

Assessing Risk Management Maturity in Emerging Economies Using Principal Component Analysis: Evidence from Tunisian Firms

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Abstract:

This study assesses the maturity of risk management practices in emerging economies, focusing on Tunisian firms to address the gap in empirical evidence beyond developed markets. A survey of 475 companies across manufacturing, services, and commercial sectors was conducted, with data analysed using descriptive statistics and Principal Component Analysis (PCA), preceded by KMO and Bartlett's tests to ensure suitability. The analysis extracted three key dimensions: strategic risk awareness, organizational risk structuring, and managerial proactivity in risk management. The findings reveal that while awareness of risk issues is growing among Tunisian firms, the implementation of structured and formalized risk management frameworks remains uneven. This study contributes to the risk governance literature by empirically identifying the latent dimensions of maturity in an under-researched context. It offers practical implications for strengthening risk systems and suggests that future research should explore the determinants driving heterogeneity in maturity levels across firms.

Keywords: Risk management maturity, PCA, Emerging economies, Enterprise Risk Management, Slovin's formula.

1- Introduction:

In recent decades, risk management has been positioned as a central concern for organizations (Ennouri, 2025). This shift has been driven by an increasingly complex and uncertain global environment.

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Globalization, technological disruption, financial instability, and geopolitical tensions have been widely recognized as key factors by which firms' exposure to diverse forms of risk—ranging from operational and financial risks to reputational and strategic risks—has been significantly amplified. Consequently, organizational resilience and long-term performance have come to be seen as critically determined by the way risks are identified, assessed, and managed.

Such recognition has not been confined to practitioners alone. Extensive examination of risk management practices and frameworks has also been carried out in the academic literature. This work has been conducted largely within the context of developed economies. Strategic tools such as Enterprise Risk Management (ERM) and integrated risk governance have been widely promoted, through which proactive engagement with uncertainty and improved decision-making processes have been enabled for organizations (Huber et al., 2025). By adopting such structured frameworks, higher levels of operational stability and strategic adaptability have been demonstrated by firms.

Yet, it is within emerging economies that the picture remains less complete. A relative limitation has been observed in empirical studies focused on risk management practices in these contexts. Institutional constraints, limited managerial expertise, and evolving regulatory frameworks are often faced by firms operating there. By these factors, the implementation of comprehensive risk management systems may be hindered. As a result, an important research challenge has been constituted by the need to understand how risk is perceived and managed by organizations in emerging economies.

This challenge becomes particularly salient when a specific national context is considered. A particularly interesting case for examination is provided by Tunisia. Since the political and economic transformation initiated by the 2011 revolution, Tunisian companies have been subjected to increased exposure to economic volatility, global market competition, and supply chain disruptions. By these structural changes, the importance of effective risk management practices has been amplified within Tunisian organizations. However, scarcity and fragmentation have been observed in empirical research addressing how

risk is actually managed by Tunisian firms, with existing studies having been largely focused on specific sectors such as banking or insurance.

It is precisely this scarcity that the present study seeks to address. A comprehensive empirical analysis of risk management practices is provided, based on a broad sample of Tunisian companies. Multiple sectors of the national economy are represented among these firms. Specifically, the following areas are aimed to be examined by the research: how risk is perceived by firms, which risk mitigation strategies are adopted, and by which organizational factors the development of structured risk management practices is influenced.

To this end, a robust methodological approach has been employed. The study is based on survey data collected from 475 Tunisian companies operating across multiple sectors of the national economy. Through the use of PCA, the underlying factors shaping risk management behavior within these organizations have been identified. From this methodological foundation, a clear set of research questions has been formulated.

The following research questions are sought to be answered by the study:

- By which types of risks are Tunisian companies prioritized in their risk management strategies?
- To what extent have structured risk management practices been implemented by Tunisian firms?
- By which organizational and managerial factors is the effectiveness of risk management practices influenced within Tunisian companies?

By systematically addressing these questions, several contributions are made by this research. First, new empirical evidence on organizational risk practices in Tunisia is provided to the literature on risk management in emerging economies. Second, practical insights are offered by the findings for managers and policymakers. Ultimately, the strengthening of the resilience of Tunisian companies in an increasingly

uncertain economic environment is sought by these stakeholders—an objective to which this study aims to offer meaningful support.

2- Literature review:

This section is organized around four key themes. First, the evolution of risk management is traced, from its traditional focus on financial protection to its current role as a strategic governance function. Second, the ERM framework is examined, with particular attention given to its conceptual foundations and organizational benefits. Third, the concept of organizational risk culture is explored, and its critical role in shaping risk management effectiveness is highlighted. Finally, the literature on risk management practices in emerging economies is reviewed, with a specific focus placed on the Tunisian context, where empirical evidence remains limited.

2-1. Evolution of risk management:

A considerable evolution has been observed in risk management over the past decades (Abdullayeva, 2025). Traditionally, risk management was primarily focused on financial protection. This protection was achieved through insurance and hedging mechanisms (Marie Both and Wilhelm, 2026). However, by the increasing complexity of business environments, the scope of risk management has been expanded (Ennouri, 2021). Strategic, operational, and reputational risks have now been incorporated alongside traditional financial concerns (Özkan-Özen et al., 2025). A wide range of risks has come to be faced by modern organizations (Ijaz and Ishfaq, 2026). Coordinated management strategies are required by these risks. Consequently, risk management has progressively been positioned as a key component of corporate governance and strategic planning (Ellili, 2026).

2-2. Enterprise risk management:

As a comprehensive framework, ERM has been developed for the identification, assessment, and management of risks across the entire organization (Tan and Lee, 2022). According to the Committee of Sponsoring Organizations of the Treadway Commission (COSO), ERM is defined as "*...the culture, capabilities, and practices that organizations integrate with strategy setting and apply when they carry out that strategy, with a purpose of managing risk in creating, preserving, and realizing value*" (as cited in Berge et al., 2026). Through

ERM, the integration of risk management processes into strategic decision-making and organizational governance structures is intended to be achieved (COSO, 2017). Potential events that may affect an organization are required to be identified under the COSO framework. Within acceptable tolerance levels, the implementation of mechanisms designed to manage risks is also mandated (Karanja, 2017). Several studies have demonstrated that organizations adopting ERM frameworks tend to achieve better risk transparency, improved decision-making processes, and enhanced organizational resilience (Berge et al., 2026; Farah et al., 2024; Khan et al., 2016).

2-3. Organizational risk culture:

Not only by formal structures is the effectiveness of risk management systems determined. By the presence of a strong organizational risk culture, it is also significantly influenced (Smith and Fatorachian, 2025). The shared values, attitudes, and behaviors that shape how risks are perceived and responded to by individuals are referred to as risk culture (Rahim et al., 2024). Open communication regarding potential risks is encouraged in organizations where a proactive risk culture has been cultivated (Domańska-Szaruga, 2020). In risk mitigation processes, employees are actively involved. Greater resilience and more effective risk oversight have been shown to be associated with such cultural attributes (Ying and Allaqtta., 2025).

2-4. Risk management in emerging economies:

A strong foundation has been established for risk management frameworks in developed economies (Zaman and Sozib, 2024). In emerging markets, however, their adoption remains uneven (Dang et al., 2020). Reactive approaches to risk management have been found to be often relied upon by companies in developing countries. A primary focus on operational risk mitigation rather than strategic risk governance has typically been observed (Ononiwu et al., 2024). Within the Tunisian context, limited empirical research has been conducted on how risk management practices are implemented by companies (Ennouri, 2025). The influence of organizational factors on these practices has also been insufficiently examined (Ogundip et al., 2024). A fragmented picture of risk management practices in Tunisia has thus been left by existing studies, with most attention having been concentrated on specific sectors

such as banking and insurance (Mardessi and Ben Arab, 2018; Monki et al., 2013).

3- Methodology:

3-1. Research objectives:

A global vision is sought to be provided by this study. Through this vision, an understanding is developed of how Tunisian companies are structured to face various risks. An exploratory quantitative approach has therefore been adopted. Between January 2024 and October 2025, a first exploratory study was conducted. Data were collected through face-to-face interviews and a structured questionnaire. Both instruments were administered to directors and risk managers. By this initial qualitative step, an in-depth view of risk management practices was obtained for each participating company. Furthermore, the overall understanding of risk management in Tunisia was significantly improved through this phase. On the basis of these insights, a statistical analysis was subsequently prepared.

3-2. Questionnaire design:

A questionnaire consisting of 22 questions was developed. Three main themes are covered by this instrument. First, general information on the company is collected. Second, logistics and risk management are addressed, including risk perception, attitudes toward risk management, and available tools. Third, mitigation tools are examined. In this questionnaire, particular interest is focused on how managers become aware of risk management within their company.

3-3. Sample description:

A total of 475 companies were targeted by the survey. These companies operate in three sectors of activity in Tunisia: manufacturing, services, and commerce. The population was composed of senior managers and executives. Responsibility for operational and strategic decision-making was held by these respondents. Face-to-face interviews were conducted with each participant.

3-4. Sample size test:

Several techniques exist for calculating the minimum sample size required for a representative and statistically significant study. Among these techniques are Cochran's theorem, Slovin's formula, and Grubbs's test. For the purposes of this research, Slovin's formula was selected.

The formula is written: as: $n = N/(1+N*e^2)$. Where:

- n : sample size required
- N : population size (our population: 771000 companies¹)
- e : is a specified margin of error (5%)

Our calculation gives $n = 771000/(1+(771000*0,05^2)) = 399,79$ companies. We can conclude that our study is representative because our sample is made up of 475 companies.

3-5. Reliability analysis:

The internal consistency of the questionnaire was assessed using Cronbach's Alpha.

Table N°1: Reliability Statistics

Scale	Cronbach Alpha
Risk awareness items	0.84
Organizational structure items	0.81
Managerial attitude items	0.79
Overall questionnaire	0.86

These results indicate high internal consistency.

3-6. Principal component analysis:

The initial questionnaire consisted of 22 items designed to capture various aspects of risk management practices. Prior to conducting the PCA, these items were grouped into six composite variables based on conceptual similarity and internal consistency. This aggregation process was supported by reliability analysis (Cronbach's alpha), ensuring that each composite variable adequately represented a coherent underlying construct. Principal component analysis was selected. Through its application, dimensionality was reduced and the latent structures underlying risk management practices were uncovered. The robustness of the extracted dimensions was subsequently confirmed.

Table N°2: KMO and Bartlett Test

Test	Value
KMO	0.82
Bartlett Test	Significant ($p < 0.001$)

These results confirm the adequacy of our data for PCA.

4- Results:

¹ Tunisian Industry Portal 2023

Table N°3: Total Variance Explained

Component	Eigenvalue	Variance %
1	3.42	34.2
2	1.91	19.1
3	1.24	12.4

Three components were retained according to the Kaiser criterion.

Table N°4: Rotated Component Matrix (Varimax)

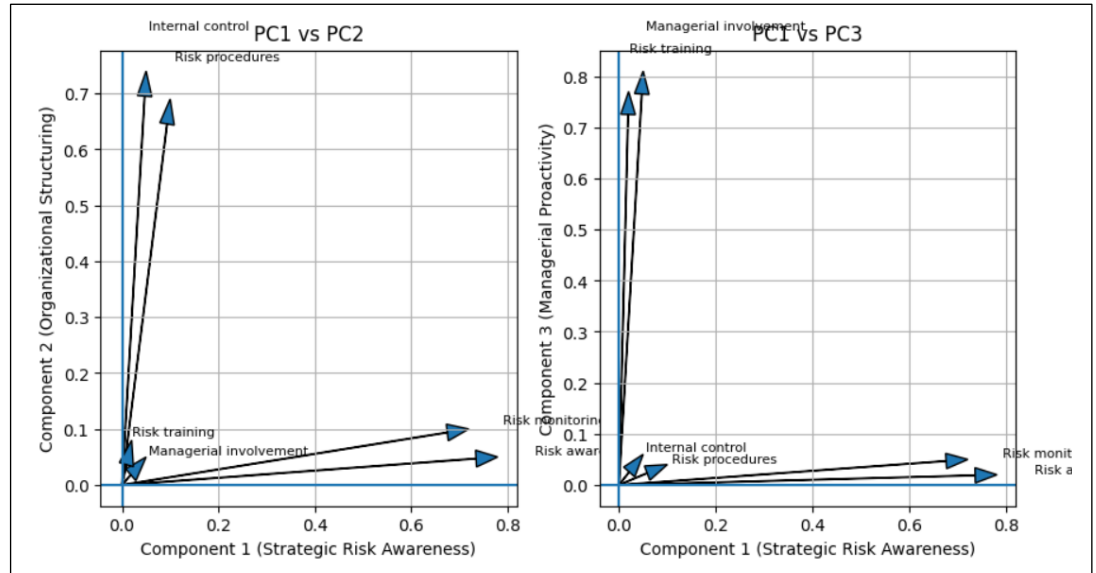
Variables	Factor 1	Factor 2	Factor 3
Risk awareness	0.78		
Risk monitoring	0.72		
Internal Control		0.74	
Risk procedures		0.69	
Managerial involvement			0.81
Risk training			0.77

Note: Only factor loadings greater than 0.50 are displayed. Loadings below this threshold were suppressed to improve readability and interpretability. All loadings were examined, and no significant cross-loadings were observed. (Factor 1: Component 1: Strategic Risk Awareness; Factor 2: Component 2: Organizational Risk Structuring; Factor 3: Component 3: Managerial Proactivity).

5- Discussion:

A comprehensive and empirically grounded understanding of the structure and maturity of risk management practices within Tunisian companies is provided by the results of this study. PCA was employed. Through this method, three core latent dimensions—strategic risk awareness, organizational structuring of risk management, and managerial proactivity—were identified as collectively shaping organizational approaches to risk management. A more nuanced understanding is thus contributed to the literature, showing how risk management is conceptualized and operationalized in an emerging economy context.

Figure N°1: PCA Biplots of Risk Management Variables (PC1–PC2 and PC1–PC3)



A clear visualization of the relationships among the observed variables is provided by the PCA biplots. In the first plot (PC1–PC2), a distinction is highlighted between strategic risk awareness variables—namely risk awareness and risk monitoring—and organizational structuring variables, which include internal control and risk procedures. Managerial involvement and risk training are emphasized in the second plot (PC1–PC3) as key drivers of managerial proactivity. The three-dimensional interpretation of risk management practices is strongly supported by the graphical structure. Thus, the robustness of the PCA results is confirmed.

5-1. Interpretation of principal components:

The first component was labelled strategic risk awareness. Through this dimension, the extent to which organizations actively identify, monitor, and integrate risk considerations into strategic decision-making processes is captured. High loadings were observed for variables such as risk identification and risk monitoring. By these variables, a growing recognition among firms of the importance of anticipating potential threats is suggested. Alignment with the literature is found here, where effective risk management is argued to begin with systematic identification and evaluation of risks (Kaplan and Mikes, 2012). Nevertheless, uneven integration of risk into long-term strategic

planning was revealed. A partial adoption of ERM principles is therefore indicated.

The second component was labelled organizational risk structuring. Through this dimension, the degree to which firms have formalized their risk management processes is reflected. Internal control systems, standardized procedures, and reporting mechanisms were among the variables with high loadings. A transition toward more structured governance frameworks is suggested for some Tunisian companies by the prominence of these variables. Consistency with prior studies is observed, where the formalization of risk management processes is considered a critical step in the institutionalization of ERM (Beasley et al., 2005). However, variability across firms was also detected. Uniform implementation of such structuring is not yet achieved, particularly among small and medium-sized enterprises.

The third component was labelled managerial proactivity. The role of leadership attitudes and organizational culture in shaping risk management practices is underscored by this dimension. High loadings were obtained for variables related to managerial awareness and risk culture. Proactive leadership is thereby shown to play a crucial role in fostering a risk-aware organizational environment. This finding corroborates previous research, in which the effectiveness of risk management systems is argued to be strongly influenced by the commitment and engagement of top management (Arena et al., 2010). In this regard, the human and behavioral dimensions of risk governance are suggested to be as important as formal structures.

5-2. Comparative analysis: Tunisia versus European contexts:

Significant differences between risk management practices in Tunisian firms and those typically observed in European organizations were revealed through a comparative interpretation of the findings.

A high level of maturity has been reached by risk management in European contexts. This maturity is characterized by the widespread adoption of integrated ERM frameworks. Within corporate governance structures, these systems are generally embedded. Dedicated risk committees, advanced analytical tools, and regulatory requirements enforcing transparency and accountability are also typically present (Nocco and Stulz, 2006). As a result, risk management in Europe is

increasingly proactive, strategic, and aligned with long-term organizational objectives.

In contrast, a transitional phase of risk management maturity is suggested for Tunisian companies by the findings of this study. Clear evidence of growing awareness and initial structuring efforts was identified. However, largely fragmented risk management practices were observed, often limited to operational risk mitigation. Only partial implementation of strategic integration was found, despite its being a defining feature of mature ERM systems.

Several factors were identified to explain this divergence. European firms operate within regulatory frameworks that strongly encourage or mandate risk management practices. Similar pressures are less pronounced in Tunisia. Organizational capabilities differ as well. Many Tunisian firms, particularly SMEs, face resource constraints that limit their ability to implement comprehensive risk management systems. Managerial culture also plays a role. The transition from reactive to proactive risk management requires a shift in managerial mindset, which is still evolving in many emerging economies. Through this comparative perspective, the structural and institutional challenges that must be addressed to advance risk governance practices in Tunisia are highlighted.

5-3. Theoretical implications:

From a theoretical standpoint, a contribution to the literature on risk management in emerging economies is made by this study. Empirical evidence on the multidimensional nature of risk management practices is provided. Three distinct yet interrelated components were identified. Through their identification, the view that risk management is not a monolithic construct is supported. Instead, a complex system involving strategic, organizational, and behavioral dimensions is suggested.

Furthermore, existing ERM frameworks are extended by the findings. An illustration is provided of how these dimensions manifest in a context characterized by institutional constraints and evolving governance structures. Traditional ERM models, largely developed in Western contexts, are thereby suggested to require adaptation when applied to emerging economies.

5-4. Managerial implications:

Several important implications for managers and policymakers seeking to strengthen risk management practices in Tunisian companies are offered by the results of this study.

First, organizations should move beyond basic risk awareness. More structured and integrated risk management frameworks should be developed. Formal procedures, internal control systems, and risk reporting mechanisms should be established.

Second, the critical role of leadership in driving effective risk management is highlighted by the findings. A risk-aware culture should be actively promoted by managers. Communication should be encouraged. Employees should be trained. Risk considerations should be integrated into strategic planning.

Third, a significant role could be played by policymakers and regulatory bodies. Guidelines, incentives, and support mechanisms tailored to the needs of local firms should be developed. Through such measures, the adoption of advanced risk management practices can be fostered.

5-5. Toward a maturity model of risk management in Tunisia:

Based on the empirical findings, a continuum of risk management maturity is proposed. Tunisian companies can be positioned along this continuum.

A reactive stage was identified, where focus is placed on operational risk mitigation. A structured stage was also identified, characterized by the implementation of formal procedures and controls. An integrated stage was further distinguished, where risk management is aligned with strategic decision-making.

Between the first and second stages, the majority of firms in this study appear to be situated. A need for further progression toward fully integrated risk governance systems is therefore highlighted.

6- Conclusion:

An examination of the structure and maturity of risk management practices within Tunisian companies was undertaken in this study. Particular attention was given to identifying the key organizational dimensions shaping these practices. A quantitative approach was

adopted, based on survey data collected from 475 firms. PCA was applied. Through this method, the latent factors underlying risk management behaviors were uncovered.

Three core dimensions were identified: strategic risk awareness, organizational structuring of risk management, and managerial proactivity. A progressive, yet incomplete, transition toward more formalized and integrated risk governance systems is reflected by these dimensions. Increasing awareness of the importance of risk management was observed among Tunisian companies. However, uneven institutionalization of these practices was found. Limited integration of risk management into strategic decision-making processes was noted across many organizations. An intermediate stage of risk management maturity is therefore suggested.

Several theoretical contributions are offered by this research. Empirical evidence on the multidimensional nature of risk management practices is provided. A more nuanced conceptualization of risk management—as a complex system encompassing strategic, organizational, and behavioral dimensions—is thereby advanced. The application of ERM frameworks is extended to the context of an emerging economy. A gap in the literature is addressed through this extension. Furthermore, the critical role of managerial attitudes and organizational culture is highlighted, supporting the view that effective risk governance depends on leadership commitment alongside formal systems.

Practical implications for managers and policymakers are also derived. Institutionalization of risk management through formal structures and integrated reporting systems is recommended. Managerial engagement and leadership are emphasized as essential drivers of risk governance. Capacity-building and training programs are called for, particularly to improve managerial competencies. A key role for policymakers is identified, through which the adoption of structured frameworks—especially among small and medium-sized enterprises—can be encouraged via incentives, guidelines, and support mechanisms.

Acknowledgment must be made of several limitations. Cross-sectional data were used, constraining the ability to capture dynamic evolution over time. Self-reported data were relied upon, introducing the

possibility of response bias. Generalizability is limited by the study's specific focus on the Tunisian context. Finally, Principal Component Analysis was employed as an exploratory method, leaving causal relationships unexplored. Future research is encouraged. Longitudinal designs should be adopted. Objective performance indicators should be incorporated. Cross-country comparisons should be undertaken. Advanced analytical techniques—such as Structural Equation Modeling or Bayesian Networks—should be applied to examine causal pathways linking risk management maturity to organizational performance.

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