

# Risk Management in Municipal Entities: Sintra City Council's Occupational Health and Safety Division

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## Abstract

The importance of risk management has become increasingly evident due to the fast-paced globalization, which has led to increased complexity and exposure to risks. With the constant emergence of new risks, European and national regulations have made it mandatory to conduct risk management processes in the public sector. However, existing literature highlights several gaps in these processes, highlighting a lack of capacity to demonstrate the assumptions for proper risk management. It shows a lack of analysis, evaluation, and treatment of risks in municipal organizations, indicating that compliance with the referred legislation is not based on the real strategic objectives of the institutions.

This study presents a risk management process for a Sintra City Council division based on the ISO 31000 Risk Management Standard. The study explains the assumptions and methodology used and presents the content in an empirical approach. Even though the assessment is focused on a Municipality in Portugal, the conclusions and suggestions provided are broad in scope and are expected to be useful to other risk management stakeholders.

**Keywords:** Risk management; Public sector; Legislation; ISO 31000; Sintra city council.

## 1. Introduction

Our world is undergoing constant change. Global population growth has driven globalization, resulting in interdependencies among modern societies where seemingly minor events can quickly trigger large-scale problems with significant losses [1]. In this context, communities face a wide range of risks that can result in substantial damages in economic, environmental, and even human life areas, causing imbalances in our society. It's essential to recognize that these risks often transcend geographical borders [2], necessitating adequate research and evaluation of their extent and impact.

Frequently, management focuses on reactive responses to existing problems rather than adopting preventive approaches to avoid them [3]. Yet, it's increasingly clear that proactive risk analysis is vital to enhance disaster prevention and response in institutions [4]. According to the European Civil Protection and Humanitarian Aid Operations (ECHO) [5], it's estimated that for every euro invested in disaster prevention, about 4 to 7 euros are saved in disaster response, emphasizing the need for investing in risk prevention.

Governments face significant challenges in dealing with risk issues due to their complexity, ambiguity, and uncertainty [3]. Different entities employ diverse methodologies, leading to a complex and multifaceted risk assessment. Hence, efforts have been made to standardize risk assessment principles, with ISO 31000 being the

most widely known and used standard to promote risk analysis uniformity. Moreover, information sharing involving stakeholders from various sectors, including risk management experts, is recognized as crucial. No stakeholder can have a 100% correct and comprehensive understanding of risk without obtaining information from others, highlighting the key role of collaboration [3].

Hassel [4] emphasizes the need for a solid foundation in complex assessments, such as national-level risk assessment. This underlines the significance of considering risk analysis in all governmental entities as an integrated system, allowing for nationwide risk studies based on lower government levels. In this context, local-level risk analysis is crucial as a poor analysis will significantly impact information provided at higher levels. Thus, establishing an initial source to enhance local risk analysis and management processes is valuable, as local empowerment contributes to national resilience [6].

Assuming that risk assessment plays a crucial role in providing information about the risks institutions, including the public sector, face, the implementation of legislation in European Union (EU) countries, such as Portugal, requiring municipal-level risk management plans is imperative. However, despite this initiative, the effective execution of these municipal risk management plans faces several challenges, as explored in this work. Currently, the implementation of municipal risk management plans is uncertain, lacking clarity and

understanding of the involved processes, necessitating efforts for deeper comprehension and effective solutions to overcome these challenges.

## 2. Problem Definition

### 2.1 Contextualization

To introduce legislative measures for the prevention and combat of corruption and related offenses into the Portuguese legal framework, the Decree-Law No. 109-E/2021, dated December 9, 2021, came into effect on June 7, 2021 [7]. This Decree-Law established the National Anticorruption Mechanism (MENAC), an independent administrative entity with powers of initiation, control, and sanctioning. It is also responsible for establishing the General Regime for Corruption Prevention (RGPC), which introduces a new package of legislative measures. According to the RGPC, the execution of the Plan for Preventing Corruption and Related Offenses (PPRCIC) is subject to control ([7], p.21-(32)), carried out as follows:

- a) The preparation of an interim evaluation report in October for situations identified as high or maximum risk.
- b) The preparation of an annual evaluation report in April of the following year, which includes, among other things, the quantification of the degree of implementation of preventive and corrective measures identified, as well as the forecast for their full implementation.

The absence or inadequate adoption of the PPRCIC constitutes an administrative offense, punishable by fines ranging from €1,000.00 to €44,891.81 ([7], p.21-(37)).

Currently, at the Municipality of Sintra (CMS), the responsibility for implementing the Plan for the Prevention of Management Risks, including Corruption and Related Offenses (PPRGIC) is assigned to a team within the Office for monitoring, auditing and statistics (GAEM). This team communicates with all departments and divisions to assess the risks occurring within the institution to comply with the legislative duties in force.

Given the extensive and diverse activities of CMS, it is unfeasible to conduct an in-depth analysis of the entire institution within the scope of this study. Therefore, the analysis will focus on a specific division: the Division for Occupational Safety and Health (DSST). The selection of DSST for the study was based on the division's willingness to participate in the proposed challenge, contributing their resources and time to provide vital information for this work.

This division has a well-defined mission [8] that governs its activities. This mission is of utmost importance as it serves as a basis for aligning the division's vision and clearly and objectively understanding the tasks it must fulfill to contribute to the organization's success while complying with the legislation.

### 2.2 Problem Formulation

Despite the implementation of the Plan for Preventing Management Risks, including Corruption Risks and Related Offenses (PPRGIC) by the Municipality of Sintra (CMS), challenges related to the effective execution of this plan arise. The weak risk management culture, coupled with the task overload faced by public sector institutions, especially in larger municipalities like CMS, can significantly impact the quality of PPRGIC implementation.

In this regard, it is crucial to encourage and raise awareness among division and department heads about the importance of risk management for the institution. This includes emphasizing the benefits of proactively identifying risks and adopting preventive measures. Furthermore, it is necessary to promote a risk management culture by encouraging collaboration across all areas of CMS to ensure the plan's success and the effective mitigation of identified risks.

Thus, the purpose of this dissertation is to conduct a risk assessment aligned with DSST's current objectives, using empirical information to improve the existing PPRGIC and contribute to the existing literature on this matter.

## 3. Literature Review

### 3.1. Holistic Approach to Risk Management in the Public Sector.

Numerous impactful events, such as the 9/11 attacks in the United States, or the economic crises of 2008 and beyond intensified the need to ensure the achievement of public objectives and foster resilient behaviors within public organizations [9]. These notable occurrences underscore the importance of adopting robust and proactive risk management strategies to address unexpected challenges and protect public interests.

To secure a sustainable future, it is crucial to deepen the understanding of the risks faced and to be prepared for adverse events through the implementation of adaptation and mitigation measures [10]. In this regard, the European Commission invited all Member States, including Portugal, to conduct a National Risk Assessment (NRA) [11], which is now known in Portugal as the "Avaliação Nacional dos Riscos" (ANR), extended to cover the risks of Money Laundering (ML), Terrorism Financing (TF), and Financing the Proliferation of Weapons of Mass Destruction (FP) [12]. This effort demonstrates Portugal's commitment to assessing and mitigating risks to promote sustainability and security in its operations.

Indeed, risk management in the public sector is used to ensure the fulfillment of institutional objectives [13]. Within the European Union (EU), various countries adopt a bottom-up approach to risk management, requiring each municipality to develop a risk analysis plan encompassing both comprehensive services and local regions. This obligation is evident, for example, in Swedish

legislation, as mentioned by Cedergren et al. ([6], p.783). However, in recent years, there has been a proliferation of risk analysis approaches, paradoxically accompanied by the absence of specific legislation providing clear guidelines for implementing these methods in institutions, as observed in the study by Riso & Castellini [14]. Consequently, the choice of method and the implementation process are left to each municipality, resulting in a diversity of approaches in public sector risk management.

In the absence of legal mandates and a weak risk management culture in public sector institutions, a negligent attitude towards executing these plans may emerge. Existing literature thus observes a limited approach to risks by public sector administrative bodies [15][9]. It is evident that the introduction of risk management models alone is considered insufficient to create the necessary conditions for implementing suitable and innovative practices in public entities [16]. It is argued that the mere existence of risk management in public institutions has increased uncertainty, leading to various complications due to inherent bureaucracies in this process [17]. Compliance with laws and document submission can be complex and demanding. Coupled with the lack of a solid risk management framework, this can generate discomfort in institutions, resulting in unintended consequences.

Furthermore, according to Arena et al. [16], when poorly managed, the implementation of risk management models can serve as a way to transfer responsibility and promote opportunistic behaviors, assuming that actions need not be taken due to the presence of these models or promoting actions to avoid blame in case of misfortune. Therefore, the lack of a more comprehensive and functional approach to public sector risk management is a challenge that must be overcome to ensure that organizations effectively achieve their objectives and resiliently address challenges.

The literature also points to a lack of the capacity to demonstrate the necessary contents and assumptions required for effective public sector risk management [15]. There is a shortage of publications in the literature addressing the empirical aspect of risk analysis in the public sector, meaning the practical application underlying the assumptions used by researchers in risk management analyses [18]. According to Cedergren et al. [6] and Strömgren & Andersson [18], theoretical methods in risk management, while coherent, are not sufficient to achieve intended objectives.

Therefore, these methods must be implemented practically and tailored to each organization. Cedergren et al. [6] and Strömgren & Andersson [18] further assert that, in the academic field of risk management, methods and recommendations are relatively abundant, but

practical studies implemented in a real-world context are scarce. These studies play a crucial role in improving risk analysis and management processes and identifying shortcomings in the assumptions and methodologies adopted.

In this context, the literature argues that, in the public sector, although there are documents regarding risk management that comply with current legislation, they are not aligned with the actual strategic objectives.

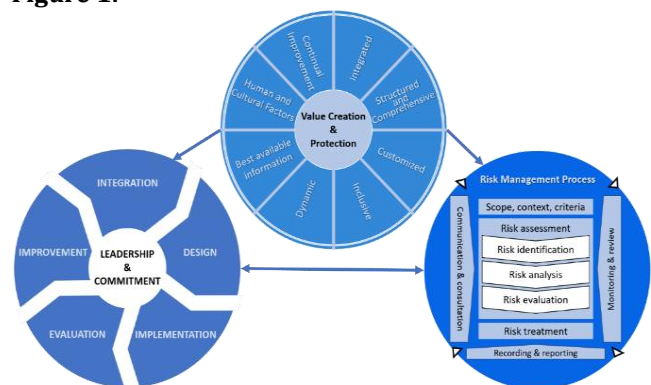
### 3.2. ISO 31000

The ISO 31000 standard, introduced in 2009 by the International Organization for Standardization (ISO), aims to assist organizations in risk management by providing a universal and easily understandable process. It establishes clear and objective guidelines for implementing a risk management plan in any domain of operation [19].

Authors such as Aven & Ylönen [20] note that despite standardization norms like ISO 31000 being non-mandatory documents within organizations, they are widely used in the context of risk and significantly influence current risk analysis and management practices. ISO 31000 is highly adaptable and applicable to various types of organizations, including public entities, covering a wide range of needs and objectives [19]. This standard is now recognized as a global reference. In addition to helping organizations comply with legislation, it plays a crucial role in decision-making and significantly contributes to enhancing an organization's knowledge, thus increasing its resilience.

In addition to addressing risks and threats, risk management based on the ISO 31000 standard also involves identifying and exploring opportunities. The standard encourages organizations to consider not only the negative consequences of uncertain events but also potential positive impacts. Proactively identifying opportunities can enable organizations to make strategic decisions that enhance their performance and achieve their objectives [19].

An illustrative summary of this standard can be seen in **Figure 1**.



**Fig. 1.** Risk management principles, structure and process

#### 4. Methodology

This chapter aims to clarify the methodology used in this work. The methodology can be divided into the following parts:

- **Definition of Objectives:** At the beginning of the study, preliminary research was conducted to determine the research possibilities, during which the objectives to be achieved were defined. The main objectives include the implementation of a risk management process in the municipal context based on the principles of ISO 31000.
- **Data Collection:** Data collection involved several stages, including strategic meetings with the Division for Occupational Safety and Health (DSST) of the Municipality of Sintra (CMS). These meetings allowed for defining the appropriate foundation and direction for the research. Brainstorming sessions were also conducted with the DSST team to gain a broader understanding of the division's areas of operation. Internal resources such as previous DSST projects, safety records, and workplace accident reports were used to enrich the research.
- **Implementation of the Proposed Model (PPRGIC):** A risk management plan was developed for the DSST, following the principles of ISO 31000 and based on the information collected thus far.
- **Validation of Results:** The results, including the identification, assessment, and treatment of risks and opportunities in the "Proposed PPRGIC," were submitted to the DSST management for validation, ensuring alignment with the division's operational reality.
- **Conclusions and Recommendations:** In the final phase of the research, a conclusion of the methodological process was prepared, highlighting the results, assessing the achievement of objectives, and making recommendations for future research based on the methodology used. This methodology provided an in-depth understanding of risk management at CMS.

#### 5. Risk Management Process

##### 5.1 Overview of the Risk Management Process

Figure 2 represents the stages of the risk management process. These stages will be detailed in the sections in parentheses.

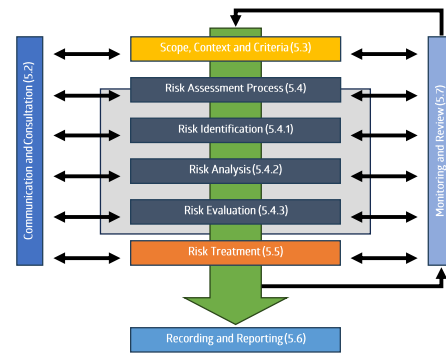


Fig. 2. Overview of the risk management process

##### 5.2 Communication and Consultation

The communication and consultation stage plays a critical role in ensuring the quality of the PPRGIC. This stage ensures that the views of stakeholders are considered and analyzed, promotes the identification, analysis, and treatment of risks in a more appropriate manner, and ensures that everyone involved understands the proposed objectives and their roles in the process. In this sense, informative and consultative communication should be established with stakeholders at all stages or activities of the risk management process.

At the Municipality of Sintra (CMS), due to a high degree of internal decentralization, the objectives of the risk management plan are shared with division heads, who, in turn, communicate them to core coordinators, sections, and other stakeholders. However, this decentralized process can result in the loss of information quality. In this work, to establish open and continuous communication with DSST, as described in the "4 Research Methodology" chapter, brainstorming sessions were conducted with division members, including core coordinators and the division head. These meetings facilitated the efficient transfer of information throughout the Risk Assessment process. Through this communication, it was possible to achieve clearer alignment among division members, improving all phases of the process.

##### 5.3 Scope, Context, and Criteria

Establishing the context is a fundamental step in the risk management process, requiring a comprehensive understanding of the division, its objectives, and the surrounding environment. This understanding is essential to gain a better understanding of the factors that can influence the division's ability to achieve expected results and to conduct the subsequent stages of the risk management process with greater clarity and precision.

Therefore, in the initial brainstorming meetings, I sought to instill in the DSST team a reflection on the internal and external context, including understanding the goals of risk management at CMS. This aimed to positively contribute to the improvement of the risk management process and the provision of value to the organization. The division's objectives, which can be found in the "Contextualization" (2.1), were highlighted to division members to promote better alignment and

provide a clear direction for the risk management process.

Furthermore, the criteria to be used in risk and opportunity assessment were defined at this stage. An initial definition of different levels of probability and impact for the risks and opportunities to be identified was carried out, including classification into 5 levels for both the probability of occurrence of risks and opportunities and the impact on the division.

## 5.4 Risk Assessment Process

### 5.4.1 Risk and Opportunity Identification

In this stage, risks were identified through brainstorming sessions, research, and critical analysis. Identification involved collecting risks, their triggers, and their consequences for the division, impacting CMS. Risks are categorized by areas for ease of understanding.

In addition to identifying risks, the scope of this work was expanded to include the identification of opportunities in line with ISO 31000 guidelines. Although the identification of opportunities is not carried out in the current PPRGCIC, its inclusion represents an innovation. The same process used to identify risks was employed to identify opportunities.

### 5.4.2 Risk and Opportunity Analysis

As recommended by ISO 31000, this crucial stage of the risk management process involves a detailed analysis of the identified risks and opportunities. To achieve a comprehensive understanding, it is essential to determine the inherent risk and opportunity level (before mitigation) for each of them. This analysis allows for a subsequent comparison based on objective and relevant criteria. For each risk and opportunity, an estimate of the probability of occurrence is assigned, considering available information, relevant history, and possible future scenarios. Additionally, the potential impact of each risk and the magnitude of the benefit associated with each opportunity to DSST will be evaluated.

By quantifying the probability and impact, it is possible to establish a scale that allows for the prioritization of risks and opportunities based on their relevance and potential impact. Thus, through careful analysis, it will be possible to gain a clearer view of the risks that require greater attention and the opportunities that should be seized.

#### 5.4.2.1 Probability Definition

To estimate the probability of occurrence for the identified risks and opportunities, a scale of levels 1 to 5 is used, with probability indicators ranging from "very low" to "very high," as seen in **Table I**. The frequency values corresponding to each risk and opportunity level were determined based on the context of the collected risks, taking into account both more frequent events, such

as occupational stress and workplace accidents, as well as less frequent ones, such as complaints about the absence of warnings in video surveillance areas. The same scale was used to analyze opportunities.

**TABLE I.** Probability indicators

Level (L)	Indicator	Frequency
5	Very High	At least once every 3 months ( $P \leq 3m$ )
4	High	Once between 3 months and 1 year ( $3m < P \leq 1y$ )
3	Moderate	Once between 1 to 5 years ( $1y < P \leq 5y$ )
2	Low	Once between 5 to 25 years ( $5y < P \leq 25y$ )
1	Very Low	Once in periods greater than 25 years ( $P > 25y$ )

#### 5.4.2.2 Impact Definition

To analyze the impact that the occurrence of the mentioned risks and opportunities can have on DSST, and consequently on CMS, the main impact categories, based on observed consequences, were established in advance. These categories for risks are:

- Operational: Considers the impact on operations and failures in meeting objectives.
- Financial: Considers financial damages to the organization, from fines to material losses.
- Reputational: Considers the level of damage to the reputation of DSST and, consequently, CMS.

The categories for opportunities are:

- Operational: Considers improvements in operations and objective fulfillment.
- Financial: Considers financial gains for the organization.
- Reputational: Considers improvements in DSST's reputation and, consequently, CMS.

For each of the defined categories, impact indicators ranging from "insignificant" to "catastrophic," with impact levels from one to five, were assigned, following a similar approach to the one used in the probability definition. The impact indicators can be found in **Table II**.

After this identification, it is established that the inherent impact level ( $I_j$ ) of each risk and opportunity corresponds to the highest impact level (L) identified, considering all categories, as expressed in **Formula (1)**.

$$I_j = \max (L) \quad (1)$$

This approach provides a comprehensive view of the potential impact of each event, taking into account the different critical areas for DSST and CMS. By combining the analysis of the probability of occurrence with the analysis of the impact resulting from each risk, it is possible to prioritize the necessary mitigation actions more effectively.

**TABLE II.** Impact indicators

Level (L)	Indicator	Categories	Risk Description	Opportunity Description
1	Insignificant	Operational	No significant operational impact	No significant operational opportunities
		Financial	No significant financial implications	No significant financial impact
		Reputational	No impact on reputation beyond the internal level	No influence on reputation beyond the internal level
2	Minimum	Operational	Small manageable operational disruptions (e.g., a few hours of downtime)	Minimal operational opportunities, of short duration
		Financial	Small budget variance, but within the capability of adjustment	Minimal financial benefits, but within the capability of integration
		Reputational	Slight impact on reputation with internal concern	Slight impact on reputation with internal recognition
3	Moderate	Operational	Moderate but manageable operational disruptions (e.g., a few days of downtime)	Moderate operational opportunities with manageable benefits
		Financial	Budget variance requiring careful attention	Financial benefits requiring careful management
		Reputational	Negative impact on reputation with local media coverage	Positive impact on reputation with local recognition
4	High	Operational	Substantial operational disruptions requiring immediate attention (e.g., several weeks of downtime)	Substantial operational opportunities requiring immediate attention
		Financial	Budget variance that may require substantial corrective measures	Substantial financial benefits requiring additional measures
		Reputational	Significant damage to reputation with notable media coverage	Significant gains in reputation with local visibility
5	Catastrophic	Operational	Critical operational disruptions with a threat to organizational continuity (e.g., months of downtime)	Exceptional operational opportunities, critical for the organization
		Financial	Budget variance threatening the organization's financial stability	Exceptional financial benefits, critical for the organization
		Reputational	Irreparable damage to reputation with significant media coverage	Exceptional gains in reputation with national/international prominence

**5.4.2.3 Determination of Inherent Risk and Opportunity Levels**

Based on the previously defined value scales for probability and impact, the corresponding values are assigned to the identified risks and opportunities. From these values, the inherent risk level ( $R_j$ ) is calculated for each risk using **Formula (2)**, and the inherent opportunity level ( $O_j$ ) is calculated for each opportunity using **Formula (3)**. These values are obtained from the inherent impact level ( $I_j$ ) and the inherent probability level ( $P_j$ ) assigned to each identified risk and opportunity.

$$R_j = I_j \times P_j \quad (2) \quad O_j = I_j \times P_j \quad (3)$$

**5.4.3 Risk and Opportunity Evaluation**

**5.4.3.1 Risk and Opportunity Appetite and Tolerance**

Risk appetite corresponds to the level of risk that the organization is willing to accept without the need for short- or medium-term mitigation actions, while risk tolerance represents the range of risks the organization can assume, albeit with the need to address them within a specified timeframe. The same applies to opportunities.

For DSST, risks with a level of twenty or higher are placed in the intolerable zone, requiring immediate action to mitigate them. Risks with an inherent risk level between twelve and sixteen are classified as tolerable for DSST but require short-term mitigation actions within a defined timeframe of up to 3 months. Risks with an inherent risk level between five and ten are also categorized as tolerable risks, but they require the definition of medium-term actions for mitigation within a defined timeframe of six months. Finally, risks with an inherent risk level equal to or less than four falls within the division's risk appetite, which means the decision can be made not to define mitigation actions; therefore, they

are acceptable risks. The same classification is adopted for opportunities.

Next, the classification of risks and opportunities for DSST will be demonstrated in **Table III**.

**TABLE III.** Risk classification

Classification	Criteria (R/O)	Priority of action on causes
Very high	20 a 25	Immediate actions should be defined
High	12 a 16	Short-term actions should be defined - 3 months
Medium	5 a 10	Medium-term actions should be defined - 6 months
Low	1 a 4	No actions need to be defined or long-term actions could be defined with the aim of continuous improvement

**5.4.3.2 Risk and Opportunity Ranking**

After determining the inherent risk level ( $R_j$ ) and inherent opportunity level ( $O_j$ ) for each identified risk and opportunity in DSST, a ranking of risks and opportunities is performed from the highest to the lowest level. This ranking allows for the prioritization of risks and opportunities, establishing the order in which they have the potential to impact DSST. By knowing the classification of risks and opportunities in order of priority, DSST can develop specific strategies to deal with them according to their relevance and potential impact.

**5.4.3.3 Risk and Opportunity Matrix**

To provide a clearer visual understanding of the identified risks and opportunities, a risk and opportunity matrix is used. This matrix is an effective visual tool composed of two dimensions: probability and impact. Through it, it is possible to directly calculate and visualize the classification of risks and opportunities, making this matrix a valuable tool in the assessment stage.

**Figure 3** shows the risk and opportunity matrix, filled with the risk appetite and tolerance values previously determined for DSST. This matrix is filled with the total number of risks and opportunities for each corresponding position.

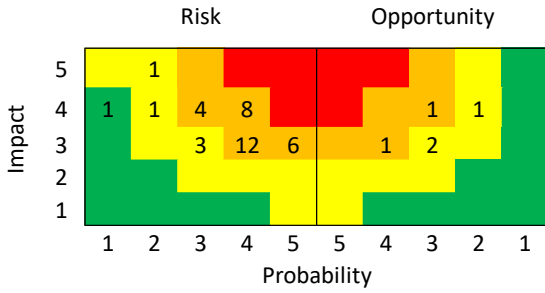


Fig. 3. Inherent risk and opportunity matrix

After classifying and filling in the matrix, it can be seen that there is only one risk classified below the DSST's risk appetite (belonging to the green zone), which means that, except one risk, all the others require mitigation actions to be defined.

The matrix also shows a greater predominance of high-ranking risks than medium-ranking risks. This predominance reflects the relevance of the risks identified and indicates that there is a combination of risks that require greater attention and others that can be dealt with over a longer period.

### 5.5 Risk and Opportunity Treatment

After carefully assessing the identified risks, their likelihood of occurrence, and potential impacts if they materialize, it became evident that all of them, except for risk "10) Complaint against the absence of surveillance camera warnings," require intervention, as mentioned in the assessment stage. Mitigation is then a fundamental approach to deal with the identified risks. The same goes for opportunities.

The mitigation process addresses risk and opportunity factors, aiming to reduce their likelihood of occurrence and minimize negative impacts in case they materialize. For the exploitation of opportunities, the goal is to maximize the likelihood of occurrence and positive impacts. This step is crucial for strengthening the division's resilience and ensuring the efficient and secure continuity of activities.

It's important to emphasize that both the risk treatment and opportunity exploitation processes are continuous and iterative. As new information and data are obtained, the measures to be taken can be adjusted or improved, always aiming to improve the risk and opportunity management of the division. Additionally, the identification of new emerging risks and opportunities or changes in the organizational environment may also require the implementation of new treatment strategies.

## 5.6 Recording and Reporting

### 5.6.1 Residual Risk and Opportunity Level

After defining the proposed mitigation measures for risks and opportunities, their reassessments are

conducted, recalculating the probability and impact values after the implementation of these measures. This reassessment determines the residual risk level ( $R_k$ ) and the residual opportunity level ( $O_k$ ), representing the risk and opportunity levels that remain after the application of treatment actions. Both residual risk and opportunity consider the values of residual impact ( $I_k$ ) and residual probability ( $P_k$ ), as expressed in **Formulas (4) and (5)**, respectively.

$$R_k = I_k \times P_k \quad (4)$$

$$O_k = I_k \times P_k \quad (5)$$

This step is crucial to verify the effectiveness of the measures taken, allowing for the identification of which risks have been properly controlled and which still require additional attention. By assigning new residual risk values to the risks, it's possible to observe the reduction in the level of risk that each one represents for the division. The same goes for opportunities.

### 5.6.2 Residual Risk and Opportunity Matrix

The residual risk and opportunity matrix represents an updated and more optimistic view of all identified risks and opportunities after the implementation of proposed mitigation and exploitation measures. In this matrix, it's possible to visualize how risks and opportunities are impacted by the proposed actions, allowing for a better understanding of DSST's current risk management scenario.

The analysis of the residual risk and opportunity matrix, represented in **Figure 4**, provides DSST with an overall view of its risk and opportunity management process. Based on this information, the division can make more informed decisions aligned with its strategies and objectives. Additionally, the matrix assists in prioritizing future actions, allowing DSST to concentrate its efforts where the potential impact is higher.

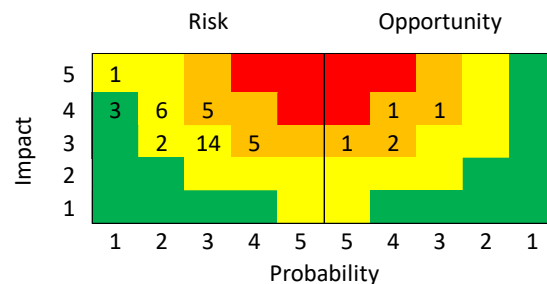


Fig. 4. Residual risk and opportunity matrix

### 5.6.3 Record of Risks and Opportunities

Based on the results obtained in the risk management process conducted for DSST within the scope of this work, significant differences in comparison to the corresponding part of DSST in the current PPRGCIC, can be observed. Several improvements have been identified in the proposed plan compared to the current plan. One of

the main differences is the increased objectivity in the conveyed ideas, reflected in both risk identification and proposed measures. The proposed plan promotes the use of concise, clear language, which is crucial given that PPRGCIC addresses various departments and divisions of CMS. This approach enhances understanding and implementation of the plan.

Another notable improvement is the level of detail in the proposed plan compared to the current plan. Many of the risks addressed in PPRGCIC were grouped into broader categories, while the proposed plan adopts a more granular approach, analyzing risks individually. This detailed approach allows for better assignment of specific mitigation measures to each identified risk, increasing the effectiveness of actions taken.

The proposed plan also introduces new concepts, such as the institution's risk appetite and tolerance. This identification allows for prioritizing risks, making it easier to set deadlines for implementing mitigation measures. Prioritizing risks will assist DSST in allocating resources appropriately, ensuring that the most critical risks are addressed with greater urgency.

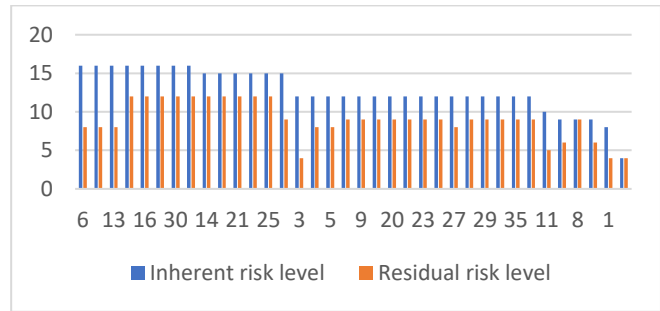
Another significant change is the presentation of identified risks in a risk matrix (impact x probability), both before and after mitigation. This matrix facilitates the visualization and understanding of the impact of mitigation measures, allowing for a clearer analysis of the results achieved.

In addition, in the proposed plan, risks are classified on a scale of 1 to 5, with the definition of their respective frequency scale and assumptions for impact values. This more detailed approach replaces the simplified division present in the current plan, contributing to a more accurate risk assessment.

Another improvement implemented is the inclusion of a column for the implementation costs of mitigation measures. While this was applied to only a group of risks, as most identified mitigation measures are organizational and related to human resources, it is expected to be useful in the future to evaluate the cost-effectiveness of more expensive measures.

The inherent and residual risk matrices reveal that the implementation of mitigation measures results in an overall reduction in risk for the majority of identified risks. This leads to a classification of high risk being reduced to medium for 18 of the identified risks, a classification of medium risk being reduced to low for 1 of the identified risks, and even a classification of high risk being reduced to low for 1 of the identified risks, placing them below DSST's risk appetite.

The overall reduction in the levels of identified risks is visually demonstrated in **Figure 5**, which shows risk levels before and after the implementation of mitigation actions.

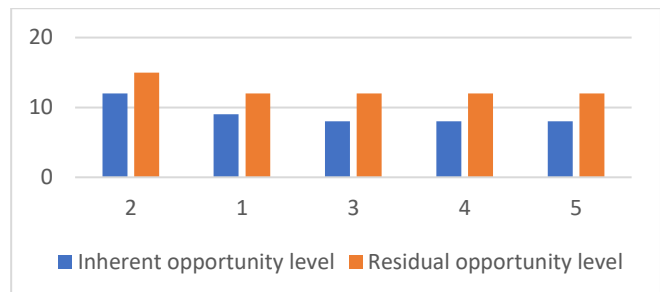


**Fig. 5.** Risk level before and after mitigation

Another clear distinction is the inclusion of opportunity assessment, as highlighted in this work. This analysis is of great importance as it provides a more comprehensive view of DSST's activities and its relationship with the external environment, complementing the Risk Assessment.

While the identified opportunities may have limited value, and the measures for their exploitation may not result in significant changes in opportunity levels, it is important to record these opportunities in DSST's risk management. Including opportunities in the proposed plan represents a positive exercise for the organization as it promotes a mindset focused on harnessing potential beneficial scenarios.

The opportunity levels before and after the implementation of exploitation actions are demonstrated in **Figure 6** below.



**Fig. 6.** Opportunity level before and after mitigation

### 5.7 Monitoring and Review

The monitoring and review phase represents a crucial component of risk management. In this stage, it is essential to maintain regular oversight of the risk management process, which includes the critical analysis of risks, risk treatment, risk exploitation, and the evaluation of performance. Key performance indicators, performance analyses, and other relevant methods can be employed. The establishment of control mechanisms is vital to identify changes that may occur in the risk management landscape. These changes might encompass shifts in the internal or external context, alterations in legislation, or shifts in risk management methodologies, among other factors.



Furthermore, continuous updates of information are fundamental for promoting the ongoing improvement of the risk management process. This involves the analysis of both successes and setbacks, fostering a culture of continuous learning.

As mentioned in "Problem Definition (2)", by prevailing legislation, the PPRGCIC undergoes regular checks. This includes the preparation of an interim assessment report, to be finalized in October of each year. To compile this report, the GMA requests departmental leaders to provide documentary evidence demonstrating the effective implementation of identified risk control measures. This evidence can encompass reports, standards, operational procedures, worksheets, checklists, and various other documents.

Despite the annual nature of the PPRGCIC review at the Sintra Municipal Council (CMS), one of the goals of this work is to promote best risk management practices within the organization, thereby contributing to a heightened emphasis on the importance of the monitoring and review phase.

## 6. Conclusions and Recommendations

This work has underscored the relevance and fundamental necessity of risk analysis and management in complex and ever-evolving environments, such as the public sector. The growing globalization and interdependence between modern societies have heightened the importance of risk prevention and response, making proactive risk analysis practices essential.

By presenting an empirical and detailed approach to the risk management process, it is expected to make a positive contribution to the existing literature in this field. The emphasis on the assumptions and methodologies used in this work should provide a starting point for future research and ongoing improvements in risk analysis and management processes.

Moreover, the proposed plan's improvements, such as the inclusion of "appetite" and "tolerance" to risk concepts, along with the adoption of a risk matrix (impact x probability), have the potential to provide a more comprehensive and objective view of the risks at hand. This approach will facilitate the prioritization of mitigation actions and the efficient allocation of resources.

The methodology employed in this study has also contributed to spreading the importance of risk management within the division, highlighting its crucial role in informed decision-making and safeguarding organizational interests. Another significant aspect is the enhancement of the division head's and their team's risk management skills, promoting critical thinking and understanding of key concepts in this field, such as

probability and impact definitions. Furthermore, by emphasizing the importance of communication in the risk management process and encouraging more comprehensive and succinct information transmission, an overall improvement in communication with various stakeholders is expected.

The methodology applied in this research aimed to convey that risk management is not merely a compliance exercise but an opportunity to enhance operational and strategic efficiency. This, in turn, seeks to provide value to the organization, fostering a continuous risk management process, and encouraging ongoing improvement, and adaptation to changes.

To strengthen risk management within the CMS and other public sector organizations, several recommendations are proposed. One of these involves the review and enhancement of the Prevention of Management Risks Plan, including Corruption and Related Offense Risks (PPRGCIC), to make it more objective, detailed, and aligned with current best practices in risk management.

Additionally, investing in the training of employees and managers involved in risk management is advised since it is fundamental for ensuring a proper understanding of the processes and methodologies adopted. Promoting a culture of awareness regarding the importance of risk management at all levels of the organization will encourage the involvement and participation of the agents concerned.

Furthermore, enhancing collaboration and information sharing with other government agencies, specialized entities, and external stakeholders is recommended. This collaboration will enrich the risk analysis and provide a broader perspective on the challenges faced. Sharing information and experiences will contribute to the improvement of risk management practices and avoid duplication of efforts.

Lastly, it is crucial to promote greater involvement from higher authorities. Committed leadership in risk management is essential to ensure that the risk culture is disseminated and integrated into all CMS activities. The commitment of top management to plan implementation and strengthening is essential for the success of risk management.

By adopting these recommendations, the CMS will be able to strengthen its resilience and ability to face future challenges. Proactive risk management is a powerful tool for driving sustainable growth in organizations and ensuring the continuity of public services provided to the community. The continuous improvement of risk management is an investment in a safer and more resilient future, and the CMS, by leading this process, can serve as an example and positively influence other public institutions.

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