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Doctoral Dissertation

**“FROM THE ERROR AS A NEGATIVE EVENT  
TO THE ERROR AS AN ORGANIZATIONAL LEARNING SYSTEM  
IN COMPLEX ORGANIZATIONS”**

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## Abstract

The current thesis intends to deepen the role of errors in the organizational field, viewed as an informational feedback which can contribute to the improvement of performance, to the effective managing of the negative consequences of errors and highlighting new ways to organize and realize the work. The current dissertation tests this new conceptualization of error in the organizational settings, especially in the complex organizations.

The first study, carried out on cross cultural Italian sample, explored the validity of the *Error Culture* scale. Results confirmed the validity, uniqueness, and generalizability of the EC scale and its influence on several outcomes, namely organizational performance, innovativeness, errors made.

The second study, conducted among hospital workers, tested an overall model including antecedents (trustworthiness) and a series of outcomes (organizational performance, innovativeness, errors made). The tested model confirmed the influence of trustworthiness on the error culture and the mediating role of error culture dimensions on the outcomes.

The third study, among the safety and professional staff of the Italian civil aviation authority, deepened the error aversion culture model in a high complexity organization, enriching it with the inclusion of the leadership variables in the error aversion reduction. Results confirmed the hypothesized model regarding the influence of leadership styles and organizational culture dimensions on the aversion approach to individual errors.

Practical implications and suggestions for future research are discussed for each of the three studies here presented.

# CHAPTER 1

## Introduction

In the organizational contexts, errors are even more used as feedback useful to improve performance, managing in a more effective way the consequences of errors, recognizing new manners for organizing productive processes. According to the *error management* perspective (cfr. Frese, Brodbeck, Heinbokel, Mooser, Schleiffenbaum, Thieman, 1991; Hofmann & Frese, 2011; van Dyck, Frese, Baer, Sonnentag, 2005), organizations with a cultural orientation to the management of errors have a wider capacity to catch, analyze, share and reflect on errors, facilitating the organizational learning and, at the end, the organizational success.

Following this theoretical assumption, we consider the human error as a systemic, contextual and cultural component of the organizations, as well as a negative feedback and, consequently, a potential source of learning and organizational “positivity”.

The three studies here presented intended to analyze the cultural orientation toward errors (Hofstede, 1991), as well as the antecedents factors and the possible outcomes, in several context joint by a similar level of high complexity, and also known as *High Reliability Organizations* or HRO (Weick, Sutcliffe, 2007).

For decades, errors have been considered only like negative events to be avoided and prevented, caused only by “wrong” behaviours of individuals.

Only psychoanalysis (Freud, 2012), even if considering errors from an individualist point of view, treated them like something to be understood, in other words like a signal or a symptom of the functioning of human mind. Similarly, in more recent years, errors are more and more considered like a signal, a “symptom” of the organizational functioning, so they are assumed to be an important source of information. Errors become one of the possible answers

of a system to a series of stimuli, situations, events and behaviours, with a meaning, more or less implicit, which need to be explored and understood.

The *Error Management* (EM) approach (Frese et al., 1991; Hofmann, Frese, 2011; van Dyck et al., 2005) explores the implicit, less evident and immediate dimensions of errors, making a distinction between errors and the consequences coming out from them. Furthermore, the EM approach suggests that not just individuals, or groups, are the causes and are responsible for the errors committed, but the organizational level, to be intended like a complex system within all the level involved must be considered at the same time (Reason, 1995, 2000): individuals, relationships, role systems, cultural assumptions and values, the socio-economic environment and so on.

The basic assumption of the Error Management approach is that it's impossible to completely avoid that errors occur, so it's not realistic pursuing this scope. Every system does make errors, so it should be better to ask the question about what to do of the errors made and how to use them for the organizational development (Frese et al. 1991; Keith, Frese, 1995).

Nonetheless, also the prevention approach should to be used, but not alone: the two approaches, the error prevention and the error management approach, are necessary to cope with and managing the errors and their consequences. The error prevention approach focuses on the avoidance of the negative consequences of errors, preventing the errors from happening; in addition to this, the error management approach emphasizes the mitigations of the negative consequences, also catching and developing the positive consequences of errors. The more the sense and meaning of errors are captured, the more they will produce positive results, improving the organizational learning, the orientation to innovation, the resilience of the entire system (Hollnagel, Woods, Leveson, 2006), promoting high performance and the suc-

cess of the whole organization (McCann, Selsky, Lee, 2009; Sitkin, 1992; Sitkin, Sutcliffe, Schroeder 1994).

For these reasons, the *High Reliability Organizations* (HRO) (Weick, 1991; Weick, Sutcliffe, 2007) are deeply involved in the error management approach, because they are confronted with a high degree of uncertainty, due to inner high complexity (i.e. technological, process based, know-how based) as well as high variability of the external demands, market needs, environmental constraints.

HRO are complex organizations, where skills needed for pursuing the productive processes are at a very high level. These characteristics on one hand increase the probability to commit errors, and on the other hand increase the potential gravity of the effects of the errors. Examples of such systems are the nuclear plants, the aeronautical organizations, the sanitary context; in these contexts, the error e its consequences could be separate in time, and the effects of the errors often are dramatic and catastrophic (Helmreich, Musson, Sexton, 2001; Hunt, Callaghan, 2008).

During the years, research studies as well as the “on field” accident investigation on occurrences happened showed that in the high complexity contexts or HRO, the even more increasing complexity of these systems (i.e. the technological complexity) was so huge and nonetheless errors and accidents continue to happen, to demonstrate that a simple individualist approach blaming the “end operator” was deeply wrong and ineffective, as well as the belief to be able to capture and avoid the totality of potential errors and risky behaviours (Cati-no, Tartaglia, 2005; Helmreich, Merrit, 1998; Helmreich, Wilhelm, Klinec, & Merritt, 2001; Reason, 1995, 2000).

Following the Chernobyl nuclear power plant accident in 1986, there was a widespread realization that organizational culture is a key factor in safety and that fostering a cul-

ture that supports safety can help reduce the number of accidents that occur in complex systems and organizations. This led to the common use of the term “safety culture.” The cultural aspects, otherwise, do not replace the prevalent approach to errors that still is the error prevention approach. Studies based on the error management perspective are less frequent and, furthermore, none of them is realized in Italian contexts, as far as we know.

With respect to the antecedents factors of errors, it has been taken into account the relationship between error and the national cultures’ aspects (Hofstede, 1980, 1991), especially uncertainty tolerance and power distance (Hammond, Farr, 2011; Helmreich, Wilhelm, Klinec, Merritt, 2001; Mohamed, Ali, Tam, 2009), but there aren’t empirical data to confirm it.

In the present dissertation we introduce and test a new conceptualization of error, testing its relationships with different correlates, and different organizational contexts, all characterized by being at high complexity level.

All the studies have been conducted in different work contexts, namely a series of random contexts, the sanitary and the civil aviation context. Samples coming from different organizations, collected randomly to validate the Italian version of the test; sanitary contexts, aviation context (Italian civil aviation authority) to verify and deep the model in more specific work sectors. The common aspects of these different work contexts are the complexity of the organizational interface between men and technology or professional complexity of the job done, and the potentially disruptive effects of the consequences of errors.

The dissertation presents three empirical studies and has several main objectives, each one related to one of the studies.

**Chapter 2** presents the first study, finalized to validate the Italian version of the *Error*

*Culture Questionnaire*, (ECQ), developed by van Dyck et al. (2005) and tested on two samples, one Dutch and one German. In particular, objectives of the study here presented are: 1) to test the psychometric validity of the questionnaire in the Italian cultural context; 2) to test and compare several models, identified on the basis of the indication of the literature; 3) to examine the construct validity, distinctiveness and reliability of the ECQ in relation to the several outcomes, namely organizational performance and innovation, and errors made.

**Chapter 3** presents the second study focused on the sanitary context, in which the relationship between error management dimensions and error avoidance dimensions is explored. The aim of this study is the identification of a comprehensive model including antecedents (trustworthiness), and outcomes (related to the organizational performance and innovativeness, and errors made). The objectives are: 4) to investigate the relation of influence played by the trustworthiness of the direct leader on the error culture dimensions (error management and error aversion facets); 5) to deeply examine the error aversion approach, not yet explored by the current literature on errors; 6) to study the role of the strain as an emotional dimension relevant in both the aversion and the management approach to errors.

The third study, presented in **Chapter 4**, emphasizes the role of the error aversion approach in the civil aviation context, specifically in a government body, the Italian Civil Aviation Authority. More particularly, the aims of the study are the followings: 7) to explore the hypothesized model of relationships between leadership dimensions (servant and resentful leadership) and organisational culture dimensions (particularly power distance and uncertainty avoidance) with the error aversion facets (that is, error strain and covering up errors); 8) to investigate influence of error aversion facets on negative outcomes, that is, errors made.

In **Chapter 5**, the findings of these studies are discussed with respect to general con-

clusions and suggestions for future research.

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## **Chapter 2**

### **The error culture: psychometric and construct validation of the Error Culture Questionnaire (ECQ) in the Italian context**

#### **Abstract**

The study presents the Italian validation of the *Error Culture Questionnaire*, (ECQ), developed by van Dyck, Frese, Baer & Sonnentag (2005) tested on a sample of 588 respondents. Objectives of the study here presented are: 1) to test the psychometric validity of the questionnaire in the Italian context; 2) to test and compare several models, identified on the basis of the indication of the literature; 3) to examine the construct validity, distinctiveness and reliability of the ECQ in relation to the several outcomes, namely organizational performance and innovation, and errors made. At the end, limitations and future research needs are discussed.

## Introduction

The Fleming's serendipitous discovery of penicillin, the post-it notes invention, the Columbus' discovery of the Americas are only some examples of how unsuitable products, failed experiments, or accidental errors that have been transformed in successful inventions by careful and creative observers. Many discoveries and new products are often the result of "unexpected outcomes", namely errors (Petroski, 1992). In line with this, errors may be conceived not only as adverse events because of the negative consequences they can result in (e.g. loss of time, disservices, accidents), but also as a form of negative feedback.

As such, errors can provide valuable information to employees and organization about how to adjust behaviour to achieve goal. Conversely, the difficulties to cope with errors, because of the anxiety and the guilty feelings they normally arise -and the subsequently covering up reactions may inhibit the possibility to modify behaviours activating learning processes (Edmonson, 1996).

These different conceptions of the errors are related and are expression of the organizational culture, such as employees' shared beliefs about appropriate response to mistakes, expectations about how colleagues will respond to a wrong action, way of communication among teammates to solve a problem or to cope with a failure, and so on (Cannon & Edmondson, 2001). Thus, "the way an organization deals with errors may determine the amount of organizational learning" (Rybowiak, Garst, Frese & Batinic, 1999, p. 528).

A first conceptualization and the first scale of the different facets influencing employees' orientation toward errors is by Rybowiak and colleagues (1999), which identified and operationalized eight factors, related to the individual attitudes and to the coping strategies to manage errors when they occur. They comprise: *error anticipation*, a general negative expect-

tancy that errors will occur; *error risk taking*, related to employees' general flexibility and openness towards errors; *error strain*, the negative emotions (i.e. fear, embarrassment, shame, guilty) that may arouse when a mistake occurs; *covering up errors*, the reaction of not admit one's error because it could be threatening or risky; *thinking about errors* and analysing them after a mistake has happened or something goes wrong at work; *error competence*, related to the knowledge of and the capability to deal with errors immediately after they occur, thus reducing their negative consequences; *communication about errors*, sharing it with colleagues or asking them to do it better; and *learning from errors* actively trying for the future to do lead to a better performance, for instance planning new work processes (EOQ–Error Orientation Questionnaire, by Rybowskiak et al., 1999).

Afterwards, van Dyck and colleagues (van Dyck, Frese, Baer & Sonnentag, 2005) revised the Rybowskiak scale by changing the perspective from an individual to an organizational one and adopting six of the eight dimensions proposed by EOQ. In addition they suggested gathering these six facets into two broader dimensions picking the “positive” and the “negative” cultural approach toward errors.

Within this perspective van Dick and colleagues developed the *Error Culture Questionnaire* (ECQ) by using the analogous EOQ items measuring the six of eight facets, for a total amount of 27 items<sup>1</sup> on the 36 of the original individual scale (see table 1), but changing the singular actor (“I”) in a collective one (“we”).

Although van Dick and colleagues as said considered the six facets introduced by Rybowskiak, in their validation article they presented only the two overall dimensions (positive and negative approach) and they did not examine the multidimensionality of each dimension. The positive organizational approach toward errors has been labelled *error management* and

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<sup>1</sup> In the study by van Dick et al. (2005) there are 28 items, but two of them (item 6 and item 17) are identical.

acknowledges the inevitability of errors and the promotion of organizational practices that effectively deal with errors. It consists of the EOQ sub-dimensions “*error competence*”, “*learning from errors*”, “*error communication*” and “*thinking about errors*”. The negative approach, labelled *error aversion*, includes the EOQ sub-dimensions “*error strain*” and “*covering up errors*” and, conversely, denies errors and it is characterized by a fear of errors and a reluctance to discuss them.

In this paper, in line with Rybowskiak et al (1999) pivotal study, we aim to examine more in depth the dimensionality of the ECQ since we believe that the identification of the different facets of each dimension can help researchers and professionals in a better understanding of the different cultural processes associated with errors. In addition, the current literature on error culture often considered only the error management dimension posited by van Dick and colleagues (Cannon & Edmondson, 2005; Hammond & Farr, 2011; Keith & Frese, 2010; Schippers, Homan & van Knippenberg, 2013) leaving quite unexplored the role of error aversion dimension. Moreover empirical studies are really scarce (Cigularov, Chen & Rosecrance, 2010; Hoffman & Mark, 2006) and these few studies used only partially the ECQ examining the role of error management in influencing performance or, sometimes, to safety outcomes, but never in relation to errors outcome. So, another aim of this study is to examine more in depth the role of the negative facets of error culture in influencing errors and organizational performance.

In summary, starting from the above mentioned considerations, the purpose of the present study is twofold. First, we intend to examine the structural validity of the *Error Culture Questionnaire* (henceforth ECQ) by van Dyck and colleagues (2005), its psychometric properties and verifying its dimensionality using an Italian sample. Then, we will examine the ECQ concurrent validity, analysing the impact of the management and aversion facets of the error

culture on both organizational performance and innovativeness and errors made (*lapses* and *mistakes*).

### **Theoretical framework**

*The error management approach: conceiving errors as a source for the organisational improvement*

Organizations confront everyday with errors: they know that deviations from the rules, changes in working routines, erroneous decisions because of a high degree of uncertainty or insufficient knowledge, are order of the day. Zaho & Olivera (2006, p. 1013) define errors as individuals' behaviours resulting in "an undesirable gap between an expected and real state", which could hesitate in immediate or potential negative consequences for organizations. In our common life, we give our attention especially to the negative outcomes that errors can generate, like incidents, accidents or injuries (West, Guthrie, Dawson, Borril & Carter, 2006), tending to overlap the erroneous action with its negative consequences.

Research on errors, as well, focuses on the organizational attitude to prevent or to avoid the errors occurrence, identifying the possible causes of the "wrong" behaviours that individuals can act or produce (i.e. fatigue, distraction, lack of experience, lack of knowledge, etc.).

However, assuming that errors cannot be totally removed or avoided in the organizational life, prevention alone is considered inadequate (Reason, 1997, 2000).

Thus, from a different perspective, errors may also be a relevant source of learning by the experience and, by this, of promoting change and innovation.

Already in the seventies, Argyris and Schön (1978) based their organizational learning model on the capability to detect, reflect on and correct errors, defining them as the difference between expected and obtained outcomes. In more recent years the error management approach

(Cigularov, Chen & Rosecrance, 2010, Frese, 1991, 1995; Gelfand, Frese & Salmon, 2011; Helmreich, 1998, 2000; Helmreich, & Merritt 1998; Keith & Frese, 2010; Sexton, Thomas, Helmreich, 2000) acknowledges the inevitability of errors, and purposes to limit the incidence of their dangerous consequences enhancing the organizational resilience (Hollnagel, Woods & Leveson, 2006) and creating systems that are better able to tolerate the occurrence of mistakes (van Dyck et al., 2005; Reason, 2000).

Furthermore, in the medium or long term, being errors a feedback to the system, they provide relevant information to rethink routines, to avoid error reiteration and, eventually, to foster the organizational learning and innovation (Chillarege, Nordstrom & Williams, 2003; Drach-Zahavy & Pud, 2010; Hofmann & Frese, 2011; Homsma, Van Dyck, De Gilder, Koopman & Elfring, 2009; Katz-Navon, Naveh & Stern, 2009; Sitkin, 1996; Sitkin, Sutcliffe, Roger & Schroeder, 1994; van Dyck et al., 2005).

In other terms, the error management approach does not have the purpose to do away with errors completely, but rather it attempts to deal with errors and their consequences after an error has occurred, enhancing its positive consequences. In this way, it becomes possible to explore new solutions and new strategies to manage the complexity of the system, increasing its flexibility and, at the end, its attitudes for learning and innovation (Helmreich, Wilhelm, Klinec, & Merritt, 2001).

#### *The error aversion approach: blaming errors*

The occurrence of an error –and the subsequent individual’s awareness to have had a wrong behaviour– tends to arise negative emotions, such as feelings of guilt, fear or embarrassment (Newton, Khanna, & Thompson, 2008; Zhao & Olivera, 2006).

In organizational contexts where a blaming culture is prevailing (Catino, 2008), consequently, workers tend to feel themselves uncomfortable when errors happen and to deny or cover their mistakes and to avoid reporting them. This coping behaviour seems to be advantageous for the individuals in the short term, inasmuch as it apparently reduces their responsibility in the erroneous action but, at the same time, it does not allow a change process to happen, for instance activating a reflection on its causes, or quickly intervening for reducing its negative consequences, or sharing the information with colleagues thus preventing its replication in the future (Provera, Montefusco & Canato, 2010).

This “dark side” of the error culture, that is the aversion orientation, has received little attention by scientific research on the error topic, for instance considering its theoretical relevance and specific contribution to the erring process. It not even had an empirical attention since, to the best of our knowledge, only few individual-level studies have been conducted (Rybowiak et al., 1999), but no organizational-level research verified its influences on the overall organizational outcomes, such as performance (e.g. goal achievement, development and innovation) or the future errors reduction.

*Measuring error management and error aversion: the multidimensionality of the construct.*

The multidimensionality of the error culture construct, posited by Rybowiak et al. (1999) in their original study, allows to better deep the complex composition of it and the different relations between the different sub-dimensions and the different outcomes, positive and negative as well.

In fact, using the sub-dimensions, does permit to say that the organizations that have an error management approach are capable to monitor their actions and to quickly detect and analyse errors after a mistake has happened or something has gone wrong at work (*thinking about*

errors); to share information with colleagues or ask them for help to solve the problem (*communication about errors*); to know how dealing with errors immediately after they occur, thus reducing their negative consequences (*error competence*); and to rethink practices and rules, for instance planning new work processes, actively preventing secondary errors (*learning from errors*). Management oriented organizations are more apt to learn from errors and to risk and experiment so, in the long run, they are more likely to improve their performance and to innovate (Hofmann & Morgeson, 1999).

Conversely, in the organizations with an error aversion approach, wrong actions tend to be punished and the logic of suspicion and guilt is adopted. In these cultural contexts people feel negative emotions (i.e. fear, embarrassment, shame, guilt) more intensely when a mistake occurs (*error strain*) and, consequently, their usual reaction is of do not admit or communicate one's error because it could be threatening or risky (*covering up errors*).

**Table 1:** The Error Culture Questionnaire (van Dick et al., 2005) and its Italian version

Van Dick et al. Dimensions	Rybowiak et al. sub-dimensions <sup>1</sup>	ECQ items
<b>ERROR MANAGEMENT</b>	THINKING ABOUT ERRORS	2. After an error, people think through how to correct it <i>(IT3- Dopo un errore, le persone riflettono su come correggerlo)</i> 3. After an error has occurred, it is analyzed thoroughly <i>(IT6- Quando accade un errore, viene analizzato in modo approfondito)</i> 4. If something went wrong, people take the time to think it through <i>(IT9- Se qualcosa è andato storto, le persone si prendono del tempo per rifletterci a fondo)</i> 5. After making a mistake, people try to analyze what caused it <i>(IT10- Dopo aver fatto un errore, le persone cercano di analizzarlo per comprenderne le cause)</i> 6. In this organization, people think a lot about how an error could have been avoided <i>(IT13- Le persone pensano a lungo su come un errore avrebbe potuto essere evitato)</i>
	COMMU-	15. When people make an error, they can ask others for advice on how to continue.

<b>ERROR AVERSION</b>	<p>NICATION ABOUT ERRORS</p>	<p>(IT1- <i>Quando le persone fanno un errore, possono chiedere agli altri consiglio su come proseguire.</i>)</p> <p>16. When someone makes an error, (s)he shares it with others so that they don't make the same mistake</p> <p>(IT7- <i>Quando qualcuno fa un errore, lo condivide con i colleghi in modo che non si ripeta</i>)</p> <p>13. When people are unable to correct an error by themselves, they turn to their colleagues</p> <p>(IT19- <i>Quando le persone non sono in grado di correggere i propri errori da sole, si rivolgono ai colleghi</i>)</p> <p>14. If people are unable to continue their work after an error, they can rely on others</p> <p>(IT24- <i>Se le persone non sono in grado di proseguire il loro lavoro dopo un errore, possono contare sui colleghi</i>)</p>
	<p>ERROR COMPETENCE</p>	<p>10. When an error has occurred, we usually know how to rectify it</p> <p>(IT18- <i>Quando capita di fare un errore, di solito sappiamo come correggerlo</i>)</p> <p>11. When an error is made, it is corrected right away</p> <p>(IT23- <i>Quando si verifica un errore, rimediamo subito</i>)</p> <p>12. Although we make mistakes, we don't let go of the final goal</p> <p>(IT27- <i>Pur compiendo degli errori, raggiungiamo comunque l'obiettivo finale</i>)</p>
	<p>LEARNING FROM ERRORS</p>	<p>1. For us, errors are very useful for improving the work process.</p> <p>(IT2- <i>Per noi gli errori sono molto utili per poter migliorare il processo lavorativo.</i>)</p> <p>7. An error provides important information for the continuation of the work</p> <p>(IT14- <i>Un errore ci dà informazioni importanti su come proseguire il lavoro</i>)</p> <p>8. Our errors point us at what we can improve</p> <p>(IT17- <i>Gli errori che facciamo ci indicano ciò che possiamo migliorare</i>)</p> <p>9. When mastering a task, people can learn a lot from their mistakes</p> <p>(IT22- <i>Quando svolgono un compito, le persone possono imparare molto dai loro errori</i>)</p>
	<p>ERROR STRAIN</p>	<p>1. In this organization, people feel stressed when making mistakes</p> <p>(IT5- <i>Quando sbagliano, le persone si sentono stressate</i>)</p> <p>2. In general, people in this organization feel embarrassed after making a mistake</p> <p>(IT8- <i>Le persone si sentono imbarazzate se fanno un errore</i>)</p> <p>3. People in this organization are often afraid of making errors</p> <p>(IT12- <i>Le persone sono preoccupate di poter sbagliare</i>)</p> <p>4. In this organization, people get upset and irritated if an error occurs</p> <p>(IT15- <i>Le persone si arrabbiano e si irritano se si verifica un errore</i>)</p> <p>5. During their work, people are often concerned that errors might occur</p> <p>(IT25- <i>Durante il loro lavoro, le persone sono preoccupate che possa capitare qualche errore</i>)</p> <p>7. There is no point in discussing errors with others</p> <p>(IT4- <i>Non c'è alcuna utilità a discutere degli errori con i colleghi</i>)</p> <p>10. Employees who admit their errors are asking for trouble</p> <p>(IT11- <i>Le persone che ammettono i loro errori sono in cerca di guai</i>)</p>
	<p>COVERING UP ERRORS</p>	<p>6. Our motto is, "Why admit an error when no one will find out?"</p> <p>(IT16- <i>Il nostro motto è "Perché ammettere un errore se nessuno lo scoprirà?"</i>)</p> <p>8. There are advantages in covering up one's errors</p> <p>(IT20- <i>Ci sono vantaggi nel coprire i propri errori</i>)</p> <p>9. People prefer to keep errors to themselves</p> <p>(IT21- <i>Le persone preferiscono non far sapere i propri sbagli</i>)</p> <p>11. It can be harmful to make your errors known to others</p> <p>(IT26- <i>Può essere pericoloso far conoscere agli altri i propri errori</i>)</p>

<sup>1</sup> Two further sub dimensions proposed by Rybowskiak and colleagues (1999) (i.e. *error anticipation*, and *error risk taking*), not used by van Dick et al. (2005,) are not presented in the table

In conclusion, to date, the ECQ scale revealed to be an appealing measure to pick the new construct of error management as a cultural orientation that may facilitate organizations to handle with errors and improve their performance.

However, although proposing an attractive attempt to operationalize the construct and corroborating it with deep interviews, van Dyck and colleagues do not furnish a psychometric validation of the scale. In addition, they wonder if the *strain* and *covering up* dimensions are part of the same construct, thus calling for a more detailed analysis of the ECQ multidimensionality.

To the best of our knowledge, no subsequent studies have simultaneously used the whole scale, including items from both the “positive” and the “negative” dimensions. Thus, there is a lack of empirical evidence of the relationship between the error management and the error aversion orientations, as well there are no studies exploring the relation among the two theoretical management-aversion dimensions and their six generative dimensions.

#### *Relationship with outcomes: the error culture consequences*

In their pivotal study, van Dyck and colleagues (2005) acknowledge that error management can reduce the negative effects of errors and furthermore promotes the positive consequences of them (i.e., resilience, learning, innovation). Specifically, in a first study conducted on a Dutch sample they showed that the error management orientation correlated with organizational performance indicators (both firm goal achievement and firm survivability), while, surprisingly, the aversion orientation didn't. In their second study, on a German sample, authors used only the “positive” part of the scale and confirmed its influence on performance (return on assets and firm goal achievement).

Thus, the ECQ revealed to be an interesting measure to pick the new construct of error management as a cultural orientation that may help organizations to improve their performance. However, authors solicit further research to clarify the lack of relation between the error aversion culture and the organizational performance.

Their results corroborate the importance of errors for the organizational development and innovation and for the organizational well-being, which is theoretically sustained (Hammond & Farr, 2011; Keith & Frese, 2005), and represent some empirical evidence of their positive impact in the organizational life (Cannon & Edmondson, 2005; Ellström, 1999).

Although the present study focuses on the organisational level, on the other hand, at the individual level, it's interesting to note that Frese and colleagues (Frese & Altman, 1989; Frese, Brodbeck, Heinhokel, Mooser, Schleiffenbaum, & Thiemann, 1991) identify the potentially positive function of errors for individuals, and developed a specific training approach defined "error management training" (EMT). It is based on the assumption that trainees should learn how to deal with errors, rather than to avoid them, considering their negative feedback as a learning opportunity (Greif & Keller, 1990), for example improving learning of word processing skill acquisition and the overall performance (Chillarege et al., 2003).

Moreover, at the team level, Cannon and Edmondson (2001) show that the cultural orientation towards errors positively influences the group performance.

Likewise, a climate of psychological safety (Edmondson 1996, 1999) –that is, when the group members feel themselves confident with the risk taking or with the resulting judgment related to the wrong action eventually committed– supports the process of learning by errors of the whole group.

Hoffman & Mark (2006) tested the relation between the error orientation of nurses and several objective outcomes, like the overall patient satisfaction or the amount of nurses' inju-

ries. The authors adapted three sub scales by Rybowskiak et al. (1999) using them as two more general factors, namely *learning from errors and general openness* and *communication of errors*. The overall safety climate of the unit predicted patients and nurses satisfaction; moreover, it negatively predicted the medication errors and nurses back injuries, above all when patients' conditions were more complex.

In addition, Cigularov, Chen & Rosecrance (2010) recognize that error management is a factor related to the promotion of the organizational well-being, leading to incidents reduction, safe behaviours increase, and open communication on safety matters. They used the four "positive" dimensions (*learning from errors, thinking about errors, error competence* and *error communication*) from van Dyck et al. (2005) combining them into an overall measure.

To summarise, evidence based research on error culture is still in its beginning, since studies are sparse. Anyhow, these preliminary investigations highlight the relevance of the error management culture in influencing many aspects of organizational performance.

On the other hand, for all we know, the "negative" approach of error aversion is disregarded or neglected. Research does not explore its role in deteriorating the organizational performance neither explore its direct influence on errors, thus soliciting the need for further research.

### *Aims and hypotheses*

According to the literature review summarised above, to the best of our knowledge no studies have examined the construct validity of the ECQ by concurrently considering all the items measuring both the positive and the negative dimension and the relative sub-dimensions. Therefore, the first aim of this study is to examine the dimensionality of ECQ and the relationships among the dimensions. In addition, since only the Hoffman's study

(2006) have examined the role of these dimensions in influencing error outcomes, the second aim of this study is to investigate the effects, yet tested in previous studies, on the organisational success (i.e. performance and innovativeness) and the effects, posited but not yet tested by previous studies, on the errors.

With regard to the factorial structure, in accordance to previous studies, two alternative models were hypothesized:

*Hp1a*) a two-factor model, respectively representing the error management and the error aversion approach, as suggested by van Dyck and colleagues (2005);

*Hp1b*) a six-factor model, as suggested by the multidimensional *criteria* used to develop the scale (Rybowiak et al., 1999).

Furthermore, in accordance with van Dyck and colleagues, we hypothesized that the “positive” and “negative” dimensions were independent (*Hp2*).

Finally, with regard to the relationships of error culture dimensions and outcomes, we hypothesized that:

(*Hp3*): the *error management* sub-dimensions will be positively related to the organizational performance and innovativeness (Edmondson, 1996; van Dyck et al., 2005; Homsma et al., 2009);

(*Hp4*): the *error aversion* sub-dimensions will not be significantly related to these outcomes (van Dyck et al., 2005).

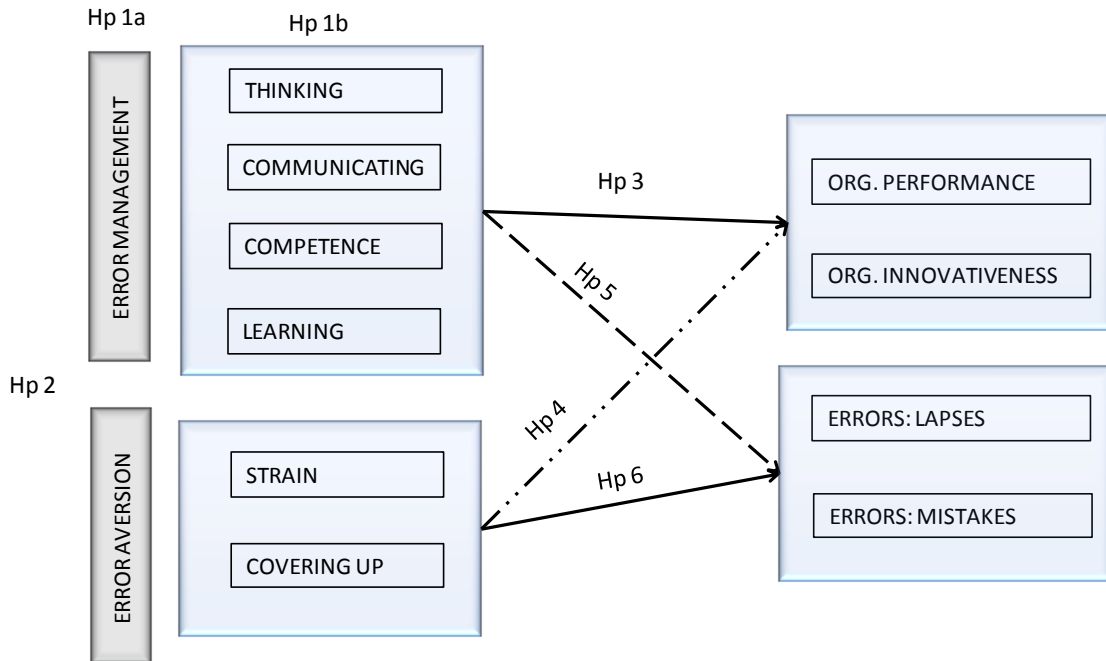
Furthermore, we hypothesize that:

(*Hp5*): the *error management* dimensions will be negatively related to errors (Hoffman & Mark, 2006);

(*Hp6*): the *error aversion* sub-dimensions will be positively related to those outcomes.

The hypothesized model is showed in Figure 1.

**Fig. 1:** The hypothesized model



Note:

- Dotted line indicates negative influence
- Continuous lines indicate positive influence
- Dotted and pointed line indicates no meaningful influence

## Method

### *Participants and Procedures*

The study involved 588 employees, working in different organizations operating in diverse sectors, as exposed in the following table 2:

**Table 2:** Productive sectors of the sample

PRODUCTIVE SECTORS		n.	%
A	Culture (education, tourism, and information)	64	10,9
B	Commerce (food, other goods)	66	11,2
C	Health and social assistance	143	24,3
D	Construction and transportation	76	12,9
E	Services (financial and insurance, consultants)	71	12,1
F	Security and Army	58	9,9
G	Public administration and other public services	100	17,0
H	Others (call centres, cleaning companies)	10	1,7
Tot.		588	100%

Participants were 316 females (53.7% of the sample, 3 missing). They aged from 19 to 63 years (Mean age: 42.8, SD: 11.8). About 45% of the sample had completed high school, while 46.5% had a university degree, and almost 8% of the sample had basic instruction. The job tenure was between 1 and 42 years (Mean tenure: 18.7 SD: 11.4). Other characteristics of the sample are: the job position, while almost the 12% are managers, the 25% are white collars, the 32% are specialized technicians and the 31% are blue collars; the presence of co-workers, while the 59% had no co-worker and the 41% had between 1 and 240 co-workers, with an average amount of co-workers of 17 (SD: 31).

Participants voluntarily took part to the study, and did not receive any kind of reward, financial or other. Trained research assistants handed out questionnaires in blank envelopes. Each participant received a presentation letter, containing a brief description of the research and of its main objectives, and individually filled out an anonymous paper and pencil questionnaire. Before administering the questionnaire, the researcher explained that the participants' responses would be totally confidential and that the study was not commissioned by the organization for which they worked.

## Measures

*Error culture.* This was measured with the 27 items of ECQ described above (Table 1). Participants were asked to indicate how often (from 1 = *never* to 5 = *always*) they act each of the listed behaviours in their present job.

*Organizational performance.* This was measured with a single item capturing how well (from 1 = *not at all* to 10 = *completely*) a company is doing with regard to its own general performance (“To what degree has your organization obtained a better performance in the last three years?”).

*Organizational innovativeness.* This was measured with a single item capturing the amount of innovativeness (from 1 = *not at all* to 10 = *completely*) the organisation actively pursues (“To what degree has your organization been innovative in the last three years?”).

*Errors.* These were measured with a 7 items scale, with a Likert ranging scale pointed from 1 (*never or almost never*) to 5 (*always or almost always*), developed *ad-hoc* for the purpose of this study. Data for item generation were collected via 58 in-depth individual interviews realized with workers from different sectors. Specifically, they were asked, using the Critical Incident Technique (Flanagan, 1954), to describe an event of “ordinary” error and an event of “exceptional” error, in the sense of unusual and/or of major severity in the consequences, both experienced directly in a recent past. It was asked to all the participants the permission to record the interview. So, all of the interviews were registered then reported on paper directly by the specific interviewer, and scrutinised via content analysis. After this, the researchers identified the content deductively according to classical error theory and taxonomies (Rasmussen, 1983; Reason, 1990) and then created the items by condensing the content, and created an initial set of 23 items. Moreover, in order to check the content validity of the newly developed items, three independent researchers revised all the items to confirm the appropriateness of wording and to check

for their adequacy, plausibility, redundancy and relevance in a general work context. As a consequence, based on the researchers' agreement and comments, the number of items was reduced to the current 7 items.

### *Data analysis*

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) (version 16.0) and *MPlus* (version 6.1, Muthén & Muthén, 1998-2010). Descriptive statistics for all study variables were computed. Our hypotheses were tested using structural equation modelling (SEM) techniques.

In order to examine the factor structure of the Error Culture Questionnaire we tested and compared two Confirmatory Factor Analysis (CFA) models: 1) a two-factor model; and 2) a six-factor model. Specifically, in the two-factor model the first factor represented the error management dimension and it was defined by loading all the items of the error competence, learning from errors, error communication and thinking about errors sub-scales; the second factor represented the error aversion dimension and it was defined by loading all the items of the error strain and covering up errors sub-scales.

In the six-factor model each sub-scales of the Error Culture Questionnaire was defined as a specific factor. In order to identify the best factor solution, based on Hoyle's (1995) recommendations and according to a multifaceted approach to the assessment of the model fit (Tanaka, 1993), we considered: omnibus fit indices such as the Chi-square ( $\chi^2$ ) and incremental fit indices such as the Comparative Fit Index (CFI), the Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR). After having ascertained the best factor structure, we examined the reliability of each dimension by using Cronbach alpha.

The posited model (Figure 2) was tested using Structural Equation Modeling (SEM) techniques. We used this approach because it permits taking measurement errors into account by defining latent variables by their indicators. For the examination of the model fit we considered the same indices used for the evaluation of CFA.

## **Results**

### *Preliminary results*

As preliminary analysis we examined the items descriptive statistics and the factor structure of errors scale. As shown in table 3, all the items were normally distributed. Furthermore results of explorative factor analysis showed a 2 factor structure: *mistakes* (4 items) and *lapses* dimension (3 items). Finally both dimensions showed a good internal consistency with Cronbach's alpha coefficients higher than .70.

**Table 3:** Errors scale: exploratory factor analysis and factors' psychometric measures.

	M	SD	SK	K	MISTAKES	LAPSES
1. Referring to incomplete or outdated knowledge to perform a task.	2.22	.839	.326	-.004	<b>.907</b>	
2. Using an inadequate procedure.	2.26	.896	.442	-.073	<b>.705</b>	
3. Making decisions not effective for our customers.	2.28	.997	.454	-.415	<b>.622</b>	
4. Not fully complying with protocols, procedures, or guidelines.	2.14	.901	.404	-.411	<b>.512</b>	
5. Forgetting to perform a task.	2.76	.874	-.224	-.246		<b>.895</b>
6. Delaying in the performance of a task.	2.18	.831	.310	-.275		<b>.595</b>
7. Being abstracted when working.	2.43	.877	.095	-.540		<b>.539</b>
Cronbach's alphas					.815	.744
% variance					45.39	7.80

Descriptive statistics of the two single item outcomes are presented in following Table 4. As shown, the two items were normally distributed.

**Table 4:** Psychometric measures of organisational performance and innovativeness

	M	SD	SK	K
Organisational innovativeness	6.23	2.344	-.532	-.350
Organisational performance	6.66	1.998	-.680	.185

#### *The ECQ's dimensionality*

Descriptive statistics of the Error Culture Questionnaire are presented in Table 5. As shown, all the items were normally distributed with the only exception of two items (COV2 and COV3) whose skewness and kurtosis indices are higher than |1|.

**Table 5:** Items' psychometric characteristics

	M	SD	Skewness	Kurtosis
TNK1	3.76	.96	-.53	-.08
TNK2	3.28	1.10	-.27	-.52
TNK3	2.96	.94	-.01	-.23
TNK4	3.55	.94	-.20	-.45
TNK5	3.07	.93	-.01	-.34
COM1	3.86	.93	-.63	.36
COM2	3.39	1.05	-.29	-.53
COM3	3.76	.88	-.45	.06
COM4	3.71	.99	-.43	-.34
CPT1	3.73	.77	-.34	.32
CPT2	3.87	.89	-.43	-.20
CPT3	4.05	.87	-.82	.60
LRN1	3.34	1.03	-.22	-.35
LRN2	3.68	.96	-.55	.05
LRN3	3.72	.97	-.61	.08
LRN4	3.79	.91	-.56	.15
STR1	3.24	.95	-.19	-.13
STR2	3.21	1.02	-.16	-.28
STR3	2.96	1.00	.02	-.18
STR4	3.07	.92	-.11	.12
STR5	2.94	1.00	.06	-.22
COV1	2.00	1.04	.84	.00
COV2	1.52	.85	1.74	2.78
COV3	1.74	1.03	1.37	1.18
COV4	1.92	1.07	.97	.10
COV5	2.71	1.16	.07	-.79
COV6	2.15	1.09	.69	-.25

We began the CFA by fitting the two-factor model as suggested by van Dyck and colleagues (2005) and the six-factor model in line with the theory that guided the construction of the scale. Results of these two models are shown in following Table 6.

**Table 6:** The two-factor and six-factor models tested

	Two-factor model			Six-factor model				
	Pos	Neg	Comm.	Learn	Think	Compet.	Cover	Strain
COM4	.695		.763					
COM3	.651		.725					
COM2	.727		.720					
COM1	.640		.703					
LRN4	.482			.752				
LRN3	.528			.748				
LRN2	.472			.717				
LRN1	.476			.595				
TNK4	.715				.803			
TNK1	.764				.731			
TNK2	.649				.708			
TNK5	.511				.633			
TNK3	.487				.626			
CPT2	.519					.716		
CPT1	.479					.638		
CPT3	.369					.533		
COV5		.725					.722	
COV3		.680					.719	
COV6		.616					.605	
COV2		.559					.592	
COV4		.547					.577	
COV1		.416					.459	
STR1		.408						.648
STR2		.352						.668
STR3		.383						.689
STR4		.479						.645
STR5		.342						.581

On the basis of the guidelines for model fit (Hu & Bentler, 1998, 1999), while the six-factor model fitted the data quite well with only the CFI lower than the cut-off criteria (>.95), the two-factor model did not with all the indices far from the cut off, as showed in following table 6. In line with this Hypothesis 1a, coming from van Dick et al. (2005) is not confirmed, while Hypothesis 1b, related to the multidimensionality of the construct, as posited by

Rybowiak et al. (1999) has been confirmed.

**Table 7: Models fit**

	$\chi^2$ (df)	p	CFI	RMSEA	SRMR
<b>Two-factor model</b>	<sub>(323)</sub> = 2315.7	< .001	.66	.103 (90% CI .099, .106)	.660
<b>Six-factor model</b>	<sub>(309)</sub> = 1050.7	< .001	.87	.064 (90% CI .060, .068);	.061

We examined modification indices to better understand the potential sources of misfit in the six-factor model. These indices provide an estimate of how much better the model would fit if a parameter currently constrained to zero was instead freely estimated. For this model, one of the places where constraints could be lifted is the loadings of TNK1 on both communication and competence factors. This indicates that this item is not a good indicator in terms of the simplicity criteria (Thurstone, 1947) so we decided to exclude this item from the analysis. Moreover, modification indices suggested that some co-variances among residuals (STR3 with STR5 and COM1 with COM3) could be freely estimated to improve model fit. Since these two pairs of items refer to specific content (i.e. *be worry about errors*, item STR3 and item STR5; *asking colleagues for help* item COM1 and item COM3), we allowed residuals of these two pairs of items to correlate. Results of the revised six-factor model are presented in Table 8 and in table 8a.

**Table 8:** The revised six-factors model tested

	Commun	Learn	Thinking	Compet.	Cover	Strain
COM4	.767					
COM3	.690					
COM2	.723					
COM1	.660					
LRN4		.755				
LRN3		.749				
LRN2		.714				
LRN1		.591				
TNK4			.821			
TNK2			.716			
TNK5			.656			
TNK3			.675			
CPT2				.723		
CPT1				.631		
CPT3				.535		
COV5					.720	
COV3					.723	
COV6					.603	
COV2					.590	
COV4					.579	
COV1					.460	
STR1						.681
STR2						.696
STR3						.619
STR4						.663
STR5						.490

**Table 8a:** Revised Six-factor model's fit

	$\chi^2$ (df)	p	CFI	RMSEA	SRMR
<b>Six-factor model revised</b>	$(282) = 826.3$	< .001	.90	.057 (90% CI .053, .062)	.056

With regards to the correlations among the factors, as shown in table 8 these correlated each other with the only exception of error strain that did not correlate with competence. Moreover, correlations suggested that while *covering up errors* negatively correlated with all

the error management factors (*error competence, learning from errors, error communication and thinking about errors*) *error strain* negatively correlated only with *error communication* and surprisingly positively correlated with both *learning from errors* and *thinking about errors*. Correlations showed a very high correlation between *error communication* and both *thinking about errors* (.70) and *error competence* (.77). Thus Hypothesis 2, concerning the independence of the error management dimensions from the error aversion dimensions, is not confirmed. Finally, all dimensions showed a good internal consistency with all coefficients above .70 with the only exception of *error competence* whose Cronbach's alpha is .68 (Table 9).

**Table 9:** Correlations among ECQ's sub-dimensions

	1	2	3	4	5	6
1- Communicating	-					
2- Learning	.55	-				
3- Thinking	.70	.54	-			
4- Competence	.77	.40	.48	-		
5- Covering up	-.65	-.32	-.38	-.41	-	
6- Strain	-.15	.13	.21	Ns	.42	-
Cronbach's alphas	.82	.79	.81	.68	.78	.79

### Exploring concurrent validity and relationships with outcomes

#### *Concurrent validity of the ECQ*

Table 10 illustrates the correlations among the variables. As shown, all the variables are meaningfully correlated, apart from *learning* with the *mistakes* and the *strain* with the *innovativeness* of the organisation.

**Table 10-** Intercorrelations among Study Variables

	COMMUN	COMP	LEARN	THINK	STRAIN	COVER
ORGANISATIONAL INNOVATION	.329**	.208**	.186**	.375**	-.078	-.207**
ORGANISATIONAL PERFORMANCE	.302**	.246**	.114*	.276**	-.162**	-.211**
ERRORS – LAPSES	-.288**	-.262**	-.140**	-.226**	.174**	.319**
ERRORS - MISTAKES	-.310**	-.285**	-.109	-.246**	.202**	.393**

\*\* : .001; \* : .005

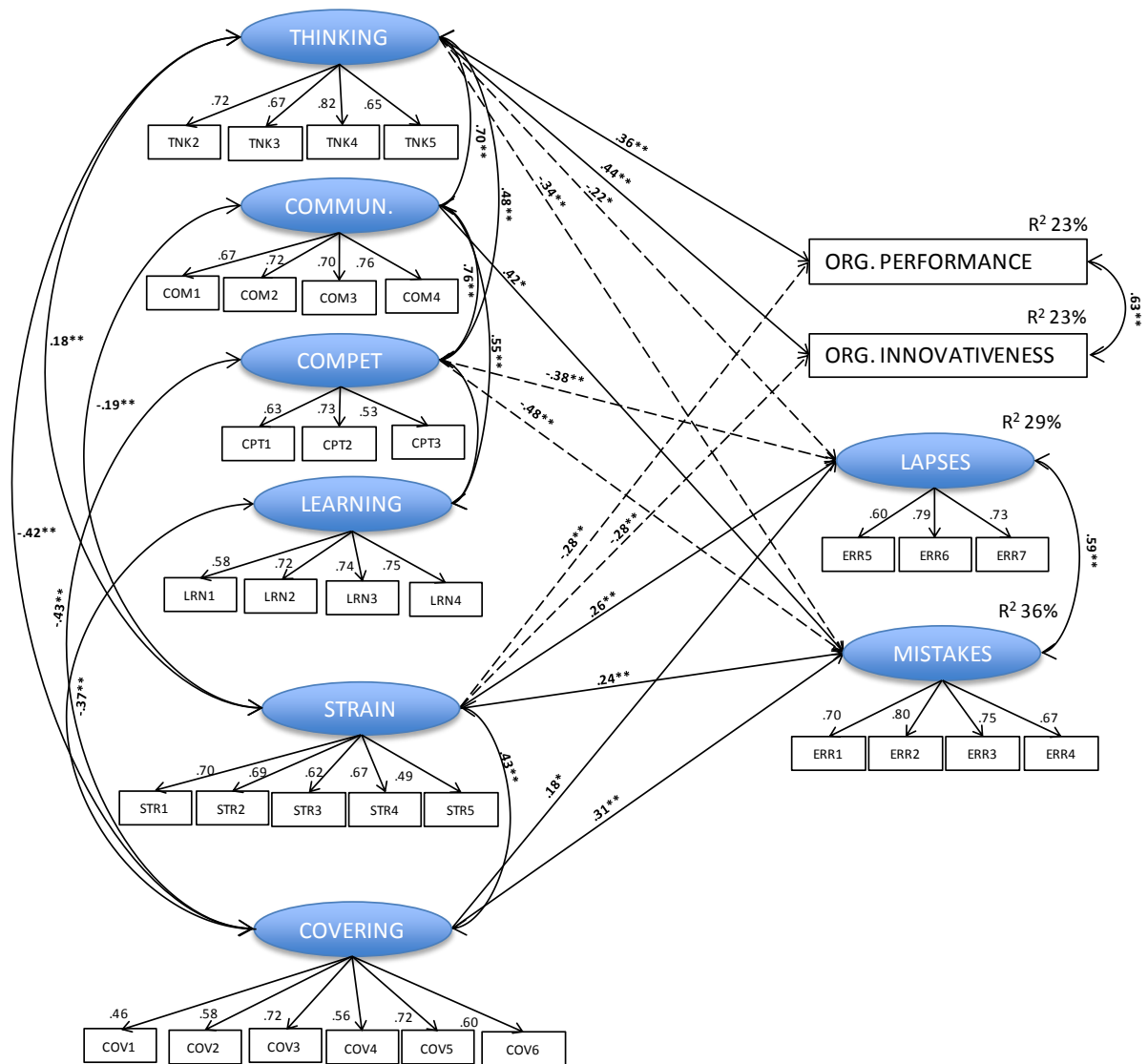
### *Structural Equation Model (SEM)*

The tested model, displayed in Figure 2, yielded an excellent fit ( $\chi^2_{(590)} = 1247.81$ ,  $p = .0000$ , RMSEA = .045 (.041–.048), CFI = .91, TLI = .89, SRMR = .050). With regard to the structural part, the model explained 23% of variance of *organisational performance*, 23% of *organizational innovativeness* the 29% of variance of *errors - lapses*, and 36% of *errors - mistakes*. In accordance with Hypothesis 3, among the error management dimensions, only *thinking on errors* was positively related to both the organizational performance and innovativeness. Furthermore, with regard to the Hypothesis 4, it has been partially confirmed. In fact, *thinking* and *competence* were negatively related to both errors dimensions /types (*lapses* and *mistakes*), but *communication* showed to be positively related to *mistakes*. At last, learning did not influence significantly any outcome, neither the positives, nor the negative ones.

Finally, Hypotheses 5 and 6 were partially confirmed. In fact, unlike to what expected on the basis of previous research, error *covering* and error *aversion* showed to be negatively related to the positive outcome of organizational performance and innovativeness

and, on the other hand, accordingly to Hypothesis 6, they are positively related to errors made, both lapses and mistakes.

**Figure 2: The Tested Model**



\*\* p<.01; \*p<.05

Note: all the path coefficients are meaningful beyond p< .01

## Discussion

### *Main results*

Overall results of this study attested to the good psychometric properties of ECQ in terms of construct and internal validity. In addition this study attested the different role of each sub-dimensions in influencing error and performance outcomes. The six dimensions model shows to be the best one, from a psychometric perspective, even if it appears to be less parsimonious. In addition it expresses a high explicative value, considering the six dimensions related each other, as the correlational data show, but each of them as a face of different phenomenon. This first consideration is very interesting and appears different with respect to the study of van Dick and colleagues that consider error management as a unique dimension, but regain the multidimensionality of the scale, originally proposed by Rybowskiak et al. (1999).

Moreover, the correlation data show that covering and strain have a different relation with the positive dimensions. While covering correlates negatively with all the four dimensions of error management, strain, surprisingly correlates positively, sparsely but significantly, with thinking and with learning. These results could be explained considering that in all cases cognitive processes of reflection, thinking and learning imply also, to be effective, a certain amount of emotional activation and are stressing in itself (Edmonson, 1996; Rybowskiak et al., 1999; Zhao & Olivera, 2006). Plausibly, the context characteristics could make the difference with respect to the consequences of the strain feelings for the errors made. It could represent an interesting topic for future research on the role played by emotions in the error management cultural approach.

Furthermore, three dimensions of the error management side, specifically *communication*, *thinking* and *competence*, are each other high correlated, so a future research matter could be to

explore a comprehensive latent factor for them. From the other hand, this could also indicate that *communication* represents a dimension which crosses or go through *thinking* and *competence*, so it could be of another level.

Moreover, the “negative” side (*error aversion*) of the error culture has been investigated for the first time, and it shows to be made up of two sub dimensions theoretically as well as empirically different. They have, in fact a correlation not so high and a diverse tendency in relation to the influence they exert on the positive and negative outcome of the present study. In effect, and in contrast with the observations made by van Dick and colleagues, in the present study, while the two of them exert a positive influence on errors made (lapses and mistakes), the strain dimension exerts also a negative influence on the positive outcomes, organizational performance and organizational innovation, while covering has no influence at all on them.

The ECQ shows also a good concurrent validity. The six dimensions influence differently the positive (*organizational performance* and *organizational innovativeness*) and the negative (errors: *lapses* and *mistakes*) outcome used in the present study, which is also the very first one, to what we know, using actual errors. Overall, the positive (error management) sub-dimensions and the negative (errors aversion) sub-dimensions of the ECQ have a diverse and opposite influence on the outcome. It’s interesting to note that the only absence of covering does not imply an improvement of the positive outcomes, which need of the error management dimension to improve.

A further consideration concerns the differences in national cultures. As van Dick et al (2005) highlight in their study, national cultures carry out an influence on attitude toward errors, because it is of course, a matter of cultures in itself. They noted, in fact, since national cultural contexts are relevant in influencing the error culture, they are also relevant in explain-

ing the different results reached in the two different countries their participants were from. For example, the Netherlands scores were lower than the Germany ones on *error intolerance* and on *uncertainty avoidance* (House, Hanges, Javidan, Dorfman, & Gupta, 2004).

In the same way, we explored the validity of the ECQ in the Italian context starting from the awareness of the different national culture (Dorfman & Howell, 1988; Hofstede, 1980) of Italy, which belongs to the European-Latin countries, that have different national cultures with respect to the Germanic or Anglo countries, where most studies have been accomplished. In fact, in Italy a blame-guilty culture is widespread, as well the power distance with authorities is stronger and leadership style is less participative (House et al., 2004). Thus, errors could be conceived as more troublemaking than in other national cultures and it has been useful to verify the consistency of the scale even in a so different cultural context.

Considering the overcoming necessity to cope with uncertain environments and to fast operate in bounded rationality conditions (March & Simon, 1958) it is becoming more and more urgent to take into account the fallibility of human reasoning (Reason, 1995) and to be able to handle the negative consequences of mistakes and to not lose their important and rich informative content, useful to rethink future actions.

In conclusion, the EC scale to date revealed to be a useful measure to pick the new construct of error management as a cultural orientation that may help organizations to rapidly detect and think over the error that may happen, to have an open and fruitful communication on it, to develop competence for managing errors and reduce their negative consequences and, last, to learn from them for improving the organisational performance, activating a “virtuous” spiral that over time leads to organisational innovation, which is a key factor for the success of all organisations (Edmonson & Moingeon, 1999; van Dick et al., 2005).

### *Limitations and future research matters*

The current study presents several limitations, at least threefold: the first is that data are cross sectional, all reached at the same time. Undoubtedly, the cross-sectional nature of our data makes it more difficult to infer causal relations among variables considered, although the posited model appears strong and based on theory and prior research.

Future studies could explore the longitudinal influence of the error culture dimensions on positive and negative outcomes (performance and errors), to confirm and strengthen the model herein examined.

Another limitation is sample related. Notwithstanding the high number of subjects involved, they are not representative of any specific sector, because the data collection was really widespread. Cautions in generalization are also linked to the sampling procedure adopted in the present study and to the limited socio-demographic information recorded from participants.

A future study could consider only one specific sector or work context and/or a specific High Reliability Organization (HRO, Pronovost, Berenholtz, Goeschel, Needham, Sexton, Thompson, Lubomski, Marsteller, Makary, & Hunt 2006; Weick et al., 2007), where the typicality of consequences of the errors that could be committed, make them high-risk environments.

A third limitation of this study consists of the utilization of self-report instruments. Moreover, since the methodology used in this study was based solely on self-report, one may question the extent to which self-reporting bias (and in particular, the individual tendency to respond in a socially desirable way) influenced the responses about behaviours like the error covering or the error strain, or the errors made.

However, the questionnaires were administered anonymously, and there was no possibil-

ity for the subject on having been identified, which may have mitigated some self-reporting bias.

The structural equation modelling, which allows for the simultaneous testing of multiple relationships, also counterbalanced the aforementioned weaknesses. All in all, future studies could include also external criteria.

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## **Chapter 3**

### **Managing errors when supervisors are trustworthy: the influence of trustworthiness on the error culture in sanitary systems**

#### **Abstract**

The study focuses on the relationship between trustworthiness of the leader (supervisor), error management dimensions and error avoidance dimensions in the sanitary context with a sample of 577. Aim of the study is the identification of a comprehensive model including antecedents (trustworthiness), and outcomes (related to the organizational performance and innovativeness, and errors made). The objectives are to investigate the relation of influence played by the trustworthiness of the direct leader on the error culture dimensions (error management and error aversion facets); to examine the error aversion approach, not yet explored by the current literature on errors; to study the role of the strain as an emotional dimension relevant in both the aversion and the management approach to errors. Limitations and future research matters are also discussed.

## **Introduction**

In all organizations and in the sanitary context as well, leaders play a crucial role in building and shaping the organizational culture (Tucker & Edmondson, 2003). This consideration can be deemed as useful for all the contexts in which organizational culture expresses itself, also with regard to the beliefs and conceptions toward errors and failures. For example, overall, leaders can sustain and assist the problem solving of co-workers and teams, and can redefine the workers' perceptions of failures and errors from sources of strain, stress and frustration to sources of learning (Tucker & Edmondson 2003).

In a more general sense Vogus, Sutcliffe and Weick (2010) note that, for example, in the sanitary context a leader who is perceived as one that blames or punishes people for the errors made, or avoids speaking up about errors, or use threatening language and expressions, will frustrate a positive safety culture. On the contrary, a leader may foster a psychological safety climate, for example through personal example: helping people, sharing a constructive approach to the errors problem solving oriented, empowering co-workers in the ability to think about errors, to applying their knowledge and learning by doing (Vogus et al., 2010).

By their behaviour, leaders exert the essential function of modelling and influence the organizational error culture (Edmonson, 2004). Therefore, the way in which the followers or co-workers perceive them can influence the system of organizational values and consequently the perception of errors and the reactions to them. In fact, leaders' values and behaviours represent an informational source that allows people to orient and monitor the shared beliefs of the team or group.

Following the social exchange theory, which states that reciprocity in exchange is expected and it is deeply founded on trust (Colquitt, LePine, Piccolo, Zapata & Rich, 2012;

Konovsky & Pugh, 1994; Whitener, Brodt, Korsgaard & Werner 1998), whenever the leader is perceived as honest, righteous, competent and positively oriented towards the co-workers, they are induced to, or is more probably that they will, act analogous behaviours, which means, for example, do not voluntarily act wrong behaviours and do not hide their own mistakes and errors. At the same, they will probably feel regret for the errors made but, knowing that the boss is benevolent, the coping strategies will be less stressing and more learning oriented. In the same way, the perception of a competent supervisor could help in monitoring and analyzing the errors for the performance improvement, searching new solutions or ways to look at the complexity of the specific work situation (Colquitt, Scott & Le Pine, 2007; Firth-Cozens, 2004).

Research in hospitals nursing units, moreover, confirms the importance of trusted leaders, that is leaders perceived as trustworthy, to increase the effectiveness of HRO and the overall safety of the units, thanks to open discussions on errors and ways to improve learning from them (Vogus & Sutcliffe, 2007). A trusted leader enhances the capability of co-workers to share their experience, because they feel themselves positively supported and so they can “run the risk” of exposure and be vulnerable (Vogus & Sutcliffe, 2007).

Starting from these general theoretical references, we assume that the trustworthiness of the supervisor (Colquitt et al., 2007; Mayer, Davis & Schoorman, 1995) can influence the organizational error culture. In fact, to go beyond the emotional discomfort of the error made and the resulting temptation to cover errors, may depend on the trustworthiness of the leader, that is, how much the leader is perceived as benevolent, honest and capable (Mayer et al., 1995), so supporting a culture oriented towards the error management and learning from errors.

Thus, the general aim of this study is to verify the influence of leaders' trustworthiness on employees' error culture and, consequently, the different approaches adopted regarding to the errors, that in turn will provoke behaviours useful for the organisational success, in terms of good performance and innovativeness (van Dick, Frese, Baer & Sonnentag, 2005) and, conversely, will limit the occurrences of the various kinds of errors made.

## **Theoretical framework**

### *Errors in the sanitary context*

Errors in medicine are a huge matter, impacting on the overall well-being of individuals, group and organizations as well. Following the Norman's (1988) definition of errors, applicable also to the sanitary context, the error types can be divided into *slips*, that is, errors in the human automation process. A slip is observable and unintended; for example the nurse who doesn't see a "*nihil* by mouth" sign hanging above a patient's bed, and while delivering lunch to patients who can eat, feeds also the "wrong" patient (Armitage, 2009). The second category of errors are the *lapses*, predominantly related to memory failure, a less observable error which may only be apparent to the protagonist which also results from failure of the execution and/or storage stage of an action (for example, the nurse which totally knows that a patient wait for a drug every 8 hours but simply forgets to give it at the time required). These first two kinds of errors are errors of action, or *skill-based errors* (Rasmussen, 1983; Rasmussen & Jensen, 1974). The third kind of errors are the *mistakes*, a deficiency or unsuccessful attempt in the logical and decision makers processes involved in choosing the result attended and the ways to achieve it. Mistakes can be *rule based* or *knowledge based* (Rasmussen, 1983; Rasmussen & Jensen, 1974; Reason, 1990). A rule-based mistake happens when, for

example, we choose a wrong but pre-packaged solution to a problem, which is familiar to us (following the wrong but apparently logical assumption that “if the problem is known, also the solution must be”); so it is expressed by the wrong application of a correct rule, or simply the wrong rule. A knowledge-based mistake happens when a wrong solution is applied to an unexpected or unknown situation; for example, in medicine, a junior doctor may decide not to use his formulary for a particular dose of a previously un-known antibiotic and he chooses the wrong dose, because of lack of information (Armitage, 2009). The whole kind of these errors can be described as *active failures* (Armitage, 2009, Reason, 1997).

Even if it is very complex to realize epidemiological studies on sanitary errors, scholars agree that errors made by doctors and nurses are a primary cause of illness, injuries or death of patients (i.e. Aiken, Clarke, Sochalski & Silber, 2002; Bovbjerg, Miller, & Shapiro, 2001; Thomas & Brennan, 2000; Vahey, Aiken, Sloane, Clarke, Vargas, 2004), to which it needs to be added organizational and context depending factors (West, Guthrie, Dawson, Borril, Carter, 2006).

The theme has been managed from several points of view, starting from the classical study *To Err is Human* published in 1999 by the USA Institute of Medicine (Kohn, Corrigan, & Donaldson, 1999). In that constitutive study, the dramatic amount of fatalities related to medical errors in the USA (from 44.000 up to 98.000 cases for year), made them a primary causal factor of death or serious physical damage, worse than all motor vehicle accidents in a year (43.458).

In Italy, as well as in many other countries, there is an analogous situation, which is described for example by the *Technical Commission on Clinical Risk* (Ministero della Salute, 2004), where the amount of deaths caused by medical errors and health services malfunctions

is assessed in 35.000 for year, especially in the operating rooms (rate of 32% for year) and in the wards (rate of 28% for year). Furthermore, in Italy the PIT 2013 (Progetto Integrato di Tutela, Integrated Protection Project) shows increasing data: denunciations for medical mistakes increased of 184% from 1994 to 2002. In 2012, 17.7% of people turn to the Italian Court for Patients' Rights (they were 16.3% in 2011) for medical mistakes. At the same time, in 2012, there are the 12.5% of reports referred to carelessness or distractions of health personnel, that is, all those behaviours or acts not directly damaging but potentially ready to cause damage to patients.

Furthermore, it appears interesting to point out, as a general consideration, the increasingly and more and more high attention addressed to the errors and to their management in the healthcare setting, which corresponds to an increasingly high sensitivity to the complexity of the contest and the need to explore and improve studies and research on it. In the last years, in fact, it has grown more and more an enhanced sensitivity of citizen/customers, not only, or not more only *patients*, but carriers of specific needs and health expectations. But, nevertheless, data collected in the diverse contexts are probably underrated. This happens for several reasons: in the medical systems, there are problems of willingness to report, so medical and nursing staffs tend to underreport errors (Katz-Navon, Naveh, & Stern, 2005, 2009; Probst, Estrada, 2010). There are few or no information about near misses as well as latent failures (Reason, 1997) of health systems, but there are evidences that they influence the quality of sanitary systems and the mortality and *morbidity ratio* (West et al., 2006).

The “victims” of the errors in medicine are more numerous than the single patient: there are the relatives, and there are also the clinicians, doctors, nurses, and in general all the clinical staff. They suffer for the errors directly and indirectly made (Maslach, & Leiter,

2005), and they are themselves also frequently exposed to a dangerous or unsafe environment (Armitage, 2009; Hoffman & Mark, 2006), which in turn grows the amount of complexity of the error management.

The efforts to solve or manage medical errors are more and more increasing, but yet not enough effective, in some cases giving rise to paradoxical results. For example, one of the reactions of the medical system to these new needs is the so called “defensive medicine”, by which the doctor uses clinical analysis to protect himself from the risk of the diagnostic error, rather than to improve the patient health.

On the other hand, many scholars note that learning takes place when people are encouraged to learn from errors (Heimbeck, Frese, Sonnentag, & Keith, 2003) and when the negative emotional impact of errors has been stand and accepted (Keith & Frese, 2005). Errors in fact represent also a negative information feedback on the system and individual functioning, even if they are also a “straining” source of knowledge (Edmonson, 1996).

Armitage (2009) notes also that it is critical to give importance not only to the cognitive processes which can create the conditions for making errors, but they must be integrated with an explicit acknowledgement of organizational and systems factors. This complex approach to errors permits to shift from blaming individuals towards the acceptance that errors are inevitable and a possible source for learning.

### *Managing error: the role of the Error Culture*

James Reason (1995, 2000) has applied this approach to errors to the British healthcare systems after the occurrence of a string of serious incidents in UK. His studies

strongly influenced the policy perspective on medical error of the British Department of Health and produced the publication of “An Organisation with a Memory” (Department of Health, 2000), where learning from incidents and mistakes and rejecting an approach to errors based only on a disciplinary-centered policy (i.e. blaming errors and punishing who commits them) are considered crucial for developing a safe healthcare system.

This means that the shared approach to errors, in other words, the *Error Culture* (van Dick, Frese, Baer, & Sonnentag 2005) of the organizations is deeply conditioned by the amount of openness to sharing information, to communicate about errors (Homsma, Van Dyck, De Gilder, Koopman, Elfring, 2009), to reflect on them, to mitigate emotional strain and to reduce the “temptation” to cover errors and failures.

Specifically, Van Dick and colleagues (2005) conceptualize the error culture in two main approaches. The *Error management*, which could be defined as the positive side of the error culture, is an approach to errors that does not attempt to do away with errors completely, which is impossible to realize, but rather to deal with errors and their consequences after an error has occurred. The Error Management approach focuses on reducing and mitigating negative error consequences and on increasing potentially positive consequences. This approach ensures that errors are quickly reported and detected, that negative error consequences are effectively handled and minimized, and that learning can occur (Frese, 1991, 1995). The second main approach of the error culture is the *Error aversion*, which aims at avoiding and prevents negative error consequences by avoiding the error itself (van Dick et al., 2005). This approach to errors implies that the fear of punishment associated with the strain caused by the awareness to be “guilty” prevents to use errors as a source of learning and improvement. Therefore, we can only try to avoid errors and the consequent blame, but this approach to er-

rors is condemned to be unsuccessfully, because of its unrealistic framework that errors could be eliminated (van Dick et al. 2005).

In many cases, especially if the errors consequences could be very serious (i.e. harming a patient) the organization expresses a blaming culture, by the tendency of bosses to punish the occurrence of errors, so discouraging the trustworthiness of employees towards their bosses and consequently any kind of learning by errors. If the shared beliefs are that errors could be used against you, the willingness to openly share and discuss about them will be very low (Edmondson, 1996).

Meanwhile, Homsma, Van Dyck, De Gilder, Koopman, Elfring (2009) note that, to learn by his own or others errors, communication about them is very important and, at the same time, that the degree of communication is sensible to the organizational approach to errors and failures. In fact, while covering up errors is an ordinary common behaviour (Cannon & Edmonson, 2005), people often are reluctant to share their errors, especially if they don't trust on their bosses and colleagues, are worry that sharing them could be used against them (i.e. loss of career, or rewards), or feel guilty and suffer for blaming and reprimands (Cannon and Edmondson, 2005; Husted & Michailova, 2002). These negative emotional and behavioural approaches to errors (Bosk, 1979) are deeply related to the reactions to the organizational conception towards errors (Homsma et al. 2009).

### *Trustworthiness and error culture*

The central question appears to be how to shift from an error avoidance centred model to an error management centred model, in which errors are considered as a source of infor-

mation and learning and can be used to enhance the individual and organizational performance. The answer lies on the organizational culture, which is modelled by the trustworthiness of the leaders. Literature proved that this factor is an important predictor of many aspects of the organizational life, such as the employees' organizational trust (Robinson & Rousseau, 1994). Also trust toward leaders can be considered as an outcome of the trustworthiness (Gill, Boies, Finegan & McNally, 2005), where trust can be defined as a behavioural intention, that is, the "willingness to be vulnerable" and it is based on the trustor's perception that the particular trustee is "trustworthy" (Colquitt et al., 2007, 2012; Mayer et al. 1995). In addition, the dimensions of perceived ability, integrity and benevolence of leaders are recognized as enablers of the overall organizational justice (Holtz & Harold, 2009), the reduction of transaction costs and performance improvement (Dyer & Chu, 2003), and the willingness to share tacit knowledge (Becerra, Lunnan & Huemer, 2008).

The perceptions of the trustor are established on the different facets of trustworthiness, based on the perception of *ability*, *integrity* and *benevolence* of the trustee (Mayer, et al., 1995).

*Ability* represents the degree on which the trustor holds to be true that the trustee had a group of skills, competencies, and characteristics useful to encompass some influence within a specific domain. Supervisors trustworthy in ability, for example, are perceived as competent and skilled, and by this "power of competence" they exert an influence on co-workers. Thus, the ability of managers to handle with errors, to cope with failures or to find effective solutions to unexpected problems may be a factor that enhances the propensity of employees to communicate and talk about their own or others errors.

A second component of trustworthiness is *Benevolence*, the extent to which a trustee is believed to want to do good to the trustor, aside from a selfish profit motive. If an employee believes a manager cares about the employee's interests, the manager will be seen as having benevolence for the employee. For instance, employees who perceive their supervisor as benevolent, will feel safe in reporting mistakes, will share with colleagues and supervisors wrong actions thinking that this will not be used to damage anybody or negatively influence the personal credibility and reputation, or inhibit carrier development, etc. Benevolence is moreover important when, after an error, some doubt, uncertainty or crisis are useful to activate a learning oriented behaviour (Miller & Friesen, 1980; Daft & Weick, 1984). Fiol and Lyles (1985) sustain in fact that also a lack of experienced control is a prerequisite for learning to occur. Learning is induced by “breaking” events that cannot be managed using the consolidated and well known ways of doing things. To handle with this, a certain amount of anxiety and insecurity are needed and benevolence of the boss makes them faceable. So, lack of perceived control over the situation helps learning to happen (Homsma et al. 2009).

The severity of consequences, moreover, has an influence on the willingness to report of employees, reducing their tendency to keep silent about their own and/or others errors, forcing them to not covering up the errors (Homsma et al. 2009). On the other side, Cannon and Edmondson (2005) consider how small errors and failures can interfere with learning, if employees have perceived them as too much marginal to be used as a source of learning.

The last component of trustworthiness is *Integrity*, defined by Mayer et al. (1995) as the perception that the trustor has that the trustee behave applying a set of principles acceptable for the trustee. If a manager is perceived with high moral integrity, for instance, employees will believe that he/she will give honest and correct information and will not manipulate

against co-workers and colleagues. This approach to errors appears to be crucial for the development of an organizational error culture, more oriented to the error management than to the error aversion. Presumably he/she will make decisions based on procedural justice criteria (Colquitt et al., 2007), so there will be used the just culture principle, not blaming for the errors made, but rewarding for sharing them with the team, colleagues and supervisor.

The way in which these three factors are combined into trustworthiness depends both on individual characteristics, and on context and situational (organizational) features. Thus, the amount of each of these factors can vary. Sometimes ability is much more important; in other cases, integrity or benevolence or a mixture of them can have a greater relevance (Mayer et al., 1995). Therefore, the three dimensions of the trustworthiness can be considered separately and partially independent each other, although they are strictly connected (Colquitt et al., 2007).

The ability of managers to handle with errors, their benevolence for people who feel safe in reporting mistakes, that will not be used to damage anybody, or the moral integrity of manager, that gives honest and correct information and don't manipulate against co-workers and colleagues, appear all to be crucial for the development of an organizational error culture more oriented to the error management and less to the error aversion.

### *Aims and Hypotheses*

The principal aim of this study is the identification of a comprehensive process that considers the influence of trustworthiness in the supervisor on both the error culture approaches (management and aversion), which in turn will influence different organizational outcomes (positive: performance, innovation; and negative: errors).

Specifically, the first objective is to explore the causal relation between trustworthiness and error culture, thus focusing on the contribution of leaders' perceptions in modelling the organizational culture about errors.

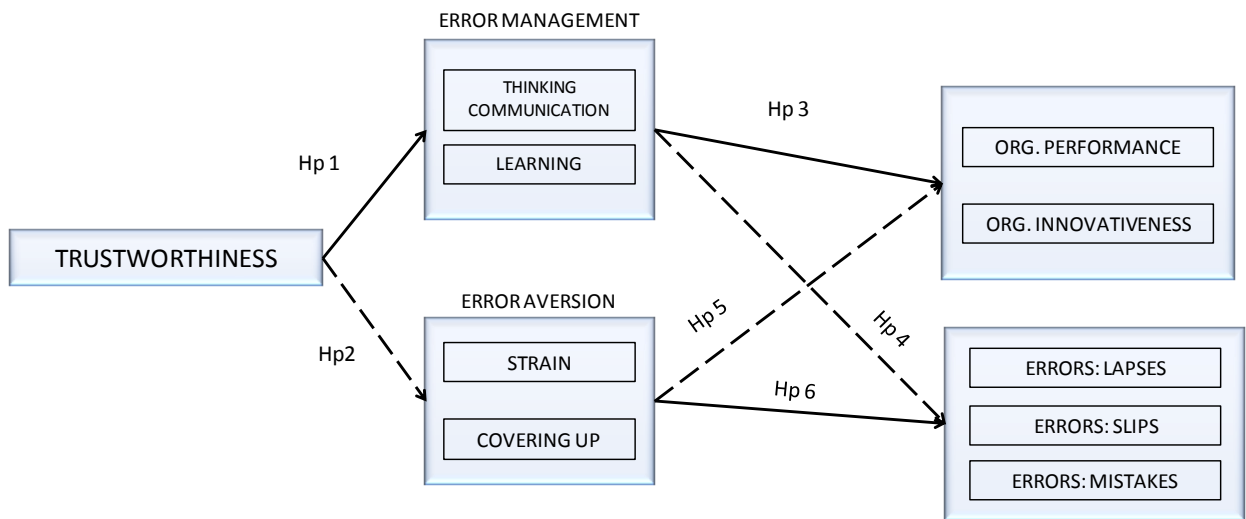
Moreover, we intend to study the influence of the management dimensions in facilitating positive performance outcomes (performance and innovation); and, concurrently, the influence of the aversion dimensions in enhancing negative performance outcomes (errors commission).

Specifically, in accordance with the literature indications, and taking into account the concurrent contribution of both management and aversion dimensions, we hypothesize (see fig. 1) that:

Trustworthiness of supervisor (comprise the specific trustworthiness sub dimensions) will be positively related to the error management dimensions (Hp1), and it will be negatively related to the error aversion dimensions (Hp2).

The error management dimensions will be positively related to organizational performance and innovation (Hp3) and negatively related to actual errors (Hp4); while the error aversion dimensions will be negatively related to the organizational performance and innovation (Hp5) and positively related to actual errors (Hp6).

**Figure 1: The posited model**



Note: - Dotted lines indicate meaningful negative influence  
 - Continuous lines indicate meaningful positive influence

## Method

### *Participants and Procedures*

The present study has been realized in the sanitary context, typically characterized by *High Reliability Organizations* (HROs) where the system complexity, due to the high levels of uncertainty, the complex task resources and demands, and the potential dramatic consequences of errors made, make it absolutely one of the more challenging organizational systems for the study of the error dimensions (Weick, 1987, Weick, Sutcliffe & Obstfeld, 1999; Weick, Sutcliffe, 2007).

The study involved 577 participants coming from twenty-three different wards belonging to public and private hospitals, clinics and medical studies. Participants voluntarily took part to the study, and did not receive any kind of reward, financial or other. Trained re-

search assistants handed out questionnaires in blank envelopes. Each participant received a presentation letter, containing a brief description of the research and of its main objectives, and individually filled out an anonymous paper and pencil questionnaire. Before administering the questionnaire, the researcher explained that the participants' responses would be very confidential and that the organization for which they worked had not commissioned the study.

Participants were 344 females (the 59.6% of the sample), and 222 males (the 38.5% of the sample) (11 unknown), aged from 22 to 69 years (average age of 43.48, SD 9.86, modal age of 50). The organizational tenure was between 1 and 40 years (average tenure of 11.9 years, SD 9.42). About 47% of the sample had completed high school with a specific degree in nursery, while 42.4% had a university degree, and almost 9% of the sample had basic education level. Other characteristics of the sample are: the job position, while almost the 62% are nurses, about 9% is head nurses; the 20% are managers and about the 9% are supporting staff. The 75.6% of the sample had an open ended work contract.

### *Measures*

*Error Culture.* This has been measured by a short version of 17 items based on the original questionnaire generated by van Dick and colleagues (2005), which is a 28 items questionnaire. Participants were asked to indicate how often (from 1 = *never* to 5 = *always*) they act each of the listed behaviours in their present job. The short version of the ECQ offered in the present study answers to a series of needs: first, it takes into account the specificity of the “*learning from errors*” sub dimension; the “*thinking*” and the “*communication*” sub dimensions

show very high positive correlation, and analogous tendency; for this reason they have been jointed in a unique sub dimension (named “thinking and communication about errors”); second, the “*learning from errors*” sub dimension appears different from the others, which could bring to consider it as a mediation variable among error management and several outcomes (that is, *organizational performance* and *organisational innovativeness, errors made*); last but not least, reducing the ECQ from 6 dimensions to four dimensions fits better in terms of parsimony of the model presented in this study.

So, the *Error management approach* of the error culture questionnaire has been measured by two dimensions, “*thinking and communication about errors*” and “*learning from errors*”. The “*thinking and communication about errors*” dimension was measured by a six-item scale (three from the original “thinking about errors” and three coming from the original “communication about errors”). An example item is: “After making a mistake, people try to analyse it”. The *learning from errors* dimension was measured by a three-item scale. An example item is: “Our errors point us at what we can improve.”

The *Error aversion approach* consists of the two dimensions of “*error strain*” and “*covering up errors*”, as in the original ECQ, but using for each of them a four-item scale. Specifically the *error strain* dimension was measured by four items scale, an example of which is: “In this organization, people get upset and irritated if an error occurs”. An example of the four items scale for the *covering up errors* dimension is: “Employees who admit their errors are asking for trouble”.

In table 1, the whole questionnaire, in English and in the Italian translation (used for realising the research) is presented, with also the descriptive statistic for each item of the scale.

### *Antecedents*

*Trustworthiness of supervisor.* This factor, declined in the three sub dimensions of *Ability* (6 items), *Benevolence* (3 items) and *Integrity* (6 items), was measured using an Italian version of 15 items (from 1= *never or almost never* to 5 = *always or almost always*), of the scale by Mayer & Davis (1999). The scale has been adapted for the needs of the present study, using the wording “supervisor” instead of the original “management” to better measure the immediate perceptions and expectations of trustees with regard to the trust (that is, the direct boss). The items of the scale, its psychometric statistics, and Cronbach’s alpha are reported in table 2.

### *Outcomes*

*Errors:* These were measured with a 10-items scale, with a Likert ranging scale pointed from 1 (*never or almost never*) to 5 (*always or almost always*), developed *ad-hoc* for the purpose of this study. The *Errors* scale used in the present study, starting from the theoretical assumptions described above, is a readjustment and integration of different scales (i.e., Lawton, 1998; Katz-Navon, Naveh & Stern, 2005, 2009; Probst & Brubaker, 2001; Zohar, 2002). It consists of three dimensions, named, following the definition of errors proposed by Reason (1997, 2000) and early described: *mistakes* (3 items), related with the so called “planning errors”; *slips* (4 items), related errors of actions often skill-based; and *lapses* (3 items), which is typically related to memory errors. The items of the scale, its factorial structure and psychometric statistics, and Cronbach’s alpha are reported in table 3.

*Organizational performance.* This has been measured with a single item capturing how well (from 1 = *not at all* to 10 = *completely*) a company is doing with regard to its own general

performance (“To what degree has your organization obtained a better performance in the last three years?”).

*Organizational innovativeness.* This was measured with a single item capturing the amount of innovativeness (from 1 = *not at all* to 10 = *completely*) the organisation actively pursues (“To what degree has your organization been innovative in the last three years?”).

The psychometric statistics and Cronbach’s alpha of the two organisational single items are reported in table 4.

### *Data analysis*

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) (version 16.0) and *MPlus* (version 6.1, Muthén & Muthén, 1998-2010). Descriptive statistics for all study variables were computed, as well as reliability assessments of study instruments. Our hypotheses were tested using structural equation modelling (SEM) techniques to analyse the links between each of the hypothesized dimensions. This approach allows taking measurement errors into account by defining latent variables by their indicators. Specifically, due to the high correlations among the three *Trustworthiness* factors (*ability*, *integrity* and *benevolence*) (see Table 5), a second order trustworthiness factor was defined by using the three subscales. Even in the case of errors, a second order factor was defined by using the three factors: lapses, mistakes and slips. Finally all the other variables were posited as a single-indicator latent variable, due to the large number of items included in the measurement instruments. In these cases, to account for measurement error and obtain more precise estimates of structural parameters, error variance for each single indicator was fixed at one minus the sample reliability estimate of the variable, multiplied by its sample variance (Bollen, 1989).

Chi-square ( $\chi^2$ ) and incremental fit indices such as the Comparative Fit Index (CFI) (Bentler & Bonett, 1980), the Root Mean Square Error of Approximation (RMSEA; Steiger, 1990) and Standardized Root Mean Square Residual (SRMR; Jöreskog & Sörbom, 1984) were considered as fit indices in accordance with a multifaceted approach of the model fit (Tanaka, 1993).

## Results

### *Preliminary results*

As preliminary analysis, we examined the items' descriptive statistics of the entire used dimensions, which are *trustworthiness* in supervisor, *thinking and communication* about errors, *learning* from errors, *covering up* errors and error *strain*, organisational *performance*, organisational *innovativeness* and *errors* made.

Descriptive statistics of the Error Culture Questionnaire are described in following Table 1. As shown, all the items were substantially normal, and all the dimensions showed a good internal consistency with Cronbach's alpha coefficients higher than .70.

With regard to the *Trustworthiness* scale, as shown in table 2 all the items were normally distributed and all the dimensions showed a good internal consistency with Cronbach's alpha coefficients higher than .80.

With regard to the *errors* scale, results of the explorative factor analysis showed a 3-factor structure: *mistakes* (3 items), *slips* (4-items) and *lapses* dimension (3-items). All the dimensions showed a good internal consistency, with Cronbach's alpha coefficients higher than .70 (see Table 3).

**Table 1:** Error culture. Psychometric characteristics

(A)	(B)	(C)	Cronbach's $\alpha$	M	SD	Skewness	Kurtosis
ERROR MANAGEMENT	THINKING AND COMMUNICATE ABOUT ERRORS	3. After an error has occurred, it is analyzed thoroughly.	.853	3.20	1.139	-.188	-.705
		4. If something went wrong, people take the time to think it through.		3.06	.999	-.126	-.232
		5. After making a mistake, people try to analyze what caused it.		3.69	.990	-.386	-.424
		15. When people make an error, they can ask others for advice on how to continue.		3.68	.929	-.339	-.368
		16. When someone makes an error, (s)he shares it with others so that they don't make the same mistake.		3.20	1.085	-.121	-.683
		13. When people are unable to correct an error by themselves, they turn to their colleagues		3.49	.942	-.350	-.214
	LEARNING FROM ERRORS	1. For us, errors are very useful for improving the work process.	.749	3.60	1.006	-.490	-.003
		7. An error provides important information for the continuation of the work.		3.85	.951	-.613	-.005
		8. Our errors point us at what we can improve.		3.86	.956	-.571	-.196
	ERROR AVERSION	ERROR STRAIN	1. In this organization, people feel stressed when making mistakes.	.752	3.49	.950	-.101
2. In general, people in this organization feel embarrassed after making a mistake.			3.54		1.006	-.328	-.246
3. People in this organization are often afraid of making errors			3.30		1.058	-.144	-.586
4. In this organization, people get upset and irritated if an error occurs			3.35		.938	-.131	-.226
COVERING UP WITH ERRORS		7. There is no point in discussing errors with others.	.714	2.49	1.144	.283	-.804
		10. Employees who admit their errors are asking for trouble.		1.92	1.123	1.059	.154
		6. Our motto is, "Why admit an error when no one will find out?"		2.01	1.171	.912	-.255
		8. There are advantages in covering up one's errors.		2.25	1.199	.593	-.630

(A) Main dimension; (B) sub dimension; (C) order number in the original scale (van Dick et al. 2005)

**Table 2:** Trustworthiness scale. Psychometric characteristics

		Cronbach's $\alpha$	M	SD	Skeweness	Kurtosis
Ability	1. My supervisor is very capable of performing its job.		3,71	1,193	-,809	-,109
	2. My supervisor is known to be successful at the things he tries to do.		3,55	1,205	-,539	-,574
	3. My supervisor has much knowledge about the work that needs done.		3,83	1,140	-,831	-,057
	4. My supervisor feels very confident about top management's skills.	.953	3,83	1,169	-,853	-,084
	5. My supervisor has specialized capabilities that can increase our performance.		3,73	1,241	-,738	-,421
	6. My supervisor is well qualified.		3,91	1,136	-1,007	,346
Benevolence	7. My supervisor is very concerned about my welfare.		3,07	1,293	-,222	-,997
	8. My needs and desires are very important to my supervisor.	.831	2,90	1,277	-,041	-1,026
	9. My supervisor really looks out for what is important to me.		3,06	1,248	-,169	-,944
Integrity	10. My supervisor has a strong sense of justice.		3,36	1,243	-,404	-,766
	11. I never have to wonder whether my supervisor will stick to its word.		3,17	1,278	-,250	-,955
	12. My supervisor tries hard to be fair in dealings with others.		3,50	1,240	-,587	-,561
	13. My supervisor's actions and behaviours are not very consistent.*	.957	3,35	1,244	-,435	-,745
	14. I like my supervisor's values.		3,52	1,207	-,566	-,497
	15. Sound principles seem to guide my supervisor's behaviour.		3,43	1,231	-,475	-,641

\*reverse item

**Table 3:** Errors made: exploratory factor analysis and factors' psychometric measures

	M	SD	Skeweness	Kurtosis	Cronbach's $\alpha$	MISTAKES	SLIPS	LAPSES
1. Administer a drug not effective in patient care. <i>Somministrare un farmaco non efficace alla cura del paziente.</i>	2.02	.900	.740	.339		.856		
2. Use an unsatisfactory diagnostic/therapeutic procedure <i>Utilizzare una procedura diagnostico/ terapeutica poco soddisfacente.</i>	2.15	.897	.419	-.387	.781	.789		
3. Identify incorrectly a patient for clinical activity. <i>Identificare erroneamente un paziente per un'attività clinica.</i>	1.85	.887	.865	.200		.513		
4. Perform an activity in much more time than the necessary. <i>Svolgere un'attività in molto più tempo di quanto sarebbe necessario.</i>	2.74	.919	.296	-.180			.795	
5. Receive from colleagues insufficient information to well perform his/her own job <i>Ricevere dai colleghi informazioni insufficienti per svolgere bene il proprio lavoro.</i>	2.75	.918	.083	-.413	.748		.652	
6. Not readily find anything you need (e.g. equipment). <i>Non trovare prontamente qualcosa di cui si ha bisogno (es. attrezzatura).</i>	2.91	.973	.027	-.347			.634	
7. Failing to comply with protocols, procedures, or guidelines <i>Non rispettare protocolli, procedure o linee guida.</i>	2.16	1.061	.683	-.307			.399	
8. Forgetting to perform a task. <i>Dimenticare di svolgere un compito.</i>	2.19	.852	.480	.418				.872
9. Being abstracted when working. <i>Distrarsi sul lavoro</i>	2.41	.922	.137	-.508	.749			.752
10. Doing less than would be required to perform a work of good quality <i>Fare meno di quanto sarebbe necessario per svolgere un lavoro di buona qualità.</i>	2.09	1.049	.781	.031				.524
% variance						33.028	11.334	6.953

Descriptive statistics of the two single item outcomes, organisational innovativeness and organisational performance, presented in table 4, show a normal distribution for each of the two items.

**Table 4:** Psychometric measures of organisational innovativeness and performance

	M	SD	Skeweness	Kurtosis
Organisational innovativeness	5.66	2.475	-.295	-.742
Organisational performance	6.15	2.235	-.578	-.220

With regard to the variables correlations, following table 5 shows that the most of them are meaningfully correlated.

**Table 5.** Correlations of all variables

	1	2	3	4	5	6	7	8	9	10	11
1. Ability	1										
2. Benevolence	.687**	1									
3. Integrity	.784**	.840**	1								
4. Mistakes	-.163**	-.087	-.146**	1							
5. Slips	-.224**	-.202**	-.236**	.595**	1						
6. Lapses	-.203**	-.196**	-.217**	.523**	.492**	1					
7. Thinking and communication	.399**	.386**	.450**	-.131**	-.330**	-.262**	1				
8. Learning	.162**	.129**	.153**	-.169**	-.073	-.187**	.470**	1			
9. Strain	-.081	-.147**	-.124**	.201**	.199**	.093	.083*	.143**	1		
10. Covering	-.160**	-.060	-.084*	.420**	.369**	.308**	-.212**	-.186**	.266**	1	
11. Org. Innovativeness	.438**	.412**	.426**	-.059	-.215**	-.144**	.445**	.164**	-.024	-.112**	1
12. Org Performance	.391**	.371**	.387**	-.071	-.201**	-.163**	.423**	.194**	-.054	-.102*	.742**

\*\* : 0.01 (two-tailed)

\* : 0.05 (two-tailed)

### *Structural Equation Modelling (SEM)*

The posited model showed a not satisfied fit ( $\chi^2_{(39gl)} = 149.39$ ,  $p < .001$ ; CFI= .96; TLI= .93; RMSEA= .070 (.058-.082),  $p < .001$ ; SRMR=.062). So, after an inspection of modification indices we added six theoretically meaningful paths. Specifically, in the final model, showed in Figure 2 ( $\chi^2_{(33gl)} = 65.54$ ,  $p = .0006$ ; CFI= .99; TLI= .98; RMSEA= .041 (.026-.056),  $p \leq .83$ ; SRMR=.023) we considered not only *standard* paths but also *not-standard* paths for separating specific from general effects (Bentler, 1990). Whereas a *standard* path answers to questions about general latent variable effects', a *not-standard* path uses residual variances to address the causes and the consequences of potentially important specific effects. In our model, two different *standard* paths and four *not-standard paths* were included:

a) The standard effects were the paths from trustworthiness to innovation and to performance;

b) One of the not-standard effects was the specific effect of *ability* on *covering*. This specific effect represents the effects that the part of ability not shared with integrity and benevolence has on covering, beyond the effect that the latent variable trustworthiness (of which ability is part) has; in addition, another not-standard effect was the path from *trustworthiness* on *lapses*: this effect reflects the contribution of trustworthiness to what is unique about lapses, that is, what lapses (an aspect of the more general factor of errors) does not share with mistakes and slips. Similarly, we added the specific effect of *thinking and communication about errors*, and *error strain* on *slips*. So these two effects reflect the contribution of thinking-communication and strain to what is unique about slips, that is, what slips (an aspect of the more general factor of errors) do not share with mistakes and lapses.

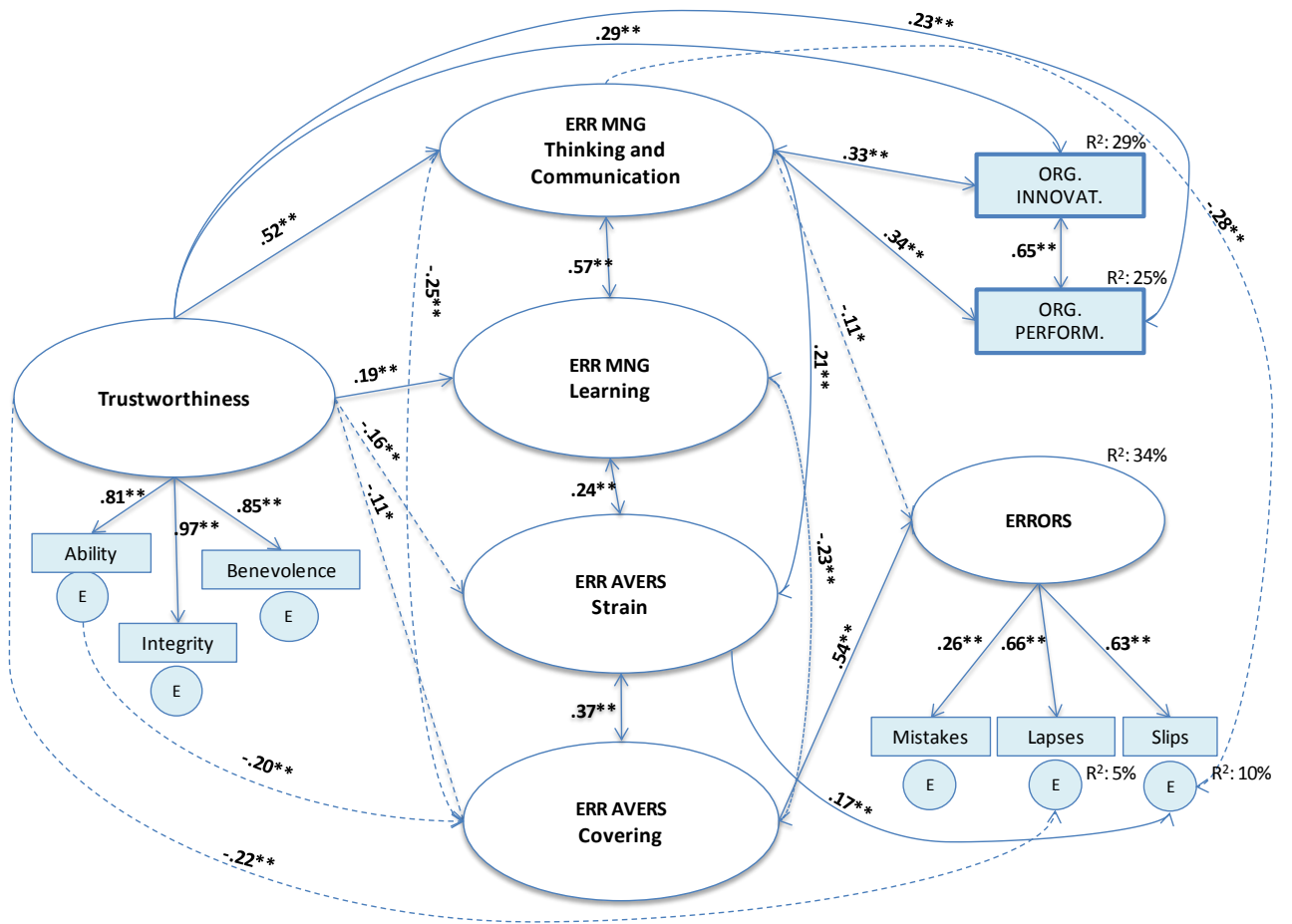
The model explained the 29% of variance of *organizational innovativeness*, 25% of variance of the *organisational performance*, and 34% of variance of *errors*, 10% of *slips* and 5% of *lapses*.

Overall, hypotheses 1 and 2 were confirmed, while hypotheses 3, 4 and 6 were only partially confirmed and hypothesis 5 was not confirmed. Specifically, *trustworthiness* positively and very significantly affected *error management* facets (Hp1) and negatively the *error aversion* facets (Hp2): so that the better the *trustworthiness* of the supervisor, the more *thinking and communication* and *learning* from errors, and the less the *covering* behaviours and *strain*, that is the emotional negative distress associated with the errors made by the co-workers. With regard to Hypothesis 3, only the error management dimension of *thinking and communication about errors* affected both *innovation* and *performance*: the more employees analyse, quickly detect errors and share information about them, the more the organisation will be more effective in achieving its goals and more capable to adopt innovations.

However, this influence relationship between the *learning* error management dimension and the organizational outcomes was not verified. Similarly, with regard hypothesis 4, while *thinking and communicate about errors* negatively affected errors (both the *error* latent variable and *slips*), *learning* did not.

With regard to hypothesis 5, neither error *strain* nor *covering* affected the organizational positive outcomes (*innovation* and *performance*). Finally, with regard to hypothesis 6, *covering* affected positively and very significantly *errors*, while *strain* affected only the specific type of errors of *slips*.

**Figure 2: The tested model**



\*\* p<.01; \*p<.05

## Discussion

The study here presented is the first, to our knowledge, which examines in depth the influence of trustworthiness of the supervisor on the error culture, considering also actual errors as outcome of the error culture dimensions, that is, the process that, starting from the influence of trustworthiness of the supervisor in modelling the error culture, in turn positively or negatively influences the organizational performance.

### *The influence of trustworthiness of supervisor on the error culture's dimensions*

The importance of leadership perception in modelling specific facets of the organizational culture is a first result of this investigation, supporting theoretical and empirical findings in the literature previously cited. Specifically, we have found that employees' perception of their supervisor as trustworthy influences their shared beliefs and attitudes towards errors: when the supervisor is seen as competent and skilled, honest and correct in his/her decisions, and having not selfish motives, then employees will take the right time to analyse mistakes when they occur, to detect what caused them, and asking to colleagues for advice or help.

Furthermore, they believe that errors represent a source for learning, being useful information for improving their work. They also feel less strained, embarrassed or afraid when an error occurs, and tend not to hide the mistakes made.

These results are coherent with the social exchange theory, according to which trust is vital to the development and deepening of social exchange relationships both because it decreases uncertainty (thus reducing the lacks of information on the behaviour that the other will act in the future and favouring the risk-taking), and because it fosters a sense of obligation, inducing employees to reciprocate behaviours and attitudes (Blau, 1964; Colquitt, LePine,

Piccolo, Zapata, & Rich, 2012). We assume that talking about errors implies to take the responsibility about the wrong action made, and that a discretionary choice is possible (to focus on errors or to cover them). Thus, perceiving the supervisor as honest and benevolent, for instance, allows employees to feel less strained and to foresee that admitting an error will not determine unfair consequences (e.g. penalties in career, being identified as a scapegoat, etc.). At the same time, for employees it is worth to communicate their mistakes, analyse and think about them, if they believe that their supervisor has the appropriate skills to properly manage the situation and to help in finding a solution.

Furthermore, the solicitation to reciprocate induces employees to be more committed in the error management process, being willing to take the risk of talking about mistakes and to start a process of change and learning, also because believing that such effort will be reciprocated in the future. However, this is only a first step on this topic and a useful direction for future research would be to promote some more studies to better analyse these relations and influences.

#### *The influence of the error management dimensions on organizational outcomes*

This study presents also some encouraging results on the importance of the error culture on the organizational performance. First, our results confirmed previous research on the influence of the error management approach on both organizational performance and innovation (Chillarege, Nordstrom & Williams, 2003; Drach-Zahavy & Pud, 2010; Hofmann & Frese, 2011; Homsma, Van Dyck, De Gilder, Koopman & Elfring, 2009; Katz-Navon, Naveh & Stern, 2009; Sitkin, 1996; Sitkin, Sutcliffe, Roger & Schroeder, 1994; van Dyck et al., 2005).

Moreover, coherently with van Dyck and colleagues' results (2005), which represents also the only study that analyzed this relationship, none of the two error aversion dimensions do influence the 'positive' outcomes of organizational performance and innovation. Our findings show that the organizations more capable to quickly detect errors, to analyse them and to communicate with teammates for help, have also a higher performance and are more innovative. However, this relationship lacks of empirical support for the learning dimension, which has no influence on the outcomes under analysis. This result is similar to Study 1 result presented above in the current thesis, and needs of further research. A possible explanation is that learning processes have an effect not in the short but in the long run. They also may be considered conditions that foster organizational adjustment and change, but they do not necessarily result in effective performance outcomes. Thus future research, that longitudinally follows the whole error management process, should be encouraged.

It is worth noting that trustworthiness showed also to have a positive direct influence on the organizational performance and on organizational innovativeness. This influence was not posited in the theoretical model of the present study, but it results to be in accordance with the general literature on trustworthiness and its effects on the organizational improvement (Colquitt et al., 2007; Mayer et al., 1995; Robinson et al., 1994). These important effects appear coherent with the purpose of risk management carried out by the trust for the leader, which implies the acceptance of the willingness to be vulnerable of the co-workers, in relation to the uncertainty related to the innovativeness. With regard to the organizational performance, the positive effect on it of the trustworthiness could be related to the commitment of the co-worker to reciprocate, in the logic of the social exchange, ability, integrity and benevolence of the boss.

Another particularly interesting result is related to the influence of the error culture on ‘negative’ outcomes, the errors. In fact literature lacks of studies on this topic (Homsma et al, 2009). Our data show that the different dimensions of the error culture can contribute to avoid errors (error management) or to provoke them (error aversion). Especially, the covering dimension exerts a strong influence on errors in general, and the strain dimension has got a positive influence on the slips, typical errors due to distraction, fatigue, stress or hurry (Rasmussen, 1983). Also the ‘thinking and communication’ dimension has a negative influence on actual errors in general and, specifically, on slips. Organizations where people are worried and feel embarrassed when an error occurs, and tend to deny or cover their possible errors because admitting an error is considered useless and even risky, not only turn down the opportunity to manage them (in this way reducing the severity of the negative consequences and finding new solutions to the problem) but also increase the likelihood of errors, which occur more frequently. Overall, these results call attention on the error culture construct, which revealed to be not only an important predictor of positive organizational outcomes, but also a factor that may contribute in reducing actual errors.

Another interesting and unexpected result regards the direct negative influence of trustworthiness on lapses. Future studies could deep this relationship, also in the sense of the implicit meaning of what has been forgotten and the possibility that trustworthiness gives to “uncover” or unveil it (e.g. Freud, 2012).

To summarize, it is possible to assert that the error culture dimensions put forth a mediating role between trustworthiness and the outcome, enhancing the positive one with the error management, as well as the negatives with the error aversion facets.

### *Limitations and future research matters*

This study presents, of course, several limitations. First, we did not take into account the specificity of the different contexts in the sanitary sector and the specificity of a typology instead of another (i.e., surgery wards or emergency room, that are high-risk sectors and where the error consequences could be very serious and immediate).

Other limitations regard the cross-sectional nature of data, and the the utilization of self-report instruments, which could facilitate the common method bias and the social desirability effect, especially with regard to the items considering errors made and in general the approach to errors. Future studies could consider objective measures of errors and of performance.

Notwithstanding the limitations of our study, we believe it offers several points and insights to be explored in future research. The findings of this study raise a first question related with the role played by the ‘strain’ dimension. In fact, actual errors appear to be mainly influenced by the covering errors dimension, while the strain dimension directly influences only the slips kind of errors. This means that, as van Dick et al. (2005) posited, even if covering and strain are facets of the same aversion approach of the error culture, they might be not very homogeneous dimensions, exerting a diverse influence on the outcomes. The error aversion approach has been less studied by the scientific literature, especially regarding the *strain* dimension. We think that the role played by the “negative” dimensions of error culture, especially of the strain, should be deepened. In fact the strain is an emotional dimension, recognized by many scholars as an inescapable component of the self-awareness of the error management (Edmonson, 1996; Fruen & Keith, 2014; Zhao & Olivera, 2006). Thus, strain could be relevant in both the covering as well as in the management approach to errors, differently

orienting the employees' attitudes toward errors, influencing behaviours of covering or analysis, communication and competence in managing errors made. However, future research focused on this dimension is needed.

As a further research question, that needs to be explored in future studies, concerns the role played by the "learning" dimension of the error management approach. In fact, the model we tested shows no influence of learning on the outcomes. So, learning could represent a distal outcome of the overall Error Management approach, consistent with the learning processes derived from the management of errors for positive extents, not in the form of blaming or avoiding them, which could explain its different trend compared with the other dimensions that arrange error management. To better deep this assumption, it could be useful a longitudinal study, better if conducted in high complexity organizations. Another interesting aspect that would need of future research regards the leaders' perceptions towards the culture expressed by the team or the group of co-workers, to investigate the overall approach to the error culture and their possible role-related (i.e. leader or follower) discrepancies.

Another emerging aspect, unexpected if compared with the existing literature on the trustworthiness (Colquitt et al, 2007, 2012) is the prevalence of the ability dimension, which influences negatively the covering dimension of error culture. It could be deepened to better understand if it comes from the typical leadership styles in the Italian sanitary sector or in Italy *tout court* (Bobbio, Van Dierendonck, & Manganelli 2012).

### *Practical implications*

Linked together with these aspects, there are no empirical studies on the “negative” side of error management (i.e. error aversion) and, consequently, there are no studies, to our knowledge, with a comprehensive approach (i.e. the positive and the negative dimensions considered together).

Another positive aspect of this study, which needs to be considered, is that, as showed, there are few studies on the error culture in the sanitary sector (Aspden, 2004; Bauer & Mulder, 2011). The most of them are dedicated to error avoidance and error prevention, with a little attention devoted to the “positive” side of errors (Tucker, Edmondson, 2003). The reason of this is probably cultural, strictly linked to the deepest values of the medical profession: errors simply must not happen (Pfeiffer & Wehner, 2012).

The error culture approach could facilitate a new conceptualization of errors and the chance to look at the errors more like opportunities and not only like adverse events. In the sanitary sector this new approach could really “make the difference” in terms of effective performance, organizational commitment, and work satisfaction.

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## **Chapter 4**

### **The vicious cycle of errors: the influence of organizational culture and leadership styles on Error Aversion culture and errors made in the Italian Civil Aviation Authority**

#### **Abstract**

The study here presented investigates the role played by organizational culture (power distance and uncertainty avoidance) and leadership styles (servant and resentful) in relations to the error aversion approach, specifically error strain and covering up errors, which in turn influence some negative individual outcomes, that is lapses and mistakes. A sample of 327 participants coming from the safety and security job of the Italian CAA (Civil Aviation Authority) has been involved in the study. Limitations and future research needs are discussed.

## Introduction

The current study is focalized on deepening the relationships between some leadership styles and cultural general orientations and the error aversion facets, which are part of the general model of the error culture (van Dick, Frese, Baer, & Sonnentag, 2005). This approach identifies two major cultural dimensions, namely error management vs. error aversion, proving that the former positively influences the organizational performance, the latter influences it negatively. However, most studies take in account only the “positive” dimension of the error culture (management) and mostly positive outcomes (e.g. organizational or workers performance, ROI, safety). We believe that it is important to fill this gap in the literature, focusing on the “negative” part of the error culture and the role it plays not only in buffering the organizational performance but also in inhibiting errors. It is plausible that the error culture on the one hand promotes, through the error management processes, organizational learning and development; on the other hand, through the error aversion processes, the failure in secondary prevention of errors, thus avoiding that the mistakes already made will be repeated.

Particularly, Error Aversion Culture (EAC) denies errors and is characterized by a fear or embarrassment towards errors and a certain reluctance to discuss them. Moreover, when errors happen, they are perceived as very frustrating and also an intervention for their correction could represent a source of emotional strain (Keith & Frese, 2005).

In the real life, many organizations indeed are characterized by an aversion approach to errors and, when somebody commits errors, they tend to adopt a blaming approach (Catino, 2008) to punish the occurrence of errors, thus reducing the potential information coming from

the event and above all, limiting the possibility to openly share errors and make them a source for organizational improvement. On the other hand, people are inherently reluctant to talk about their mistakes (Edmonson, 1996), because the common expectation is that talking about errors could probably lead to negative reactions, prejudice and activation of the fundamental attribution error (Weiner, 1985) which means, for example, that if an employee made a mistake in a specific situation, he/she will always make mistakes in every situation (Brown, Williams, & Leeshaley, 1994). Furthermore, an open communication is achieved when people are confident that they will not be blamed or ridiculed when errors occur (Edmondson, 1999). On the other hand, the process of acceptance and sharing of communication about errors is, first of all, a process related to the emotional impact and to the emotional elaboration of the errors and of the chance that they can happen (Cannon & Edmonson, 2005).

In spite of the frequency of the difficult relationship between people and errors in the organizations, the aversion approach of error culture born from the reason that it is modestly investigated by scientific research and, in addition, the underlying processes that could lead to the error aversion culture in the organizational contexts are not yet clearly explored, as well as the influence that they could exert on negative outcomes like the errors made. This lack of studies is in contrast, again, with the everyday experience of the substantial presence of shares difficulties to talk about errors, to activate reflexive processes of learning about them, to give evidence of their occurrence. Hence, it begins of huge importance to better understand the presence and relevance of the organizational dimensions which could influence the propensity to cover errors and to avoid using them also as a source of knowledge and learning.

## Theoretical framework

### *The error process*

All kinds of organizations are constantly confronted with the errors matter, but not all the errors are managed in the same way. In the aviation context, specifically, the theme is order of the day. Usually, high attention has been given especially to the errors when they can generate negative consequences, like incidents, accidents, injuries (West, Guthrie, Dawson, Borril & Carter, 2006). So, traditionally the consideration towards errors has been focused on the organizational attitude to prevent them, identifying the possible causes (i.e. fatigue, distraction, lack of experience, lack of knowledge, etc.) of the “wrong” behaviours that individuals can act or produce. In the aviation field, usually this meant to identify in the “end user operator” (that is, the pilot) as the primary level of errors causation and, subsequently, the guilty part (often unable to inform about the happened, because dead) of many incidents and especially accidents (crashes of aircrafts with fatalities and injured people). Giving a look to data of the Statistical Summary of Commercial Jet Airplane Accidents in 2013 (Boeing, 2014) the primary causes of many accidents are still the LOC-I (Loss Of Control In flight) and the CFIT (Controlled Flight Into Terrain), in other words, where the last “defence line” (Reason, 1990, 1995, 1997, 2000) from the accident, that is the pilot, committed something wrong or not made something right.

But the story of the aeronautical accidents taught that considering them as the consequence of the pilots’ errors was simplistic and useless to prevent the occurrence of them in the future. So, the potential system failures of the organizations (Reason, 1990) captured more and

more the attention of the scholars with a growing consideration to the recognition of the complex causes of the accidents (Helmreich & Merrit, 2000).

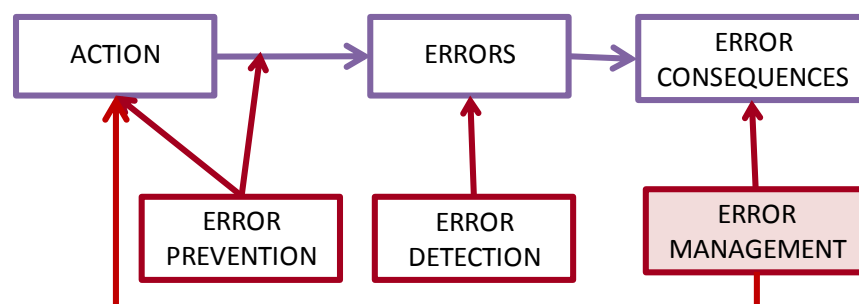
So, progressively, thanks to the increasingly focus on the search of the “root causes” of several accidents not to be merely charged with individuals (i.e. the Chernobyl nuclear disaster, the Columbia Shuttle accident, the Bhopal chemical disaster, just to cite some of the major catastrophic accidents of the last decades), the centre of attention of theory and research on errors shifted towards on the potential failures that the organizational systems can produce (Reason, 1990, 1997). But the general approach, also in the organizational settings, remained the prevention of errors, whose general scope is to enlarge the control: the intervention strategies aim to avert incorrect behaviours whenever possible (Reason, 1997) in order to reduce or eliminate errors and consequently the negative effects of them, also because, as Reason (1995) notes, the consequences of errors tend to be incremental and can become catastrophic mistakes.

On the other hand, if we take into account that errors cannot be totally removed or avoided in the organizational life, the real limitation of a solely preventive or avoiding approach becomes more than evident (Rybowiack, Garst, Frese & Batinic, 1999). Organizations confront everyday with errors and know that deviations from the rules, changes in working routines, erroneous decisions because of a high degree of uncertainty or insufficient knowledge, are order of the day.

For this reason, in more recent years, a new approach focused on the possible positive effects of error in the medium or long term, starting from the assumption that if they are conceived as a feedback to the organization, they can be a source of information to develop the resilience of the system and to foster the organizational learning (Hofmann & Frese,

2011; Sitkin, 1996; van Dyck, Frese, Baer & Sonnentag, 2005). This new approach, called *error management*, considers errors as one of the possible reactions that a complex system can give to, and not only like a deviation from established conditions given by a prearranged model. This new construct reveals to be particularly useful in complex systems (as aviation is) where, despite high proceduralisation, employees handle a lot of information and make decisions under uncertain conditions. At this regard, Gelfand and colleagues (Gelfand, Frese & Salmon 2011) have proposed an integrated approach, named Error Process, to deal with errors in the organizational settings. The authors argue that, within the error process, three main phases or stages must be recognized: the first is the *Error prevention*, the second is the *Error Detection*, and the last phase of the error process is the *Error Management* (see figure 1). As they note, primarily the error can be avoided by error prevention, once the error occurred it must be identified (detected) and, finally, once the error has been identified, it must be managed (Gelfand et al., 2011).

**Figure 1.** The Error Process (Gelfand, Frese & Salmon 2011)



*Error culture and organisational culture: power distance and uncertainty avoidance*

The influence of the cultural antecedents on organizational orientation toward errors has been emphasized by several scholars. For example, Helmreich and colleagues (Helmreich, Wilhelm, Klinec & Merritt, 2001) highlight the cultures mainly present in the aviation system and in the aviation operating context: the professional, the organizational and the national ones. They studied these three different kinds of cultures in many countries (22 for the national cultures). The results of their study show how the power distance and the uncertainty avoidance are important cultural antecedents of the safety approach of pilots in the operative setting, for example in accepting and managing appropriately the automated cockpit (e.g., Helmreich, 1998).

In the same direction, Gelfand and colleagues (2011), using the Hofstede (1980) taxonomy, from a theoretical point of view, state that national cultures influence the decisional processes of the team. In particular, in cultures characterized by the presence of a high power distance, the probability that the group members could give feedback to their boss is reduced; while in cultures characterized by an high uncertainty avoidance the frequency of procedural violations is reduced, although this implies as well a loss of flexibility, coping and resilience of the system, when something unexpected happens (Gelfand et al., 2011).

Geert Hofstede (1980), starting with the idea that organizations are expressions of broader cultural systems, explored the influences of national culture on organizational cultures. As Avallone and Farnese (2005) underlined, the Hofstede (1980) model pinpoints power distance and uncertainty avoidance as the national cultural dimensions that mainly influence organizational cultures. In every organization, in fact, the basic assumptions are related to who has the power to take decisions and the kind of the decisions taken (power distance), and the

kind of rules and procedures established to maintain the correct functioning of the organization (uncertainty avoidance). Moreover, accordingly to Hofstede (1980), from the interaction between the two cultural approaches, derive the specific kind of organizational culture.

Power distance dimension expresses the extent to which people are willing to accept an unequal distribution of power, wealth and prestige. Individuals working in organizations with high power distance rely heavily on hierarchy, which implies an unequal distribution of authority and the lack of upward mobility.

Nations with different levels of power distance will have different cultural expectations: in cultures with high power distance subordinates expect to be told what to do; for them hierarchy of existential inequality and the ideal boss is a benevolent autocrat. Instead, in cultures with low power distance, hierarchy is considered equality in the roles created for your convenience and does not reflect the essential differences between people. In these cultures, the subject is entitled to be consulted by their superiors and the ideal garment has a democratic attitude and resourceful.

Power distance carries out an important role in the organizational approach to errors. In high power distance organizations, the perception of superiors and subordinates as two separate and inherently unequal groups increases the social distance between the two parties within the work context (Gelfand et al., 2011). Superiors are considered as indisputable authority, and subordinates tend to accept the directives in uncritical way, so avoiding being implicated in wider problems (Hofstede, 1983, 1991). Moreover, to protect themselves from the risk of troubles, subordinates feel uncomfortable in expressing opinions or in exposing personal ideas. They will be less participative, and communication about errors tends to result insufficient and inappropriate (Brockner, Ackerman, Greenberg, Gelfand, Francesco, Chen,

Leung, Bierbrauer, Gomez, Kirkmann, Shapiro, 2001; Helmreich et al, 2001; Robert, Probst, Matocchio, Drasgow, & Lawler, 2000).

On the other hand, leaders are worry about errors which could happen “closely” to them, that is, trouble making, where the importance may be given to a selfish protection of reputation and public image. Furthermore, in organizations highly centralized and stratified, typical of high power distance cultures, people cannot show motivated to take on extra responsibilities from monitoring and managing errors, unless this is included in their work tasks (Aycan, Kanungo & Sinha, 1999; Brockner et al., 2001; Newman & Nollen, 1996; Gelfand et al, 2011).

Starting from these theoretical considerations, consequences of power distance culture on error culture become evident: for example, Gelfand et al. (2011) argue that the organizational error culture has an important impact on the design of error management training in organizations. People learn from errors when they use metacognitive processes to reflect on errors for analysing, monitoring and assessing their own behaviours (Newton, Khanna & Thompson, 2008); if they have personal resources, like work self-efficacy (Bandura, 1986) or the orientation to change, that facilitate the coping capacity (Rybowiak et al., 1999); and when they are actively encouraged to learn from errors, using processes of error management training (Heimbeck, Frese, Sonnentag & Keith, 2003).

The error management culture ensures that errors are quickly reported and detected, that negative error consequences are effectively handled and reduced, and that learning occurs (Frese 1991, 1995) not only when people are encouraged to learn from errors (Heimbeck, Frese, Sonnentag, & Keith, 2003) but also when the negative emotional impact of errors is reduced (Keith & Frese, 2005, 2010). In addition, from an organizational perspective, conditions of interperson-

al threatening, or negative emotional reactions in response to errors, may inhibit the exchange of relevant information and the inquiry into the views and experiences of others, giving rise to defensive routines in the organization and preventing it from learning (Edmondson & Moingeon, 1999; Gelfand et al., 2011).

The second cultural dimension coming from the Hofstede model, that is uncertainty avoidance, concerns the ways in which human societies have learned to cope with uncertainty. For example, technology is often used to guard against uncertainties inherent in the environment while the laws and regulations help to protect us from the uncertainties arising from the behavior of others. Hofstede (1980) argues that different companies have different levels of tolerance of uncertainty, ambiguity, unknown risks and that these different levels depend on the extent to which their members feel threatened by these situations. When uncertainty avoidance is low, people are more willing to accept ideas and innovative behavior while, with high uncertainty avoidance, any change or difference is not tolerated and causes strain and frustration. Control, rules and regulations are much more accepted in cultures with high uncertainty avoidance. Organizations operating in these cultures have a greater tendency to formalization and standardization (Hofstede, 1980).

Although high uncertainty avoidance implies a loss of flexibility, coping and resilience of the system when something unexpected happens (Gelfand et al, 2011), however there is some suggestion in the organizational research that this orientation may also activate an adaptive strategy to reduce uncertainty, engaging in proactive behaviour to reduce risks. So employees from these cultures may both adhere to the norm, or adapt and change to acquire a safer position in the future (Baker & Carson, 2011; Geletkanycz, 1997; Schneider & De Meyer, 1991).

Through the programming, planning and preventing functions and processes, organizational cultures with high uncertainty avoidance look for making behaviors more predictable, thereby decreasing stress and anxiety arising from new situations, perceived as uncertain and ambiguous. So, cultures with high uncertainty avoidance tend to promote the error prevention (Gelfand et. al., 2011; Rapp, Bernardi & Bosco, 2011). For example, managers from cultures with high uncertainty avoidance spend more time to plan and organize activities (Hofstede 1983) and co-workers actively search information to manage and control (Beckmann, Menkhoff and Suto 2008), also using the so called "*tried-and-true*", methods, reinforcing the sense of control over the environment by decreasing the perceived anxiety and stress (Hofstede, 1980). Similarly, we may suppose that these cultures promote the errors monitoring and early detection, which is a relevant phase of the error management process.

#### *Error culture and leadership stiles: servant and resentful leadership*

As Schein (1985) states, the unique and essential function of leadership is to handle and manage the organizational culture, thus facilitating the process of change. Organizational culture feeds the leadership stiles and, conversely, leaders behavior influence the cultural development of the organization (Schein, 1985).

In times of continuing happening crises (social, economical, political, organizational), where the errors made often cause unpredictable consequences, the theme of how leaders can influence error culture in organizations is order of the day, but few or no research have been done on the realm of error learning (Deng, Bligh, Kohles, 2010). But the different leadership

styles can impact in different ways on the effects on employees of errors in the workplace. For example, with regard to the error culture, some scholars show how supportive leadership in a supportive context is an antecedent of the positive orientation to learning from errors (Cannon & Edmondson, 2001; Edmondson, 1996), overcoming the widespread tendency of people to separate themselves from any responsibility or link with the errors made (Deng et al., 2010) also to avoid the negative emotions often associated with them, like guilty or shame (Tangney, 1991).

To this regard, the model of *servant leadership* (Greenleaf, 1977) shows to be of particular interest. Servant leadership expresses a type of leadership with a strong ethics part (Avolio & Gardner, 2005; Hu & Liden, 2011), and encourages organizational functioning through high levels of employee trust in management (Greenleaf, 1977; Liden, Wayne, Zhao, & Henderson, 2008). The servant leaders emphasizes personal integrity in her/his all life (work, family, social community) and uses internalized moral standards to serve as a role model for co-workers, showing authentic and deep interest for their support and development. So, for servant leaders the first priority is represented by the best interest of followers and they care about the need of each individual. So, servant leaders, showing genuine concern for all team members, gain co-workers' trust and build long-term relationships (Liden et al., 2008; Hu & Liden, 2011).

At the opposite side, aversive leadership styles (Pearce & Sims, 2002), for example resentful leadership (Liden et al., 2008) discourage employees from error sharing and error learning, punishing and penalizing them, and overall fostering strain and distress, so the inclination to cover errors becomes prevailing

Hence, the general objective of the present study is to outline the process by which cultural factors contribute to increase or limit the error aversion approach, which in turn increases the likelihood that errors could happen in relation to antecedents, namely the organizational culture dimensions (*power distance* and *uncertainty avoidance*), and the leadership styles (namely *servant leadership* and *resentful leadership*) that can influence the two dimensions (*strain* and *covering up*) composing the *error aversion* orientation; and the effects that the two dimensions (*strain* and *covering up*) composing the Error Aversion dimensions exert on negative outcomes, that are errors individually made (specifically *lapses* and *mistakes*), because it could increase the strain feelings when an error occurs (for example, related to lack of awareness or distraction) and because it could tend to facilitate hiding the errors, making it impossible to understand the meaning of the errors made and the consequent learning and future changing of behaviors.

#### *Aims and hypotheses*

According to the literature review presented before, the first aim of this study is to verify the influence of the organisational cultural models, that is, *power distance* and *uncertainty avoidance* (Hofstede, 1980) as well as the influence of the leadership styles, *servant* vs *resentful* (Liden et al., 2008; Bobbio, Van Dierendonck & Manganelli, 2012), on the aversion culture facets, specifically, *covering up errors* and *error strain* (van Dick et al. 2005).

Hence, with regard to the relationships of organisational dimensions, leadership dimensions and error aversion facets, we hypothesized that:

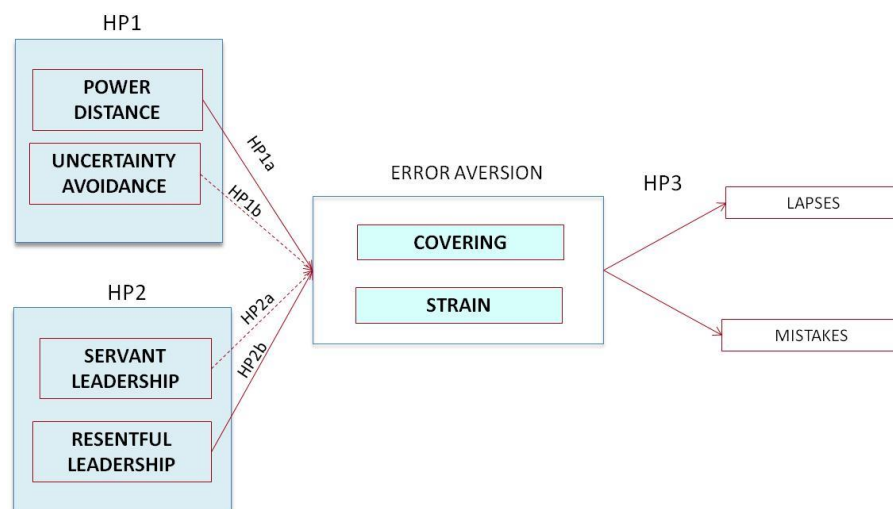
(Hp1) Organisational culture dimensions that are *power distance* and *uncertainty avoidance* influence the two error aversion facets, specifically *covering up errors* and *error strain*. Particularly: (Hp1a) *power distance* positively influences *covering up errors* and *error strain*, while (Hp1b) *uncertainty avoidance* negatively influences *covering up errors* and *error strain*.

(Hp2) Leadership style dimensions, specifically *servant leadership* and *resentful leadership*, influence the two error aversion facets, specifically *covering up errors* and *error strain*. Particularly: (Hp2a) *servant leadership* exerts a negative influence on *covering up errors* and *error strain*, and (Hp2b) *resentful leadership* positively influences the two facets of error aversion, which are *covering up errors* and *error strain*.

(Hp3): both the *error aversion* facets (*covering up errors* and *error strain*), will be positively related to the errors made that are lapses and mistakes (Hoffman & Mark, 2006).

The hypothesized model is showed in the following Figure 2.

**Fig. 2:** The hypothesized model



Note: Dotted lines indicate negative influence, continuous lines indicate positive influence.

## **Method**

### *Participants and Procedures*

The study involved 327 employees, belonging to the Italian Civil Aviation Authority, and specifically coming from the jobs directly involved in safety and security matters. The considered population was of 442 people so the respondents' amount was the 74% of it.

The Italian Civil Aviation Authority is the only regulatory body in charge for all the civil aviation regulation, certification, oversight and control in the field of civil aviation in Italy. It deals with many aspects of the regulation of civil aviation, controlling and monitoring the application of the national and international rules, the discipline of the administrative-economic aspects of the air transport system. Among the issues addressed one of the most important is undoubtedly the safety assurance and safety improvement of the civil aviation system, in the double meaning of Safety and Security, in accordance with and pursuant to the international standard. Safety is related to the design construction, maintenance and operation of aircraft, as well as the assessment of aircraft operators and flight crew. The term Security, however, refers to the security on the ground, on aircraft, inside and outside of airports for the prevention of unlawful acts.

Participants were 264 males (80% of the sample), corresponding to the gender distribution in the organisation population. They aged from 35 to 64 years (Mean age: 53, SD: 11.8). About 45% of the sample had completed high school, while 46.5% had a university degree, and almost 8% of the sample had basic instruction. The job tenure was between 1 and 42 years (Mean tenure: 18.7 SD: 6.4). Further characteristics of the sample are: the geographical

distribution, where the 34.5% comes from the North of Italy, the 37.5% is located in Central Italy, and the 28% belongs to the local offices in the South of Italy (islands included).

The organizational tenure was between 1 and 40 years (average tenure of 11.9 years, SD 9.42). About 48% of the sample had university degree, and almost 39% had completed high school studies. 9% of the sample had basic education level (3% missing). Other characteristics of the sample are: the job position, while almost the 80% are professional and technical staff, and the 19.5% are managers. Almost the 97% of the sample had an open ended work contract. The overall characteristics of the sample were totally similar to the population ones.

Participants voluntarily took part to the study, and did not receive any kind of reward, financial or other. The questionnaires had been administered via intranet, thanks to the cooperation of the information technology staff of the organization involved in the study.

Each participant received a presentation letter via e-mail by the ENAC General Director, containing a brief description of the research and of its main objectives, and the explanation that the participants' responses would have been totally confidential. Employees had the chance to fulfill the questionnaire in a three months period, to promote an amount of participation to the study the wider it was possible to have.

### *Measures*

*Power distance.* This dimension was measured with 5 items derived from the Hofstede's theoretical conceptualization of national cultures (Wu, 2006). Participants were asked to indicate, using a scale from 1 (*never*) to 5 (*always*), the frequency with which their bosses behave in ways facilitating the belief of an unequal distribution of power between the persons.

*Uncertainty avoidance.* This dimension was measured with 5 items derived from the Hofstede's theoretical conceptualization of national cultures (Wu, 2006). Participants were asked to indicate, using a scale from 1 (*never*) to 5 (*always*) the frequency of own and others behaviours facilitating the expectations of well-defined and organised task and jobs.

*Servant leadership.* This dimension was measured by 4 items coming from the scale developed by Liden, Wayne, Zaho, & Henderson (2008) and specifically related to the *conceptual skills* dimension, which indicates the manager's being endowed with the knowledge of the specific context and of the tasks to make, so being in a situation to effectively support and assist co-workers. Participants were asked to indicate how often (from 1 = *never* to 5 = *always*) their boss shows an approach problem solving oriented and shows to be able to think in a complex way, using real competence and knowledge of the organization.

*Resentful leadership.* This dimension was measured by 3 items coming from the scale developed by Liden, Wayne, Zaho, & Henderson (2008), specifically the "*forgiveness*" dimension, which is conceived in reverse items but, in the present study, has been used as direct and not as reverse items and renamed in *resentfulness*. Participants were asked to indicate how often (from 1 = *never* to 5 = *always*) their boss shows a critical, severe and no supportive behavior towards the co-workers.

*Error strain.* This dimension was measured with 5 items coming from the Error Culture Questionnaire (van Dick et al., 2005). Participants were asked to indicate how often (from 1 = *never* to 5 = *always*) they feel each of the listed moods in their present job.

*Covering up errors.* This dimension was measured with 5 items coming from the Error Culture Questionnaire (van Dick et al., 2005). Participants were asked to indicate how often (from 1 = *never* to 5 = *always*) they act each of the listed behaviors in their present job.

*Errors.* These were measured with an 8 items scale developed *ad-hoc* for the purpose of this study, starting from the classical error taxonomies (Rasmussen, 1983; Reason, 1990, 1997) and asking people to indicate the frequency (from 1 = *never* to 5 = *always*) of the errors they individually commit. It consists of two dimensions, named *mistakes*, which refers to errors of planning in taking decisions or using inadequate or insufficient knowledge, tools or equipment and *lapses*, which is memory errors, for instance forgetting something which was needed to execute (Reason, 1997). On the other hand, the slips dimension, related to errors of execution, wasn't found meaningful in the specific organizational context of the civil aviation authority.

All scales' items are presented in the following tables 1, 2, 3 and 4.

### *Data analysis*

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) (version 16.0) and *MPlus* (version 6.1, Muthén & Muthén, 1998-2010). Descriptive statistics for all study variables were computed and are described ahead. Our hypotheses were tested using Structural Equation Modelling (SEM) techniques. This approach, in fact, permits taking measurement errors into account by defining latent variables by their indicators. Moreover, for the examination of the model fit, we considered, according to a multifaceted approach to the assessment of the model fit (Tanaka, 1993): omnibus fit index, particularly the Chi-square ( $\chi^2$ ), and several incremental fit indices, specifically the Comparative Fit Index (CFI), the Root Mean Square Error of Approximation (RMSEA) and the Standardized Root

Mean Square Residual (SRMR). We examined also the reliability of each dimension by using Cronbach's  $\alpha$ .

## Results

### *Preliminary results*

As preliminary analyses we examined the items' descriptive statistics and the factor structure of each of the scales used in the present study.

With reference to *Power Distance* and *Uncertainty Avoidance*, table 1 shows that all the items were normally distributed. Furthermore, results of explorative factor analysis empirically confirm the two theoretical factors: *Power Distance* (5 items) and *Uncertainty Avoidance* (5 items). Finally, both dimensions showed a good internal consistency with Cronbach's  $\alpha$  coefficient close to .80.

Table 2 indicates the psychometric characteristics and factor structure of the leadership dimensions, specifically *servant* and *resentful* leadership. All the items were normally distributed and results confirmed the two-factors structure. Both dimensions showed sufficient internal consistency with Cronbach's  $\alpha$  coefficient close to .70.

With regard to the error aversion culture, the psychometric characteristics and factorial structure are presented in table 3. While the five items of error strain facet showed to be normally distributed, the item number 4 of the 5 items forming the *covering up errors* facet showed a pronounced asymmetry, probably related to the specific context, where it could be difficult to admit

a covering approach to errors. Nonetheless, the two facets of error aversion showed good internal consistency, with Cronbach's  $\alpha$  higher than .70.

Finally, exploratory factor analysis of actual errors scale showed a 2 factor structure. The final error scale consists of two dimensions, named *mistakes* (4 items); and *lapses* dimension (4 items), with all the items normally distributed and the Cronbach's  $\alpha$  indicating sufficient internal consistency, as is shown in table 4.

**Table 1.** Power distance and uncertainty avoidance: exploratory factor analysis and factors' psychometric measures.

	M	SD	SK	K	Cronbach's $\alpha$	Power distance	Uncertainty avoidance	
1. Supervisors rarely ask employees their opinions	2.91	1.120	.328	-.778		<b>.871</b>		
2. Supervisors take most of their decisions without consulting employees	3.10	1.114	.289	-.938		<b>.855</b>		
3. When dealing with employees, supervisors must often use their authority and power.	2.57	1.069	.639	-.109	.83	<b>.681</b>		
4. Employees are afraid to express their disagreement with their supervisors	2.49	1.097	.571	-.272		<b>.572</b>		
5. Supervisors do not delegate important tasks to their employees.	2.72	1.075	.510	-.378		<b>.566</b>		
1. Our work is based on accurate operating instructions	2.85	1.040	.285	-.316			<b>.770</b>	
2. We have many procedural standards	3.30	1.068	-.041	-.594			<b>.743</b>	
3. There are many rules and regulations that inform workers about what the organization expects of them.	2.93	1.014	.250	-.221	.79		<b>.728</b>	
4. What we are required to do at work is defined in detail	2.30	.897	.697	.733			<b>.619</b>	
5. Supervisors expect their employees to faithfully follow instructions and procedures.	3.24	.981	.038	-.242			<b>.425</b>	
	% variance						26.405	22.514

**Table 2.** Servant and resentful leadership: exploratory factor analysis and factors' psychometric measures.

	M	SD	SK	K	Cronbach's $\alpha$	Servant Leadership	Resentful leadership	
1. My manager is able to think through complex problems.	3.45	1.016	-.179	-.455		<b>.898</b>		
1. My manager has a thorough understanding of the organization and its goals.	3.48	.987	-.133	-.349	.89	<b>.848</b>		
2. My manager can solve work problems with new or creative ideas.	2.92	1.049	.195	-.388		<b>.787</b>		
3. My manager can tell if something work related is going wrong.	3.50	1.002	-.224	-.328		<b>.750</b>		
1. My manager maintains a hard attitude towards people who have offended him/her at work	2.71	1.053	.426	-.249			<b>.769</b>	
2. My manager finds it difficult to forget things that went wrong in the past	2.58	.977	.529	.141	.69		<b>.631</b>	
3. My manager keeps criticizing people for the mistakes they have made in their work	2.22	.976	.915	.777			<b>.546</b>	
	% variance						42.432	16.166

**Table 3.** Error aversion dimensions: exploratory factor analysis and factors' psychometric measures.

	M	SD	SK	K	Cronbach's $\alpha$	ERROR STRAIN	COVERING UP ERRORS
1. People in this organization are often afraid of making errors.	2.77	.978	.144	-.005	.81	.801	
2. In general, people in this organization feel embarrassed after making a mistake.	2,84	,910	,232	,037		.707	
3. In this organization, people feel stressed when making mistakes	2,58	,946	,409	,118		.662	
4. During their work, people are often concerned that errors might occur	2,80	,952	,179	-,140		.643	
5. In this organization, people get upset and irritated if an error occurs	2,71	,888	,180	-,092		.605	
1. Our motto is, "Why admit an error when no one will find out?"	1.53	.780	1.673	3.085	.76		.838
2. Employees who admit their errors are asking for trouble	1.41	.747	2.346	6.534		.653	
3. There are advantages in covering up one's errors	1.69	.988	1.597	2.205		.631	
4. It can be harmful to make your errors known to others	1.92	.887	1.005	1.083		.522	
5. People prefer to keep errors to themselves	2.60	1.065	.264	-.431		.391	
					% variance	35.2	10.78

**Table 4.** Errors scale: exploratory factor analysis and factors' psychometric measures.

	M	SD	SK	K	MISTAKES	LAPSES
1. To be based on outdated knowledge to perform a task	2.34	1.069	.513	-.306	.727	
2. To make a decision based on marginal information	1.77	.860	1.055	.684	.641	
3. To use incomplete knowledge to perform a task.	2.23	.947	.340	-.363	.614	
4. To use only some of the tools provided (e.g. equipment, forms)	2.12	.984	.909	.765	.438	
1. Forgetting to perform a task.	1.78	.725	.574	-.172		.783
2. Delaying in the performance of a task.	1.97	.883	.654	.009		.699
3. To get a wrong execution of a task.	1.72	.679	.406	-.822		.408
4. Being abstracted when working.	2.33	.802	.339	.544		.383
Cronbach's alphas					.71	.68
% variance					31.49	7.67

Table 5 shows the inter-correlations among the study variables, indicating that there were several meaningful relations between them, so providing initial support for the predictive validity of the servant leadership dimensions and the cultural dimensions with respect to the errors aversion facets. Particularly, the two aversion culture facets were not too much correlated, confirming that they are diverse, as well as the individual errors made. On the other hand, the relations between the study variables and the errors made are irregular, anticipating a diverse evolution of their influence on the errors made.

**Table 5.** Correlations among study variables

	1	2	3	4	5	6	7
1. Power distance							
2. Uncertainty avoidance	.008						
3. Servant leadership	<b>-.263**</b>	<b>.297**</b>					
4. Resentful leadership	<b>.337**</b>	.050	<b>-.257**</b>				
5. Covering	<b>.230**</b>	<b>-.186**</b>	<b>-.195**</b>	<b>.299**</b>			
6. Strain	<b>.246**</b>	-.024	-.002	<b>.186**</b>	<b>.430**</b>		
7. Mistakes	<b>.152**</b>	<b>-.189**</b>	-.089	.052	<b>.144*</b>	<b>.131*</b>	
8. Lapses	-.054	<b>-.172**</b>	<b>-.130*</b>	.083	<b>.129*</b>	.051	<b>.461**</b>

\*\* : .001; \* : .005

Finally, table 6 shows the measurement part of the model where all the items were meaningful at .000

**Table 6.** Measurement part of the model

Item	Covering	Strain	Power distance	Uncertainty avoidance	Servant leadership	Resentful leadership	Lapses	Mistakes
1	.57	.59	.87	.62	.92	.61	.72	.59
2	.60	.62	.66	.42	.85	.71	.66	.70
3	.61	.79	.88	.74	.81	.63	.51	.68
4	.55	.70	.54	.75	.70		.51	.50
5	.72	.64	.55	.76				

*Structural Equation Model (SEM)*

The tested model, displayed in Figure 2, yielded an excellent fit ( $\chi^2_{(538df)} = 900.664$ ,  $p = .0000$ ; CFI= .90; TLI= .89; RMSEA= .047 (.042-.053),  $p \leq .05$ ; SRMR=.067).

With regard to the structural part, the model explained 16% of variance of *error strain*, 30% of variance of *covering up errors*, and 9% of *errors - mistakes* and, not meaningful, the 4% of variance of *errors – lapses*.

As shown in Figure 2, Hypothesis 1 is partially confirmed. In fact, Hypothesis 1a, related to the influence of power distance on the errors aversion facets, has been confirmed only for its influence on error strain. This means that in organizations where the distribution of power is felt as unequal, and the perceived distance between managers and employees is high, the negative emotions when an error is made augment, and people feel more stressed and afraid when an error occurs. This doesn't necessarily mean that the presence of strain implies a tendency to hide errors, because in this specific context, the prevention of errors is an organizational value in itself.

Furthermore, the tested model shows also an unexpected direct relationship between power distance and mistakes. Conversely, Hypothesis 1b has been confirmed only with regard

to the negative influence of uncertainty avoidance on covering up errors, but it shows no influence on error strain. This means that uncertainty avoidance facilitate feelings of positive control on the events and of prevention of errors, so negative emotions do not come into view.

Also Hypothesis 2, concerning the leadership styles and their influence on the error aversion facets, is partially confirmed.

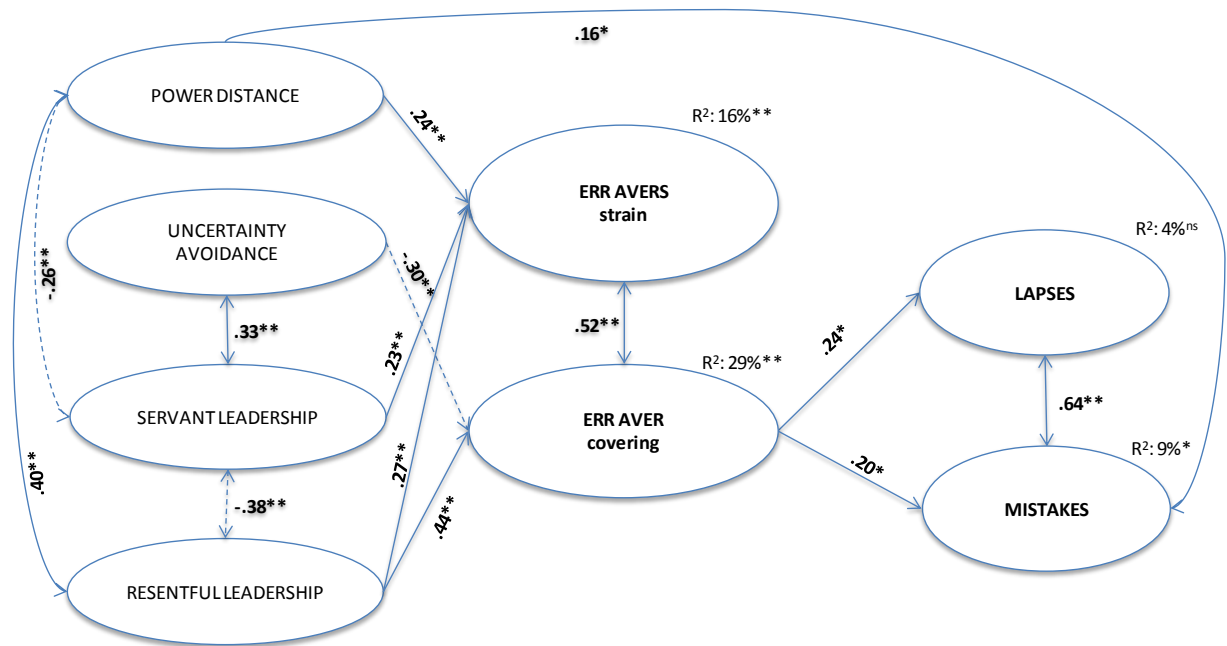
In particular, Hypothesis 2a relative to the supposed negative influence of servant leadership on error aversion facets has been not confirmed. Surprisingly, it shows positive influence only on the strain facet, while there is no influence on covering up with errors.

On the other hand, Hypothesis 2b has been totally confirmed. Resentful leadership shows to have direct positive influence both on error strain and covering up errors. This means that when managers adopt a resentful leadership style, being offended and revenging towards employees when they make errors or do not meet leader's expectations, people will feel guilty, afraid, embarrassed, and will tend to deny and hide their errors.

Finally, also Hypothesis 3 has been only in part confirmed. *Error strain* does not show to condition effective errors (neither *lapses* nor *mistakes*), while *covering up errors*, consistent with the posited model, positively influences both *lapses* and *mistakes*.

Overall, the factors leadership related we considered as antecedents of the error aversion orientation, proved to have a relevant predictive power, contributing to explain much about the "generation" of this cultural orientation; while the error aversion orientation resulted to exert an influence on effective errors only by the means of covering behaviors and the overall explanatory power of the model compared with factual errors is not high, as  $R^2$  index shows (9% for mistakes and only 4% for lapses).

**Figure 2: The Tested Model**



\*\* p<.01; \*p<.05

## Discussion

### *Main results*

The “negative” side (*error aversion*) of the error culture, made up of two sub dimensions theoretically as well as empirically different, presented a diverse tendency in relation to the influence they exert on the errors made, that is, on the outcomes. Specifically, while error covering influenced both kinds of errors made (lapses and mistakes), the strain facet exerted no influence, neither positive nor negative, on errors. This result can be read in the following terms: the *strain* facet could be considered as an emotive level, while covering represents a behavioural response to the disease and distressed provoked by the errors made (Hofmann & Frese, 2011a, 2011b). This could be the reason why strain doesn’t have a direct influence on errors behaviors. Feeling threatened may inhibit the exchange of relevant in-

formation and the inquiry into the views and experiences of others, giving rise to defensive routines (Edmondson & Moingeon, 1999). Thus, strain could be considered a coping activator (Rybowiack, 1999), and in this sense it could even positively turn on the management side of error culture. The strain facet of error culture, in this way assume the role of a “gate” or “bridge” dimension, depending on the way it is managed if it could lead to positive instead of negative results or behaviours.

Overall, the bi-dimensionality of the aversion approach that emerged is coherent with van Dyck and colleagues’ (2005) suggestion that strain and covering up may not be part of the same construct, referring to separate processes that do not always coincide.

A second relevant result of this study concerns the influences of antecedents of error aversion facets, that is, power distance and uncertainty avoidance, servant and resentful leadership. To summarise, as regards the strain, it is positively influenced by all these dimensions, except that uncertainty avoidance. Coherently with the literature and as posited in the present study, strain is positively influenced by power distance and resentful leadership, confirming that the emotional activation is always present and it can be a sort of a gate, making change direction to behaviours. Surprisingly, also the servant leadership positively influences the feeling of strain due to errors made. This result could indicate that the emotional activation sensitivity and arousal can be expressed when we are confronted with a leader able to guarantee integrity and conceptual skills which can support decisions and problem solving (Edmondson et al. 2005; Liden et al., 2008). However, more studies on the strain facet are needed, also to deepen the variety of contrasting emotions and coping strategies associated.

Also the context characteristics could make the difference with respect to the consequences of the strain feelings for the errors made. Investigation on emotions and errors is still in an

early stage, there is evidence that different negative emotions have different effects on judgment (Lee & Allen, 2002; Roseman, Wiest, & Swartz, 1994; Smith & Ellsworth, 1985; Zhao and Olivera, 2006). It could as well represent an interesting topic for future research on the role played by emotions in the error management cultural approach. Anyway, as Zhao and Oliveira (2006) underline, negative emotions are not likely to function in the same way. Moreover, our results confirm what Mohamed and colleagues (2009) studied in high uncertainty avoidance environment, which present a more likely propensity towards safety awareness and beliefs and consequently few covering behaviours.

As regards the covering up behaviours, our study shows that they are strongly enhanced by a resentful leadership style, while reduced by cultural contexts supporting uncertainty avoidance. Thus, a cultural context where strategies of processes and actions monitoring are valued and rewarded seems to facilitate the explication of errors and accountability. Both these results are consistent with our hypotheses and give a first empirical foundation to literature suggestions.

This study gives a further contribution to the literature on error culture, showing the importance of the error aversion orientation also on “negative” outcomes, which are actual errors. Although the explicative power of the overall model with respect to these outcomes is low, this is a relevant result, since it gives an empirical support to this relationship, to the best of our knowledge never explored before. Specifically, while the strain dimension didn’t exert any influence, the covering up dimension influenced both type of errors. This result on one hand reinforces the bi-dimensionality of the error aversion construct, as highlighted above; on the other hand

elicit further research about the role played by the strain dimension in the error management process.

Lastly, to our opinion a further element of interest of the present study is that it has been realized in Italy, where a blaming culture is still deep-rooted (Catino, 2008), as well as the power distance with authorities is often strong and leadership styles are few participative and servant (Bobbio et al., 2012; House, Hanges, Javidan, Dorfman & Gupta, 2004). Thus, errors could be conceived as more troublemaking than in other national cultures.

In addition, the specific context of the present study presents a series of characteristics which tend to reinforce the national cultural attitude. Italian CAA is in fact a government body, and derives its culture by the public administration context. Furthermore, its mission is strongly portrayed by the ruling scope, whereas safety related norms, regulations and procedures for the entire civil aviation sector are inherently an essential part of the job done. Furthermore, a remarkable aspect of this study is its specificity, with a very high rate of response. To have evaluated the specific organizational context of the Italian CAA, that could be considered as a high reliability organization (HRO, Weick & Sutcliffe, 2007), interconnected with the other complex system of the other organizations of the aeronautical sector.

### *Practical implications*

The results of the present study appear interesting also with respect to the practical use that Italian CAA could make of them. For example, the development of an approach to organizational roles more participative and inter functional between the diverse departments, could facilitate an easier sharing of errors made and improve the organizational learning, reducing also covering behaviors and consequently errors made, whereas the strain feelings

could be used for the development of greater awareness, to spend in positive coping behaviors to manage errors. Moreover, these cultural dimensions and their relation with the error dimensions could be widespread for the entire aeronautical sector, accordingly with its institutional mission of promoter of a positive error culture in the aeronautical organizations.

#### *Limitations and Future research matters*

The current study presents at least two limitations: the first one is that data are cross-sectional, all reached at the same time. The cross-sectional nature of our data makes it more difficult to infer causal relations among variables considered. Future studies could explore the longitudinal influence of the error aversion dimensions on negative outcomes (errors), to better confirm and strengthen the model herein examined.

Another limitation of this study consists of the utilization of self-report instruments. This could give rise to the question regarding how the self-reporting bias and, specifically, the individual tendency to respond in a socially desirable way, influenced the responses about behaviours like the error covering or the error strain, rather than the errors made. However, the questionnaires were administered anonymously, giving assurance of privacy observance, which may have mitigated some self-reporting bias. The SEM, which allows for the simultaneous testing of multiple relationships, also counterbalanced the aforementioned weaknesses. All in all, future research could utilize objective outcome and longitudinal data.

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## **Chapter 5**

### **General conclusions**

The main purpose of the thesis here proposed was to deepen the role of the error culture model (Van Dyck, Frese, Baer, & Sonnentag, 2005) in the organizational settings, with a specific attention dedicated to the complex systems (Weick, 1987; Weick, Sutcliffe, 2007) where errors made could have severe consequences. The general aims of the thesis were: to validate the Error culture questionnaire in the Italian context, exploring its influences on positive (organizational performance and innovation) and negative (errors made) consequences in several working sectors, with a specific focus on the sanitary sector and on the civil aviation sector, particularly for the individually made errors. Furthermore, the interest was focalized also on the forerunners of the error culture, specifically pertinent to the trustworthiness of the supervisor, declined in its dimensions of ability, benevolence and integrity, (Mayer, Davis, & Schoorman, 1995) to organizational culture, in its dimensions of power distance and uncertainty avoidance (Avallone, Farnese, 2006; Hofstede, 1980, 1983, 1991), and to leadership styles, that is servant and resentful leadership (Greenleaf, 1977; Liden, Wayne, Zhao, 2008).

All in all, the studies presented have reached the proposed aims.

In the first study, we examined the structural validity and psychometric properties of the Error Culture Questionnaire (van Dick et al., 2005) and, moreover, we analyzed its concurrent validity by examining the influence of error management and error aversion facets on positive (organizational performance and innovativeness) and negative (errors)

outcome.

Generalizability of the error culture construct and its good psychometric properties have been demonstrated, as well as its concurrent validity.

In the second and in the third study we deepened the influence, on error culture dimensions, of some antecedents. Specifically, in the second study, realized with a sample coming from the sanitary sector, we studied the influence of trustworthiness on error culture, finding that trustworthiness positively influenced error management facets, and negatively the error aversion facets, confirming also the mediating role of error culture dimensions on outcomes.

The third study, carried out in the Italian Civil Aviation Authority, deepened the influence of power distance, uncertainty avoidance (Hofstede, 1980) and leadership styles, that is resentful and servant leadership (Liden et al., 2008)

This study also confirmed the hypothesized role of influence of cultural and leadership dimensions on errors aversion facets which have a mediating role of influence on lapses and mistakes.

All in all, the dissertation draws attention on some main issues related to the the different role of each sub-dimensions in influencing error and performance outcomes.

The Error culture Questionnaire expressed a high explicative value, showing also that error management isn't a unique dimension, but regain the multidimensionality of the scale, originally proposed by Rybowskiak, Garst, Frese & Batinic (1999). The kind of influence on errors, even if always present, showed some differences in the three studies. The strain facet could be considered a sort of crossing point between aversion and management of errors, considering that emotional activation is involved also in cognitive processes of reflection, thinking and

learning (Edmonson, 1996; Rybowskiak et al., 1999; Zhao & Olivera, 2006). Also the context characteristics could make the difference with respect to the consequences of the strain feelings for the errors made, as indicated in study three, which is context specific. It represents a topic for future research on the role played by emotions in the error management cultural approach.

Moreover, we explored the validity of the ECQ in the Italian context with the awareness that in general is still blaming oriented, and often searching the guilty is easier than searching the reason of errors (Catino, 2003, 2008; Hofstede, 1983). But the growing need to cope with uncertain environments and critical situations makes urgent to consider that the fallibility of human reasoning is unavoidable (Reason, 1990) and learn to handle the negative consequences of mistakes considering errors as sources of information and learning make them tools to rethink events and develop future improvements.

With respect to the antecedent, study two and study three here presented are the first, to our knowledge, which explore in depth the influence of trustworthiness of the supervisor on the error culture dimensions, and the organizational cultures and leadership stiles on the error aversion facets, considering also errors made, at a collective (study two) and individual level (study three) as outcome of the error culture dimensions.

Moreover these studies are the first realized in Italy exploring complex systems (sanitary and aeronautical) to better understand the implications of error culture dimensions for the safety and the well-being of people engaged in them.

The main limitations of the three studies presented are related to the cross-sectional na-

ture of the data and to the self-report approach, so future longitudinal studies, as well as objective outcomes, are required to confirm the hypothesized causal paths and the mediated relationships among the variables.

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