional category with time as consultants.

Time working as professional consultants

- Less than 5 years
- More than 10 years
- Between 5 and 10 years

Figure 3. Working time as consulting professionals
Source: elaborated by the authors (2020).

The academic level of respondents is presented in Figure 4, where 86.4% have a master's degree or are studying, 7.7% are doctoral candidates or have PhDs, and 7.7% only have a degree.
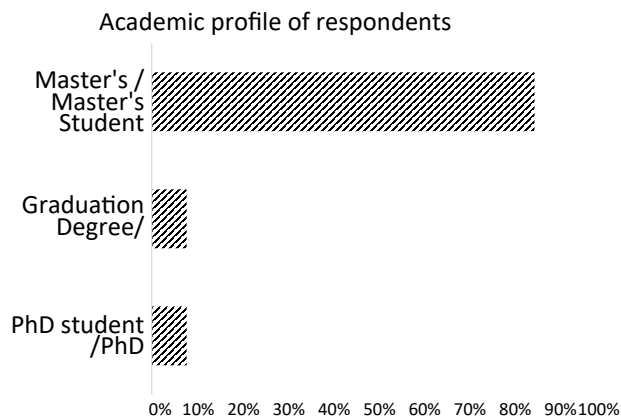

Academic profile of respondents

Figure 4. Characterization of the sample used in the survey
Source: elaborated by the authors (2020).

The stratification of the results aimed at dividing the data into different levels, obtaining the largest volume of information, increasing the depth of the analysis and identifying the variables that could impact less or more on the level of entropy through the responses obtained.

The scale was divided into five score levels. Each response category was given an equivalent weight on a scale from 1 to 5, where entropy grows to the right and decreases to the left (Figure 5).

Entropy's impact levels on the organization and quantification				
Level 1 Primary	Level 2 Low	Level 3 Significant	Level 4 Serious	Level 5 Critical
Responses from respondents				
(1 ◄		Entropy level	►	5
-				+
Equivalence scale with entropy level				
(≤10%)	(11%-20%)	(21%-30%)	(31%-40%)	(41%+)

Figure 5. Entropy's impact levels on organization and quantification

Source: elaborated by the authors (2020) based on Barret, (2010b).

Based on Barret's (2010b) model, the study provided a systemic approach in all phases of treatment, analysis and discussion of results, considering social, organizational, personal, informational and cultural entropies. Barrett (2010b) talks about what happens with mechanical systems and with human systems, such as organizations. The amount of energy leaving an organization (value-added work) is equal to the amount of energy that is placed minus the amount of energy needed to keep the organization running.

In this case, the degree of dysfunction or disturbance in an organization is high, due to factors such as: excessive control, caution, confusion, bureaucracy, hierarchy, competition and guilt, generating a higher demand for energy so that employees have their activities completed. This additional energy is called entropy because it is caused by factors that are endemic to the culture of the organization. The energy involved in overcoming cultural entropy is an energy that is not available for work as an added value (Barrett, 2010a).

<10%: Primary level - this is a low level of entropy.

11% - 20% - Minor issues: This level of cultural entropy reflects issues that require structural adjustment. It is important to reduce the level of cultural entropy to improve performance.

21% - 30% - Significant issues: This level of cultural entropy reflects significant issues requiring cultural, structural transformation, and leadership coaching. It is important to reduce the level of cultural entropy to improve performance.

31% - 40% - Serious issues: this level reflects serious problems and requires leadership develop-

ment, transformation in structure, and organizational structure.

41%+ - Critical issues: this level reflects critical problems that demand changes in leadership, and restructuring of the structure, culture and development of new strategies for leadership development (Barrett, 2010b).

Each question was analyzed separately, in comparison with the scale pattern defined in the questionnaire, and the numerical measures of position (Equation 1) were obtained through the weighted average between the number of quantifiers pointed out by the respondents and the weight assigned to them, in addition to serving as a marker of the method for its validation, indicating its proportionality. When the average falls the entropy is also reduced.

Ten issues were adopted: Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9, and Q10 (Figure 6). It should be noted that the results express the points of view of the professional respondents, as well as may present pertinent variation due to the volume of information that reaches them daily and the dynamics of the subject in constant transformation. The data collected are presented in sections 1 to 5, namely 1- management, 2- leadership, 3- strategy, 4- organizational culture, and 5- operational practices.

The process of building the qualitative and quantitative evaluation method of organizational entropy was under the perspective of entropy and is guided by the levels of entropy proposed by Barret (2010b) and is used in data processing.

The method of evaluation of the Organizational Entropy Level (NEo), adopted in this study, contemplates quantitative and qualitative aspects, using descriptive statistics as support for analysis and data treatment. The essence of the method is in the holistic and multidisciplinary approach of the organization, besides its endogenous and exogenous connections. It applies to any business type, size and nature. The methodology for the calculation of entropy is based on the already existing cultural entropy and from this, standards and parameters are developed for the NEo method.

$$NEo = \frac{\sum \dot{x} \cdot \dot{w} / 100^2}{Nqo}$$

Where,

NEo : organizational entropy level (%)

$$\sum = \text{sum}$$

QUESTIONS BY SECTION				
1. MANAGEMENT	**Q1** How is the communication of organizational performance considered by organizations?			
	☐ Essential ☐ High priority ☐ Mean priority ☐ Low priority ☐ Not a priority			
	Q2 How do you feel about the level of commitment of companies to knowledge management, inside and outside the corporate environment?			
	☐ Very satisfied ☐ Satisfied ☐ Indifferent ☐ Little satisfied ☐ Dissatisfied			
2. LEADERSHIP	**Q3** Which leadership profile do you identify most frequently in the organizations you work with?			
	☐ Servant-Leader and Visionary - Acts with humility and compassion ☐ Easily manages conflicts and invests in relationship building ☐ Considers the internal environment its priority with little interface with external environment ☐ Does not consider the organizational context in decision making ☐ Focused only on financial results			
	Q4 How do you rate the communication skills of leaders?			
	☐ Extraordinary ☐ High ☐ Intermediate ☐ Low ☐ Incipient			
3. STRATEGY	**Q5** Which stakeholder offers the greatest influence on the definition of the strategy?			
	☐ Society ☐ Employees ☐ Competition ☐ Governments ☐ NGOs			
	Q6 What level of priority is given by organizations to Risks and Opportunities in decision making?			
	☐ Very high priority ☐ High ☐ Mean ☐ Low ☐ Not considered			
4. ORGANIZATIONAL CULTURE	**Q7** What is the main motivation of companies to invest in cultural, social, sex or inclusion diversity?			
	☐ Value Generation ☐ Competitive differential ☐ Improve Corporate Image ☐ Pressure from Society ☐ Legal Requirement			
	Q8 What is the level of stakeholder awareness within the organizational context, objectives and goals?			
	☐ Very high ☐ High ☐ Mean ☐ Low ☐ Not considered			
5. OPERATIONAL PRACTICES	**Q9** What is the level of alignment between operational practices and strategic planning in organizations?			
	☐ Very high ☐ High ☐ Moderado ☐ Low ☐ None or insignificant			
	Q10 How do you evaluate the recognition offered by companies in the participation of employees in problem solving?			
	☐ Excellent ☐ Very good ☐ Good ☐ Bad ☐ Very bad			

Figure 6. Questions by section adopted in the survey

Source: elaborated by the authors (2020) based on Barret (2010b).

$\dot{x}$: quantifier quantity (absolute number of respondents for each quantifier)

$\dot{w}$: weight assigned to the quantifier i

Nqo : total number of quantifiers used in the survey

Taking as an example the result of a hypothetical survey, with a sample of 30 respondents, one can demonstrate the use of the method. Thus, when asked about the level of investment in diversity, the researcher obtained the following results: 11 respondents stated that it was "Essential"; 13 "High priority"; and 6 "Medium priority". Thus, the resulting calculation is shown in table 1.

When comparing the results with the qualitative standard employed, it is concluded that the level of entropy is at level 2 of 11%-20%, with less serious issues, requiring adjustments by leadership to improve the performance of the organization.

4. RESULTS AND DISCUSSION

Management

Figures 7 and 8 present the absolute qualitative results regarding the importance of communication of organizational performance when 42% consider communication to be essential for organizations, 23% consider it to be a medium priority, 27% low priority, and 8% high priority. Regarding

Question	Essential		High priority		Medium priority		Low priority		Not a priority		Mp= ∑wixi / ∑wi	∑WiXi	Nqo	Score % NEo
	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi				
Q1	11	1	13	2	6	3	0	4	0	5	3,7	55,0	5,0	11
Calculation	Mp=∑wixi / ∑wi =((1*11)+(2*13)+(3*6)+(4*0)+(5*0))/15=3,7													
	∑WiXi=(1*11)+(2*13)+(3*6)+(4*0)+(5*0=55,0													
	Score % NEo=(∑WiXi/100)/Nqo=(55/100)/5=0,11=11%													

Chart 1. Example of Entropy Level Calculation for Quanti-qualification-Photetic Research
Source: elaborated by the authors (2020) based on Barret (2010b)

the level of commitment of companies to knowledge management, 77% of respondents considered themselves "not very satisfied" and 8% "dissatisfied".

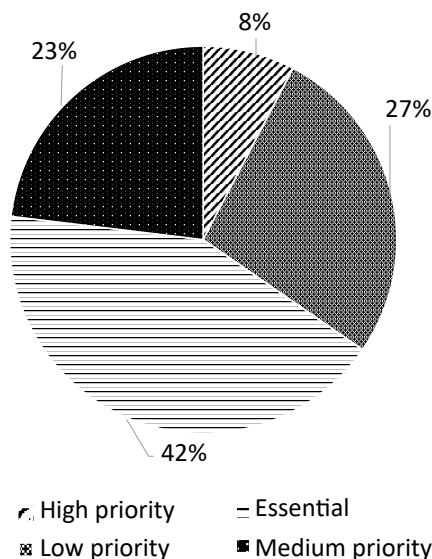Figure 7. Importance of organizational performance communication
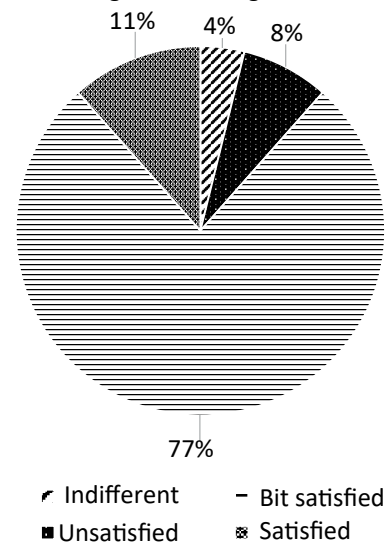Source: elaborated by the authors (2020).

Figure 8. Level of satisfaction with knowledge management in organizations
Source: elaborated by the authors (2020).

In the view of McAuley et al. (2013), it is not uncommon for organizations to have closed strategic planning that is not communicated or shared with the tactical and operational levels. And this factor favors an environment of unconscious decision making with no factual basis, generating damage to the organization's performance and consequently increasing the degree of risk and losses.

When Ben (2016) published G. N. Lewis' (1930) quote, where he says that "Gain in entropy always means loss of information and nothing else," he leads us to analyze the outcome of respondents' dissatisfaction with the importance given to communicating organizational performance to stakeholders.

When there is no well-defined organizational context and stakeholders are not properly identified and their interests in the organization are not properly mapped, it is difficult to have good communication because you do not know who they are and what their interests are. It is not possible to communicate properly (Markina; Dyachkov, 2014).

For Q1, Mp=4.1 and the entropy level of 12.2% point to an entropy level between 11%-20%, i.e., it is closer to reaching the primary level; Q2, on the other hand, presents an Mp=6.6 and an entropy level of 17.8%, which refers to level 2 of low entropy (11%-20%), signaling the need for improvement (Table 2).

Question	Essential		High priority		Medium priority		Low priority		Not a priority		Mp= ∑wixi / ∑wi	∑WiXi	Nqo	Score % NEo
	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi				
Q1	11	1	2	2	6	3	7	4	0	5	4,1	61,0	5,0	12,2
Calculation	Mp=∑wixi / ∑wi =((1*11)+(2*13)+(3*2)+(4*0)+(5*0))/15=4,1													
	∑WiXi=(1*11)+(2*2)+(3*6)+(4*7)+5*0)=61,0													
	Score % NEo=(∑WiXi/100)/Nqo=(61/100)/5=0,122=12,2%													
Question	Very satisfied		Satisfied		Indifferent		Not very satisfied		Dissatisfied		Mp= ∑wixi / ∑wi	∑WiXi	Nqo	Score % NEo
	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi				
Q2	0	1	3	2	1	3	20	4	2	5	6,6	89,1	5,0	17,8
Calculation	Mp=∑wixi / ∑wi =((1*0)+(2*3)+(3*1)+(4*20)+(5*2))/15=6,6													
	∑WiXi=(1*0)+(2*3)+(3*1)+(4*20)+(5*2)=89,1													
	Score % NEo=(∑WiXi/100)/Nqo=(89,1/100)/5=0,178=17,8%													

Chart 2. Stratification Questions Q1 and Q2
Source: elaborated by the authors (2020).

To improve management and achieve a balance, it is necessary to raise the level of leadership commitment to issues related to knowledge management. Practical actions can include greater investment by organizations in training and development, and implementation of digital platforms for sharing data and information, creating an interface between the internal and external environments (Martínez-Berumen et al., 2014; Santamaría-bonfil et al., 2016).

Organizations can develop mechanisms based on strategic thinking which, in turn, is resource and capacity based in the development of artifacts for managing enabling contexts aimed at boosting organizational knowledge and they can value cognitive surpluses. This means valuing the time the company has to develop extra work activities, motivating voluntary actions and creating new projects to encourage innovation and entrepreneurship (Rezende et al.; 2016; Gohil; Deshpande, 2014).

According to Ursacescu and Cioc (2016), informational entropy directly impacts four processes that deserve the organizations' attention, as in table 3, and when a level of disorganization is identified, entropy levels are likely to be high (Araújo et al., 2015).

Process	Description
Management Process	Set of structures, functions and relationships established for the purpose of decision making, based on training resources.
Innovation Process	Process that allows the implementation of new goods, services and new technologies, based on access and exploitation of information and knowledge.
Communication and Information Process	Technologies, practices and infrastructure that enable data processing for organizational processes.
Business Strategy	Definition of the strategic direction, objectives and actions necessary to achieve them.

Chart 3. Organizational processes exposed to information entropy
Source: Ursacescu; Cioc (2016)

The different relationships between the various elements that make up the organizational system can offer, solely through their interactions, a moderate degree in the production of entropy and the flow of negative input entropy for open systems (Chang, 2013). Another point to consider is the complexity of organizations, since each typology has unique characteristics and a management model that applies to one and may not be applicable to another without first assessing the operating context (Jing, 2011).

The collaboration of negative entropy for the management system is correlated to the inclusion and exclusion of elements within the system and the relationships that occur between them. In many situations, organizations hire and fire professionals, buy companies and sell companies, split up or form conglomerates, and the energy of one adds up to the other. Thus, it raises and lowers entropy, depending on the situation, which makes the role of leaders even more challenging (Quarati et al., 2016; Foster; Burkett, 2008).

Leadership

When asked about the leadership profile that consultants identify most frequently in organizations, Figures 9, 10 and

11 present the following results: 58% reported that leaderships are focused only on financial results; 31% considers the internal environment their priority with little interface with the external environment; 8% ignore the organizational context in their decision-making, and only 4% have the profile for conflict management.
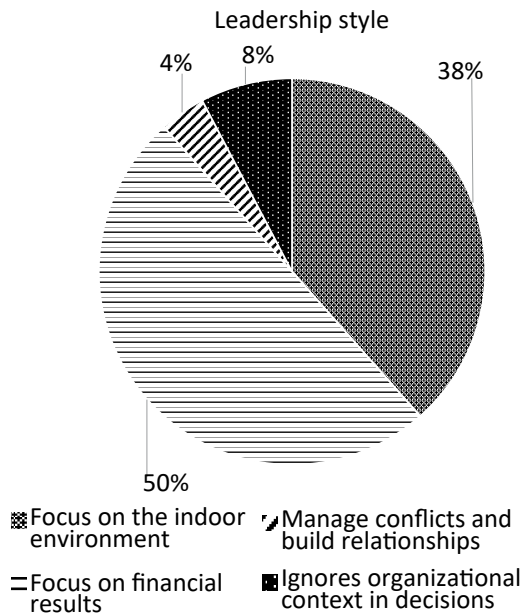

Figure 9. Profile of the leaders indicated in the survey
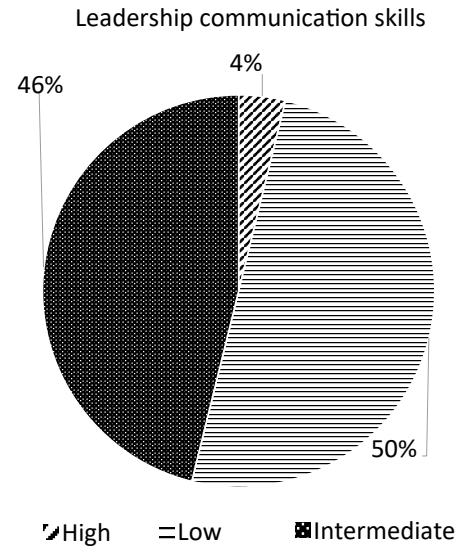Source: elaborated by the authors (2020).

Figure 10. Leadership communication skills
Source: elaborated by the authors (2020).

For Q3, Mp=6.7 and the entropy level reaches 20.2%, and for Q4, Mp=6.0 and entropy level=18%, demonstrating that leadership needs to change management focus because it is close to significant levels of entropy (Chart 4).

Question	Servant-Leader and Visionary - Acts with humility and compassion		Easily manages conflicts and invests in relationship building		Considers the internal environment its priority with little interface with the external environment		Does not consider the organizational context in decision making		Focused only on financial results		Mp= ∑wixi / ∑wi	∑WiXi	Nqo	Score % NEo
	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi				
Q3	0	1	1	2	12	3	2	4	11	5	6,7	101,0	5,0	20,2
Calculation	Mp=∑wixi / ∑wi =((1*0)+(2*1)+(3*12)+(4*2)+(5*11))/15=6,7													
	∑WiXi=((1*0)+(2*1)+(3*12)+(4*2)+(5*11))=101,0													
	Score % NEo=(∑WiXi/100)/Nqo=(101/100)/5=0,202=20,2%													
Question	Extraordinary		High		Intermediate		Low		Incipient		Mp= ∑wixi / ∑wi	∑WiXi	Nqo	Score % NEo
	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi				
Q4	0	1	1	2	12	3	13	4	0	5	6,0	90,0	5,0	18
Calculation	Mp=∑wixi / ∑wi =((1*0)+(2*1)+(3*12)+(4*13)+(5*0))/15=6,0													
	∑WiXi=(1*0)+(2*1)+(3*12)+(4*13)+(5*0)=90,0													
	Score % NEo=(∑WiXi/100)/Nqo=(101/100)/5=0,180=18%													

Chart 4. Stratification section 2 Leadership - Questions Q3 and Q4
Source: elaborated by the authors (2020).

According to Lee (2010), many leaders have low entropy. This can contribute to their management process and to the fact that personal values such as a sense of justice, ability to listen, and teamwork, which creates an inclusive organizational environment, are able to reduce organizational entropy. The author also reinforces that confidence in decision making and the ability to communicate and create relationships are paramount for creating organizational culture and generating value for the business. As suggested by Barrett (2010b), leaders have seven levels of awareness, as shown in chart 5.

Level of leadership awareness		Characteristics
7	Serfdom	Visionary leader: service to society, humanity and the planet. Focus on ethics, social responsibility, sustainability and future generations. Displays wisdom, compassion and humility.
6	It makes the difference	Mentor / Partner Leader: Strategic alliances and partnerships, server leadership. Focus on employee satisfaction, mentoring and coaching. Displays empathy and uses intuition in decision making.
5	Internal cohesion	Inspiring Leader: Strong cohesive culture and capacity for collective action. Focus on vision, mission and values. Displays authenticity, integrity, passion and creativity.
4	Transformation	Facilitator / Influencer: Empowerment, adaptability and continuous learning. Focus on personal growth, teamwork and innovation. Displays courage, responsibility, initiative.
3	Self-esteem	Performance manager: high performance systems and processes. Focus on strategy, performance, excellence, quality, productivity and efficiency. Shows pride in performance.
2	Relationship	Relationship Manager: employee recognition, open communication and conflict resolution. Creates employee and customer loyalty and treats people with dignity.
1	Survival	Crisis manager: financial stability, organizational growth and employee health and safety. Shows calm in the face of chaos and determination amid danger.

Chart 5. Levels of leadership awareness and its characteristics
Source: elaborated by the authors (2020), based on Barrett (2010b).

Level 1 leaders are generally concerned with financial return and have a high capacity to manage budgets, take care of the health and safety of their employees, know how to deal with complex short and long term situations, and are concerned with the level of compliance of their management in complying with regulations and procedures. An-

other positive point is the organization's ability to deal with crises and financial survival. Leaders who have a survival profile are afraid to delegate and trust people and are often sabotaged by their own leadership style. They are greedy, lonely and this does not contribute to an efficient management, generating high entropy.

Relationship leadership is a manipulative profile, has low communication skills and does not avoid conflicts. They demand obedience in exchange for personal benefits and are generally paternalistic. They don't trust their team and doubt people's ability. According to Barrett (2010b), this profile holds a leadership position generally in family businesses. This could explain why respondents evaluate the communication capacity of leaders as follows: 96% consider them "low or intermediate" and only 4% agree that leaders have high communication capacity.

Strategy

In figure 11, which deals with organizational strategy, Q5, Mp=4.3 proves to be on the right track in the search for low entropy. Still the score of 13% in the level of entropy, shows that it needs an effort to align the strategies directed to the attack to the competition with the other stakeholders, such as employees and society, even if it is at the level of low entropy.
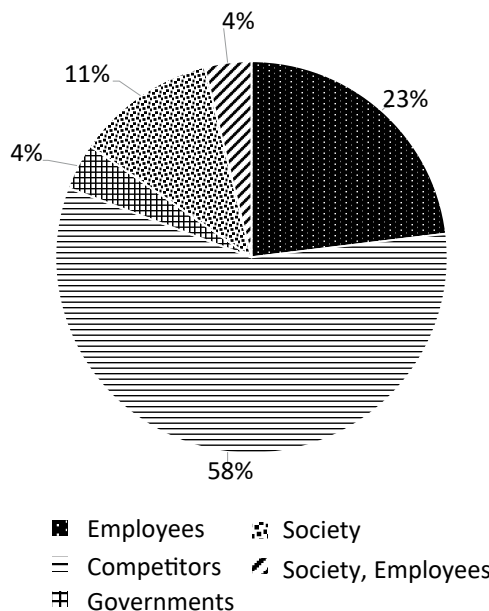
Level of stakeholder influence on strategy definition

Figure 11. Level of influence of stakeholders on the definition of the strategy
Source: elaborated by the authors (2020).

For Q5 (figure 11 and table 6), Mp=5.6 and an entropy score of 15.8% means a significant level of entropy and refers to the demand for improved communication with stakeholders, allowing them to know the company and its purpose.

According to the consultants, 58% of the companies are more influenced by the competition when defining their strategy and 23% are influenced by their employees.

From the perspective of entropy in strategy and management, organizations need the engagement of their leaders to define a coherent strategy with their exogenous interfaces. By defining a strategy that does not take into account the possible interpretations of the desires of all those involved, the ability to judge in the face of the complexity of the decision-making environment is impaired or restricted to a shallow approach, when it should be deep and comprehensive, because the relevant information and data that can indicate weaknesses may be at all levels of the organization (Ceptureanu et al., 2017; Bruyn, 2014).

When considering the priority given by organizations to risks and opportunities in decision-making (Figure 12 and question 6), 42% of respondents stated that organizations are not prepared to contemplate them. Furthermore, 27% consider them to be of medium priority and another 27% consider them to be of high priority, the latter being more focused on large corporations while 4% do not.

The definition of the organizational strategy must be thought out and structured based on the energy density surrounding the organization. Everything around it may interfere with the execution of this strategy, imposing a cor-

responding variation on the economic systems, as occurs in natural systems (Annila; Salthe, 2009). The organization's environment is the set of all factors or forces that act on it and that can impact the organization's performance or be impacted by it (Chun et al., 2013).

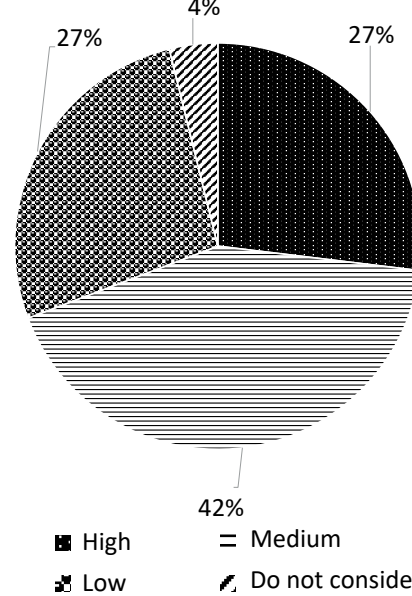

Priority in the assessment of risks and opportunities

High   Medium

Low   Do not consider

Figure 12. Priority given to risks and opportunities
Source: elaborated by the authors (2020).

According to Kümmel (2016), the appreciation of financial results by organizational leaders is undoubtedly what motivates the existence of organizations. However, it cannot be admitted that in the 21st century this is the only one, be-

Question	Society		Collaborators		Competition		Governments		"NGOs"		Mp= ∑wixi / ∑wi	∑WiXi	Nqo	Score % NEo	Score % NEo
	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi					
Q5	4	1	6	2	15	3	1	4	0	5	4,3	65,0	5,0	13	
Calculation	Mp=∑wixi / ∑wi =((1*4)+(2*6)+(3*15)+(4*1)+(5*0))/15=4,3														
	∑WiXi=(1*4)+(2*6)+(3*15)+(4*1)+(5*0)=65,0														
	Score % NEo=(∑WiXi/100)/Nqo=(65/100)/5=0,13=13%														
Question	Very High		High		Mean		Low		"Not considered		Mp= ∑wixi / ∑wi	∑WiXi	Nqo	Score % NEo	Score % NEo
	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi					
Q6	0	1	7	2	7	3	11	4	1	5	5,6	79,1	5,0	15,8	
Calculation	Mp=∑wixi / ∑wi =((1*0)+(2*1)+(3*12)+(4*13)+(5*0))/15=6,0														
	∑WiXi=(1*4)+(2*6)+(3*15)+(4*1)+(5*0)=79,1														
	Score % NEo=(∑WiXi/100)/Nqo=(79,1/100)/5=0,158=15,8%														

Chart 6. Stratification section Strategy - Questions Q5 and Q6
Source: elaborated by the authors (2020).

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cause no enterprise will survive without considering other elements that make up the existence of a business. Therefore, they must keep in mind the principle of sustainability when defining their strategies.

Organizational Culture

Diversity (Figure 13) in organizations is driven by several factors, according to respondents: 38% consider that companies promote investments in diversity due to legal requirements, 31% due to pressure from civil society, 23% to improve the image towards their clients and consumers, and only 8% consider investing in diversity, whether cultural, gender, social or of any nature as a competitive differential.
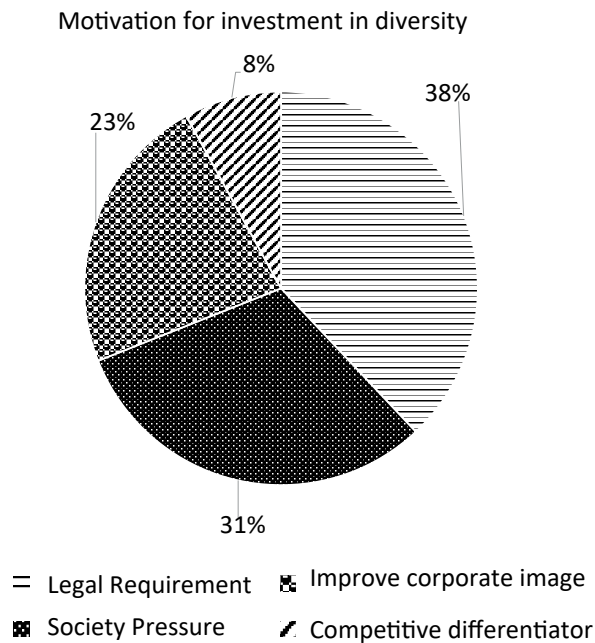

Motivation for investment in diversity

= Legal Requirement :: Improve corporate image

:: Society Pressure ⁄ Competitive differentiator

Figure 13. Motivation for investment and corporate diversity
Source: elaborated by the authors (2020).

The organizational culture is an intangible element and transforms itself over time, suffering the influence of factors often unknown to companies. The organization is a dynamic and living system and it needs to consider this fact within management. If there is a transformation into a variable within the system, the whole system will suffer less or more the impact of that event (Rădulescu, 2013).

When promoting actions to transform the organizational culture, the leaders need to understand the mistakes of the past, evaluate what is not working, and only after a careful analysis new changes should be promoted. Barrett (2010a) points out that three factors hinder culture change management: 1. focusing only on personal alignment; 2. giving attention only to the cohesion of groups; and 3. failing to customize transformation programs.

Some elements need to be considered by organizations to strengthen their culture and can be listed in steps as described in Chart 7.

Professionals who act in the position of managers cannot forget the role they represent within organizations. They must maintain higher standards when it comes to people. In the conception of Prahalad (2010), people seek justice, not favors. They want someone to listen to them, to care, to value the importance of loyalty to the organization, profession, community, society and, above all, family.

Actions directed towards social and environmental responsibility programs can reflect in a greater integration between the company, its employees and society, as well as improve the company's image. At the same time, it can raise the level of commitment to organizational values and culture of the organization, because according to chart 8, the level of Q7=8.2 and entropy above 24.6% reaches a serious level of entropy (21%-30%), putting the organization at high risk for decision making that can generate losses of human and financial capital.

With respect to Q8, Mp=5.9 indicates that it is closer to achieving an equilibrium level. However, improving the interface between the internal and external environment is necessary. The entropy of 17.8% reinforces the size of the effort to be detached in the search for a more assertive communication.

In the consultants' assessment of the level of stakeholder awareness (Figure 14), regarding the organizational context, objectives and goals are defined. Only 11% of respondents agree that stakeholders have satisfactory knowledge about the organization, both internally and externally, and the remaining 89% know that this level is between the low and medium level.

According to Ceptureanu et al. (2017), an organization without a systemic vision will not achieve corporate entrepreneurship. This is because, according to the authors, the beginning of everything is the knowledge of its operating environment, and therefore a consistent approach of the parties involved in its value chain, and cannot under any hypothesis ignore the variables of economic, managerial, demographic, cultural, scientific, psycho-sociological, and educational nature, which also include the elements of ecological, political and legal importance that constitute its organizational essence.

	Stages	Description
1	Leadership Commitment	The process of total system change begins with the personal commitment of the leader and the leadership team to their own personal transformation. This is necessary because the culture of the organization reflects leadership awareness. A cultural change initiative must be owned and supervised personally by the leader of an organization and fully supported by the leadership team. Cultural transformation is not something that can be delegated, nor can it be given to an external team of consultants. It is something that the organization must do for itself, and it is always in progress: it is not a project, it is a process! It's important for leaders to be aware that this can happen, and they must be willing to go forward for the good of the company.
2	Baseline Measurement	Once the leader and the leadership team are committed to the process, an assessment of the cultural values of the entire organization should be performed and, at the same time, a scorecard of current levels of organization performance, employee engagement, customer satisfaction, cultural entropy, value alignment, etc. should be built. The idea is to develop a set of baseline measurements from which the progress of cultural transformation can be measured.
3	Vision and Mission	After completing the baseline measurements, the next step is to define where the company is going and how to get there. It is time to develop an internal and external vision and mission for the organization. If the organization already has a vision and mission, it will be important to revisit it, especially if there are new people on the leadership team. Defining the vision is the job of the leadership team. This task cannot be delegated. Everyone should participate and give their contributions and comments; once the leadership team is comfortable with the vision of the statements, they have produced it should be validated and communicated.
4	Values and Behaviors	As part of the process of developing a vision and mission for the organization, it is also important to define the values and behaviors of the organization. The results of the evaluation of cultural values will be useful in this sense. As far as possible, all employees should be involved in this process. Values should have single words or short sentences that are easy to remember, should support the vision and mission, should include relationship values, as well as organizational values, i.e., trust and continuous improvement.
5	Convincing reasons for change	There must be a clear understanding among the executive level as to why the organization is embarking on a whole system change process. The process of change must be grounded and driven by the realistic optimism that provides hope for success to the population of employees and executives. In companies that suffer from low performance, the reasons for change must be convincing. For high-performance companies, the reasons for change must focus on three factors: how the company can remain adaptable; its positioning for the future; and building its long-term resilience.
6	Personal alignment	The personal alignment should start with the leadership team. To this end, it will be important for all the members of the leadership team to focus on their own personal domain, seeking feedback and, if necessary, receiving coaching (counseling). Once the leadership team has embarked on a process of personal mastery to improve its emotional intelligence it must share the knowledge acquired with other team members.
7	Structural alignment	The structural alignment program aims to reconfigure structures, systems, processes, policies, incentives, and procedures to reflect the organization's vision, mission, values, and desired behaviors, institutionalizing them in the organization's culture. In large organizations, structural alignment can take 2 to 3 years to implement. The responsibility for this usually falls on the Human Resources function. This step is one that is most often forgotten in cultural transformation initiatives.
8	Alignment of values	The purpose of the value alignment program is to instill the organization's adopted values and behaviors in the population of executives and employees. From the informative content, the program should give participants the opportunity to explore their own values and understand and practice the concept of value-based decision making. For example, if we value trust, then we make decisions that allow us to display trust. If we value responsibility, then we make decisions that allow us to display responsibility.
9	Mission alignment	The mission alignment program aims to disseminate the organization's vision and mission to the executive and employee population. Despite its informative content, the program should give participants the opportunity to explore their own sense of mission and vision and see how their role supports the organization's vision or mission. It vital that everyone in the organization has a clear vision between the work they do every day and the vision and/or mission of the organization. Without a clear line of sight, people are not able to value their contribution and understand how they make a difference.

Chart 7. Levels of leadership awareness and its characteristics

Source: elaborated by the authors (2020) based on Barrett (2010a).

Question	Value Generation		Competitive differential		Improve image		Pressure from Society		Legal requirement		Mp= ∑wixi / ∑wi ∑WiXi	Nqo	Score % NEo
	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi			
Q7	0	1	2	2	11	3	9	4	10	5	8,2	123,0	5,0	24,6
Calculation	Mp=∑wixi / ∑wi =((1*0)+(2*2)+(3*11)+(4*9)+(5*10))/15=8,2												
	∑WiXi=(1*0)+(2*2)+(3*11)+(4*9)+(5*10)=123,0												
	Score % NEo=(∑WiXi/100)/Nqo=(123/100)/5=0,246=24,6%												

Question	Very High		High		Mean		Low		"Not considered		Mp= ∑wixi / ∑wi	∑WiXi	Nqo	Score % NEo
	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi			
Q8	0	1	3	2	9	3	14	4	0	5	5,9	89,0	5,0	17,8
Calculation	Mp=∑wixi / ∑wi =((1*0)+(2*3)+(3*9)+(4*14)+(5*0))/15=5,9												
	∑WiXi=(1*0)+(2*3)+(3*9)+(4*14)+(5*0)=89,0												
	Score % NEo=(∑WiXi/100)/Nqo=(89/100)/5=0,178=17,8%												

Chart 8. Stratification section Organizational Culture - Q7 and Q8
Source: elaborated by the authors (2020)

Stakeholders' level of knowledge about organizations

11%

35%

54%
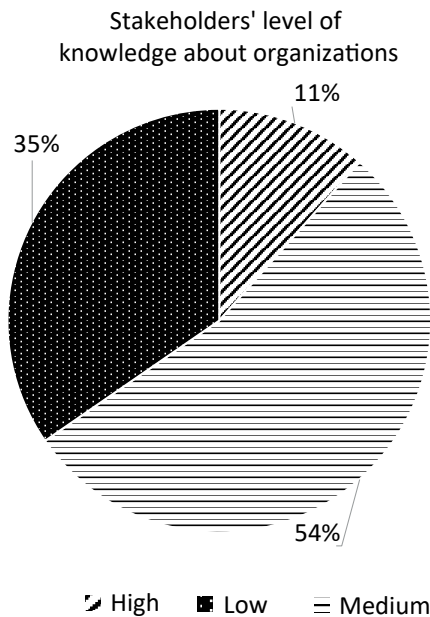
◪ High   ▦ Low   ═ Medium

Figure 14. Stakeholders' level of knowledge about organizations
Source: elaborated by the authors (2020).

The organizational structure formed by its tangible and intangible elements will remain unchanged until the increase of entropy changes its configurations, that is, the disorder. The influence that entropy exerts on the organization will generate critical instability, which may lead to the fragmentation of the system. However, everything can be corrected in time when there is proper monitoring and measurement of system performance, preventing a situation where the survival of the organization is put at risk (Stephen; Dixon, 2009).

Organizational entropy can erupt and affect your culture when abrupt changes in hierarchical levels occur. When the organization goes through a period of financial crisis generated by external factors, such as economy, government policies, among others, some command lines are moved or removed, or exponential numbers of layoffs occur, leading the organization in a forced manner to take rigid measures for financial balance. At this moment, entropy increases, and the closing of activities often occurs (Chappel; Dewey, 2015).

Operational Practices

Regarding the level of alignment between operational practices (Figure 15) and strategic planning in organizations, the majority of consultants (65%) agree that organizational practices do not reflect their strategic planning, and there is a great disparity between theory and daily practice. According to Hongkun et al. (2016), operational practices in organizations highlight the level of awareness, the efficiency of communication and valorization of the workforce. The survey also showed that 65% of the consultants classify the level of valorization of the participation of collaborators in the solutions of problems as "very bad or bad", 31% understand that it would be "good", and 4% "very good" (Figure 16).

According to Grecio (2016), by accepting the fact that energy conservation is important for the maintenance of functioning systems and that the energy of the universe is constant and transformed indefinitely, an analogy can be made with the energy that individuals release in operational practices within organizations.

As organizational practices are not aligned with the strategy defined as the path to follow, there is more and more distance between where the company wants to reach and

what effectively happens to sustain its mission. Thus, the energy available to manage the business, not directed, causes more energy to be undertaken and thus creates an environment conducive to fragmentation by the pressure exerted on the system (Vasconcelos et al., 2015).
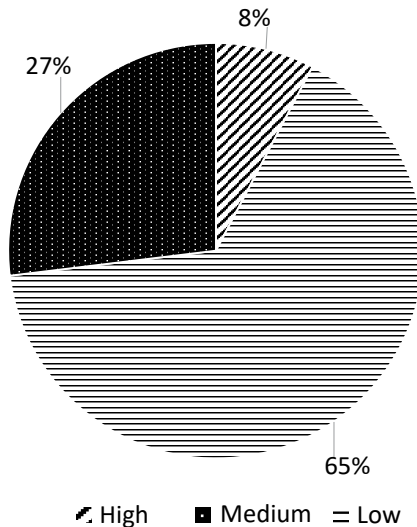

Figure 15. Level of alignment between operational practices and strategy
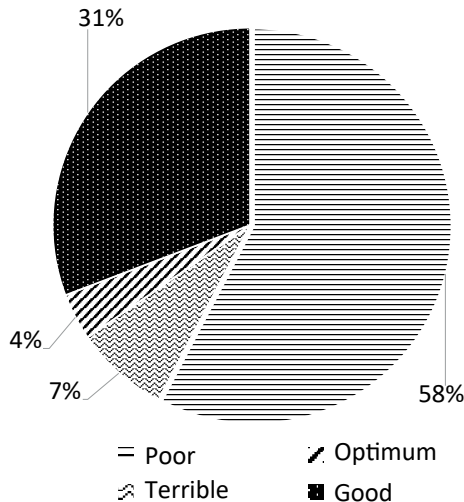Source: elaborated by the authors (2020).

Figure 16. Level of appreciation of employees in solving problems
Source: elaborated by the authors (2020).

Table 9 presents the results that deal with operational practices: Q9, Mp=6.2 and 18.6% entropy; Q10, Mp=6.4 and 19.2% entropy. They show that the organization is close to the significant energy level. This means that the organizational strategy is far from the organization's practices. In this

sense, alignment action is necessary, through training and workforce development.

Poor information and communication can also directly impact organizational performance, either positively or negatively. The gap between the organization's philosophy and how the workforce understands it needs to be reassessed in practice. Organizational climate surveys can indicate the factors that are impacting and directing more effective actions to correct possible deviations (Almeida-Santos et al., 2014; Johnson et al., 2013).

In analyzing the reasons why people work in organizations, a variety of reasons may arise and possibly will not be summarized in just one, but in several. For McAuley et al. (2013), the following can be enumerated: economic reward, individual satisfaction, affiliation to a social group, among others, which will vary according to individual values.

The research shows that organizations need to understand their workforce and give people a sense of belonging to the organization, and that for a business to have an effective management it is essential that it has enough competent professionals to manage people and not just numbers, giving due attention to the different aspects that raise employee morale and motivation (McAuley et al., 2013).

The disorder caused by entropy leads to a greater disorder and this can be observed in the value attributed to the recognition of employees. The greater the disorganization in the system, the less chance a leader has of acknowledging that his employees deserve some recognition, since his/her participation in management is lost in the midst of so much turbulence, although he/she can perform actions that could represent value to the organization (Ali et al., 2017; Bolisani; Bratianu, 2018).

An organization as an open system is thermodynamically possible, considering that the increase of order generates the reduction of entropy and may tend to a state of organization, passing from a lower level to a higher one, depending on the conditions of the system, and learning is the factor that leads to this condition. In this way, an analogy to the unbalance in business communication could be compensated by the valorization of knowledge.

5. CONCLUSIONS

The study proved that open systems, such as organizational systems, can reduce or increase entropy. The concept of entropy is in itself an indicator of the state of the system that is related to the state of different factors that interact with organizations, and the study demonstrates how entropy can be a measure of disorganization of the open system "enterprise organization".

Question	Very High		High		Moderate		Low		None or insignificant		Mp= ∑wixi / ∑wi	∑WiXi	Nqo	Score % NEo
	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi				
Q9	0	1	2	2	7	3	17	4	0	5	6,2	93,0	5,0	18,6
Calculation	Mp=∑wixi / ∑wi =((1*0)+(2*2)+(3*7)+(4*17)+(5*0))/15=6,2													
	∑WiXi=((1*0)+(2*2)+(3*7)+(4*17)+(5*0)=93,0													
	Score % NEo=(∑WiXi/100)/Nqo=(93/100)/5=0,186=18,6%													
Question	Excellent		Very Good		Good		Bad		Very Bad		Mp= ∑wixi / ∑wi	∑WiXi	Nqo	Score % NEo
	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi	Xi	Wi				
Q10	0	1	1	2	8	3	15	4	2	5	6,4	96,0	5,0	19,2
Calculation	Mp=∑wixi / ∑wi =((1*0)+(2*1)+(3*8)+(4*15)+(5*2))/15=6,4													
	∑WiXi=(1*0)+(2*1)+(3*8)+(4*15)+(5*2)=96,0													
	Score % NEo=(∑WiXi/100)/Nqo=(96/100)/5=0,192=19,2%													

Chart 9. Stratification section of Operational Practices - Q9 and Q10 Questions

Source: elaborated by the authors (2020).

Although there are different views in the literature on the application of the second law of thermodynamics in open human systems, there is evidence that such application may be feasible in terms of approaching this study in a qualitative manner.

The study confirmed that the understanding of how energy affects the organizational context is the essence of the management system, when through this understanding one can create mechanisms to face risks and take advantage of new opportunities, bringing balance to the organizational system.

Finally, a qualitative-quantitative evaluation method of organizational management, Neo method, was developed from the perspective of entropy, based on the qualitative principles of entropy. It can be concluded that the qualitative approach was based on the development of an evaluation method to raise the level of understanding of organizational management practices from the perspective of entropy in open systems.

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