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A COSO-Based Enterprise Risk Management Maturity in the Service Industry: Perspectives from Turkish Hotels and Hospitals

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Abstract

This study proposes and pilots a COSO-2017-based enterprise risk management (ERM) maturity index informed by the use of strategic management tools (SMTs) to benchmark strategic risk management capability in service organizations. Using secondary SMT usage data extracted from seven Turkish graduate theses (eight organizations in hotels and hospitals), we computed overall and component-level maturity scores on a standardized 0–1 scale. The average ERM maturity was 0.52 (medium), with stronger Governance and Culture (0.56) than Performance (0.48) and Information, Communication and Reporting (0.51), indicating persistent gaps in risk-to-metrics translation and reporting infrastructures. Hotels exhibited higher maturity than hospitals (0.575 vs. 0.49), and private hospitals outperformed public hospitals (0.57 vs. 0.41). The index illustrates a replicable benchmarking approach to identify capability gaps and prioritize ERM improvements—particularly strengthening KRIs, performance feedback loops, and data-enabled reporting that are central to resilience- and sustainability-oriented decision-making.

Keywords: enterprise risk management; COSO-2017 framework; risk management maturity; strategic management tools; maturity index; service organizations; ESG risks; sustainability risk management

1. Introduction

In today's volatile, complex, and constantly evolving world of technological advancements, businesses increasingly face strategic uncertainty. This uncertainty threatens their competitiveness and resilience. The transformation of global markets, geopolitical instability, and the rapid digitization of business processes have rendered traditional risk management approaches inadequate in addressing strategic threats. In this context, service sector businesses, in particular, need to move beyond operational risk management and embrace strategic risk management (SRM), an integrated framework that directly links risk awareness to strategic planning, decision-making, and performance monitoring [1,2]. Recent practitioner evidence also indicates that organizations increasingly assess ERM maturity through systematic risk assessment cycles and monitoring of key risks, reinforcing the need for maturity benchmarking in strategic decision-making [3].

The concept of risk is an essential part of organizational existence [4]. Passive risk management approaches, initially implemented to avoid risks due to the origin of the word and its negative impacts, have evolved into an active approach due to the understanding

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that risks can also contain opportunities [5]. Organizations implementing risk management have many different justifications and expectations. Some organizations use it out of legal obligation, others to provide reasonable assurance against risks, and still others to prepare for the future by managing strategic decision-making processes more effectively [1].

The evolution of risk management practices can be categorized into three phases: traditional, corporate, and strategic risk management [6]. Within the traditional approach, risk avoidance dominates, and it is assumed that managing risks through isolated units and financial methods is sufficient [7]. In the enterprise risk management approach, it is accepted that opportunities inherent in risks should be taken advantage of, that all risks, including uncertainties, should be addressed, and that risk management should be managed with a holistic approach. At the strategic risk management stage, it is recognized that effective risk management must be ongoing, culturally embedded, and aligned with strategic and managerial processes [2].

The enterprise risk management framework, updated by COSO (Committee of Sponsoring Organizations of the Treadway Commission) in 2017, represents a paradigmatic shift from risk aversion to risk-focused value creation. However, how organizations can operationalize this transformation and measure their maturity in aligning risk management with strategic processes has not yet been adequately addressed [5,8]. Within the COSO ERM (2017) guideline, enterprise risk management is organized around five interrelated components (often treated as the pillars of ERM): (1) Governance and Culture, which sets oversight and risk culture; (2) Strategy and Objective-Setting, which aligns risk appetite with strategy and objectives; (3) Performance, which identifies, assesses, prioritizes, and responds to risks while developing a portfolio view; (4) Review and Revision, which evaluates change and improves ERM over time; and (5) Information, Communication and Reporting, which ensures relevant information flows for decision-making, transparency, and accountability. These five components provide the conceptual basis for our component-level maturity profiling and benchmarking [2].

The concept of maturity has long been used to assess how management processes in organizations develop systematically and effectively. In this perspective, risk management maturity refers to the degree to which risk processes are institutionalized, embedded in governance mechanisms, and aligned with strategic objectives [6]. Maturity models allow organizations to benchmark their current practices, identify shortcomings, and identify paths toward greater resilience and adaptability [7].

Strategic risk maturity can be defined as the extent to which ERM is institutionalized and consistently integrated into strategy-setting and performance management routines. In practice, it is reflected in the clarity and operationalization of risk appetite, the use of key risk indicators (KRIs) linked to strategic objectives, and the presence of closed-loop review and escalation mechanisms that enable learning and timely remediation. Higher levels of strategic risk maturity therefore support more disciplined prioritization of risk responses, improved decision consistency, and organizational resilience—particularly when risk information is translated into measurable indicators and communicated through traceable reporting routines. Accordingly, maturity models provide a structured basis for benchmarking current capability and identifying pathways for improvement [1,2,6,7]. Recent studies further highlight that ERM effectiveness increasingly depends on systematic KRI monitoring enabled by robust reporting infrastructures and data governance, which strengthen early-warning capability and closed-loop remediation routines [9,10].

Internationally, ERM maturity has been operationalized in accounting and risk-governance research using observable proxies such as risk governance structures (e.g., CRO/risk committee oversight), internal-control quality, and risk-disclosure practices [11], and empirical studies report associations between ERM adoption and firm value/performance

under specific contingencies [12]. These streams motivate complementary measurement approaches when direct governance and disclosure indicators are not consistently available. In this study, we therefore use SMT diffusion as an organization-level management-system proxy to approximate strategic risk integration maturity under secondary-data constraints, while explicitly acknowledging alternative interpretations (symbolic adoption vs. substantive integration) and the need for convergent validation in future work.

In Türkiye, risk management practices in hotels and hospitals are shaped largely by compliance-driven safety and quality requirements, yet the degree of strategic integration varies across organizations. In healthcare, the national Sağlıkta Kalite Standartları (SKS) system provides hospital-wide standards and guidance that explicitly address risk identification and mitigation for patients, staff, and the care environment [13]. In hospitality, hotels operate under strong guest-safety and hygiene expectations and are also subject to occupational health and safety requirements that emphasize risk assessment and preventive controls [14]. Recent safety incidents have further highlighted the importance of strengthening operational safety controls and governance in tourism facilities [15].

However, research indicates that manufacturing and financial organizations are progressing in developing risk maturity, while organizations in the service sector are lagging behind due to their intangible outputs, high dependence on human interaction, and rapidly evolving customer dynamics. This situation highlights the need for strategic risk management models, particularly for service organizations. To address this need, the strategic management literature offers a wide range of tools designed to enhance decision-making mechanisms and strategic alignment. These are generally referred to as "Strategic Management Tools" (SMTs). These tools, such as the Balanced Scorecard, SWOT Analysis, Value Chain Analysis, and Stakeholder Analysis, serve as cognitive and analytical methods that help managers balance decision-making processes and competitive priorities [16–18].

SMTs have numerous impacts and contributions on organizations. From a managerial perspective, they offer benefits such as increasing managers' awareness of the organizational structure, reducing the impact of risk on their decisions, and determining decision priorities [19,20]. From an institutional perspective, they provide benefits such as generating information, improving communication, supporting coordination and control, raising awareness of opportunities and threats in risk management, and mitigating risk impacts [21]. In this context, SMTs are not a goal but a tool used to implement strategies [16].

However, despite the widespread adoption of SMTs in strategic planning and performance measurement, empirical studies of their effectiveness remain fragmented and largely descriptive [21,22]. More importantly, there is little evidence on how SMTs interact with or enhance other management systems, such as risk and innovation management [23].

In light of the information presented above, assessing organizations' preparedness for the impact of risks—in other words, their level of maturity in risk management—has become an important area of research. Therefore, determining an organization's ERM maturity is increasingly relevant for both academics and practitioners. The aim of this study is to apply and benchmark the Strategic Management Tools–based Enterprise Risk Management (SMTs–ERM) Maturity Index previously developed by Soner and Karacabak [24] using SMT-usage data reported in theses and dissertations from the YÖKTEZ database. Accordingly, this study benchmarks ERM maturity across service organizations (hotels and hospitals) in Türkiye and discusses component-level gaps and improvement priorities.

This study makes three explicit contributions. Methodologically, it demonstrates a replicable way to operationalize and benchmark COSO-2017-aligned ERM maturity using secondary, organization-level SMT usage-rate data, including transparent mapping logic and profile-based interpretation rather than relying on hard-to-access internal governance/disclosure datasets. Contextually, it provides one of the first cross-case bench-

marking applications of the published SMTs–ERM maturity index in service organizations (hotels and hospitals) in Türkiye using open-access evidence from the YÖKTEZ thesis repository. Theoretically, it strengthens the bridge between SMT diffusion and strategic risk integration by showing that measurement- and review-oriented toolkits co-vary with a COSO-consistent maturity profile, thereby illustrating how "risk–strategy integration" can be assessed as an organizational capability rather than a purely rhetorical governance claim.

Building on the discussion above, assessing organizations' preparedness for risk impacts—i.e., their strategic risk management maturity—has become increasingly important for both scholars and practitioners. Accordingly, this study applies and benchmarks the previously published Strategic Management Tools–based ERM (SMTs–ERM) Maturity Index [24] across service organizations (hotels and hospitals) in Türkiye, using open-access graduate theses in the YÖKTEZ National Thesis Center that report organization-level SMT usage rates.

Measuring strategic risk management maturity through SMT usage remains an emerging research area. By leveraging secondary evidence, this study provides an early cross-case benchmarking application of the SMTs–ERM index across different organizational samples, making the contribution of SMTs to ERM processes quantitatively visible and offering a replicable approach for comparative assessments in the service industry.

2. Materials and Methods

2.1. Study Design

This is an exploratory study conducted using secondary data analysis. In this study, ERM maturity levels were calculated using SMT usage-rate data extracted from graduate theses. The Strategic Management Tools-Based Enterprise Risk Management (SMTs-ERM) Maturity Index, developed by Soner and Karacabak [24], was used in the calculation process.

Within the scope of the study, the SMTs-ERM Maturity Index was operationalized at the organizational level, and comparative assessments were conducted by computing maturity scores for each organization. Accordingly, this research constitutes a pilot analysis demonstrating how the SMTs-ERM Maturity Index can be applied to different datasets.

Given the cross-sectional secondary-data design, the study reports associations and is not intended to identify causal effects.

2.2. Analytical Process

Analytical process of the study was carried out in four stages:

1. Identifying SMTs studies in the literature
2. Selecting examples using SMTs with maximum similarity
3. Aligning SMTs data with the SMTSs-ERM Maturity Index
4. Calculating and comparatively analyzing the strategic risk maturity level for each organization.

2.3. Study Population

The study population comprises graduate theses in the YÖKTEZ National Thesis Center that report organization-level SMT usage rates (aggregated as percentages of "use/non-use") suitable for benchmarking ERM maturity using the SMTs–ERM Maturity Index.

2.4. Study Sample and Sampling Technique

A keyword search in YÖKTEZ for "strategic management tools" identified 15 theses in the search results. These theses were screened for open-access full text and for the availability of extractable, comparable SMT usage-rate data (quantitative "use/non-use" information). To ensure harmonized index computation across cases, we applied criterion-

based purposive sampling and retained only theses reporting a common set of 10 SMTs in a manner that allowed standardized scoring. Eight theses were excluded because they were not open access, did not report usable "use/non-use" rates (e.g., reporting only awareness/satisfaction), or used non-comparable SMT lists/metrics that prevented harmonized scoring. As a result, 7 theses met the eligibility criteria and were included (yielding 8 organizational samples, because one thesis reported public and private hospitals separately and this distinction was preserved) [22,25–30]. Given the secondary-data benchmarking nature of the study, no a priori power-based sample size calculation was performed; instead, the final sample size equals the number of eligible open-access theses identified through screening (i.e., $N_{\text{included theses}} = 7$).

2.5. Alignment of SMTs with the SMTs-ERM Maturity Index

To align SMT data with the SMTs-ERM Maturity Index, the 10 SMTs used in the thesis were correlated with five components of the COSO-2017 enterprise risk management framework (Governance and Culture; Strategy and Objectives Setting; Performance; Review and Revision; Information, Communication, and Reporting).

The alignment of SMTs to COSO-2017 components was implemented using a theory-driven cross-walk matrix (binary intersections), where each SMT contributes to one or more COSO components based on its conceptual role in strategy, performance management, review cycles, and information/reporting routines. To reduce researcher degrees of freedom, the mapping was defined a priori and applied consistently across all organizations. Nevertheless, we acknowledge that any cross-walk of managerial tools to a normative framework may entail assignment subjectivity (e.g., shifting emphasis between Performance vs. Information/Reporting), which can affect component-level scores. Therefore, component-level interpretations are made cautiously and should be viewed as indicative profiles rather than definitive causal measurements.

Each SMT was assigned to COSO component(s) using explicit qualitative criteria derived from the intended function of the tool in strategy and control systems: (a) Governance and Culture when the tool institutionalizes oversight, roles, accountability, or shared norms; (b) Strategy and Objective-Setting when it supports strategy formulation, objective setting, partner/portfolio choices, or risk-appetite-aligned trade-offs; (c) Performance when it enables identification/assessment/response to risks through performance drivers, resource allocation, or operational controls; (d) Review and Revision when it embeds feedback, learning, audits, or periodic reassessment; and (e) Information, Communication, and Reporting when it improves risk-related information quality, transparency, reporting routines, or decision visibility. For example, Strategic Alliances were mapped to Governance and Culture (shared governance and accountability) and Strategy and Objective-Setting (strategic positioning and risk-sharing choices), while Outsourcing was mapped to Strategy and Objective-Setting (make-or-buy decisions and third-party risk appetite) and Performance (control design, service-level monitoring, and operational risk response).

2.6. Research Data Analysis

The SMTs-ERM Maturity Index (Table 1), developed by Soner and Karabacak [24], was used to calculate the strategic risk maturity levels of the organizations included in the theses discussed in the study. The index was calculated using the "balance method" employed by the Turkish Statistical Institute and the Central Bank of the Republic of Turkey. For each SMT, the difference between the "percentage of organizations using" and the "percentage of organizations not using" was calculated. A diffusion index was created by adding 100 to this value. A maturity score (between 0 and 1) was calculated based on the averages.

Table 1. SMTs-ERM Maturity Index [17].

COSO 2017 ERM Framework Components	Order (n)	Strategic Management Tools	Number of SMTs Users (YES)	Percentage of SMTs Users (YES)	Number of People Not Using SMTs (NO)	Percentage of People Not Using SMTs (NO)	Index Calculation
Governance and Culture	Example *	Benchmarking	3	75%	1	25%	(75 − 25) + 100 = 150
	1	A		X		Y	(X − Y) + 100 = Z
	2	B		X		Y	(X − Y) + 100 = Z
	3	C		X		Y	(X − Y) + 100 = Z
Strategy and Objective -Setting	4	A		X		Y	(X − Y) + 100 = Z
	5	D		X		Y	(X − Y) + 100 = Z
	6	E		X		Y	(X − Y) + 100 = Z
Performance	7	A		X		Y	(X − Y) + 100 = Z
	8	B		X		Y	(X − Y) + 100 = Z
Review and Revision	9	C		X		Y	(X − Y) + 100 = Z
	10	D		X		Y	(X − Y) + 100 = Z
	11	E		X		Y	(X − Y) + 100 = Z
Information, Communication, and Reporting	12	A		X		Y	(X − Y) + 100 = Z
	13	F		X		Y	(X − Y) + 100 = Z
AVERAGE OF INDEX SCORES (AS)					∑Z/n (13) = AS		
MATURİTY SCORE (MS)					AS/max Z (200) = **MS**		
Minimum value is 0, Maximum value is 1							
Fail (0–0.20), low (0.21–0.40), average (0.41–0.60), good (0.61–0.80), very good (0.81–1).							

* This line illustrates an example application related to calculating the maturity level of corporate risk management based on strategic governance tools associated with COSO components. Note: In Table 1, "Rank" indicates the number of relationships between strategic management tools associated with COSO components, and "A, B, C, D, E, F" Strategic management tools associated with COSO components.

The secondary data used in this study report SMT usage as "use vs. non-use" responses that are aggregated into organizational usage percentages. Accordingly, the balance/diffusion calculation is ultimately driven by binary adoption signals and may compress variance by not capturing the intensity, frequency, organizational scope, quality of use, or systemic integration of SMTs into decision and control cycles. The resulting maturity scores should therefore be interpreted as a parsimonious adoption-based estimate rather than a fine-grained measure of "how well" SMTs are implemented.

Based on the scores obtained, the organizations' strategic risk management maturity levels were classified into the following five categories:

1. Weak (0–0.20)
2. Low (0.21–0.40)
3. Medium (0.41–0.60)
4. Good (0.61–0.80)
5. Very good (0.81–1.00).

2.7. Mathematical Formulation of the Index

Let U_{oj} denote the percentage of respondents reporting "use" of SMT j in organization o, and N_{oj} denote the percentage reporting "non-use" (typically $U_{oj} + N_{oj} = 100$). For each SMT–COSO intersection used in the index, the balance value and diffusion index are computed as:

$$B_{oj} = U_{oj} - N_{oj} \tag{1}$$

$$DI_{oj} = B_{oj} + 100 = \left(U_{oj} - N_{oj}\right) + 100 \tag{2}$$

where $DI_{oj} \in [0, 200]$. The average diffusion score for organization o across all mapped SMT–COSO intersections (n) is:

$$AS_o = \frac{1}{n}\sum_{k=1}^{n} DI_{ok} \tag{3}$$

Finally, the maturity score (scaled to 0–1) is obtained by normalizing with the maximum possible diffusion value (200):

$$MS_o = \frac{AS_o}{200} \tag{4}$$

(Optional, if you want to show component scoring explicitly) For COSO component c with intersection set S_c, the component maturity score is:

$$MS_{oc} = \frac{1}{200} \cdot \frac{1}{\mid S_c \mid}\sum_{k \in S_c} DI_{ok} \tag{5}$$

Note: Here, n (and $\mid S_c \mid$) corresponds to the number of SMT–COSO intersections defined by the cross-walk and used in Table 1.

2.8. Index Construction, Weighting, and Robustness Considerations

For each organization o and tool t, the diffusion score is computed as:

$$DI_{o,t} = (\%Use_{o,t} - \%NonUse_{o,t}) + 100.$$

Since $\%Use_{o,t} + \%NonUse_{o,t} = 100$, this reduces to $DI_{o,t} = 2 \times \%Use_{o,t}$ (range 0–200). Tool-level maturity is then scaled to $[0, 1]$ by $M_{o,t} = DI_{o,t}/200$. Component scores are computed as the arithmetic mean of $M_{o,t}$ across tools mapped to each COSO component, and the total maturity score is the mean of the five component scores (component-symmetric aggregation).

Equal weighting across SMTs and COSO components was adopted for transparency and parsimony under secondary-data constraints, and because the study reports component-level profiles rather than estimating a single optimal weighting scheme. To examine the sensitivity of results to aggregation choices, we conducted simple robustness checks using the available component scores. First, rankings based on the median (instead of the mean) of component scores were highly consistent with the baseline results (Spearman's $\rho \approx 0.98$). Second, leave-one-component-out recomputations also preserved the overall ranking pattern (Spearman's ρ ranging from ≈ 0.93 to 1.00). These checks suggest that the descriptive benchmarking patterns are not driven by a single component or aggregation choice. Finally, we acknowledge that binary "use/non-use" coding may compress variance and introduce measurement bias; accordingly, results are interpreted as adoption-based signals rather than precise measures of usage intensity.

COSO components are conceptually related and operationally intertwined in practice; therefore, the component scores in this index are intended as profile lenses rather than orthogonal latent dimensions. The cross-walk allows a tool to contribute to multiple components, reflecting integration across governance, strategy, performance monitoring, review, and reporting. Accordingly, component scores may be correlated, and we interpret them jointly as a maturity profile. For transparency, future work (or supplementary reporting where feasible) can present component-score correlations and examine whether alternative cross-walk rules materially change component-level profiles.

2.9. Validity and Reliability

In this study, SMT diffusion is used as a *pragmatic proxy* for the extent to which strategy-related management systems are in place that can support risk–strategy integration (e.g., target-setting, measurement, feedback, and cross-unit coordination). Importantly, SMT usage does not necessarily imply fully embedded ERM governance (e.g., risk committee effectiveness), explicit risk appetite articulation, or consistently risk-based decision-making. Therefore, throughout the manuscript we interpret the scores as proxy-based strategic risk integration maturity, rather than a comprehensive audit of ERM implementation quality.

Two alternative interpretations are acknowledged: (i) symbolic adoption, where tools are reported as "used" but remain decoupled from decision and control routines, and (ii) substantive integration, where tools are linked to KRIs, review cycles, ownership, and remediation. The study cannot fully distinguish these mechanisms using thesis-based secondary data; hence findings are reported as indicative benchmarking signals under explicit boundary conditions.

Compared with other ERM proxies (e.g., presence/quality of risk committees, risk appetite statements, internal control maturity, or disclosure-based measures), SMT diffusion was selected because it is the only consistently observable organization-level evidence available across the included open-access theses, enabling harmonized cross-case computation. Future research should perform convergent validation by triangulating SMT-based scores with governance artefacts and disclosure/internal-control indicators.

In this study, organizational ERM maturity is operationalized indirectly through reported Strategic Management Tool (SMT) usage rates and their COSO-2017 component alignment. This proxy captures the extent to which strategy-related management systems (e.g., measurement, planning, benchmarking, and feedback tools) are present and potentially capable of supporting risk–strategy integration, rather than providing a direct observation of ERM implementation quality. Accordingly, the proxy may be vulnerable to ceremonial adoption and decoupling, where tools are reported as "used" without being meaningfully embedded in decision routines and control systems. Moreover, the proxy does not directly observe core integration mechanisms such as risk appetite processes

(RAP), Key Risk Indicator (KRI) architecture, and closed-loop control and review cycles. Therefore, the index results should be interpreted as a pragmatic benchmarking estimate of strategic risk management capability under secondary-data constraints, and not as a definitive measure of fully institutionalized ERM maturity.

In the 7 theses included in the study, the Turkish translation of the questionnaire taken from Rigby and Bilodeau's "Management Tools and Trends 2009" report [31] was used. In 5 of the theses, Cronbach's Alpha internal consistency coefficients were calculated to determine the reliability of the statements revealing the participants' perspectives on the use of strategic management tools, and these coefficients ranged from 0.724 to 0.956. Therefore, it was understood that the scales have good-to-very-good reliability (Table 2).

Table 2. Reported validity and reliability evidence for the SMT-usage measurement instruments in the included theses.

Source (Year)	Sector/Sample	City	Reliability	Availability
Ergül (2017) thesis [27]	23 private hospitals	Ankara	Cronbach's α = 0.812	Full text accessible (https://tez.yok.gov.tr/UlusalTezMerkezi/) (accessed on 9 November 2025)
Demir (2015) thesis [29]	51 hospitals (21 public, 24 private, 6 university)	Ankara	Not reported	
Şentürk (2010) thesis [25]	110 Hotels	Antalya	Cronbach's α = 0.724	
Ödemiş (2014) thesis [30]	106 Hotels	Ankara	Cronbach's α = 0.956	
Çağatay (2019) thesis [28]	80 Hospitals (21 public, 17 private, 2 university)	Amasya, Ordu, Tokat, Samsun and Çorum	Cronbach's α = 0.91	
Turan (2020) thesis [26]	3 Hospitals (1 public, 1 private, 1 university)	Edirne	Cronbach's α = 0.925	
Güzel (2024) thesis [22]	26 Private healthcare organizations	Antalya	Not reported.	

2.10. Limitations

Comprehensive and standardized datasets on the actual usage rates of SMTs and their relationship to risk management are virtually nonexistent in the national and international literature. Therefore, for the purpose of the study, existing and accessible secondary data were used. Therefore, the research is limited to theses in the YÖKTEZ database.

Additionally, because SMT usage is self-reported and used as a proxy, the index may overestimate maturity in cases of symbolic tool adoption and underestimate maturity where ERM is embedded through sector-specific routines not captured by the selected SMT list. The proxy does not measure the depth of ERM integration (e.g., existence and operationalization of RAP, KRI thresholds, audit trails, and control-cycle evidence), which limits construct validity and calls for cautious interpretation of cross-case differences.

A further limitation is the binary granularity of the underlying measurement (use/non-use). Even when reported as percentages, these data do not preserve information on intensity, scope, or quality of SMT deployment; thus, component and overall maturity values may be conservative and should be interpreted cautiously.

3. Results

3.1. SMTs Used in Theses

The commonly used SMTs in the theses included in the analysis are listed below:

1. Core Competencies
2. Benchmarking
3. Total Quality Management
4. Mission-Vision Statements
5. Strategic Planning
6. Strategic Alliances
7. Balanced Scorecard
8. Outsourcing
9. Supply Chain Management
10. Customer Relationship Management

3.2. Organizational SMT Usage Rates

The SMT usage rates of the organizations in the examined theses are presented in Table 3. SMT usage rates consist of the opinions of the research groups participating in the theses regarding whether they use the 10 SMTs mentioned above.

3.3. Relationship Between SMTs and COSO-2017 Components

Table 4 shows the relationship between SMTs commonly used in the reviewed theses and the components of the COSO-2017 enterprise risk management framework. The selection of these tools represents the most common intersections between organizations' strategic decision support mechanisms and risk management performance in the literature.

When examining this relationship, the Balanced Scorecard, Total Quality Management, Benchmarking, and Strategic Alliances tools demonstrated the highest maturity contribution. These tools enhance the risk evidence capacity of COSO-2017, particularly with its "Strategy and Goal Setting" and "Performance" components. In contrast, the Strategic Planning tool's contribution was found to be limited.

3.4. Enterprise Risk Management Maturity Levels of Organizations

The maturity levels of the organizations within the scope of the study according to the COSO-2017 Enterprise Risk Management Framework components and their overall enterprise risk management maturity levels are shown in Table 5.

The analysis results showed that organizations' overall enterprise risk management maturity levels ranged from 0.20 to 0.65. The highest maturity level was found in Şentürk's [25] study (MS = 0.65), while the lowest was found in Turan's [26] study (MS = 0.20). The average maturity score was 0.52, meaning it was in the "medium" category.

When evaluated in terms of the components of the COSO-2017 framework:

- Governance and Culture: Ranges from 0.26 to 0.72, with an average of 0.56.
- Strategy and Goal Setting: Ranges from 0.21 to 0.65, with an average of 0.50.
- Performance: Ranges from 0.17 to 0.63, with an average of 0.48.
- Review and Revision: Ranges from 0.17 to 0.70, with an average of 0.53.
- Information, Communication, and Reporting: Ranges from 0.11 to 0.68, with an average of 0.51.

These values indicate that organizations' strategic awareness levels are relatively strong in the governance area, but limited in the information, reporting, and performance components.

Table 3. SMTs usage rates (*).

Used SMTs/Theses	Şentürk (2010) [25]		Ödemiş (2014) [30]		Demir (2015) [29]		Ergül (2017) [27]		Çağatay (2019) Kamu [28]		Çağatay (2019) Özel [28]		Turan (2020) [26]		Güzel (2024) [22]	
	+	−	+	−	+	−	+	−	+	−	+	−	+	−	+	−
Core Competencies	68	42	52	54	48	110	8	137	110	114	50	39	9	80	25	65
	62%	38%	49%	51%	30%	70%	6%	94%	49%	51%	56%	44%	10%	90%	25%	75%
Benchmarking	86	24	69	37	64	94	80	65	115	109	53	36	12	77	36	54
	78%	22%	65%	35%	41%	59%	55%	45%	51%	49%	60%	40%	13%	87%	36%	64%
Total Quality Management	90	20	53	53	93	65	6	139	166	58	74	15	48	41	73	17
	82%	18%	50%	50%	59%	41%	4%	96%	74%	26%	83%	17%	54%	46%	73%	27%
Mission-Vision Statements	88	22	73	33	109	49	140	5	186	38	65	24	33	56	71	19
	80%	20%	69%	31%	69%	%31%	97%	3%	83%	17%	73%	27%	37%	63%	71%	29%
Strategic Planning	82	28	68	38	86	72	130	15	135	89	62	27	25	64	51	39
	75%	25%	62%	38%	54%	46%	90%	10%	60%	40%	70%	30%	28%	72%	51%	49%
Strategic Alliances	52	58	41	65	48	110	117	28	61	163	44	45	6	83	19	71
	47%	53%	37%	63%	30%	70%	81%	19%	27%	73%	49%	51%	7%	93%	19%	81%
Balanced Scorecard	36	74	24	82	22	136	65	80	169	55	50	39	1	88	18	72
	33%	67%	22%	78%	14%	86%	45%	55%	75%	25%	56%	44%	1%	99%	18%	82%
Outsourcing	66	44	28	78	78	80	30	115	99	125	48	41	17	72	63	27
	60%	40%	25%	75%	49%	51%	21%	79%	44%	56%	54%	46%	19%	81%	63%	37%
Supply Chain Management	70	40	38	68	68	90	115	30	144	80	49	40	21	68	65	25
	64%	36%	35%	65%	43%	57%	79%	21%	64%	36%	55%	45%	24%	76%	65%	35%
Customer Relationship Management	100	10	89	17	74	84	120	25	135	89	68	21	18	71	74	16
	91%	9%	81%	19%	47%	53%	83%	17%	60%	40%	76%	24%	20%	80%	74%	26%

* (+) = Use; (−) = Not use.

Table 4. Associations Between SMT Usage and COSO ERM (2017) Components.

COSO 2017 ERM Framework Components		Governance and Culture	Strategy and Objective-Setting	Performance	Review and Revision	Information, Communication, and Reporting
STRATEGIC MANAGEMENT TOOLS	Core Competencies	X	X	X		
	Benchmarking		X	X	X	
	Mission and Vision Statement	X	X			
	Total Quality Management	X	X	X	X	
	Strategic Planning		X			
	Strategic Alliances	X	X			
	Balanced Scorecard		X	X	X	X
	Outsourcing		X	X		
	Supply Chain Management		X	X		
	Customer Relationship Management	X				X

Note: In Table 4, "X" indicates a conceptual linkage (cross-walk) between a given SMT and the COSO component(s), rather than an empirical test of causality. Accordingly, the mapping should be interpreted as a theory-based content alignment that supports component profiling.

Table 5. Organizational Enterprise Risk Management (ERM) Maturity Levels.

Maturity Index	Şentürk 2010 [25]	Ödemiş 2014 [30]	Demir 2015 [29]	Ergül 2017 [27]	Çağatay 2019 [28]	Çağatay 2019 [28]	Turan 2020 [26]	Güzel 2024 [22]
Sector	Hotel	Hotel	Public/private/ foundation Hospital	Private Hospital	Private Hospital	Public Hospital	Public/ private Hospital	Private Hospital
City	Antalya	Ankara	Ankara	Ankara	Central Black Sea	Central Black Sea	Edirne	Antalya
Sample size	110	106	158	145	89	224	89	100
Governance and Culture Maturity Score	**0.72**	0.58	0.47	0.54	0.68	0.59	0.26	0.63
Strategy and Objective-Setting Maturity Score	**0.64**	0.47	0.43	0.53	0.62	0.59	0.21	0.52
Performance Maturity Score	**0.63**	0.45	0.41	0.50	0.59	0.61	0.17	0.51
Review and Revision Maturity Score	0.64	0.52	0.41	0.66	0.63	**0.70**	0.17	0.47
Information, Communication, and Reporting Maturity Score	0.62	0.53	0.30	0.64	0.66	**0.68**	0.11	0.51
ERM Total Maturity Score (MS)	**0.65**	0.50	0.42	0.55	0.63	0.61	0.20	0.53

When the organizations covered in these theses were evaluated from a sectoral perspective, hotel businesses (MS Average = 0.575) were found to have higher corporate risk management maturity scores than hospital businesses (MS Average = 0.49). In terms

of healthcare businesses, the average maturity score was calculated as 0.57 for private healthcare businesses [22,27,28], and 0.41 for public healthcare businesses [26,28,29]. It was determined that the corporate risk management maturity level of private healthcare businesses was higher than that of public healthcare businesses. These patterns may help contextualize sectoral differences under the studied boundary conditions; however, they should not be interpreted as causal explanations.

Given the small number of organizational samples and the secondary-data nature of the study, group differences are primarily interpreted descriptively. As an exploratory check, we compared total maturity scores between hotels (n = 2) and hospitals (n = 6) using a Mann–Whitney U test; the difference was not statistically significant (U = 8, two-sided $p = 0.64$), consistent with limited power. Accordingly, sectoral contrasts are reported as indicative patterns for pilot benchmarking rather than confirmatory evidence.

Overall, the findings indicate that risk management maturity remains low in organizations where strategic management tools are not used in an integrated manner. Measurement-focused tools such as Balanced Scorecard and Benchmarking, in particular, appear to reinforce a risk-aware decision-making culture. Conversely, the lack of maturity in information flow and reporting processes suggests that risk awareness has not been fully disseminated throughout the organization.

4. Discussion

This study piloted the SMTs–ERM Maturity Index [24] on secondary data extracted from seven highly comparable postgraduate theses (covering eight service organizations) to estimate COSO-2017-aligned enterprise risk management maturity through organizations' reported use of ten strategic management tools (SMTs). By operationalizing ERM maturity as a diffusion-based score derived from "use vs. non-use" balances for each SMT and then scaling the resulting averages to a 0–1 maturity metric, the model offers a pragmatic bridge between "strategy practice" and ERM capability assessment.

Across the analyzed organizations, overall ERM maturity ranged from 0.20 to 0.65, with an average of 0.52 (i.e., "medium"). Interpreted through COSO's "Integrating with Strategy and Performance" lens [2], this mid-level profile suggests that ERM-related structures and intentions exist, but integration into performance management cycles and decision routines remains uneven. In practice, medium maturity often reflects a "partly institutionalized" risk posture: governance mechanisms and risk-aware rhetoric can be present while the organization still struggles to convert risk information into measurable, decision-relevant indicators and feedback loops [8].

The component-level pattern in this study reinforces that interpretation. Governance and Culture displayed the highest average score (mean = 0.56), whereas Performance was the lowest (mean = 0.48); Information, Communication, and Reporting was also constrained (mean = 0.51), despite a relatively comparable spread across organizations. From a COSO-2017 perspective, this specific configuration is meaningful: it indicates that "tone, oversight, and cultural prerequisites" are relatively stronger than "risk-to-metrics translation" and "risk-informed performance management." In other words, the maturity bottleneck appears less about having risk management language and more about using risk information systematically—through risk appetite–aligned targets, key risk indicators (KRIs), and closed-loop review processes that shape strategic choices.

As a practical implementation pathway, service organizations can: (1) translate the risk appetite statement into a small set of risk limits/thresholds for priority risks; (2) define KRIs explicitly linked to strategic objectives and assign an accountable owner for each KRI; (3) implement a dashboard that displays current KRI values, thresholds (green/amber/red), trend, and remediation status; (4) institutionalize a closed-loop review cadence (e.g.,

monthly risk review, quarterly committee reporting) with escalation rules; and (5) integrate KRI exceptions into performance management and budgeting decisions (risk-adjusted targets and resource allocation). Illustrative KRIs may include patient-safety incidents, medication errors, or critical-stock shortages in hospitals, and demand volatility/cancelation rates, guest-safety incidents, or supplier disruption indicators in hotels.

The observed gaps in Performance and Information/Reporting point to a practical need for an ERM data pipeline rather than additional policy statements alone. Organizations can strengthen "risk-to-metrics" translation by establishing an ERM data architecture that specifies data governance (roles, ownership, access), data quality controls, and data lineage across operational systems. Building on risk appetite and strategic objectives, firms should define a focused set of key risks, translate them into KRIs with clear thresholds and accountable owners, and embed closed-loop dashboards that track status, exceptions, and remediation actions through review cycles. Where data availability permits, advanced analytics (e.g., anomaly detection and short-horizon prediction) can support early warning for incidents, demand volatility, and supply disruptions, thereby improving both performance monitoring and transparent reporting.

A recurring theme in ERM research is decoupling: organizations may adopt risk frameworks, committees, and policies without fully embedding risk thinking into operational control systems and management accounting routines [8,32]. In service organizations, this gap is often amplified by the fact that performance is multi-dimensional and stakeholder-driven (e.g., safety, satisfaction, continuity, regulatory compliance), making it harder to define a parsimonious indicator set that is both strategically aligned and operationally actionable. The present results—higher Governance/Culture versus lower Performance and relatively limited Information/Reporting—align with this widely observed "implementation challenge" and highlight where managerial effort should concentrate: translating strategic objectives into measurable outcomes, and then establishing reliable, transparent reporting infrastructures.

Notably, the SMT-to-COSO mapping used in the index provides an additional explanation for the observed pattern. The model assigns maturity contributions via SMTs that intersect with COSO components; tools such as Balanced Scorecard, Total Quality Management, Benchmarking, and Strategic Alliances were identified as having the "highest maturity contribution," particularly for Strategy & Objective-Setting and Performance. This is conceptually consistent with how these tools function in practice: they formalize strategic priorities, create performance architectures, and generate comparable evidence for managerial review. Recent evidence similarly emphasizes that performance systems (especially Balanced Scorecard-type architectures) can act as an "anchor" for integrating ERM into strategic management and performance governance [33]. Therefore, organizations that use measurement- and feedback-oriented tools more intensively would be expected to display stronger maturity—particularly in the performance and review dimensions. Importantly, these patterns should be interpreted as associational rather than causal. Reverse causality and endogeneity are plausible: more mature or more established organizations may be more likely to adopt and institutionalize SMTs, and unobserved factors (e.g., size, complexity, regulation, or digitalization capacity) may jointly drive both SMT use and ERM maturity. Accordingly, the present findings are best read as indicative evidence of co-occurrence between SMT toolkits and ERM maturity profiles.

Sectoral analysis indicates that hotels had higher mean maturity (MS average = 0.575) than hospitals (MS average = 0.49). While this pattern should be interpreted cautiously due to the limited sample, several plausible mechanisms align with both strategic management and sustainability/resilience logics. First, hotels operate in a context of pronounced demand volatility, reputational sensitivity, and crisis exposure (e.g., geopolitical

shocks, disasters, supply disruptions), which can increase the perceived value of structured planning, benchmarking, and performance dashboards—tools that the index treats as maturity-enhancing. Second, tourism and hospitality resilience research increasingly links organizational survival and sustainable competitiveness to proactive risk sensing, adaptive capabilities, and learning-oriented governance—capacities that are operationalized in COSO's "review/revision" and "information/communication/reporting" components and can be supported by structured strategic toolkits [34]. From this angle, higher maturity in hotels can be interpreted as a response to a more intense "environmental uncertainty → management system sophistication" pathway.

Within healthcare, results also highlight meaningful heterogeneity: private healthcare organizations showed higher average maturity (0.57) than public healthcare organizations (0.41) in the underlying theses. One interpretation is that private hospitals face stronger market discipline and competition pressures (e.g., patient choice, service differentiation), which can accelerate the adoption of measurement-oriented tools and integrated managerial systems. However, healthcare ERM scholarship also cautions that hospitals' risk portfolios are complex and tightly coupled (clinical, operational, legal, reputational), and implementation maturity often depends on data infrastructure and cross-functional coordination—conditions that are not uniformly available across organizational types [10,35]. Importantly, the presence of at least one "good" maturity public hospital case in this dataset (e.g., MS $\approx$ 0.61 in the extracted results) suggests that public-sector constraints do not mechanically imply lower maturity; rather, governance consistency, institutional learning, and information systems capacity likely moderate the relationship.

A sustainability-oriented interpretation requires an explicit link between ERM capability and long-term value creation under ESG (Environmental, Social, and Governance)-related uncertainties. COSO and the World Business Council for Sustainable Development emphasize that ESG-related risks (often labeled "sustainability risks") can materially affect organizational viability and should be embedded in ERM governance, strategy-setting, performance monitoring, and reporting processes [36]. In service sectors such as healthcare and hospitality—where social impacts (patient safety, workforce wellbeing), environmental impacts (energy/waste footprints), and governance compliance (data privacy, procurement integrity) are salient—ERM maturity can be seen as a capability that supports sustainable operations, not merely risk avoidance. In this study, the relative weakness in Performance and Information/Reporting implies a practical sustainability gap: even when leadership endorses risk-aware culture, organizations may still lack robust "risk-to-metrics" pathways that enable ESG-sensitive decisions, transparent reporting, and continuous improvement.

To make the sustainability link explicit, a next-step extension is to add an ESG risk materiality layer on top of the current maturity scoring. This layer would map material ESG risk themes (e.g., climate/energy, workforce wellbeing and safety, privacy/data governance, procurement integrity, and supply chain disruptions) to risk appetite and strategy, and translate them into ESG-linked KRIs and impact indicators (e.g., energy consumption, waste, safety incidents, workforce metrics). Embedding these indicators into closed-loop dashboards with ownership and remediation would strengthen the Performance and Information/Reporting components and make ERM benchmarking more decision-relevant for sustainability management.

5. Limitations and Future Research

The included theses span 2010–2024, a period during which ERM practice and enabling digital infrastructures have evolved substantially (including the shift toward COSO's 2017 "integrating with strategy and performance" emphasis). Earlier datasets may therefore under-represent more recent ERM capabilities such as KRI architectures, dashboard-driven

monitoring, data governance, and closed-loop remediation routines. Accordingly, maturity scores should be interpreted as time-stamped benchmarking estimates for the period captured in each thesis, and cross-case comparisons should be read cautiously when cases come from different years. As a simple robustness check, Table 5 indicates that mean maturity scores are similar for earlier (2010–2015; MS $\approx$ 0.52) and later (2017–2024; MS $\approx$ 0.50) cases, suggesting that differences are not driven solely by time. Future replications should re-estimate maturity with contemporary primary data and, where feasible, conduct sensitivity checks (e.g., excluding pre-2017 cases or stratifying results by time windows).

This research relies on secondary data on Strategic Management Tool (SMT) usage rates and is limited to theses accessible in the YÖKTEZ database. Moreover, standardized and comprehensive datasets linking SMT usage to risk management outcomes remain scarce in both national and international literature. Accordingly, the findings should be viewed primarily as a pilot application demonstrating the index's feasibility and its potential for cross-sector comparison rather than as generalizable definitive conclusions. Nevertheless, the validity and reliability analyses reported within the underlying theses support the methodological robustness of using these secondary data for an initial benchmarking exercise.

The included theses are methodologically heterogeneous in design, sectoral context, sampling frames, and measurement settings. To maximize comparability, we extracted only the harmonizable organization-level SMT usage rates derived from the same questionnaire lineage and retained cases reporting a common set of 10 SMTs with compatible "use/non-use" percentages. Nevertheless, residual heterogeneity may influence the maturity profiles, reinforcing that the results are illustrative, exploratory benchmarking signals rather than confirmatory cross-sector estimates.

Building on this point, the sectoral comparisons should be interpreted within clearly specified boundary conditions. These findings are constrained by a limited evidence base (seven theses/eight organizational samples) drawn from a single national context (Türkiye) and two service domains (hotels and hospitals). As a result, observed sectoral differences may partly reflect contextual factors—such as regulatory regimes, incentive structures, case mix and service complexity (particularly in healthcare), local market conditions, and the level of digitalization and data infrastructure—rather than ERM competence alone. Accordingly, the sectoral comparisons should be interpreted as indicative benchmarking signals within this scope, not as universal claims about sector-level ERM maturity.

Future research should therefore employ multi-country and multi-sector designs with stratified sampling and controls for organizational size, complexity, regulatory exposure, and digitalization level. Methodologically, multilevel models and quasi-experimental approaches (e.g., propensity score matching) can be used to separate contextual effects from ERM capability. Because the proposed index is SMT-centric and based on generic tool adoption signals, it does not explicitly identify which ESG risks are material for a given organization (e.g., climate transition/physical risks, workforce and safety, privacy, procurement integrity, or supply chain exposure), nor does it incorporate CSRD/ISSB/GRI-aligned ESG metrics by design. Accordingly, the current maturity scores should not be interpreted as a direct measure of ESG risk management performance. Future research can develop a two-layer extension: (i) an ESG materiality mapping that links salient ESG risks to strategy and risk appetite, and (ii) an indicator/KRI layer that integrates ESG impact metrics into closed-loop monitoring and reporting. Where data allow, climate scenario analysis (e.g., stress testing), supply chain risk analytics, and NLP-based analysis of ESG disclosures/internal reports can be used to validate and enrich ESG alignment; where ESG information is limited, a literature-based conceptual extension can still specify transparent mapping rules and a minimum indicator set.

A further limitation concerns potential subjectivity in the SMT–COSO assignment. Although the mapping was defined a priori and applied consistently, alternative plausible assignments (e.g., tools contributing more strongly to Performance versus Information/Reporting) may shift component-level profiles and scores. To strengthen content validity, future studies can employ a Delphi process with ERM and management control experts and quantify agreement using Kendall's W or Krippendorff's alpha. Where organizational documents are accessible, a complementary data-driven approach may use NLP/semantic embedding on strategic plans, risk reports, and audit/risk committee artefacts to infer tool–process alignment. When document access is not feasible, a critical literature review can be used to make the underlying assumptions explicit and to justify (or revise) the cross-walk rules.

In addition, the sensitivity of the balance method to binary measurement (use/non-use) should be addressed. Binary indicators compress variance and do not capture intensity, frequency, organizational scope, quality of use, or systemic integration of SMTs into decision and control cycles. Future research can therefore collect ordinal or continuous indicators of usage (e.g., intensity, frequency, and scope) and incorporate integration-quality markers (e.g., linkage to KRIs, review cycles, and decision routines). An index constructed using Item Response Theory (IRT) or Rasch scaling may help distinguish organizational "ability" (maturity) from item "difficulty" (tools that are harder to implement). From a technical perspective, survey data can be complemented with managerial telemetry (e.g., dashboard access logs, refresh rates, and reporting cadence) to reduce self-report bias and capture usage depth. When such quality data are unavailable, robustness and sensitivity analyses (e.g., alternative scaling/weighting schemes and ranking stability checks) should be conducted, and the limitations of adoption-only measurement should be explicitly acknowledged.

A key limitation is that the study design does not allow causal inference about whether SMT adoption increases ERM maturity or whether more mature organizations simply use more tools. The association may be two-directional and confounded by organizational characteristics (e.g., size, complexity, governance capacity, regulation, and digitalization). Future research should address this by using longitudinal designs with repeated measurements and cross-lagged modeling, or quasi-experimental approaches such as difference-in-differences when SMT/ERM initiatives are introduced at identifiable time points. Where suitable exogenous variation exists (e.g., regulatory changes or digitalization incentives), instrumental-variable strategies can be explored. From a technology perspective, adoption timing and intensity can be approximated using ERP/BI log files (e.g., dashboard usage, refresh rates, and reporting cadence). In the absence of longitudinal data, results should be framed explicitly as associational, and realist or narrative synthesis can be used to articulate plausible mechanisms and guide hypothesis-driven replications.

Beyond measurement improvements, further studies can (i) test the index in additional sectors (finance, education, manufacturing, etc.), (ii) track maturity changes within the same institutions using time-series or monitoring designs, and (iii) examine how digital transformation—particularly integration with AI-powered decision systems—affects strategic risk management maturity. In addition, future work can extend the measurement design by incorporating graded usage indicators and objective usage evidence (e.g., telemetry) to validate adoption-based estimates.

6. Conclusions

This study introduces and applies a COSO-2017-based enterprise risk management (ERM) maturity index informed by the use of strategic management tools (SMTs) to evaluate strategic risk management capability in service organizations. Overall results suggest a medium level of ERM maturity (MS = 0.52), indicating that risk management is increasingly

recognized at the strategic level, yet remains only partially embedded in implementation and measurement routines.

Across COSO components, maturity is relatively stronger in Governance and Culture (average 0.56), while persistent gaps are observed in Performance (0.48) and Information, Communication and Reporting (0.51). This profile implies that senior-level awareness and formal policies are more developed than the data/feedback loops required for consistent performance monitoring, learning, and transparent reporting.

These findings align with prior ERM maturity research emphasizing that formal structures and "risk-aware" rhetoric may coexist with limited operational embedding—particularly when risk information is not translated into decision-relevant metrics and feedback loops [32,37,38]. In the COSO-2017 "integrating with strategy and performance" perspective, the observed pattern (stronger Governance & Culture relative to Performance and Information/Reporting) is consistent with a common implementation gap: organizations adopt governance mechanisms and policies faster than they institutionalize risk-to-metrics architectures, KRI thresholds, and closed-loop performance routines [32,37–39]. Our results extend this stream by showing that the diffusion of strategic management tools—especially measurement- and review-oriented toolkits—co-varies with a COSO-aligned maturity profile in service settings [37,40].

Policy and managerial implications follow directly from the component-level profile. For managers, the most immediate priority is to strengthen "risk-to-metrics translation" by (i) converting risk appetite into a limited set of measurable thresholds for top risks, (ii) defining a small KRI set linked to strategic objectives with accountable owners, and (iii) embedding KRI exceptions into routine performance reviews and resource-allocation decisions [10,37,39]. Second, organizations should invest in information, communication and reporting infrastructures—e.g., traceable dashboards that show KRI status, thresholds, trends, and remediation actions—thereby enabling learning and timely escalation [10,39]. Third, strategic planning should be made more dynamic via scenario-based indicators and periodic review cycles to reduce symbolic adoption [32,37]. At the policy level, sector regulators and quality/oversight bodies can accelerate maturity by issuing minimum expectations for (a) risk governance roles and escalation pathways, (b) KRI-based monitoring for safety/continuity risks, and (c) standardized reporting templates that support comparability across organizations [10,38,40]. In healthcare, these expectations can be integrated into quality and patient-safety programs; in hospitality, they can be aligned with safety, business continuity, and crisis-preparedness requirements [10,40].

Findings also reveal meaningful sectoral contrasts. Hotels exhibit higher maturity than hospitals, and private hospitals outperform public hospitals, suggesting that institutional context and managerial configurations shape how risk practices translate into operational resilience.

Regarding SMTs, measurement-oriented tools—particularly Balanced Scorecard, Total Quality Management, and Benchmarking—show the strongest alignment with ERM components, consistent with their capacity to strengthen measurement, feedback, and accountability in strategic processes. Conversely, the relatively weak contribution of Strategic Planning indicates that risk considerations are not yet systematically integrated into long-term planning, limiting the organization's ability to balance threats and opportunities.

Beyond reporting sectoral differences, our findings highlight a capability-pattern consistent with COSO-2017's "integrating with strategy and performance" emphasis: governance and culture practices appear to mature faster than risk-to-metrics architectures and information/reporting routines. This supports the study's methodological contribution of using SMT diffusion as an observable proxy under secondary-data constraints, while also offering a theoretically grounded explanation for the observed component-level gaps. From

a sustainability perspective, the maturity index provides a practical illustrative benchmarking approach to prioritize ERM capability building that supports resilient service delivery and continuity. Managers may consider using the component-level profile to target improvements where maturity deficits are greatest, particularly by: (i) integrating ERM with strategic management systems through risk-linked indicators and KRIs aligned with risk appetite; (ii) strengthening information, communication, and reporting through traceable digital dashboards with clear ownership and remediation tracking; (iii) making strategic plans more dynamic through scenario-based risk indicators and closed-loop review cycles; (iv) institutionalizing risk culture through continuous training and sector-specific toolkits; and (v) establishing an ERM data architecture that specifies data governance, quality, and lineage across systems—optionally complemented by anomaly detection/predictive analytics for early warning signals (e.g., incidents, demand volatility, and supply issues) where data infrastructure allows.

As a practical extension, future applications can follow a simple protocol: (1) conduct an ESG materiality assessment and map material ESG risks to strategy and risk appetite; (2) link each material risk to COSO components and define ESG-linked KRIs with thresholds and owners; (3) select a parsimonious set of ESG indicators aligned with prevailing reporting standards (e.g., CSRD/ISSB/GRI) and impact metrics (energy, waste, safety, workforce); (4) embed indicators into closed-loop dashboards with remediation tracking; and (5) where feasible, complement monitoring with scenario analysis (e.g., climate stress testing) and supply chain risk analytics to strengthen forward-looking resilience.

The study contributes by demonstrating a measurable and comparable framework for the frequently cited—but often hard to operationalize—risk–strategy integration, showing how ERM can be assessed as an indicator of strategic capacity rather than remaining an abstract governance claim. Future research should validate the index with primary datasets, extend benchmarking to additional sectors, and test longitudinal applications (e.g., repeated measurement every 3–5 years) to track maturity change, including the role of digital transformation and AI-enabled decision systems.

Given the small number of cases and the single-country setting, the conclusions of this study should be treated as context-bound pilot evidence. A clear next step is replication with primary datasets across multiple countries and service sectors using stratified sampling (e.g., by organizational size, complexity, regulatory intensity, and digitalization level). Where feasible, future studies should also link maturity scores to objective outcomes (e.g., incident rates, disruption recovery time, service continuity metrics, audit findings, or compliance events) and apply multilevel modeling or propensity score matching to reduce contextual bias and strengthen causal interpretability.

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Abbreviations

The following abbreviations are used in this manuscript:

COSO	Committee of Sponsoring Organizations of the Treadway Commission
ERM	Enterprise risk management
SRM	Strategic risk management
SMTs	Strategic management tools
SMTs-ERM	The Strategic Management Tools-Based Enterprise Risk Management
KRIs	Key risk indicators

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