

Strategic perspective of error management the role of leadership and an error management culture: a mediation model

Strategic
perspective of
error
management

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Abstract

Purpose – Errors are inevitable, resulting from the human condition itself, system failures and the interaction of both. It is essential to know how to deal with their occurrence, managing them. However, the negative tone associated with them makes it difficult for most organizations to talk about mistakes clearly and transparently, for fear of being harmed, preventing their detection, treatment and recovery. Consequently, errors are not managed, remaining accumulated in the system, turning into successive failures. Organizations need to recognize the inevitability of errors, making the system robust, through leadership and an organizational culture of error management. This study aims to understand the role of these influencing variables in an error management approach.

Design/methodology/approach – In this paper methodology of a quantitative nature based on a questionnaire survey that analyses error management, leadership and the organizational culture of error management of 380 workers in Portuguese companies.

Findings – The results demonstrate that leadership directly influences error management and indirectly through the organizational culture of error management, giving this last variable a mediating role.

Originality/value – The study covers companies from different sectors of activity on a topic that is little explored in Portugal, but part of the daily life of organizations, which should deserve greater attention from directors and managers, as they assume a privileged position to promote and develop error management mechanisms. Error management must be the daily work of leaders. This study contributes to theoretical knowledge and business practice on error management.

Keywords Error management, Leadership, Organizational culture error management

Paper type Research paper

1. Introduction

Errors are an inevitable part of all human activity and are prevalent in complex environments such as organizations, being impossible to eliminate them (Ramanujam and Goodman, 2003; Zhao and Olivera, 2006). Organizations have invested a lot in error prevention, implementing increasingly simpler systems and processes, easy to operate and maintain and ideally error-

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proof. However, these investments brought a reduction in errors in operations, but they also showed their limitations and the impossibility of eliminating all the errors that occur that can lead to negative results and too disturbing outcomes (Parry *et al.*, 2015).

The most common is that organizations depend only on error prevention as a way to avoid them, focussing on the idea that errors must be eliminated before they occur, trying to eradicate its presence through mechanisms (e.g. system engineering, human factors, security systems, among others), aimed at reducing the occurrence. However, the exclusive emphasis on error prevention has its limits, especially in the long term, in that it simply reduces the possibility of learning from them, and minimizes the possibility that some errors can result in long-term positive consequences (van Dyck *et al.*, 2005).

Error prevention is likely to lead to a culture of blame and punishment for the presence of errors, creating a strong tension caused by errors and, consequently generating harmful work behaviours of covering up errors, becoming a norm or rule. People, when working in error punishing cultures, develop a tendency to ignore and cover-up mistakes because the threats they face if they disclose them do not outweigh the benefits (Zhao and Olivera, 2006; Dimitrova *et al.*, 2017). Therefore, a pure and simple error prevention approach cannot adequately deal with the fact that errors are unavoidable. A second “line of defence” is needed by organizations – error management – an active approach to errors designed to control and reduce the negative consequences of errors, preventing recurrence (Guchait *et al.*, 2018) and increasing positive effects such as learning, creativity and innovation (Frese and Keith, 2015; Wang *et al.*, 2018; Dahlin *et al.*, 2018) and decreased turnover (Jung and Yoon, 2017). It is here that this study gains a strong justification, highlighting the importance of an error management approach in organizations, contributing to the knowledge and understanding of facilitating variables. Organizations that only emphasize the prevention of errors, do not accept errors and this has been a stance taken by a large number of companies, which shows failures and poor management (Love and Smith, 2016). Since errors are unpredictable, error prevention must be complemented by error management strategies (van Dyck *et al.*, 2005; Deng *et al.*, 2022; Matthews *et al.*, 2022). The purpose of this article is to understand the role of leadership and an organizational culture of error management in the effective use of an error management strategy in organizations, whose literature theoretically recognizes its importance, with the need for more empirical studies remaining (Gelfand *et al.*, 2011; van Dyck *et al.*, 2005; Cannon and Edmondson, 2005). Therefore, it is intended to answer the following research question: what is the role of leadership and an organizational culture of error management in an error management strategy in organizations? There are no known studies dealing with the influence of both variables in an approach to error management in an organizational environment, encompassing various sectors of activity, namely in Portugal. This study contributes to filling this gap in a topic so relevant to leaders and managers.

To that end, this article, after this introduction, presents a literature review on the strategic perspective of error management, the role of leadership and an organizational culture of error management as facilitating variables for error management. Then, the methodology is presented. In the results section, a statistical analysis is carried out, and in the discussion section the analysis is complemented by discussing the results taking into account the explained literature review, and the implications and suggestions for future investigations are presented. Finally, the conclusions are presented.

2. The strategic perspective of error management

Managing errors effectively is crucial to the success of any business (Guchait *et al.*, 2016; Deng *et al.*, 2022). By the way, the relationship between error management and organizational performance is well evidenced in the literature (van Dyck *et al.*, 2005; Gelfand *et al.*, 2011; Swanson and Hsu, 2011; Oliveira *et al.*, 2020).

Error management accepts errors as an intrinsic part of organizational life and is concerned with dissociating errors from their consequences (van Dyck *et al.*, 2005). Its focus is on the effective way to deal with errors after they occur, to minimize their negative consequences, such as scheduling delays, quality and production problems, and even low employee performance, among others (Homsma *et al.*, 2009; Swanson and Hsu, 2011), maximizing positive consequences such as learning, creativity and innovation (Frese and Keith, 2015; Wang *et al.*, 2018; Dahlin *et al.*, 2018), that positively contributes to organizational success in today's competitive and global market (Hernández and Galvis, 2021). Therefore, error management must be seen as a value creation process from the strategic point of view and organizational development that managers must adopt in conducting their companies; the faster they do it, the faster companies will produce better results (Oliveira *et al.*, 2020).

In organizations committed to managing errors, the main objective is not to prevent isolated errors, whether human or technological, but to make the system as robust as possible, to manage the errors that will undoubtedly happen. For this, it is essential to provide the necessary resources that make the system resilient, such as the existence of an organizational culture where communication and learning about errors are encouraged (Cusin and Goujon-Belghit, 2019). An effective error management climate promotes open communication and error sharing (Cigularov *et al.*, 2010; Koc, 2013) and encourages individuals to treat mistakes as normal, rather than something they can be blamed for (Gold *et al.*, 2013). It also encourages employees to report their mistakes (Gronewold *et al.*, 2013) and helps to quickly detect and handle errors (Frese and Keith, 2015).

Managing errors is, therefore, recognizing the inevitability of errors and adopting an organizational focus in their management, admitting greater tolerance to errors, enabling an understanding of their nature and the mechanisms behind them, improving detection of them and reducing the probability of them being repeated. It is a process comprising three main steps: error detection, explanation, handling and recovery. Error detection is essential for reducing negative results and error recovery. Once an error has been detected, it is important to explain why it occurred. Once an error is detected, it is important to recognize and explain what happened and why. Error explanation represents the second step of the error handling process (Kanse *et al.*, 2005) and it is important for learning from mistakes and for facilitating the final step, treatment and recovery, which may involve modifying an existing plan or developing a new one, to compensate for the error. Error handling or recovery aims to make it easier and faster to recover the state of the system when an error has been made (Keith and Frese, 2008).

In short, error management is a process that is concerned with increasing the speed at which errors are signalled and detected, to ensure that learning occurs (van Dyck *et al.*, 2005). Error management is possible through fast detection and damage control. Once an error is detected, it is necessary to act quickly and have the actions properly defined to manage it. As it is not possible to eradicate errors, a systemic focus on error management in organizations is important.

2.1 Error management facilitators

Error management is a difficult and complex process, particularly in today's dynamic organizational environment (Bauer and Mulder, 2013; Reason, 2000). Error management is influenced by several individual factors and the culture of organizations (Deng *et al.*, 2022; Matthews *et al.*, 2022). Thus, from the outset, an error management strategy will be facilitated, if it exists: (1) A general expectation that errors will occur; if individuals assume that errors do occur and this is accepted and natural thinking, then error management is facilitated because individuals are prepared to see errors when they do occur. If people do not recognize the possibility of errors occurring, then little effort will be made to identify whether an error has

occurred (Hofmann and Frese, 2011). (2) A positive and constructive view of mistakes; if there is a positive and constructive view of errors, accepting that they can be valuable for learning and to stimulate greater attention and adaptability to new situations, and if this is an organization's belief and value, then error management is facilitated because individuals in organizations are better equipped to detect and handle errors. An organization that promotes awareness of the occurrence of errors produces a high level of communication about errors, makes its members willing to learn from errors individually, makes them aware of possible error situations and appropriate reactions to them. On the contrary, if people are guilty, punished or if there are other negative reactions to the errors, it is likely that the error communication will be reduced, as in these cases, the most likely response to an error is not to report it, but to try to find other culprits (Cigularov *et al.*, 2010; Koc, 2013; Gold *et al.*, 2013; Gronewold *et al.*, 2013). As a result, the opportunities for detecting, learning and preventing the same error from being repeated in the future are reduced. The degree to which individuals have a positive and constructive view of mistakes makes them, in the organization; admit the mistakes they make, allowing them to be treated in search of their current or future benefits. These individual behaviours are also used to assess organizational culture (Akgün *et al.*, 2021) they portray an organizational culture that reveals some tolerance to error, that is, to make the system as tolerant as possible to error, insofar as its consequences are minimized. (3) Transparency of the organization's systems structures; the greater the degree of transparency of the organization's systems structures, the easier the error management becomes, that is, the more people know the situations in which they work and obtain feedback, the better understanding they have of the organization and, consequently, the more effectively will be able to handle errors. Thus, error management can be facilitated by the clarity of systems. (4) Organizational hierarchies. In organizational contexts, there is additional complexity due to hierarchies. All organizations are made up of people and depend on other organizations to get the resources they need. Likewise, all organizations at the various hierarchical levels that comprise them have leaders with the responsibility to help them achieve their goals. Leaders play an important role as they have a responsibility to monitor the progress of individuals and teams towards goals and provide the necessary feedback for error detection and management (Salas *et al.*, 2004).

The literature suggests that monitoring mutual performance is critical to reducing errors that can be catastrophic (Salas *et al.*, 2004; Wilson *et al.*, 2005) and those leaders can play an important role in significantly improving the process error management.

Given the above, it appears that for a strategic approach to error management, it is important to take into account, in addition to individual perceptions, the influences of the social context (of the system), that is, it is deduced that either the culture organizational, or leadership, can assume a marked relevance in the error management process in organizations, since leaders in companies influence behaviours (of their employees or teams) and cultural support models (Avolio and Gardner, 2005; Block, 2003; Schein, 2004; Bass and Avolio, 1994), for the implementation of processes that lead to the achievement of results.

3. The role of organizational culture in error management

The literature shows that all organizations have a culture that establishes a set of norms and values, as well as practices and procedures, which lead to behaviours shared by its members (Schein, 2004; House *et al.*, 2004; Panda, 2022). Organizational culture is the sum of all shared and correct certainties that a group has or will possess (learning) throughout its history. It is the set of implicit assumptions shared and taken as true by a group, which determine how that group perceives, thinks and reacts to its various environments (Schein, 2004). In this way, organizational culture can be conceived as a set of values and practices defined and

developed by the organization, based on which a system of beliefs, norms and expectations that shape the thinking and behaviour of individuals is socially constructed. It allows, therefore, to create a feeling of harmony in the members of an organization, as they all feel that they have the same generic set of values, sharing clear ideas about what behaviours are acceptable or unacceptable in the context of their company. It is, therefore, a set of characteristics that individualizes each organization and makes it unique compared to any other, and may vary substantially depending on the sector of activity, region, country or business strategy. The different aspects of the culture of organizations, due to their differences in values, beliefs, norms and strategic guidelines, can have different and significant implications in the error management process (Gelfand *et al.*, 2011; Göktürk *et al.*, 2017), insofar as this is an organizational process that does not try to end errors, but rather to deal with errors and their consequences after they occur, ensuring that errors are quickly reported and detected, that negative consequences are effectively minimized and treated, and that learning, creativity and innovation occur (van Dyck *et al.*, 2005; Frese and Keith, 2015; Wang *et al.*, 2018; Dahlin *et al.*, 2018).

According to van Dyck *et al.* (2005), organizations, more implicitly or explicitly, develop a culture of dealing with errors and this culture is different from organization to organization. Consequently, organizations develop a particular form of error culture – “error management culture” – a concept that applies to the idea of managing errors at the level of a unit (e.g. organization). The same authors argue that a strong organizational culture at the level of norms and common practices of communication about errors, detection, analysis and rapid correction of errors is essential to reduce negative consequences and promote positive consequences of errors. They suggest that organizations should promote and develop a culture of error management as a performance-boosting measure. In their study, they validated that a positive error management culture is related to success, leading to beneficial organizational results, such as performance and innovation. Too Rochlin (1999) states that there must be an organizational focus (shared) that does not blame the error so that it can be reported. An organizational culture of error management is compatible with a general awareness of errors, that is, assuming the inevitability of errors (Ramanujam and Goodman, 2003), which increases the probability of detecting errors and prepares the organization for their treatment. As such, an organizational culture that is aware of errors supports error handling. For this purpose, an environment of safety and reliability in the interaction between the parties, (actions of individual workers) based on the social structure, beliefs, rituals and myths of the entire organization, is required (Cusin and Goujon-Belghit, 2019).

Edmondson (2004) and Rochlin (1999) argue that there is a cultural dimension to how organizations deal with mistakes. In this sense, an error management culture can be of central importance for companies considering following an error management strategy (Wang *et al.*, 2018, 2020; Deng *et al.*, 2022; Panda, 2022).

Thus, analysing the influence of the organization’s culture, that is, the behaviours, attitudes and beliefs of its members regarding the way they deal with day-to-day errors in the performance of their functions, as the objective of this empirical study, assumes that is extremely important for error management, so the following research hypothesis is formulated:

H1. An organizational culture of error management positively influences error management.

4. The role of leadership in error management

The new theories of leadership that have been developed in recent years play an important role in understanding how leaders motivate to perform better. However, surprisingly little attention has been paid to error management in organizations. Several authors have drawn attention to

the need to review contemporary theories of leadership, so that they address error management and its practices, such as detecting, treating, sharing and learning from mistakes (Judge *et al.*, 2008; Bass and Avolio, 1994). In general, existing theories and research highlight those organizational contexts are characterized by hierarchical levels, where leaders assume particular importance, being key players and the main actors who, through their actions, decisions and provision of feedback, can encourage members of their teams to adopt productive attitudes and behaviours in the face of error (Cannon and Edmondson, 2005; Salas *et al.*, 2004). They may frame mistakes as learning opportunities rather than something to hide or punish (Rodriguez and Griffin, 2009; Nielsen *et al.*, 2013; Deng *et al.*, 2022; Dimitrova *et al.*, 2017).

According to Edmondson (2004), error detection rates are strongly and positively associated with high levels of “leader coach”, which suggests that certain leaders establish a climate of openness that facilitates reporting and discussing errors. Too authentic leadership, in the study by Farnese *et al.* (2019), was positively related to reducing the existence of errors, promoting a work environment oriented toward error management and learning (Nielsen *et al.*, 2013; Farnese *et al.*, 2019).

In addition to shaping learning, leaders need to train their subordinates to a constructive view of mistakes and a general expectation that mistakes will occur, so that they recognize them and focus efforts to detect them. Leadership is a relationship founded on credibility and trust. Without these two factors, people do not take risks and, without taking risks, there is no change or evolution and companies perish (Kouzes and Posner, 2003). So, a fundamental requirement for error management is that organizations have leaders who accept errors as an intrinsic characteristic of the organization, which although not desirable, can appear at any time, and despite having negative consequences, it can also produce positive results.

Error management converges to situate leaders as central figures, who through their actions and attitudes can reverse, or at least reduce, the negativity conveyed by errors (Maurer *et al.*, 2017; Farnese *et al.*, 2019). Leaders are, thus, in a favourable position for the dissemination of error management because, in the first place, it is the leaders who must favour and facilitate processes of quick and open error communication along with the various hierarchical levels of organizations. Second, to effectively address errors, leaders must be close to the source of error, which requires them to set clear objectives and incorporate a strong and compelling vision of error responses in them. If leaders act in this way at the hierarchical level of organizations, the error management process will be facilitated and significantly improved. Based on the explained arguments a second research hypothesis is stated:

H2. Leadership positively influences error management.

5. Organizational culture of error management versus leadership

From the foregoing analysis, it can be deduced that there is an interrelationship between organizational culture and leadership. According to Schein (2004), culture and leadership are two sides of the same coin, as leaders create cultures when they create groups and organizations. Leadership can influence the nature of organizational culture is a well-known assumption and evidenced in the literature (Avolio and Gardner, 2005; Block, 2003). Leaders in organizations become key elements for the dissemination/modification of culture, being the transmitting and stimulating centre of values, attitudes, beliefs and other elements that define the organization’s culture. It is the leaders who create mechanisms for the development of the culture and the characteristics and qualities of that culture are operationalized and taught by them to their followers (Block, 2003; Bass and Avolio, 1994). Consequently, it is up to the organization’s leadership to perceive the dysfunctional elements of the organization’s culture and manage the shift to a culture prepared for the general expectation that mistakes will inevitably occur and to build a positive view of them. In organizations, beliefs about mistakes

need to be not only captured in formal and documented organizational policies (e.g. vision) but also reflected in the daily activities and procedures whose role of the leader is fundamental for the purpose.

Cannon and Edmondson (2005), found a positive relationship between leadership and orientation towards learning through mistakes and, as a result, left open the importance of attesting to the role of team leaders in a clear alignment of developing constructive beliefs and behaviours about the error.

Given the arguments explained, leaders can take a catalytic role and implement practices and procedures for an error management approach. It is expected that it is the leaders who indoctrinate and do, make act and change behaviours and attitudes leading to error management in organizations. Due to the background of the literature, research hypothesis three is formulated:

H3. Leadership positively influences an organizational culture of error management.

6. Methodology

6.1 Conceptual framework

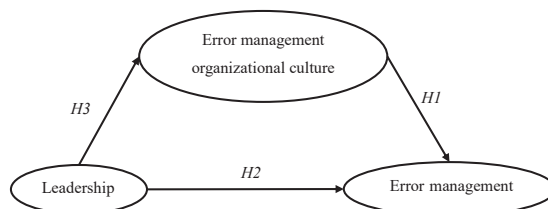
Figure 1, shows the conceptual model, being considered a mediation model, where the independent variable (Leadership) causes the mediating variable (Organizational culture of error management) and this one, for its instead, conveys the effect of an independent variable on the dependent one (Error management).

6.2 Research design

6.2.1 Type of investigation. The present study is non-experimental, cross-sectional and quantitative. The study was carried out in the form of a questionnaire survey to assess the perspective of respondents regarding their attitude and behaviour towards practices and procedures that promote error management.

6.2.2 Population and sample. The target population of this study are Portuguese over 18 years old who are working in Portuguese companies in different sectors of activity. After eliminating some incomplete questionnaires, the sample consisted of 380.

6.2.3 Sampling technique. The convenience sampling technique was used which is non-probabilistic workers were selected because they have characteristics that are consistent with the objectives of the investigation. With this sampling technique, respondents are chosen according to a certain criterion of convenience, for example, their immediate availability and knowledge of the subject under study, as well as the associated low cost. In this way, the inclusion of employees from companies from the various activity sectors under study, with characteristics such as functions, level of academic qualifications and knowledge of the organization in terms of organizational culture and leadership to ensure obtaining the set of information that would allow the achievement of the study objectives.



Source(s): Own Elaboration

Figure 1.
Conceptual model

6.2.4 Instruments. The questionnaire comprises four parts. The first part assesses leadership, the second analyses the organizational culture of error management, the third analyses error management and the fourth part characterizes the respondents in terms of socio-demographic and professional data (gender, age, educational qualifications, seniority, hierarchical position, sectors of activity and size of the organization).

To assess error management, 7 items (Table 1) were used, leadership was measured using 9 items (Table 2) and the organizational culture of error management was assessed using 7 items (Table 3), from the study by Oliveira *et al.* (2020). To measure the items under study, a 5-point Likert frequency scale was used (1- *Never* to 5- *Always*).

Table 1.
Descriptive analysis of
error management

	<i>M</i>	<i>SD</i>	<i>Sk</i>	<i>Ku</i>
EM1- I feel that mistakes provide me with useful information and important lessons to improve my work	4.28	0.79	-0.86	0.46
EM2- In the performance of my work I constantly try to detect my mistakes	4.38	0.74	-1.09	1.05
EM3- When I make a mistake, I immediately try to correct it	4.69	0.59	-1.88	3.13
EM4- When I make a mistake at work, I share it with my colleagues so they don't make the same mistake	3.99	0.84	-0.67	0.52
EM5- I feel that mistakes help me to evolve	4.08	0.90	-0.86	0.57
EM6- I constantly try to avoid mistakes that will occur in my work	4.47	0.73	-1.27	1.28
EM7- When I make a mistake, I analyse it minutely	4.15	0.82	-0.68	0.10

Source(s): Own Elaboration

Table 2.
Descriptive analysis of
leadership

	<i>M</i>	<i>SD</i>	<i>Sk</i>	<i>Ku</i>
L1- My supervisor recognizes the errors	3.35	0.89	0.28	-0.42
L2- When I make a mistake, I reveal it to my boss, as I have total openness to talk to him about the mistakes	4.43	0.77	-1.37	1.87
L3- My supervisor encourages learning through the mistakes that are made so that they don't happen again	3.74	1.05	-0.35	-0.79
L4- My supervisor helps me to detect my mistakes	3.50	0.94	-0.19	-0.41
L5- My supervisor assumes the errors with me and helps me to correct them	3.83	1.00	-0.50	-0.54
L6- My boss encourages me to share my mistakes	3.31	1.15	-0.16	-0.69
L7- I have constructive feedback from my supervisor on the mistakes I make	3.58	1.02	-0.24	-0.70
L8- In my company, supervisors try to prevent mistakes from being made	3.78	0.98	-0.36	-0.57
L9- My supervisor helps me to analyse the mistakes I make	3.47	0.99	-0.15	-0.59

Source(s): Own Elaboration

Table 3.
Descriptive analyses of
the error management
organizational culture

	<i>M</i>	<i>SD</i>	<i>Sk</i>	<i>Ku</i>
C1- In my company, there is a general concern with learning about the mistakes made	3.52	1.08	-0.13	-0.91
C2- In my company, there is a general concern to detect errors that occur	3.56	0.96	-0.05	-0.78
C3- In my company, there is a general concern with correcting errors	3.68	0.98	-0.12	-0.89
C4- In my company, mistakes are seen as an opportunity for improvement	3.42	1.02	-0.14	-0.65
C5- In my company, the prevention of errors is encouraged with constant guidelines	3.12	1.00	0.02	-0.59
C6 - My company promotes the analysis of errors that occur	3.08	0.92	0.23	-0.25
C7- In my company, people talk openly about the mistakes that are made	3.48	0.99	-0.08	-0.70

Source(s): Own Elaboration

6.2.5 Data collection and ethical procedures. The data collection process was carried out using Google Forms, which supported the creation of the questionnaire. Data collection took place between April and June 2019, covering 64 Portuguese companies from eight sectors of activity. The companies that agreed to participate in the study sent an email to their workers, which stated the objectives of the study, and it was also ensured that the filling in of the questionnaires would be anonymous and confidential, as well as the processing of data, to preserve the identity of each respondent.

6.3 Analytical procedure/technics

After data collection, a database was built using the IBM Statistical Package for Social Sciences Statistics 26 software, and to carry out the characterization of the sample and the descriptive analysis of the variables, descriptive statistics were used. According to Kline (2016), we also analysed the existence of missing cases, outliers and the sensitivity of the items (asymmetry coefficients ($|Sk| \leq 3$) and flatness ($|Ku| \leq 7$)).

To analyse the causal relationships between the variables, the analysis of structural equations was applied. This technique consists of analysing two models: the measurement model and the structural model (Marôco, 2014). To analyse the measurement model, we started by applying an exploratory factor analysis (EFA) using the principal components method to extract the factors and the Kaiser criterion to measure the minimum number of factors to retain (eigenvalues greater than 1). To verify the adequacy of the application of EFA to the sample, we use the index of Kaiser-Meyer-Olkin ($KMO > 0.7$ reveals the acceptable suitability of the sample) and the test ($p < 0.05$) of sphericity of Bartlett (Hair *et al.*, 2014).

In the confirmatory factor analysis (CFA), the adequacy of the structure that emerged from the EFA was tested. To this end, the maximum likelihood estimation method (implemented in the AMOS (Analysis of a Moment Structures) software) was used and the following goodness-of-fit indices were used: the ratio of the Chi-square statistics to the degrees of freedom (χ^2/df) less than 3 (Kline, 2016), goodness of fit index (GFI) and comparative fit index (CFI) superior than 0.90 are indicators of a good fit (Hair *et al.*, 2014), root mean square error of approximation (RMSEA) is considered good in the range [0.05, 0.08] (Arbuckle, 2014).

The reliability of the variables under study was assessed using Cronbach's alpha and composite reliability, according to Hair *et al.* (2014), these indicators are considered adequate if they present values greater than 0.7. When analysing convergent validity, the average variance extracted (AVE), must have values greater than 0.5 and when analysing discriminant validity, the square of the correlation between the variables must be lower than the value of AVE (Hair *et al.*, 2014).

In the structural model, causal relationships are analysed, that is, the hypotheses under study are tested and the percentage of variance explained by the dependent variables in the structure model is analysed using the coefficient of determination (R^2). The significance of the direct, indirect and total effects of the mediation model was evaluated with the test of Sobel (Marôco, 2014).

7. Results

7.1 Sample characterization

The sample is composed of 380 individuals, the majority being men (71.3%, $n = 271$) and 54.5% ($n = 207$) of the respondents are 40 years old or younger. With regard to education, most have higher education qualifications (53.5%, $n = 203$). In terms of seniority in the organization, most individuals have worked in the organization for more than 5 years (82.3%, $n = 313$). Regarding the hierarchical position within the organization, the majority of respondents (77.1%, $n = 291$) occupy the position of middle managers/technical staff, 18.7% ($n = 71$) occupy management positions and 4.2% ($n = 16$) occupy administrator/manager positions. Regarding company size, it appears 48.2% ($n = 183$) of individuals perform

functions in large companies, 26.3% ($n = 100$) in medium-sized companies, 16.3% ($n = 62$) in companies small scale and 9.2% ($n = 35$) in micro-enterprises.

Finally, with regard to activity sectors, 54.5% ($n = 207$) of respondents belong to the construction area, 16.6% ($n = 63$) to the automotive area, 12.6% ($n = 48$) to the services area, 7.1% ($n = 27$) to the hotel and tourism area, 4.2% ($n = 16$) to the industry area, 2.4% ($n = 9$) to the environment and energy area, 1.8% ($n = 7$) to the communication area and 0.8% ($n = 3$) to the real estate area.

7.2 Descriptive analysis of constructs

Table 1 shows that individuals tend to manage errors in organizations (the mean frequency values of all items have values well above the midpoint 3, on a scale from 1 to 5), although there are negatively skewed distributions for all items, which means that there are still some individuals with low-frequency levels. Thus, it is noteworthy that when individuals make a mistake, they seek to correct it immediately ($M = 4.69$, Standard deviation (SD) = 0.59), try to avoid mistakes that will occur in their work ($M = 4.47$, $SD = 0.73$), and when they perform the functions in their work, they constantly seek to detect the mistakes they make ($M = 4.38$, $SD = 0.74$).

About leadership (Table 2), individuals attribute a higher frequency level to the item “when I make a mistake I reveal it to my boss, as I am completely open to talk to him about the mistakes” ($M = 4.43$, $SD = 0.77$) and lower to the item “my boss recognizes the errors” ($M = 3.35$, $SD = 0.89$).

Table 3 shows that there is a general concern to correct errors ($M = 3.68$, $SD = 0.98$), to detect errors that occur ($M = 3.56$, $SD = 0.96$) and to learn about the mistakes made ($M = 3.52$, $SD = 1.08$).

7.3 Measurement model

The KMO measure and Bartlett sphericity test revealed good adequacy of the sample for each of the variables under study, after eliminating the items EM1, EM4, EM5, L1, L2 and L8, for presenting values in the communalities below 0.5 (Error management: $\chi^2(6) = 444.34$, $p < 0.001$, KMO = 0.78; Leadership: $\chi^2(15) = 1453.64$, $p < 0.001$, KMO = 0.90; Error management organizational culture: $\chi^2(21) = 1384.94$, $p < 0.001$, KMO = 0.91). The EFA showed that the three variables under study have a one-dimensional structure. Then, the CFA after the elimination of item C6 (the residue of item C6 had a strong correlation with the residue of item L9), the adjustment indices of the model revealed a good fit quality ($\chi^2 = 277.477$, $df = 97$, $\chi^2/df = 2.861$, GFI = 0.917, CFI = 0.948, RMSEA = 0.070) according to Arbuckle (2014), Hair et al. (2014) and Kline (2016). Table 4 show that the loadings vary from 0.655 to 0.853 ($\lambda \geq 0.5$) and individual reliabilities vary from 0.429 to 0.728 ($R^2 \geq 0.25$). Cronbach's alpha and composite reliability values are greater than 0.79, which is considered acceptable (Hair et al., 2014). The AVE values of the leadership and organizational culture of error management constructs are greater than 0.5 and the error management construct presents a value that is within the acceptability limit, which is an indicator of adequate convergent validity (Hair et al., 2014).

The correlations between the three constructs are positive and significant (Table 5), with the highest correlation between the leadership and the organizational culture of error management constructs ($r = 0.74$). The AVE values of the constructs are greater than the square of the correlation between the constructs, so there is evidence of discriminant validity (Hair et al., 2014).

7.4 Structural model

Leadership and the error management organizational culture explain 39% of the variability of error management and leadership explains 55% of the variability of the error management

Constructs	Items	Loadings	R ²	Cronbach's alpha	Reliability composite	AVE	Strategic perspective of error management
Error management	EM7	0.742	0.551	0.79	0.80	0.50	
	EM6	0.727	0.529				
	EM3	0.693	0.480				
	EM2	0.655	0.429				
Leadership	L3	0.853	0.728	0.91	0.90	0.61	
	L7	0.789	0.623				
	L9	0.779	0.607				
	L5	0.775	0.601				
	L6	0.773	0.598				
	L4	0.713	0.508				
Error management organizational culture	C1	0.814	0.663	0.89	0.88	0.56	
	C3	0.788	0.621				
	C7	0.759	0.576				
	C2	0.758	0.575				
	C4	0.678	0.460				
	C5	0.674	0.454				

Source(s): Own Elaboration

Table 4. Reliability and confirmatory analysis of the model

	EM	Le	EMOC
EM	0.50 ^a	0.35	0.31
Le	0.59 ^{***}	0.61 ^a	0.55
EMOC	0.56 ^{***}	0.74 ^{***}	0.56 ³

Note(s): Legend: ^{***} $p < 0.001$, ^a Diagonal elements are values of the AVE. Below the diagonal are the correlation coefficients. Above the diagonal are the squared correlation coefficients

EM: Error Management, Le: Leadership; EMOC: Error Management organizational culture

Source(s): Own Elaboration

Table 5. Analysis of correlations between constructs

organizational culture. The empirical results (Table 6) show that the organizational culture of error management positively and significantly influences error management ($\beta = 0.27$, $p < 0.01$), which empirically supports hypothesis 1.

Regarding hypothesis 2, this is empirically supported, as leadership positively and significantly influences error management ($\beta = 0.39$, $p < 0.001$).

There is sufficient statistical evidence to affirm that leadership positively and significantly influences the organizational culture of error management ($\beta = 0.74$, $p < 0.001$), which empirically supports hypothesis 3.

	Hypothesized path	β	Z	Results
H1	EMOC → EM	0.27	3.11 ^{**}	Supported
H2	Le → EM	0.39	4.36 ^{***}	Supported
H3	Le → EMOC	0.74	12.50 ^{***}	Supported

Note(s): ^{**} $p < 0.01$, ^{***} $p < 0.001$

EM: Error Management, Le: Leadership; EMOC: Error Management organizational culture

Source(s): Own Elaboration

Table 6. Structural model analysis results

Leadership had a total effect of 0.593 on error management, with a direct effect of 0.390 and an indirect effect, mediated by the organizational culture of error management, of 0.203. The indirect effect, mediated by the organizational culture of error management, corresponds to 34.23% of the total effect of leadership on error management. Through the application of the Sobel test, it was concluded that the mediation effect of the organizational culture of error management related to the effect of leadership on error management is statistically significant ($Z = 3.029, p < 0.01$). Thus, it is concluded that although leadership directly influences error management, leadership also indirectly influences error management, through the organizational culture of error management, whereby the organizational culture of error management assumes the role of mediating variable.

8. Discussion

The foregoing results allow us to state that both the organizational culture of error management and leadership influence how errors are managed in organizations. Culture takes on a deep meaning for error management in organizations (Reason, 2000) and can act as an influencing variable (van Dyck *et al.*, 2005). Different aspects of organizational culture can have significant implications for the error management process (Gelfand *et al.*, 2011; Göktürk *et al.*, 2017; Wang *et al.*, 2020; Panda, 2022; Deng *et al.*, 2022; Matthews *et al.*, 2022). Thus, an error management approach will be easier if there is a strong organizational culture with practices, procedures, norms and values conducive to error management. Allied to culture, the greater the focus of leaders on the dissemination of behaviours, among their subordinates, leading to error management, the more effective error management will be. This result corroborates the fact that leaders are the fundamental actors in organizations who, through their actions, decisions and provision of feedback, can encourage their team members to adopt productive attitudes and behaviours in the face of error (Cannon and Edmondson, 2005; Salas *et al.*, 2004; Maurer *et al.*, 2017; Farnese *et al.*, 2019). They may frame mistakes as learning opportunities rather than something to hide or punish (Rodriguez and Griffin, 2009; Deng *et al.*, 2022; Nielsen *et al.*, 2013; Dimitrova *et al.*, 2017).

There is enough statistical evidence to affirm that leadership positively and significantly influences the organizational culture of error management. These results corroborate the literature, whose leaders play an important role in the creation and development of culture, occupying a privileged position in organizations to promote and increase mechanisms and behaviours conducive to error management (Avolio and Gardner, 2005; Block, 2003; Bass and Avolio, 1994; Schein, 2004). The results of this investigation clearly show that error management should be a daily work of leaders. Leadership is the most significant variable for the model, causing greater variability in error management, which is why it is fundamental. This is an important contribution of this study that corroborates the attention of several authors in the literature (Judge *et al.*, 2008; Bass and Avolio, 1994) to the need to review contemporary theories of leadership, so that they address error management and their practices, such as detecting, processing, sharing and learning from errors. It is important to emphasize that, in the face of constant change processes, which are imposed on organizations in a global market, where errors are inevitable, an error management approach at the corporate level must be considered and faced as a value creation process from a strategic and organizational development point of view. This is an objective practical implication of this study.

Given the above, the aim is to have contributed to boosting future research in this field, especially in the Portuguese business context, since, so far, empirical studies involving the variables proposed here and the relationships established between them are unknown, which confers some peculiarity to this study. This study contributes to theoretical knowledge of error management and business practice on strategic error management, as a management tool for leaders and managers.

The need for future studies is justified for the expansion of knowledge and improvement in this field of study; namely, it would be interesting to know the type of organizational culture most suited to an error management approach. Study the various styles of leadership, to verify which one is best suited to an error management approach, allowing for a direct relationship to be established between the leadership style and the way to manage errors. In this line of thought, a comparison between several countries with similar organizational cultures will bring much knowledge to research in this area.

Since the phenomenon of errors may not be immediate, a longitudinal study aiming to investigate the relationships in a temporal sequence between the organizational culture variables of error management, leadership and error management may be useful to understand and assess change and the development of the phenomenon under analysis.

9. Conclusion

The objective of this investigation was to understand the role of leadership and an organizational culture of error management, in the use of an error management strategy in organizations, in the Portuguese business context. For this purpose, a cross-sectional, quantitative study was carried out, covering several companies from various sectors of activity, allowing the assessment of the representative perspective of 380 respondents regarding their attitude and behaviour towards the practices and procedures that promote error management.

The empirical results show that leadership directly influences error management and indirectly through the organizational culture of error management, giving this last variable a mediating role, thus confirming the study hypotheses formulated.

These results are interesting because they allow shedding new light on the practice of a strategic error management approach in organizations, providing details of the influences of the variables under study. In addition to theoretical contributions, the data obtained make clear practical contributions to the management of organizations: the more focused leaders are on developing common practices, standards and procedures for error management, the stronger the organizational culture of error management. Error management assumes an essential dimension in the leader's role. Error management must be part of the leader's functions, as with other skills classically assigned to leaders.

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