UNIVERSIDADE CATÓLICA PORTUGUESA

Enterprise Risk Management and Firm Value:

Empirical Analysis of Listed Portuguese Firms

Viktoriia Holovchenko

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Empirical Analysis of Listed Portuguese Firms

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by

Viktoriia Holovchenko

under the guidance of

Professor Manuel Ricardo Fontes da Cunha

Católica Porto Business School, Universidade Católica Portuguesa

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List of Abbreviations

ERM - Enterprise Risk Management

TRM - Traditional Risk Management

CRO - Chief Risk Officer

COSO - Committee of Sponsoring Organizations of the Treadway Commission

S&P - Standard and Poor's

OLS - Ordinary Least Squares

ROA - Return on Assets

ISO - International Organization for Standardization

ICB - Industry Classification Benchmark

ICAEW - The Institute of Chartered Accountants in England and Wales

Resumo

A Gestão de Risco Empresarial (sigla em inglês, ERM – *Enterprise Risk Management*) tem vindo a revelar-se uma ferramenta abrangente para gerir uma ampla gama de riscos complexos. Esta ferramenta representa uma mudança significativa na forma como as empresas gerem os riscos e tornou-se uma parte essencial das operações empresariais. Tanto a literatura como a teoria económica sugerem que a implementação do ERM aumenta o valor da empresa e melhora o seu desempenho. No entanto, as evidências empíricas sobre o seu impacto ainda são limitadas e os resultados permanecem inconsistentes.

O principal objetivo deste trabalho final de mestrado é contribuir para a literatura, examinando a relação entre a implementação da ERM e o valor da empresa ao longo de um horizonte temporal alargado e em diferentes setores, com um foco específico em Portugal, utilizando uma nova *proxy* para medir o nível de implementação do ERM, baseada no mais recente quadro desenvolvido pelo *Committee of Sponsoring Organizations of the Treadway Commission (COSO)*. A nossa análise inclui uma amostra de 14 empresas que fazem parte do índice PSI da Bolsa de Valores de Lisboa, pertencentes ao setor não financeiro, abrangendo o período de 2017 a 2023. Construímos um modelo de regressão utilizando a metodologia dos Mínimos Quadrados Ordinários (sigla em inglês, OLS – *Ordinary Least Squares*), em que a variável explicada é o *Tobin's Q*, utilizado como *proxy* para o valor da empresa, e a variável explicativa é o ERM *Score*, que representa o nível de implementação do ERM.

Os resultados mostram que a implementação do ERM não tem um impacto significativo no *Tobin's Q*, o que significa que o mercado não reconhece nem reage a diferentes níveis de adoção do ERM como um fator competitivo que contribui para o valor da empresa. No entanto, a implementação do ERM apresenta uma relação positiva e significativa com o desempenho contabilístico, medido pelo

ROA. Ou seja: embora o ERM influencie positivamente o desempenho contabilístico das empresas, ele não influencia diretamente a sua avaliação de mercado. Relativamente aos fatores determinantes da adoção do ERM, os nossos resultados revelam que a dimensão da empresa é um fator que influencia positiva e significativamente a implementação de um sistema de ERM.

Palavras-chave: Gestão de Riscos Empresariais, Valor da Empresa, PSI

Número de palavras: 9970

Abstract

Enterprise risk management (ERM) has emerged as a comprehensive framework for managing a wide range of complex risks. This approach represents a significant change in how firms manage risks and has become an essential part of business operations. Both the literature and economic theory suggest that the implementation of ERM increases firm value and improves its performance. However, empirical evidence regarding its impact remains limited, and the results are inconsistent.

The main objective of this master's final assignment is to contribute to the literature by examining the relationship between ERM implementation and firm value over an extended time horizon and across different industries, with a specific focus on Portugal, using a new proxy to measure the level of ERM implementation, based on the latest framework developed by the Committee of Sponsoring Organizations of the Treadway Commission (COSO). Our analysis includes a sample of 14 companies that are part of the PSI of the Lisbon Stock Exchange, belonging to the non-financial sector, covering the period from 2017 to 2023. We build a regression model using the OLS methodology, where the explained variable is Tobin's Q, used as a proxy to firm value, and the explanatory variable is an ERM Score, which represents the level of ERM implementation.

The results show that ERM implementation does not have a significant impact on Tobin's Q, meaning that the market neither recognizes nor reacts to different levels of ERM adoption as a competitive factor contributing to firm value. However, ERM implementation shows a positive and significant relationship with accounting performance, as measured by ROA. In other words, although ERM positively influences firms' accounting performance, it does not directly influence their market valuation. Regarding the determinants of ERM adoption,

our findings reveal that firm size is a factor that positively and significantly influences the implementation of an ERM system.

Keywords: Enterprise Risk Management, Firm Value, PSI

Number of words: 9970

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Introduction

Interest in risk management has increased significantly in recent years, with a growing number of organizations implementing and exploring comprehensive risk management systems. Risk management has become a widely discussed topic in finance research. In early theoretical models of perfect markets, it was considered unnecessary, as firms and investors were assumed to diversify risk efficiently (Modigliani & Miller, 1958). However, market imperfections make risk management essential (Froot et al., 1993).

In the 1990s, there was a growing focus on governance, risk, and control, with several studies encouraging companies to reconsider their approach to risk management. As a result, the concept of risk management received a lot of interest in the early 2000s, particularly because of significant events that happened at that time, such as financial scandals. The 2007 financial crisis, which affected American companies, increased attention to risk management and led to the creation of new frameworks and the adoption of new regulations. In 2004, the New York Stock Exchange introduced new corporate governance regulations requiring the audit committees of listed companies to review and approve risk management processes (Fraser & Simkins, 2016).

The Committee of Sponsoring Organizations of the Treadway Commission (COSO) first published the Enterprise Risk Management-Integrated Framework in 2004, and describes ERM as "*a process, effected by an entity's board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives*" (COSO, 2004). In 2017, COSO updated the framework and

released “Enterprise Risk Management-Integrating with Strategy and Performance”. The updated document emphasizes the significance of integration risk management in both the strategy-setting process and performance (COSO, 2017).

The existing literature suggests that companies that make the transition from a traditional risk management approach to enterprise risk management can benefit significantly from it. The primary advantage of ERM over traditional risk management is that it considers the firm's risks holistically and cross-functionally, rather than assessing risks within individual departments (Cohen et al., 2017). Enterprise risk management is a tool that assists companies in identifying potential risk areas and developing strategies to mitigate those risks. Effective implementation of ERM reduces operational costs, controls spending, and maximizes profitability (Aquino et al., 2022). Companies that successfully establish an effective ERM can have a long-term competitive advantage over those that handle and monitor risks individually (Nocco & Stulz, 2006).

Several previous studies have used the hiring of a CRO as an indicator of a firm's commitment to ERM (Liebenberg & Hoyt, 2003; Pagach & Warr, 2011). In this study, we use the ERM score to evaluate the level of ERM implementation within firms. The classification is based on the twenty principles outlined by COSO in “Enterprise Risk Management - Integrating with Strategy and Performance” (2017). For each principle, I assigned a score of 1 if it was identified in the company’s published reports and documents, and a score of 0 if it was not.

According to economic theory and ERM literature, companies will experience significant benefits by adopting this integrated approach. The literature shows that most studies focus on ERM within specific industries or countries. For instance, most recent empirical studies, such as those by Lechner and Gatzert (2018) and Aquino et al. (2022), primarily focus on large economies, paying little attention to smaller markets. In addition, while many studies indicate a positive

relationship between ERM and firm value (Bertinetti et al., 2013), some empirical research is still unable to completely support those arguments and found no significant relation between ERM and firm value (Santos, 2021). Therefore, more empirical evidence is needed to better understand the importance of ERM.

This Master's Final Assignment aims to examine Portuguese-listed firms across different industries that contribute to a more comprehensive understanding of how ERM practices impact firm value. The main objective of this study is to examine whether there is a relationship between the level of implementation of ERM and firm value. To analyze this research question, we construct an OLS regression model to assess the effect of ERM implementation, using ISO 31000, size, leverage, sales growth, ROA, dividends, and beta as control variables, with Tobin's Q as a proxy for firm value as the explained variable. The sample consists of 14 Portuguese-listed firms. We examine firms from seven industries that are significant in the Portuguese economy: Utilities, Oil and Gas, Retail, Basic Resources, Industrial, Telecommunications, and Consumer Services. The data cover a period of seven years, from 2017 to 2023. The results show that ERM implementation has no significant impact on Tobin's Q as a proxy for firm value. Meanwhile, ERM implementation has a positive and significant relationship with accounting performance, as measured by ROA. Additionally, firm size is identified as the main determinant of ERM implementation.

Thus, the present Master's Final Assignment is structured in 4 chapters. In Chapter 1, I review the literature about the definition and evolution of the concept of risk, the comparison between TRM and ERM, the advantages and challenges in implementing ERM, and the COSO Framework. Chapter 2 presents the methodology, the variables, and the sample collected to understand the relationships between the variables. Chapter 3 corresponds to the analysis and discussion of results, and Chapter 4 presents the main conclusions, limitations, and recommendations for future research.

Chapter 1
Literature Review

1.1. Definition and evolution of the concept of risk

The concept of risk first emerged in the mid-seventeenth century, derived from the Anglo-French word "risqué", and established a quantifiable relationship between time and uncertainty. Before that time, in pre-industrial societies, risk was not recognized. Instead, the uncertainties of daily life were expressed and managed through various religious and magical beliefs, including concepts such as fate, providence, and luck. Beginning in the seventeenth century, significant advancements in social, intellectual, and economic life changed ideas about uncertainty, the future, and human agency, paving the way for the development of the concept of "risk" (Reith, 2004).

According to the Institute of Chartered Accountants in England and Wales, business risk is defined as "*the amount of the uncertainty as to the benefits that the business will derive from pursuing its objectives and strategies*". Risk is essential in any enterprise, as it comes with the pursuit of opportunities to generate returns for its owners (ICAEW, 2002). The Oxford dictionary describes risk as the chance that something negative could happen in the future, or a situation that might be dangerous or lead to a bad result. A common definition of risk is "the possibility of loss". According to Yates and Stone (1992), risk consists of three aspects: potential losses, the significance or impact of these losses, and the uncertainty of which losses will occur. Therefore, risk has two sides: one represents the opportunity for return, while the other signifies the potential for loss.

There are three main categories of risk: preventable risks, strategic risks, and external risks. Preventable risks arise in the company, are controllable, and

should be eliminated or avoided, and related to illegal, unethical, or improper actions by employees and managers, as well as failures in routine operational processes. This risk category is most effectively managed through active prevention, which involves monitoring operational processes and making decisions toward established standards. Managing strategy risks requires a different approach than handling preventable risks. A rules-based control model is inadequate for these types of risks. Instead, companies need a risk management system specifically designed to lower the chances of these risks occurring and to improve the firm's ability to manage risks. External risks cannot be prevented, companies need a different approach to manage them. These risks emerge from external events that are outside the company's control, such as natural disasters or significant changes in the macroeconomic environment. The focus should be on identifying these risks early, though they often become evident only after they occur, and companies should reduce their potential impact (Kaplan & Mikes, 2012).

The idea that risk is an inevitable part of business has been around for a long time, but the development of risk management functions within organizations is relatively recent. Different types of risks can restrict the achievement of strategic goals, which makes is essential to implement systems that contribute a culture of risk awareness and management throughout all levels of the organization (Woods, 2007).

1.2. Traditional Risk Management

The integration of risk management into business decision-making processes began in the late 1940s and early 1950s. Over the years, companies have been able to transfer certain risks to insurance companies. These risks include natural catastrophes, accidents, human error, fraud, and, as insurance markets

expanded, they began to cover more commercial risks, such as company credit risk. However, companies wanted to have better loss prevention and control strategies, so instead of just buying insurance, they started researching how certain risks could be prevented or minimized. In some cases, companies decide to manage and finance the risks themselves, which results in a more comprehensive approach to managing insurable risks. In the 1970s, companies started to investigate financial risks more carefully, including changes in exchange rates, commodity prices, interest rates, and stock prices. Around this time, financial risk management began to be more systematic and finance tools such as futures, options, swaps were developed to help companies hedge these types of risks (Dickinson, 2001).

Risk management has been a subject of extensive debate since the early days of finance research, where it was considered irrelevant (Modigliani & Miller, 1958) under the assumption of perfect market conditions. Based on the financial theory introduced by Modigliani and Miller in 1958, known as the "risk management irrelevance principle," some finance researchers responded by citing capital market imperfections and proposing theories that explain why risk management can increase firm value. They have found several ways that risk management can add value to a company. These value-increasing benefits involve lowering expected costs associated with tax payments, financial difficulties, underinvestment, asymmetric information, and undiversifiable stakeholders (Mcshane et al., 2011).

Historically, risk management developed in a "siloed" manner, with insurance risk, technological risk, environmental risk, financial risk, and operational risk, as separate issues and managed independently (Rao & Marie, 2007). The main disadvantage of managing each risk class in a separate silo is that it creates inefficiencies due to the lack of coordination among the different risk management departments. In contrast, an enterprise risk management approach

would see all these risk categories as part of the company's overall risk profile and manage them in a more integrated and holistic manner (Liebenberg & Hoyt, 2003). Kerstin et al. (2014), based on the report from the Chartered Institute of Management Accountants (CIMA), describe three important weaknesses of the silo mentality. The first weakness is that risk is monitored in individual divisions, and overall risk could be unchecked. The second problem is the potential for developing an overly aggressive risk culture. The final weakness is the dependence on mathematical risk models, which can be risky because these models might allow certain levels of risk.

Traditional theories of risk management often focus on transaction costs, agency costs, and other policies that may function as an alternative to risk management. According to theory, companies with high debt levels have higher agency costs because of underinvestment issues. Furthermore, they have greater problems in coordinating finance and investing strategies, as well as increased transaction costs in times of financial crises. Consequently, it is reasonable to assume that companies with greater debt levels will use risk management to mitigate these problems (Lundqvist, 2015). Traditional risk management primarily focuses on pure risks (hazard risks where the consequences may or may not result in losses). This approach has a strong emphasis on identifying and controlling insurable risks, such as natural hazards, through a structured process with five components:

- Risk Identification: Identifying potential risks that could affect the organization.
- Risk Analysis: Evaluating each risk with a qualitative assessment to classify exposures.
- Risk Control: Implementing both preventive actions for future risks and corrective actions for past issues.
- Risk Financing: Setting resources to cover small to medium risks.

- Risk Administration: Implementing specific risk management activities.

In traditional risk management, each department manages its own risks. They manage risk in accordance with risk management frameworks, which are adjusted to each strategy, profitability level, product, pricing, and management relationship (Simona-Iulia, 2014). The combination of managing all types of firm risks within a well-governed system results in an integrated approach to risk management, or ERM (Lundqvist, 2015).

1.3. Transition from Traditional Risk Management to Enterprise Risk Management

Risk management began as a so-called 'silo-based' approach to corporate risk management in the late 1940s and early 1950s, continuing until the mid-1990s. For many years, financial markets and a company's capacity to prevent, minimize, balance, or transform risks into opportunities have been significantly impacted by risk management, its procedures, metrics, and tools. Enterprise Risk Management, a recently developed framework, transforms the previous silo-based approach into a comprehensive, strategic, and integrated system. The advantage of an integrated approach over traditional risk management is that it manages risks systematically and consistently, rather than in isolation, thereby avoiding inefficiencies caused by a lack of coordination between different risk management departments (Kraus & Lehner, 2012).

In the 1990s, there was a growing focus on control, risk, and governance, with several significant publications advancing the ideas of risk management and governance. These included the Cadbury Report (UK), the Toronto Stock Exchange Dey Report (Canada), the Group of Thirty Report (USA), and CoCo (the Criteria of Control model created by the Canadian Institute of Chartered

Accountants). At this time, many people believed that enterprise risk management was just another popular management approach, especially because consultants frequently promoted it (Fraser & Simkins, 2016).

Starting in 2000s, a wave of financial scandals hit companies worldwide, which resulted in severe consequences, such as the Enron collapse, and further amplified the demand for a more comprehensive strategy (Arena et al., 2010). During that period many efforts have been made to encourage companies, primarily in the financial sector, to adopt ERM. In that year, the New York Stock Exchange (NYSE) released new corporate governance guidelines, that required audit committees of listed companies to take a more active role in risk management. As a result of these regulations, many boards required their audit committees to examine and approve risk management practices. The 2008-2009 financial crisis revealed that many companies lacked effective risk management. For this reason, financial regulators increasingly encouraged to enterprise risk management. This enables companies to manage a wide range of risks in an integrated, enterprise-wide manner, in contrast to traditional risk management, which manages particular risk categories independently in risk "silos" (Fraser & Simkins, 2016). In February 2010, were proposed by the Securities and Exchange Commission (SEC) new rules for improved risk-related disclosure in annual statements. These rules focused on how a company's compensation practices and policies relate to risk management and the leadership structure of the board of directors (Bertinetti et al., 2013).

After the global financial crisis, companies have significant challenges in strengthening their governance and risk management. Boards and audit committees have become more conscious of risk, and as a result, risk management practices continue to develop and improve. To solve that issue, COSO started a project to create a framework that management teams could use to assess and improve the risk management practices of their companies. In 2004,

COSO introduced the "Enterprise Risk Management-Integrated Framework" to help companies manage and integrate risk management into their overall strategy. The International Organization for Standardization (ISO) introduced ISO 31000:2009 - Risk Management, which provides a comprehensive framework, process, and set of principles that can be used in risk management across all types of organizations, whether in the public or private sector (Frigo & Anderson, 2011). Enterprise risk management was developed as a more advanced form of traditional risk management, with a broader focus and priorities (Simona-Iulia, 2014).

1.4. Enterprise Risk Management

Enterprise Risk Management examines the company's whole risk portfolio in an integrated way, as opposed to traditional silo-based risk management (Gatzert & Martin, 2015). Integrated risk management involves the identification and assessment of the various risks affecting the firm's value, and the implementation of a comprehensive, organization-wide approach to manage those risks (Meulbroek, 2002). Enterprise risk management extends traditional risk management by taking a more comprehensive approach, with the aim to integrate the risk management process across the organization's internal systems, processes, and personnel (Culp, 2002). This approach helps companies understand the diverse range of risks they face and allows them to identify and analyze potential threats that could affect financial performance (Boris, 2012).

ERM has emerged as a new approach for managing the diverse risks organizations face, and policymakers continue to focus on improving mechanisms that strengthen corporate governance and enhance risk management practices (Beasley, 2016). Several recent frameworks are designed to guide organizations in implementing ERM. Among the most prominent and

frequently mentioned are COSO's Enterprise Risk Management: Integrating with Strategy and Performance (2017), and ISO 31000:2018. The COSO Enterprise Risk Management-Integrating with Strategy and Performance framework emphasizes the importance of incorporating risk into both the strategy-setting process and driving performance (COSO, 2017). ISO 31000 is an international standard that offers principles and guidelines for effective risk management. These principles include: integration into organizational processes; structured and comprehensive approach; customized approach; inclusive participation; dynamic process; best available information; human and cultural factors; and continuous improvement. This framework provides the core elements of the risk management system: identification, assessment, treatment, monitoring, and communication (ISO 31000:2018). According to COSO's Enterprise Risk Management-Integrated Framework, ERM is a process implemented by the board of directors, management, and other personnel within the company. It is used in strategy settings and across the enterprise to identify potential events that could impact the company and manage risks within the established risk appetite, thereby providing a reasonable level of assurance (COSO, 2004). Based on the COSO framework Harner (2010) focused on four areas of risk-related tasks for boards: understanding enterprise risk-management practices; discussing risk-management philosophy and risk appetite; reviewing the risk portfolio with risk appetite; and being informed of the most important risks.

Kleffner et al. (2003) state that in contrast to the traditional "silo" based approach to managing risk, the ERM approach requires a company-wide approach for identifying, assessing, managing, and reacting to risk events. Frigo and Anderson (2011) describe that for ERM to be effective, it needs to be incorporated into both the strategy execution and strategic planning processes. According to Lundqvist (2015), the addition of the risk governance component to traditional risk management systems is a crucial step in implementing ERM and

helps integrate risk management throughout the company. Liebenberg and Hoyt (2003) refer that ERM combines various risk management activities into a single framework, that allows companies to recognize the connections and relationships between different risks, which may be ignored in traditional risk management.

Arena et al. (2010) structured their institutional perspective analysis of ERM dynamics using three components: risk rationalities, uncertainty specialists, and technologies. The discursive and visual domains that frame the development of risk concepts from uncertainty are known as risk rationalities. Corporate roles involved in managing uncertainty include not only ERM leaders, commonly known as Chief Risk Officers, but also risk specialists, internal auditors, and management accountants, who are interested in taking a larger part in risk management. The third component is technologies, which refers to the detailed sets of practices and procedures implemented to achieve risk management and control. Brodeur et al. (2010) state that corporate leaders should ensure that their company's ERM practices are well adapted to the company's business culture and risks that it faces. Additionally, they argue that best practices are essential in each of the five ERM dimensions: risk organization and governance, risk culture, risk appetite and strategy, risk transparency, and risk-related business processes and decisions. Risk transparency can only be achieved when a risk reporting process generates informative and well-organized reports. Assessing a company's risk capacity is the first step in determining its risk appetite. They define risk capacity as the company's ability to withstand risk when it becomes a reality while avoiding undesirable consequences. The definition of "risk culture" refers to the ethical standards for both individuals and groups within a company. It defines the company's willingness to take risks, as well as its capacity to identify, understand, and manage those risks. The most effective boards ensure that all their members take responsibility for risk oversight. Management and boards must work together to guarantee the implementation of best practices

across all these dimensions (Brodeur et al, 2010). Effective ERM implementation relies on several critical concepts, with communication and prioritization playing crucial roles. Open conversations regarding objectives and risks help establish understanding and engage staff in risk management. Prioritization, often achieved through predefined risk significance scales, helps organizations assess and manage risks effectively (Fraser & Simkins, 2016).

1.5. Comparison between TRM and ERM

Enterprise Risk Management (ERM) and Traditional Risk Management (TRM) strive to manage risk, but they approach it in rather different ways. In contrast to traditional risk management, which manages individual risk categories in isolated "silos," ERM allows firms to manage a broad range of risks in an integrated and comprehensive manner. This strategy combines all the risks across the entire firm, provides a clearer assessment of the firm's overall risk situation, and improves operational and strategic decision-making (Liebenberg & Hoyt, 2003).

McShane et al. (2018), based on the work of several scholars, describe the main differences between ERM and TRM. As noted earlier, a primary difference between TRM and ERM is how each framework approaches and manages risks. TRM adopts a siloed strategy, where each department deals with its own risks independently. As a result, risks are frequently managed separately without understanding how to interact with each other in the company. By contrast, ERM takes a comprehensive approach to risk and aggregates all risks into a single portfolio to understand how they interact with one another. This method examines not only internal factors, but also external, such as changes in the market or economy that can impact the evaluating risk portfolio. TRM has limited strategic scope and influence, because of this, risk management in this framework

is not an important element in the decision-making of the board, which means it has minimal influence on the company. On the other hand, ERM is deeply integrated into strategic decision-making. In this approach, the board of directors and senior executives are actively involved in risk management and regard it as a fundamental element of corporate governance. It's worth noting that ERM considers risk appetite in evaluating different strategies to achieve objectives. Additionally, TRM and ERM differ significantly in how they allocate capital. In the TRM framework, the focus is more on cost control and loss avoidance rather than on using capital as a tool to manage risk. On the other hand, ERM takes a capital approach that allocates resources to achieve the highest risk-adjusted return. As mentioned above, in the TRM framework, risk ownership can be ambiguous, and specific risks may be managed by different departments. ERM, however, establishes clear ownership and accountability for all types of risks. TRM often focuses on measurable risks, such as hazard risks and financial risks, but it may ignore other types of risks, such as operational, strategic, and reputational risks. ERM, in contrast, aims to manage all types of risks and prioritize critical ones, whether financial, operational, strategic, or reputational, which allows the company to proactively manage them. Therefore, McShane et al. (2018) emphasized that TRM and ERM represent very different approaches to managing company risks. TRM is narrower and focuses on specific risks in isolation, often with a reactive approach that aims to control costs and prevent losses. In contrast, ERM adopts a broader perspective and integrates risk management with corporate governance and overall corporate strategy.

1.6. Advantages of Enterprise Risk Management

A growing number of companies are adopting ERM practices to improve the effectiveness of their risk management systems and increase firm value. Several studies and authors have examined the role of ERM in improving firm value, and the findings indicate that it can result in better operational performance (Grace et al., 2015). Most studies provide empirical evidence that ERM creates value (Baxter et al., 2013; Hoyt & Liebenberg, 2011). Bertinetti et al. (2013) found a statistically significant positive correlation between firm value and the implementation of ERM. From an economic perspective, their findings suggest that the market perceives the ERM adoption as a value driver, rather than a cost to the company. According to Gordon et al. (2009), the relationship between ERM and company performance depends on how well ERM aligns with five key factors: industry competition, firm size, firm complexity, environmental uncertainty, and board of directors' monitoring. Their study revealed a positive relationship between ERM and firm performance. According to several researchers, the ERM approach should create synergies across various risk management activities, increase capital efficiency, reduce earnings and stock-price volatility, and lower external capital costs and the marginal cost of risk reduction (Berry-Stölzle & Xu, 2018).

The COSO framework (2017) states that companies that integrate enterprise risk management throughout the entity can benefit in several ways: expanding the range of opportunities; identifying and managing risks across the entire entity; improving positive outcomes while reducing negative surprises; minimizing performance variability; optimizing resource allocation; and improving company resilience. ERM helps companies anticipate risks that could impact performance and allows them to implement actions that minimize disruptions and maximize opportunities. These benefits emphasize that risk

should not be seen as a potential obstacle or challenge to strategy development and execution. Instead, the changes that risk brings and how companies respond to it can create strategic opportunities (COSO, 2017).

Nocco and Stulz (2006) suggest that companies that successfully implement ERM have a long-term competitive advantage over those that manage risks separately. Their main argument is that a company can better perform its strategic plan if it measures and manages its risks in a consistent and systematic manner and provides its business managers with the information needed to optimize the trade-off between risk and return. They state that ERM adds value by influencing businesses on both a "macro" or company-wide and a "micro" or business-unit level. ERM adds value at the macro level by helping senior management measure and control the risk-return trade-off. Through this ERM assists the company in keeping access to the capital markets and other resources required to perform its business objectives and strategic plan. At the micro level, ERM becomes an integral part of daily operations for managers and workers throughout the company. Aquino et al. (2022) identify three benefits that arise from the implementation of ERM: financial benefits, as efficient ERM implementation reduces operational costs, controls spending, effectively manages corporate expenses, and maximizes profitability potential; corporate governance, as a well-structured ERM system helps management to assess significant risks more effectively; brand reputation, as robust risk management adds value to the shareholders and strengthens the brand's reputation by effectively managing and mitigating risks.

1.7. Challenges in implementing Enterprise Risk Management

Companies that adopt Enterprise Risk Management (ERM) often face several challenges. The main obstacle, according to Kerstin et al. (2014), is that implementing ERM is a resource-intensive and time-consuming process. The lack of resources or experience required for successful ERM implementation can lead to time-consuming processes. Additionally, there are various types of human errors. Since ERM systems depend on individuals to correctly identify, assess, and report risks, another challenge is the reliance on human factors. Human errors and a lack of experience in risk management can negatively impact the effectiveness of the ERM system. Another challenge is that the process can be complicated and difficult to understand, often requiring a detailed knowledge of risk management. It is impossible to create a standard ERM system that works for all types of businesses, as risk management practices can vary across different organizations. Overall, the establishment of ERM processes can be complex and sophisticated (Kerstin et al., 2014).

1.8. COSO Framework for ERM

The Committee of Sponsoring Organizations of the Treadway Commission (COSO) was founded in 1985 as a private-sector initiative to sponsor the National Commission on Fraudulent Financial Reporting, supported by five major professional associations in the United States. Currently, COSO's objective is to provide leadership in three interrelated areas: Enterprise Risk Management (ERM), Internal Control, and Fraud Deterrence and Governance. The COSO Internal Control-Integrated Framework, first issued in 1992 and updated in 2013, was created as guidance to strengthen confidence in different types of data and information. COSO has released two frameworks for ERM: the first titled

"Enterprise Risk Management-Integrated Framework" and the second, "Enterprise Risk Management-Integrating with Strategy and Performance" (COSO 2004, 2017).

The COSO Internal Control-Integrated Framework (1992) focuses on the importance of internal control as a fundamental aspect of achieving company goals. In contrast, the COSO Enterprise Risk Management-Integrated Framework (2004) attributes the achievement of these goals to effective enterprise risk management. Figure 1 shows that COSO (2004) divides a company's objectives into four categories: strategic, operational, reporting, and compliance. According to this framework, the internal control system, along with the five elements defined in the previous framework (control environment, risk assessment, control activities, information and communication, monitoring), also includes: objective setting (business goals must be established before management can identify potential events that may impact their achievement); event identification (all internal and external events that could affect the accomplishment of organizational goals must be identified); and risk response (management must decide to avoid, accept, or mitigate the risk, and implement actions to reduce it) (Krstić & Đorđević, 2012; COSO, 2004).

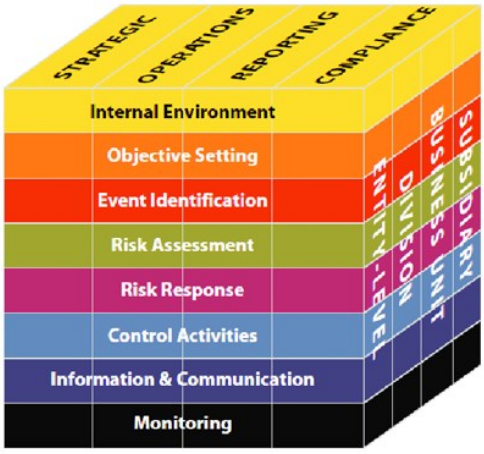

Figure 1: The ERM model in COSO (2004)

In October 2012, after the 2007/2008 financial crisis, COSO released the document "Risk Assessment in Practice". This version focuses on the risk assessment process, aiming to support organizations in the continuous growth of the ERM adoption process. The first step in the risk assessment process is to develop a standardized set of evaluation criteria that can be applied across all business units, departments, and capital projects. According to "Risk Assessment in Practice", the risk evaluation process involves six steps: identifying the risks, developing criteria, assessing the risks, analysing how risks interact, prioritizing the risks, and responding to them. Identifying and responding to risks are not widely covered in this document, as these criteria were already addressed in the previous framework (COSO, 2012).

In June 2017, COSO released the revised version of the 2004 Framework, titled "Enterprise Risk Management - Integrating with Strategy and Performance", to respond to the growing complexities of risk in the corporate world. The main purpose of the 2004 Framework was to help companies better protect and enhance shareholder value. The updated 2017 Framework helps companies predict risks more effectively and allows them to stay proactive with the understanding that change brings opportunities. This document focuses on considering risk in both the strategy-setting process and performance improvement. The Framework provides principles that can be used from performance to strategic decision-making. A set of principles is covered by the five interrelated components of the COSO 2017 framework, namely: governance and culture, strategy and objective setting, performance, review and revision, and information, communication and reporting. Governance plays a crucial role in setting an organization's tone and emphasizes the importance of enterprise risk management. Strategy and objective setting are interconnected in the strategic planning process. They are the foundation for identifying, evaluating, and responding to risks. The performance is related to the response given to

potential risks that impact the achievement of strategic objectives. By continuously reviewing performance, organizations can assess the effectiveness of the ERM components and make any necessary adjustments. Information, communication, and reporting related to the process of obtaining and sharing relevant information from both internal and external sources and ensuring it flows across all levels within the organization. These five components include twenty fundamental principles, which are designed to align with an organization's mission, vision, and core values, integrating risk management into the development of corporate strategy. Figure 2 shows these principles, which cover everything from governance to monitoring. Their practices can be adapted for various organizations, regardless of size, type, or industry (COSO, 2017).

Figure 2: Components and Principles of the COSO ERM Framework (2017)

The 2017 COSO ERM Framework expands on the 2004 Framework by taking a broader approach to risk management and integrates concepts such as risk appetite, risk tolerance, strategy, and objective setting. This Framework focuses on two critical aspects of enterprise risk management that significantly impact firm value: the possibility of the strategy not aligning and the consequences of the strategy chosen. The first aspect considers the possibility that a company's

strategy might not align with its mission and vision. A misaligned strategy can prevent a company from achieving its goals or compromise its values, even if successfully implemented. The second aspect focuses on the implications of the chosen strategy. The main point is that the chosen strategy needs to align with the company's risk appetite and drive the organization to set objectives and efficiently allocate resources (COSO, 2017).

Chapter 2
Theoretical framework and methodology

2.1. Variables and Model

The purpose of this study is to examine the relationship between Enterprise Risk Management (ERM) practices and firm value. Tobin's Q ratio is used as a proxy for the explained variable that represents firm value. This ratio compares the sum of the market value of equity plus the book value of liabilities to the book value of its assets (Hoyt & Liebenberg, 2011). The explanatory variable in this study is the level of ERM implementation, whereas the control variables are ISO 31000, size, leverage, sales growth, ROA, dividends, and beta. We test the hypothesis that there is a relationship between ERM implementation and firm value. For this analysis, an Ordinary Least Squares (OLS) regression was conducted, with clustering at both the firm and year levels and robust standard errors, to examine the effect of the explanatory variable on the explained variable.

In this research, we have the ERM score variable to assess the level of ERM implementation in firms. The classification is based on the twenty principles described by COSO in "Enterprise Risk Management - Integrating with Strategy and Performance" (2017). These principles are grouped into five interrelated components: Governance and Culture, Strategy and Objective-Setting, Performance, Review and Revision, and Information, Communication and Reporting. The score is based on whether the firms incorporate these principles. For each principle, I assigned a score of 1 if it was identified in the firms' published reports and documents, and 0 if not. Therefore, our ERM score variable represents the sum of the values (0 or 1) for all the principles, ranging from 0 to 20. To determine this, I reviewed publicly available materials, that include

consolidated annual reports, corporate governance reports, and sustainability reports published annually by each firm.

In the literature, enterprise risk management activities are typically assessed through announcements of Chief Risk Officer (CRO) appointments and keyword searches in annual reports to identify the presence of a CRO or a risk management committee (Liebenberg & Hoyt, 2003; Pagach & Warr, 2011), or through ERM surveys (Beasley et al., 2005). For instance, Izah and Ahmad (2011) examine ERM as a dummy variable and assign a value of 1 to firms that implement ERM and 0 to those that do not. Iswajuni et al. (2018) and Otero González et al. (2020) assessed ERM disclosures in firms' annual reports by searching for terms such as "ERM", "Chief Risk Officer", "Risk Management Committee", "Holistic Risk Management" and "Integrated Risk Management," and measured ERM using a dummy variable. However, this approach may be overly simplistic to capture the complexity of a system that is comprehensive.

Furthermore, other ERM scores have been developed in the literature. In their study, Gordon et al. (2009) introduced an ERM Index (ERMI) to measure firms' ERM practices. This index is based on COSO's four objectives of ERM: strategy, operations, reporting, and compliance. They created an index to evaluate how effectively an organization achieves these objectives through its ERM. The analysis indicates that their ERM Index (ERMI) is generally reliable, though not without imperfections, as a measure of ERM effectiveness. Nevertheless, these methods may have limitations due to the lack of an accurate way to measure ERM engagement (McShane et al., 2011). To determine ERM activities and differentiate between insurers with high-quality and lower-quality risk management systems, Bohnert et al. (2018) used Standard & Poor's ERM rating. However, in our study, this measure is not practical for identifying the level of ERM implementation, as ERM ratings may not be available for all firms, particularly in certain industries.

The main advantage of our classification is that it provides a more detailed and comprehensive assessment of ERM implementation in firms. By using the twenty principles of COSO's Framework we capture various aspects of ERM, not only traditional areas such as risk management and assessment, but also other crucial components such as organizational culture and strategy-setting. However, this measure also has certain limitations. First, the COSO Framework was released in 2017, which restricts the availability of data for the ERM score variable before this year. Second, the framework does not define the relative weight or significance of each principle within the ERM system. As a result, this study assigns equal weight to each principle, which may not accurately reflect their actual importance or impact. Furthermore, the ERM score was evaluated based on the existence or not of the principles within firms rather than the quality of their implementation.

We also examine whether firms' risk management processes align with the ISO 31000 international standard and have created a dummy variable that takes the value of 1 if a firm implemented risk management processes in accordance with ISO 31000, and 0 if it has not. Based on the literature, we include the following firm characteristics that impact firm value: size, leverage, sales growth, ROA, dividends, and beta. The size of the company is measured by the natural logarithm of the book value of total assets, which is frequently used by various authors. Beasley et al. (2005) found evidence that larger firms have a higher tendency to adopt ERM programs. Some authors argue that size has a significant positive impact on firm value. They state that larger firms are better able to manage market conditions and remain competitive, which increases investor confidence. Additionally, larger companies have greater flexibility and easier access to capital markets compared to smaller firms (Iswajuni et al., 2018). In contrast, Bertinetti et al. (2013) found a negative and significant relationship between size and firm value. Thus, the relation between Tobin's Q and size is ambiguous. Sales growth is commonly used as a proxy for future growth

opportunities and is measured based on historical one-year sales growth. It is expected that firm value has a positive relationship with sales growth. We include return on assets (ROA) in our regression to control for company profitability which is measured as net income divided by total assets. Maharani and Suardana (2014) suggest that profitability reflects a company's ability to generate profits, manage its assets efficiently, and maintain capital. Profitability is measured using various ratios, one of which is the return on assets (ROA), used in our study. Theoretically, ROA and firm value are positively correlated. Furthermore, Iswajuni et al. (2018) found a significant positive effect between ROA and firm value. In contrast, Izah and Ahmad (2011) state that ROA has a negative and significant relationship with firm value. We included a leverage variable, defined as the ratio of the book value of liabilities to the market value of equity. The impact of financial leverage is ambiguous. On the one hand, higher leverage can create investment opportunities by funding profitable projects with positive net present value. On the other hand, excessive leverage can increase the probability of bankruptcy and lead to difficulties for a company (Hoyt & Liebenberg, 2011).

Following Hoyt and Liebenberg (2011), we include a dividend payment indicator (Dividends) in our model. In the literature, this indicator is typically measured as a dummy variable, where a value of 1 indicates that a company pays dividends in the current year, and 0 otherwise. However, in our study, we utilize the dividend payout ratio instead. This approach aims to improve research that relies on binary indicators and provides a clearer distinction between firms that pay higher dividends and those that pay lower dividends. The expected effect is ambiguous: on the one hand, dividends may signal that a firm does not have growth opportunities. On the other hand, paying dividends could positively affect firm value by limiting free cash flow that might be otherwise used for managerial consumption (Hoyt & Liebenberg, 2011). As part of evaluating the

factors that influence firm value, I also include Beta in the analysis to capture firms' volatility and risk exposure relative to the market (Kove, 2020).

Based on these variables, the first regression model is described as follows:

$$TobQ_{i,t} = \beta_0 + \beta_1 ERMScore_{i,t} + \beta_2 ISO31000_{i,t} + \beta_3 Size_{i,t} + \beta_4 Leverage_{i,t} + \beta_5 SalesGrowth_{i,t} + \beta_6 ROA_{i,t} + \beta_7 Dividends_{i,t} + \beta_8 Beta_{i,t} + \varepsilon_{i,t}$$

I have also analyzed the effect of the level of ERM implementation on firm performance. We measure accounting performance using ROA (Olayinka et al., 2017; Baxter et al., 2013). Under this condition, ROA is the explained variable, while the explanatory and control variables remain the same as in the first regression model. The second regression model is presented as follows:

$$ROA_{i,t} = \beta_0 + \beta_1 ERMScore_{i,t} + \beta_2 ISO31000_{i,t} + \beta_3 Size_{i,t} + \beta_4 Leverage_{i,t} + \beta_5 SalesGrowth_{i,t} + \beta_6 Dividends_{i,t} + \beta_7 Beta_{i,t} + \varepsilon_{i,t}$$

Based on Bertinetti et al. (2013), we decided to develop a third equation to identify the factors influencing ERM implementation. As a result, we introduce the third regression model:

$$ERMScore_{i,t} = \beta_0 + \beta_1 ISO31000_{i,t} + \beta_2 Size_{i,t} + \beta_3 Leverage_{i,t} + \beta_4 SalesGrowth_{i,t} + \beta_5 Dividends_{i,t} + \beta_6 Beta_{i,t} + \varepsilon_{i,t}$$

In this analysis, i denotes the firm and t denotes the time across all three models. These models are developed using regression analysis, with Tobin's Q and ROA as the explained variables. These two measures offer distinct perspectives: Tobin's Q reflects market valuation, while ROA represents the firms' operational performance. The sample selection was based on the availability of relevant data for the study period. Appendix 1 provides a summary of the expected impact of each variable, as well as their definitions and data sources.

2.2. Data and descriptive statistics

This study aims to examine the impact of the level of ERM implementation on Tobin's Q as a proxy for firm value. The analysis includes 14 firms listed on the PSI of the Lisbon Stock Exchange. I selected these firms because they are the largest and most liquid companies in Portugal and provide transparent financial data. For this research, data were collected from 2017 to 2023, which resulted in a total of 98 observations. According to the Industry Classification Benchmark (ICB) guidelines, the sample includes the following industries and their respective proportions: Utilities (21,4%), Energy (7,1%), Retail (14,3%), Basic Resources (21,4%), Industrial (21,4%), Telecommunications (7,1%), and Consumer Services (7,1%). This study used data extracted from the companies' annual reports, the SABI database, and Yahoo Finance to obtain accurate and comprehensive information about each company. The ERM Score values were obtained from the companies' annual reports, based on the 20 principles of the COSO framework. Table 1 shows the frequency distribution of the ERM Score.

ERM Score	Frequency	Percentage, %
13	19	19,39%
14	13	13,27%
15	14	14,29%
16	30	30,61%
17	8	8,16%
18	11	11,22%
19	3	3,06%

Table 1: ERM Score frequency distribution

As demonstrated, most firms achieved a good score, while 32,6% of the sample recorded a score below 15. It is important to note that the sample does not include firms with low ERM scores. Refer to Appendix 2 for a detailed analysis of the ERM Score by firm and year. Figure 3 shows the evolution of the average ERM Score over the years, from 2017 to 2023. The data shows a consistent increase in the ERM score, which rose from 14,50 in 2017 to 16,79 in 2023. This steady growth indicates the overall improvement in the ERM processes across the analyzed

firms. The largest absolute variation was between 2020 and 2021, with a variation of 0,79 points. This may result from various factors, such as a greater focus on risk management and efforts to better align with the COSO 2017 principles.

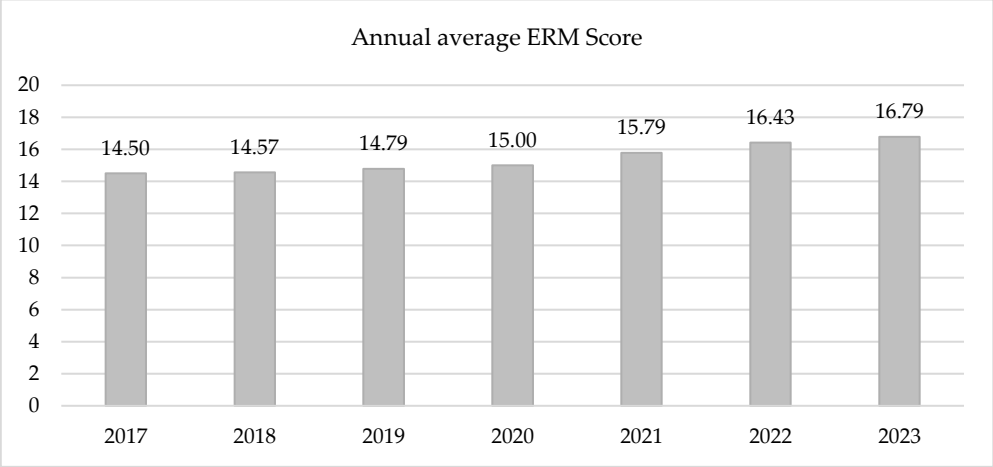

Figure 3: Annual Average ERM Score

Table 2 shows the descriptive statistics for the explained, explanatory, and control variables. Among the 98 observations, the average value of Tobin's Q for firms is 1,13, while the median Tobin's Q is 1,05. This result is greater than 1, which means that the median firm in the median year has a market value higher than the cost of its assets. The median ERM Score is exactly 16, which indicates that most firms have a high ERM Score. In the total sample, 26,5% of firms have implemented risk management processes under the ISO 31000 standard. The median firm in the median year has a natural logarithm of accounting assets equal to 22,27, which is very close to the mean and shows a relatively symmetric distribution of size. On average, firms have a leverage ratio of 2,46, which demonstrates that they rely more on debt than equity. The median is significantly lower than the mean, which implies that a few firms with very high leverage drive the average higher. The mean beta of the firms in the sample is 0,80. The average sales growth rate is 7%, while the median is lower at 4%, which means that most firms have moderate sales growth. The average return on assets is 4,7%, which means that, on average, firms earn 4,7% on their total assets.

Variables	Mean	Median	Std. Dev.	Min	Max
Tobin's Q	1,130	1,051	0,274	0,716	1,945
ERM Score	15,408	16,000	1,695	13,000	19,000
ISO 31000	0,265	0,000	0,441	0,000	1,000
Size	22,283	22,267	1,148	19,895	24,798
Leverage	2,462	1,379	3,045	0,278	16,678
Sales Growth	0,070	0,042	0,198	-0,405	0,743
ROA	0,047	0,037	0,045	-0,076	0,291
Dividends	0,635	0,464	0,631	0,000	4,647
Beta	0,805	0,803	0,594	-0,764	2,116

Table 2: Descriptive Statistics

In the previous literature, many authors have explored differences in the means and medians between companies with ERM practices and those without. For instance, Hoyt and Liebenberg (2011) report differences in the means and medians of variables between firms with identifiable ERM practices and those without. They found that firms with ERM programs tend to be less indebted and have higher Tobin's Q values. In our study, we aimed to assess how the results differ for firms that implemented risk management processes aligned with the ISO 31000 standard compared to those that did not. Table 3 shows the differences in the mean and median values of each variable across the observations. Both the mean and median values of Tobin's Q are higher and statistically significant for firms that have implemented risk management processes based on the ISO 31000 standard.

	(1) ISO 31000= 1		**(2) ISO 31000= 0**		**Difference (1)-(2)**	
Variables	Mean	Median	Mean	Median	Mean	Median
Tobin's Q	1,274	1,253	1,078	1,030	0,197***	0,223**
ERM Score	15,000	15,000	15,556	16,000	-0,556	-1,000*
Size	22,189	22,111	22,317	22,319	-0,128	-0,208
Leverage	1,321	0,753	2,874	1,580	-1,552**	-0,827***
Sales Growth	0,067	0,052	0,071	0,042	-0,004	0,010
ROA	0,064	0,065	0,040	0,029	0,024**	0,036***
Dividends	0,588	0,496	0,653	0,455	-0,065	0,041
Beta	0,791	0,815	0,810	0,803	-0,019	0,012
Observations	26		72			

Table 3: Differences between observations with and without ISO 31000 standard

*The statistical significance of the difference in means is measured using a t-test. The significance of the difference in medians is assessed using a non-parametric Wilcoxon rank-sum test. Significance levels are denoted as follows: *** denote p-values <0.01, **denote p-values <0.05, and *denote p-values <0.10.

Chapter 3
Estimation Results

3.1. Analysis and Discussion of Results

This chapter presents the estimation results for the equations with a focus on the impact of ERM implementation levels on Tobin's Q. To achieve this, an OLS regression was conducted to estimate the effects across all observations. The estimation of the specifications was performed using STATA statistical software. I conducted an OLS regression with clustering at the firm level and robust standard errors to account for potential correlations within firms over time. Additionally, clustering by year controls for correlations of errors within the same year across all firms.

Table 4 shows two different specifications along with their respective coefficient estimates. The results reveal no significant relationship between the level of ERM implementation and firm value. The findings indicate that in all specifications, the ERM Score variable coefficient is negative, but not statistically significant. Our sample consists of firms listed on the PSI, which are industry leaders with well-established risk management frameworks. As a result, investors probably already expect these firms to manage risk effectively, so the market does not react to changes in the level of ERM implementation as a factor that significantly influences firm value. In specification (ii), where we cluster by year, the coefficient for ISO 31000 shows a significant relationship with firm value at the 5% significance level. This dummy variable provides a clear distinction between firms that fully commit to a recognized standard and those that do not. Firms that explicitly mention ISO 31000 in their annual reports may be perceived as having a more structured risk management approach. The positive coefficient indicates that firms that implemented risk management based on ISO 31000 standard have Tobin's Q approximately 0,15 higher than those that did not, when

all other variables remain constant. The leverage coefficient in the specification (ii) is negative and statistically significant, which indicates that if leverage increases by 1%, the firm value decreases by 0,02, as measured by Tobin's Q. This could be because higher leverage signals increased risk to the market, and investors are concerned about the firm's ability to meet its debt obligations. Other control variables have small and insignificant coefficients in all specifications that don't have a strong effect on firm value. The variables size, ROA, sales growth, and dividends have a positive relationship with Tobin's Q, while beta shows a negative relationship.

Variables	**OLS regression with clusters and robust errors**	
	(i)	**(ii)**
ERM Score	-0,0135	-0,0135
	(0,0385)	(0,0127)
ISO 31000	0,1539	0,1539**
	(0,1560)	(0,0518)
Size	0,0014	0,0014
	(0,0481)	(0,0238)
Leverage	-0,0231	-0,0231***
	(0,0154)	(0,0041)
Sales Growth	0,0263	0,0263
	(0,0924)	(0,0528)
ROA	0,0490	0,0490
	(0,6391)	(0,5362)
Dividends	0,0232	0,0232
	(0,0386)	(0,0309)
Beta	-0,0070	-0,0070
	(0,0351)	(0,0626)
Constant	1,3098	1,3098**
	(1,0103)	(0,3998)
Cluster by firm	14	No
Cluster by year	No	7
R-Squared	0,1840	0,1840
Number of Observations	98	98

Table 4: Estimation results of the regression of the level of ERM implementation on Firm Value
*Robust standard errors in parentheses. ***denote p-values <0.01, and **denote p-values <0.05.

Our findings align with Tahir and Razali (2011), who provided evidence that ERM does not affect firm value, as well as Anton (2018), who studied a sample during the financial crisis and found that ERM adoption did not have a significant impact on firm value. Additionally, our results align with those of Maia (2020) and Santos (2021), who also classified ERM using the same approach as this research, with an ERM Score ranging from 0 to 20 based on the twenty principles of "Enterprise Risk Management - Integrating with Strategy and Performance" by COSO. In our sample, all firms already have high ERM scores and further increases in the level of ERM implementation do not significantly impact firm value. The market does not perceive the involvement of firms in higher levels of ERM implementation as a significant factor because these firms already have well-developed risk management practices.

We conducted an additional analysis using ROA as a proxy for firm accounting performance to more effectively evaluate the impact of ERM implementation. This approach allows for a comparison of the results and helps determine whether the level of ERM implementation influences firm value and firm accounting performance. Table 5 shows the regression results examining the relationship between ERM implementation and firm accounting performance. The findings suggest that the coefficient for ERM Score is positive and statistically significant, which means that firms with higher levels of ERM implementation tend to achieve better accounting performance, as measured by return on assets (ROA). Firms with higher ERM scores improve their internal processes, which results in better returns on assets. The ISO 31000 variable is statistically significant and positive at the 10% level, which means that firms that implemented risk management processes in accordance with ISO 31000 standard have a ROA that is 1,72% higher than those that did not, when all other control variables remain constant. The size variable has a negative effect on accounting performance and is statistically significant at the 5% level, this indicates that larger firms have

lower profitability per unit of assets. The leverage variable also has a negative and significant effect on firm performance, with a significance level of 1%. Firms with more debt (higher leverage) tend to have a lower ROA, as increased debt leads to higher interest expenses, which reduce profitability. The sales growth variable is positive and statistically significant at the 1% level. This suggests that higher sales growth leads to higher ROA and improves profitability. The dividends variable is negative and statistically significant at the 1% level, which indicates that if the dividends pay-out ratio increases by 1%, the firm accounting performance decreases by 1,09%, when all other control variables remain constant. This could be because firms that pay higher dividends have lower retained earnings, which limits their reinvestment opportunities and reduces short-term profitability. Beta does not have a significant effect on ROA in this model.

Variables	**OLS regression with cluster and robust errors**
ERM Score	0,0064**
	(0,0021)
ISO 31000	0,0172*
	(0,0094)
Size	-0,0137**
	(0,0045)
Leverage	-0,0050***
	(0,0016)
Sales Growth	0,1055***
	(0,0236)
Dividends	-0,0109***
	(0,0035)
Beta	-0,0041
	(0,0039)
Constant	0,2626**
	(0,1039)
Cluster by firm	14
R-Squared	0,5198
Number of Observations	98

Table 5: Estimation results of the regression of the level of ERM implementation on Firm Accounting Performance

*Robust standard errors in parentheses. ***denote p-values <0.01, **denote p-values <0.05, and *denote p-values <0.10.

Our findings are consistent with Kove (2020) and Baxter et al. (2013), who found that companies with high-quality ERM systems tend to have better accounting performance, as measured by ROA. This suggests that effective ERM implementation not only mitigates risk but also contributes to overall company efficiency and profitability. However, in our first regression model, we found no significant relationship between Tobin's Q and the level of ERM implementation. The primary reason for this, as mentioned earlier, is that our sample consists of the largest companies in Portugal, which already have established risk management practices. As a result, additional improvements in the level of ERM implementation do not have a significant impact on firm value.

3.2. The Determinants of ERM Implementation

In this section, we examine the relationship between ERM implementation and its determinants. To achieve this, we conducted an OLS regression with clustering at the firm level and robust standard errors to assess the dependence between ERM implementation and the selected control variables. Table 6 shows the regression results that examine the factors that influence ERM implementation, with ERM Score as the explained variable. The size variable has the greatest contribution to the implementation of ERM. The coefficient for this variable is positive, statistically significant at the 5% level, and equals 0,50, indicating that as size increases, the ERM Score increases by 0,50 points. These findings align with the expectation that size positively influences ERM adoption, as larger firms have greater resources and higher risk exposure, which leads to ERM implementation. Additionally, research by Bertinetti et al. (2013), Osório (2020), and Carvalho (2021) supports our finding that the size of firms positively

influences ERM implementation. The other control variables are statistically insignificant.

Variables	**OLS regression with cluster and robust errors**
ISO 31000	-0,4149
	(0,8556)
Size	0,5006**
	(0,1707)
Leverage	0,0357
	(0,0412)
Sales Growth	0,3107
	(0,5369)
Dividends	0,2349
	(0,2092)
Beta	0,2558
	(0,2203)
Constant	3,8994
	(3,7947)
Cluster by firm	14
R-Squared	0,1649
Number of Observations	98

Table 6: Estimation Results for the Determinants of ERM Implementation
*Robust standard errors in parentheses. **denote p-values <0.05.

Chapter 4
Conclusions

4.1. Main conclusions

This Master's Final Assignment examines the impact of ERM implementation levels on firm value, with a sample of 14 Portuguese firms listed on the PSI of the Lisbon Stock Exchange from 2017 to 2023. To answer the research question, an OLS regression was conducted, with clustering at both the firm and year levels, and robust standard errors. Tobin's Q was the explained variable, while the explanatory variable was the ERM Score, as a proxy for the level of ERM implementation, along with control variables that typically influence Tobin's Q. This research contributes to the field by using the ERM Score as a proxy to assess the quality of ERM implementation, based on alignment with the 20 principles described in "Enterprise Risk Management - Integrating with Strategy and Performance" framework from COSO.

The findings of this study show that the level of ERM implementation does not have a significant impact on Tobin's Q. This could be because the sample consists of firms that already have well-developed ERM practices, and the market does not perceive additional improvements in ERM implementation as a factor that significantly influences firms value. This result is consistent with the findings of Otero González et al. (2020), who concluded that ERM implementation did not have a significant impact on firm value. Regarding the control variables, leverage was statistically significant and have a negative impact on Tobin's Q. Furthermore, the results of the OLS regression show that the coefficient for ISO 31000 has a significant positive relationship with firm value at the 5% significance level, which implies that the market tends to respond more strongly to formal international standards such as ISO 31000.

Our additional analysis reveals a significant positive relationship between the level of ERM implementation and accounting performance, measured by ROA, at the 5% significance level. This means that firms with higher levels of ERM implementation tend to perform better in terms of accounting profitability. This result is consistent with other studies that also found a positive and significant impact, such as the research by Maharani and Yonnedi (2023), which showed that ERM implementation has a positive and significant influence on ROA. In addition, we found that firm size is a determinant that positively contributes to the implementation of ERM.

4.2. Limitations and Future Research

Although the ERM Score variable offers certain advantages over alternative measures used in previous empirical research, especially those relying on dummy variables, it also has notable limitations. One major limitation is its interpretation, as the score is assigned based on the assumption that the disclosure of ERM practices reflects their actual implementation within the firm. This reliance on disclosed information may not always align with actual firm practices. Another limitation is that the COSO framework does not differentiate the relative importance of each of its 20 principles. The ERM Score assumes equal weight for all principles, which may not accurately represent their actual significance. This suggests that firms analysed without a clear understanding of the most critical elements of risk management.

For future research, the relationship between the level of ERM implementation and firm value can be further analysed by focusing on a larger sample of firms, which includes those where risk management practices are less developed. It is recommended to have firms with both high and low levels of ERM. Additionally, it would be valuable to use a more comprehensive classification to measure ERM implementation. Future research offers a wide range of questions to explore,

particularly regarding the implementation of ERM in firms and its potential impact on firm value. Thus, a more comprehensive ERM framework, along with a larger and more diverse sample, could help develop a more effective approach to understanding how ERM impacts firm value.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of my written thesis, "Enterprise Risk Management and Firm Value", Grammarly was used for grammar and style correction. The prompts used were implicit, as Grammarly automatically suggests corrections. After using this tool, I reviewed and edited the content as necessary, and I take full responsibility for the content of the work presented. I also declare that I am aware of and respect the Artificial Intelligence Rules of Conduct of Católica Porto Business School.

Bibliography

Anton, S. G. (2018). The impact of enterprise risk management on firm value: Empirical evidence from Romanian non-financial firms. *Engineering Economics*, *29(2),* 151-157.

Aquino, P. G., Jalagat, R. C., Mubeen, M., Mehmood, W., & Zehra, B. (2022). Enterprise risk management: An important process for feasible profit and growth. *Contaduría y Administración, 67(2),* 118-141.

Arena, M., Arnaboldi, M., & Azzone, G. (2010). The organizational dynamics of enterprise risk management. *Accounting, Organizations and Society*, *35(7),* 659-675.

Baxter, R. J., Bedard, J. C., Hoitash, R., & Yezegel, A. (2013). Enterprise risk management program quality: Determinants, value relevance, and the financial crisis. *Contemporary Accounting Research, 30(4),* 1264-1295.

Beasley, M. S. (2016). *What is Enterprise Risk Management?* NC State Poole College of Management, Enterprise Risk Management Initiative. Retrieved from: https://www.erm.ncsu.edu

Beasley, M. S., Clune, R., & Hermanson, D. R. (2005). Enterprise risk management: An empirical analysis of factors associated with the extent of implementation. *Journal of Accounting and Public Policy, 24(6),* 521-531.

Berry-Stölzle, T. R., & Xu, J. (2018). Enterprise risk management and the cost of capital. *Journal of Risk and Insurance, 85(1),* 159-201.

Bertinetti, G. S., Cavezzali, E., & Gardenal, G. (2013). *The effect of enterprise risk management implementation on firm value of European companies* (Working Paper). Department of Management, Università Ca'Foscari Venezi.

Bohnert, A., Gatzert, N., Hoyt, R. E., & Lechner, P. (2018). *The drivers and value of enterprise risk management: Evidence from ERM ratings* (Working Paper). School of Business and Economics.

Boris, B. (2012). *Enterprise risk management and firm performance: A Dutch perspective* (Doctoral dissertation). University of Amsterdam.

Brodeur, A., Buehler, K., Patsalos-Fox, M., & Pergler, M. (2010). A board perspective on enterprise risk management. *McKinsey Working Papers on Risk, 18*, 1–15.

Carvalho, P. F. M. L. D. (2021). *Enterprise risk management e o custo do capital próprio: Uma análise empírica à realidade portuguesa* (Dissertação de mestrado). Católica Porto Business School.

Cohen, J., Krishnamoorthy, G., & Wright, A. (2017). Enterprise risk management and the financial reporting process: The experiences of audit committee members, CFOs, and external auditors. *Contemporary Accounting Research, 34(2),* 1178-1209.

COSO. (2004). *Enterprise risk management—Integrated framework.* Retrieved from: http://www.coso.org

COSO. (2012). *Risk assessment in practice.* Retrieved from: http://www.coso.org

COSO. (2017). *Enterprise risk management: Integrating with strategy and performance.* Retrieved from: http://www.coso.org

Culp, C. L. (2002). The revolution in corporate risk management: A decade in innovations in process and products. *Journal of Applied Corporate Finance, 14*(4), 9-26.

Dickinson, G. (2001). Enterprise risk management: Its origins and conceptual foundation. *The Geneva Papers on Risk and Insurance. Issues and Practice, 26*(3), 360-366.

Fraser, J. R., & Simkins, B. J. (2016). The challenges of and solutions for implementing enterprise risk management. *Business Horizons, 59*(6), 689-698.

Frigo, M. L., & Anderson, R. J. (2011). Strategic risk management: A foundation for improving enterprise risk management and governance. *Journal of Corporate Accounting & Finance, 22*(3), 81-88.

Froot, K. A., Scharfstein, D. S., & Stein, J. C. (1993). Risk management: Coordinating corporate investment and financing policies. *The Journal of Finance, 48*(5), 1629-1658.

Gatzert, N., & Martin, M. (2015). Determinants and value of enterprise risk management: Empirical evidence from the literature. *Risk Management and Insurance Review, 18*(1), 29-53.

Grace, M. F., Leverty, J. T., Phillips, R. D., & Shimpi, P. (2015). The value of investing in enterprise risk management. *The Journal of Risk and Insurance, 82*(2), 289-316.

Gordon, L. A., Loeb, M. P., & Tseng, C. Y. (2009). Enterprise risk management and firm performance: A contingency perspective. *Journal of Accounting and Public Policy*, 28(4), 301-327.

Harner, M. M. (2010). Barriers to effective risk management. *Seton Hall Law Review, 40*(4), 1323-1366.

Hoyt, R. E., & Liebenberg, A. P. (2011). The value of enterprise risk management. *Journal of Risk and Insurance, 78*(4), 795-822.

ICAEW. (2002). No surprises: The case for better risk reporting. *Balance Sheet*, *10(4),* 18-21.

International Organization for Standardization. (2018). *ISO 31000:2018 - Risk management: Guidelines*. https://www.iso.org/standard/65694.html

Iswajuni, I., Manasikana, A., & Soegeng, S. (2018). The effect of enterprise risk management (ERM) on firm value in manufacturing companies listed on Indonesian Stock Exchange year 2010–2013. *Asian Journal of Accounting Research, 3(2),* 224-235.

Izah, M. T., & Ahmad, R. R. (2011). The relationship between ERM and firm value: Evidence from Malaysian public listed companies. *International Journal of Economics and Management Science, 1*(2), 32–41.

Kaplan, R., & Mikes, A. (2012). Managing risks: a new framework. *Harvard Business Review*. https://hbr.org/2012/06/managing-risks-a-new-framework

Kerstin, D., Simone, O., Nicole, Z., & Lehner, O. M. (2014). Challenges in implementing enterprise risk management. *ACRN Journal of Finance and Risk Perspectives, 3*(3), 1-14.

Kleffner, A. E., Lee, R. B., & McGannon, B. (2003). The effect of corporate governance on the use of enterprise risk management: Evidence from Canada. *Risk Management and Insurance Review, 6*(1), 53-73.

Kove, M. (2020). *The impact of enterprise risk management and corporate governance on firm value* (Master's thesis). Università Ca' Foscari Venezia.

Kraus, V., & Lehner, O. M. (2012). The nexus of enterprise risk management and value creation: A systematic literature review. *ACRN Journal of Finance and Risk Perspectives, 1*(1), 91-163.

Krstić, J., & Đorđević, M. (2012). Internal control and enterprise risk management – from traditional to revised COSO model. *Economic Themes, 50*(2), 151-166.

Lechner, P., & Gatzert, N. (2018). Determinants and value of enterprise risk management: Empirical evidence from Germany. *European Journal of Finance, 24*(10), 867-887.

Liebenberg, A. P., & Hoyt, R. E. (2003). The determinants of enterprise risk management: Evidence from the appointment of chief risk officers. *Risk Management and Insurance Review, 6*(1), 37-52.

Lundqvist, S. A. (2015). Why firms implement risk governance–Stepping beyond traditional risk management to enterprise risk management. *Journal of Accounting and Public Policy, 34*(5), 441-466.

Maia, M. C. T. D. C. (2020). *Enterprise risk management and firm value: Evidence from the construction & engineering industry* (Master's dissertation). Católica Porto Business School.

Maharani, C., & Yonnedi, E. (2023). The influence of advanced enterprise risk management implementation analysis. *Jurnal Akuntansi, 13*(3), 187-198.

Maharani, I. G. A. C., & Suardana, K. A. (2014). Pengaruh corporate governance, profitabilitas dan karakteristik eksekutif pada tax avoidance perusahaan manufaktur. *E-Jurnal Akuntansi Universitas Udayana, 9*(2), 525-539.

McShane, M. K., Nair, A., & Rustambekov, E. (2011). Does enterprise risk management increase firm value? *Journal of Accounting, Auditing and Finance, 26*(4), 641-658.

McShane, M. (2018). Enterprise risk management: History and a design science proposal. *The Journal of Risk Finance*, 19(2), 137-153.

Meulbroek, L. K. (2002). A senior manager's guide to integrated risk management. *Journal of Applied Corporate Finance, 14*(4), 56-70.

Modigliani, F., & Miller, M. H. (1958). The cost of capital, corporation finance and the theory of investment. *American Economic Review, 48*, 261-297.

Nocco, B. W., & Stulz, R. M. (2006). Enterprise risk management: Theory and practice. *Journal of Applied Corporate Finance, 18*(4), 1-8.

Olayinka, E., Emoarehi, E., Jonah, A., & Ame, J. (2017). Enterprise risk management and financial performance: Evidence from an emerging market. *International Journal of Management, Accounting and Economics, 4*(9), 937-952.

Osório, M. D. A. L. D. N. (2020). *Enterprise risk management e a criação de valor: Uma análise empírica do caso português* (Master's dissertation). Católica Porto Business School.

Otero González, L., Durán Santomil, P., & Tamayo Herrera, A. (2020). The effect of Enterprise Risk Management on the risk and the performance of Spanish listed companies. *European Research on Management and Business Economics, 26*(3), 111-120.

Oxford Dictionary. (2020). *Definition of risk*. Retrieved from: www.oxfordlearnersdictionaries.com/definition/english/risk_1

Pagach, D., & Warr, R. (2011). The characteristics of firms that hire chief risk officers. *Journal of risk and insurance, 78(1),* 185-211.

Rao, A., & Marie, A. (2007). Evaluation of enterprise risk management (ERM) in Dubai – An emerging economy. *Management Accounting Quarterly, 8(3),* 10-22.

Reith, G. (2004). Uncertain times: The notion of 'risk' and the development of modernity. *Time & Society, 13(2–3),* 383-402.

Santos, D. F. C. F. D. (2021). *Enterprise risk management and value: Evidence from the utility sector* (Master's dissertation). Católica Porto Business School.

Simona-Iulia, C. (2014). Comparative study between traditional and enterprise risk. *Economic Science Series, 23*(1), 276-283.

Tahir, I. M., & Razali, A. R. (2011). The relationship between enterprise risk management (ERM) and firm value: Evidence from Malaysian public listed companies. *International Journal of Economics and Management Sciences, 1*(2), 32-41.

Woods, M. (2007). Linking risk management to strategic controls: a case study of Tesco plc. *International Journal of Risk Assessment and Management, 7(8),* 1074-1088.

Yates, J. F., & Stone, E. R. (1992). The risk construct. In J. F. Yates (Ed.), *Risk-taking behavior* (pp. 1–25). John Wiley & Sons.

Appendices

Appendix 1: Variable Definitions and Sources

Variable	Expected Sign	Measurement	Source
Tobin's Q		Measures firm performance and calculated as [(market value of equity + book value of liability)/ book value of assets].	SABI database
ERM Score	+	The sum of the 20 principles described in COSO's "Enterprise Risk Management – Integrating with Strategy and Performance"	Companies' annual reports
ISO 31000	+	ISO 31000 is a dummy variable that takes the value of 1 if a company implemented risk management processes in accordance with ISO 31000 standard, and 0 if it has not.	Companies' annual reports
Size	Ambiguous	Measures firm size and calculated as natural logarithm of the book value of total assets	SABI database
Leverage	Ambiguous	Measures firm leverage and is calculated as book value of liabilities on the market value of equity	SABI database
ROA	+	Measures profitability and is calculated as net income divided by total assets	SABI database
Sales Growth	+	Measures sales growth and is calculated as Sales in year t minus sales in year t-1/sales in year t-1	SABI database
Dividends	Ambiguous	Measured using the payout ratio, calculated as the ratio of dividends paid to net income	Companies' annual reports
Beta	Ambiguous	Beta represents the ratio of the covariance between the return of a company's shares and the return of the market (PSI) to the variance of the market's return	Yahoo Finance

Table 7: Variable expected signs, measurement, and sources of information

Appendix 2: ERM Score per Firm for 2017-2023

Principles	EDP	EDP R.	REN	Galp	Jerónimo Martins	Sonae	Corticeira Amorim	Navigator Company	Semapa	Altri	Mota-Engil	CTT	NOS	Ibersol
1. Exercises Board Risk Oversight	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2. Establishes Operating Structures	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3. Defines Desired Culture	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4. Demonstrates Commitment to Core Values	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5. Attracts, Develops, and Retains Capable Individuals	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6. Analyses Business Context	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7. Defines Risk Appetite	1	0	1	1	0	0	0	1	0	0	1	1	0	0
8. Evaluates Alternative Strategies	0	0	0	1	0	0	0	0	0	0	0	0	0	0
9. Formulates Business Objectives	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10. Identifies Risk	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11. Assesses Severity of Risk	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12. Prioritizes Risks	1	1	1	1	1	1	1	1	1	1	1	1	1	1
13. Implements Risk Responses	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14.Develops Portfolio View	0	0	0	1	0	0	0	0	0	0	0	0	0	0
15. Assesses Substantial Change	1	0	0	0	0	0	0	0	1	0	1	1	1	0
16. Reviews Risk and Performance	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17. Pursues Improvement in Enterprise Risk Management	0	0	0	1	0	0	0	1	0	0	0	0	0	0
18. Leverages Information and Technology	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19. Communicates Risk Information	1	1	0	0	0	0	0	1	0	0	1	1	1	0
20. Reports on Risk, Culture, and Performance	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Score	16	14	14	17	13	13	13	16	14	13	16	16	15	13

Table 8: ERM Score per Firm for 2017

Principles	EDP	EDP R.	REN	Galp	Jerónimo Martins	Sonae	Corticeira Amorim	Navigator Company	Semapa	Altri	Mota-Engil	CTT	NOS	Ibersol
1. Exercises Board Risk Oversight	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2. Establishes Operating Structures	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3. Defines Desired Culture	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4. Demonstrates Commitment to Core Values	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5. Attracts, Develops, and Retains Capable Individuals	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6. Analyses Business Context	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7. Defines Risk Appetite	1	0	1	1	0	0	0	1	0	0	1	1	0	0
8. Evaluates Alternative Strategies	0	0	0	1	0	0	0	0	0	0	0	0	0	0
9. Formulates Business Objectives	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10. Identifies Risk	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11. Assesses Severity of Risk	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12. Prioritizes Risks	1	1	1	1	1	1	1	1	1	1	1	1	1	1
13. Implements Risk Responses	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14.Develops Portfolio View	0	0	0	1	0	0	0	0	0	0	0	0	0	0
15. Assesses Substantial Change	1	0	0	0	0	0	0	0	1	0	1	1	1	0
16. Reviews Risk and Performance	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17. Pursues Improvement in Enterprise Risk Management	0	0	0	1	0	0	0	1	0	0	0	0	1	0
18. Leverages Information and Technology	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19. Communicates Risk Information	1	1	0	0	0	0	0	1	0	0	1	1	1	0
20. Reports on Risk, Culture, and Performance	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Score	16	14	14	17	13	13	13	16	14	13	16	16	16	13

Table 9: ERM Score per Firm for 2018

Principles	EDP	EDP R.	REN	Galp	Jerónimo Martins	Sonae	Corticeira Amorim	Navigator Company	Semapa	Altri	Mota-Engil	CTT	NOS	Ibersol
1. Exercises Board Risk Oversight	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2. Establishes Operating Structures	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3. Defines Desired Culture	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4. Demonstrates Commitment to Core Values	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5. Attracts, Develops, and Retains Capable Individuals	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6. Analyses Business Context	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7. Defines Risk Appetite	1	1	1	0	0	0	0	1	0	0	1	1	0	0
8. Evaluates Alternative Strategies	0	0	0	1	0	0	0	0	0	0	0	0	0	0
9. Formulates Business Objectives	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10. Identifies Risk	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11. Assesses Severity of Risk	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12. Prioritizes Risks	1	1	1	1	1	1	1	1	1	1	1	1	1	1
13. Implements Risk Responses	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14.Develops Portfolio View	0	0	0	1	0	0	0	0	0	0	0	0	0	0
15. Assesses Substantial Change	1	0	0	0	0	0	0	0	1	0	1	1	1	0
16. Reviews Risk and Performance	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17. Pursues Improvement in Enterprise Risk Management	0	1	0	1	0	0	0	1	0	0	0	0	1	0
18. Leverages Information and Technology	0	0	0	0	0	0	0	0	0	0	0	0	1	0
19. Communicates Risk Information	1	1	0	0	0	1	0	1	0	0	1	1	1	0
20. Reports on Risk, Culture, and Performance	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Score	16	16	14	16	13	14	13	16	14	13	16	16	17	13

Table 10: ERM Score per Firm for 2019

Principles	EDP	EDP R.	REN	Galp	Jerónimo Martins	Sonae	Corticeira Amorim	Navigator Company	Semapa	Altri	Mota-Engil	CTT	NOS	Ibersol
1. Exercises Board Risk Oversight	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2. Establishes Operating Structures	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3. Defines Desired Culture	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4. Demonstrates Commitment to Core Values	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5. Attracts, Develops, and Retains Capable Individuals	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6. Analyses Business Context	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7. Defines Risk Appetite	1	1	1	0	0	0	0	1	0	0	1	1	0	0
8. Evaluates Alternative Strategies	0	0	0	1	0	1	0	0	0	0	0	0	0	0
9. Formulates Business Objectives	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10. Identifies Risk	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11. Assesses Severity of Risk	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12. Prioritizes Risks	1	1	1	1	1	1	1	1	1	1	1	1	1	1
13. Implements Risk Responses	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14.Develops Portfolio View	0	0	0	1	0	0	0	0	0	0	0	0	0	0
15. Assesses Substantial Change	1	0	0	0	0	0	0	0	1	0	1	1	1	0
16. Reviews Risk and Performance	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17. Pursues Improvement in Enterprise Risk Management	0	1	0	1	0	0	0	1	0	0	0	0	1	0
18. Leverages Information and Technology	0	0	0	0	0	0	0	0	0	0	0	0	1	0
19. Communicates Risk Information	1	1	0	0	0	1	0	1	1	0	1	1	1	1
20. Reports on Risk, Culture, and Performance	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Score	16	16	14	16	13	15	13	16	15	13	16	16	17	14

Table 11: ERM Score per Firm for 2020

Principles	EDP	EDP R.	REN	Galp	Jerónimo Martins	Sonae	Corticeira Amorim	Navigator Company	Semapa	Altri	Mota-Engil	CTT	NOS	Ibersol
1. Exercises Board Risk Oversight	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2. Establishes Operating Structures	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3. Defines Desired Culture	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4. Demonstrates Commitment to Core Values	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5. Attracts, Develops, and Retains Capable Individuals	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6. Analyses Business Context	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7. Defines Risk Appetite	1	1	1	1	0	1	1	1	0	1	1	1	0	0
8. Evaluates Alternative Strategies	0	0	0	1	0	1	0	0	0	0	0	0	0	0
9. Formulates Business Objectives	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10. Identifies Risk	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11. Assesses Severity of Risk	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12. Prioritizes Risks	1	1	1	1	1	1	1	1	1	1	1	1	1	1
13. Implements Risk Responses	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14.Develops Portfolio View	0	0	0	1	0	0	0	0	0	1	0	0	0	0
15. Assesses Substantial Change	1	1	0	0	0	1	0	0	1	0	1	1	1	1
16. Reviews Risk and Performance	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17. Pursues Improvement in Enterprise Risk Management	0	1	0	1	0	0	1	1	0	0	0	0	1	0
18. Leverages Information and Technology	0	0	0	0	0	1	0	0	0	0	0	0	1	0
19. Communicates Risk Information	1	1	0	1	0	1	0	1	1	0	1	1	1	1
20. Reports on Risk, Culture, and Performance	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Score	16	17	14	18	13	18	15	16	15	15	16	16	17	15

Table 12: ERM Score per Firm for 2021

Principles	EDP	EDP R.	REN	Galp	Jerónimo Martins	Sonae	Corticeira Amorim	Navigator Company	Semapa	Altri	Mota-Engil	CTT	NOS	Ibersol
1. Exercises Board Risk Oversight	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2. Establishes Operating Structures	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3. Defines Desired Culture	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4. Demonstrates Commitment to Core Values	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5. Attracts, Develops, and Retains Capable Individuals	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6. Analyses Business Context	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7. Defines Risk Appetite	1	1	1	1	0	1	1	1	0	1	1	1	0	0
8. Evaluates Alternative Strategies	0	0	0	1	0	1	0	0	0	0	0	0	0	0
9. Formulates Business Objectives	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10. Identifies Risk	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11. Assesses Severity of Risk	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12. Prioritizes Risks	1	1	1	1	1	1	1	1	1	1	1	1	1	1
13. Implements Risk Responses	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14.Develops Portfolio View	0	0	0	1	0	0	1	0	0	1	0	0	1	0
15. Assesses Substantial Change	1	1	0	1	0	1	0	1	1	1	1	1	1	1
16. Reviews Risk and Performance	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17. Pursues Improvement in Enterprise Risk Management	0	1	0	1	0	0	1	1	0	1	0	0	1	0
18. Leverages Information and Technology	0	1	0	0	0	1	0	0	0	0	0	0	1	0
19. Communicates Risk Information	1	1	1	1	0	1	0	1	1	1	1	1	1	1
20. Reports on Risk, Culture, and Performance	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Score	16	18	15	19	13	18	16	17	15	18	16	16	18	15

Table 13: ERM Score per Firm for 2022

Principles	EDP	EDP R.	REN	Galp	Jerónimo Martins	Sonae	Corticeira Amorim	Navigator Company	Semapa	Altri	Mota-Engil	CTT	NOS	Ibersol
1. Exercises Board Risk Oversight	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2. Establishes Operating Structures	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3. Defines Desired Culture	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4. Demonstrates Commitment to Core Values	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5. Attracts, Develops, and Retains Capable Individuals	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6. Analyses Business Context	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7. Defines Risk Appetite	1	1	1	1	1	1	1	1	0	1	1	1	0	0
8. Evaluates Alternative Strategies	0	0	0	1	0	1	0	0	0	0	0	0	0	0
9. Formulates Business Objectives	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10. Identifies Risk	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11. Assesses Severity of Risk	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12. Prioritizes Risks	1	1	1	1	1	1	1	1	1	1	1	1	1	1
13. Implements Risk Responses	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14.Develops Portfolio View	1	0	0	1	0	0	0	1	0	1	1	0	1	0
15. Assesses Substantial Change	1	1	0	1	0	1	0	1	1	1	1	1	1	1
16. Reviews Risk and Performance	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17. Pursues Improvement in Enterprise Risk Management	1	1	0	1	0	0	1	1	0	1	0	0	1	0
18. Leverages Information and Technology	1	1	0	0	0	1	0	0	0	0	0	0	1	0
19. Communicates Risk Information	1	1	1	1	0	1	0	1	1	1	1	1	1	1
20. Reports on Risk, Culture, and Performance	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Score	19	18	15	19	14	18	15	18	15	18	17	16	18	15

Table 14: ERM Score per Firm for 2023