THE EVOLUTION OF ENTERPRISE RISK MANAGEMENT: FROM ENTERPRISE INTEGRATION TO CAPABILITY EXPANSION – A BIBLIOMETRIC ANALYSIS

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Abstract
Enterprise Risk Management (ERM) has evolved in recent years as an integrating architecture of company risk exposures; however, the existence of a formal risk framework is not automatically a guarantee of proper functional integration, efficient usage of risk information in decision-making processes, identification of risk interdependencies, development of adaptive capacities or usage of risk signals for predictive monitoring.
This article examines the differences between risk architecture, process maturity and functional capabilities and whether modern research suggests the replacement of ERM or its functions through a portfolio of capabilities. The study combines bibliometric performance assessment and science mapping using Biblioshiny on a final selection of 702 documents, thematic content analysis and a separate comparative scrutiny of selected professional and regulatory frameworks. The bibliometric results indicate that risk management and ERM are still the fundamental conceptual center, however, artificial intelligence, resilience, dynamic capabilities and digital transformation are becoming more differentiated concepts after 2021. Analysis shows that enterprise-wide integration is the most common area (58.4%), but four important temporal shifts are emerging: resilience/adaptation, analytics/AI/digitalization, sustainability/ESG (Environmental, Social, Governance) and risk-strategy-performance integration. The regulatory stream is focused on concepts like board accountability, risk appetite, multi-horizon and scenario analysis, operational resilience, third-party dependencies, data governance, ongoing monitoring and lifecycle risk management.
The paper therefore theorizes the next generation of risk management as a functional extension rather than replacement of key components of the discipline and proposes the distinction between ERM architecture – ERM process maturity – ERM capability development.

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Keywords
Enterprise Risk Management; risk governance; risk management capabilities, organizational resilience; decision support; advanced risk analytics; bibliometric analysis; thematic evolution.

JEL Classification
G32; G34; M10

Introduction

The evolution of Enterprise Risk Management (ERM) represents a long-standing effort to eliminate the fragmentation caused by specialized risk functions. Traditional organizational structures frequently divide financial, operational, legal, compliance, technological and strategic risks among various groups. Such specialization protects local expertise, but it can also result in incompatible taxonomies, isolated data, different evaluation methods and limited visibility into aggregate exposure. ERM arose as an enterprise-wide framework designed to bring these disparate perspectives together through shared terminology, ownership, escalation, reporting and governance. Formal integration, however, is not the same as functional integration.

Arena, Arnaboldi and Palermo (2017) demonstrated how the concept of integrated risk management can be compromised by organizational pressures and residual fragmentation. McShane (2018) also places ERM in a transition from fragmented disciplinary roots, arguing that silos remain present in practice and research. Two organizations may report ERM adoption while differing significantly in their ability to integrate risk knowledge, interpret interconnected exposures, influence managerial decisions, and adapt when assumptions change. This challenge has grown in importance as the purpose of risk management has evolved. Cyber risk, ICT (Information and Communication Technology) and cloud dependencies, supply-chain disruptions, geopolitical unpredictability, sustainability transitions and AI (Artificial Intelligence) related hazards all involve interdependence, rapid change and cross-domain dissemination. According to Romanosky and Petrun Sayers (2023), while cyber risk can be integrated into ERM, it is generally interpreted as operational rather than strategic risk. Monazzam and Crawford (2024) highlighted organizational resilience; Luther, Gunawan and Nguyen (2024) concentrate on systems thinking in complex situations; and Hussain (2026) defines dynamic ERM as a strategic competency that includes sensing, strategic integration and reconfiguration. These findings suggest that modern ERM has to be considered not only as a comprehensive framework, but also in terms of the functional capabilities it can enable. A second challenge refers to the use of information. Producing risk reports is not the same as influencing decisions. Meidell and Kaarbøe (2017) demonstrate that ERM influences decision-making through risk technologies and knowledge management. Crovini, Santoro, and Ossola (2020) explicitly incorporate risk management and decision-making, whereas Hristov et al. (2022) link ERM to performance management systems and key risk indicators. Gleißner and Berger (2024) advocate a decision-oriented ERM based on value drivers and quantitative aggregates. The fundamental questions become not just whether the risk is identified, but also if risk information can influence the definition, comparison or

selection of managerial options. Professional and regulatory systems follow similar trends. These standards have broadened risk management expectations from periodic identification and reporting to governance, strategic alignment, resilience, sustainability, information integrity and ongoing surveillance. These frameworks are mostly institutional expectations rather than evidence of organizational effectiveness and are therefore treated separately in the normative part of this research.

Current ERM studies have addressed a broad range of topics, including implementation, execution, governance, efficacy, strategic integration and emerging risk management practices. A longer-term perspective is needed to understand the evolution of the conceptual framework of the domain and to establish whether recent developments are isolated themes or a more general enhancement of ERM-related competencies. The bibliometric methodology is suitable for this purpose, as it allows for the analysis of conceptual frameworks, thematic relations and chronological development in a wide and multidisciplinary corpus of literature. The present study complements this view through thematic content analysis and an independent assessment of specific professional and regulatory structures.

The research therefore addresses the following research questions (RQ):

RQ1: How has the conceptual and thematic structure in risk management and ERM research changed over the years?

RQ2: What are the organizational, strategic, informational and analytical capabilities most present in the literature reviewed?

RQ3: Which of the above dimensions show statistically significant temporal fluctuations over the time intervals considered?

RQ4: To what extent do the analyzed professional and regulatory frameworks align with the capabilities identified in academic literature?

The research also examines whether the differentiation of ERM architecture, process maturity and functional capability enhancement provides a useful analytical framework to interpret the current evolution of Enterprise Risk Management.

1. Review of the scientific literature

The ERM literature usually refers to integration as if it were characterised as a single condition, although a closer examination reveals several separate layers. Taxonomic integration refers to standardized terminology and assessment structure. Information integration refers to the ability to compare aggregate judgements from several functions. Organizational integration entails consistent ownership, escalation and cross-functional knowledge transfer. Managerial integration occurs when risk information is used to define objectives, allocate resources, and construct or select strategic alternatives. The first three kinds can coexist without the fourth. Romanosky and Petrun Sayers (2023), for example, demonstrate that a risk can be included in an enterprise taxonomy while being phrased in a way that understates its strategic dimension. Stasse, Hilhorst and ten Rouwelaar (2025) define ERM as a continuous and integrated process, identifying both fundamental and strategic ERM elements. The synthesis thus employs the residual integration gap concept to describe circumstances where shared architecture exists, but knowledge integration, interpretation or coordinated action remains insufficient.

This idea is consistent with important perspectives on ERM that question the idea that formal integration automatically results in organizational integration. Managing interrelated risks and organizational limits through increasingly formalized risk management frameworks is full of difficulties, according to Power (2009). Also, Mikes and Kaplan (2015) argue that ERM practices lack a common model that can be applied to all organizations. Bromiley et al. (2015) describe ERM as a dynamic domain that requires increased integration with corporate governance, strategic planning and extensive management studies. These views highlight the need to differentiate between the existence of a holistic ERM framework and its operational application in a company. Risk governance is an essential component of ERM. Jankensgård (2019) describes ERM through risk-governance and risk-aggregation mechanisms. Malik, Zaman, and Buckby (2020) demonstrate that strong risk committee governance can enhance ERM effectiveness and firm performance, whereas the mere existence of a committee is insufficient. According to Sheedy and Canestrari-Soh (2023), stronger executive accountability is associated with more proactive and diligent risk behaviours. Ogunsanya and Ogunfowora (2026) strengthen micro-foundations by connecting ERM effectiveness to transformational leadership, risk management culture and group power. These studies suggest three distinct components: formal authority architecture, sense of accountability and collective behavioral capability.

The study thus defines the gap between implementation and effectiveness as the difference between the formal presence of roles, committees and procedures and clear evidence that they influence, in a real way, behaviours, risk interpretations or decisions. The risk appetite tool provides additional coordination mechanisms by converting capacity, tolerance and strategic ambition into limits and escalation thresholds.

A relevant area of examination has been the implementation and development of ERM. Beasley, Clune, and Hermanson (2005) focus on the ERM implementation phase and find organizational characteristics associated with more advanced implementation. By employing the Risk and Insurance Management Society Risk Maturity Model, Farrell and Gallagher (2015) describe the maturity of ERM from a range of organizational angles, including management buy-in, risk culture, strategic integration and the recognition of risk interdependencies. Similarly, Oliva (2016) introduces a multi-level ERM maturity model for large organizations and their supply chains. Hoyt and Liebenberg (2011) examine the implementation of ERM and its association with firm value in an empirically relevant study. The findings demonstrate that ERM maturity is by nature a multidimensional concept and cannot be reduced to the mere existence of formal policies or procedures. The distinction developed in this study is not intended to replace existing maturity models; instead, it separates ERM architecture and process maturity from the development of functional capability, to determine whether capabilities such as anticipatory monitoring, decision integration, interdependency analysis, adaptive reconfiguration and organizational learning develop to the same extent as formal and organizational maturity.

Crovini, Santoro and Ossola (2020) link risk management to decision-making processes. Hristov et al. (2022) add a strategic dimension and combine ERM with performance management systems and Key Risk Indicators (KRIs) to support decision-making. Gleißner and Berger (2024) relate decision-oriented ERM to value drivers and

quantitative aggregation. Hilbck Rios et al. (2026) integrate political risk management, decision theory and iterative learning. The result is a clear line between risk-informed strategy evaluation and risk-integrated strategy development: the former assesses the consequences of a decision, while the latter alters how choices are defined.

From an analytical perspective, risk reporting, information quality and utility for decision-making are distinct. According to Meidell and Kaarbøe (2017), the impact of ERM on decision-making is influenced by risk knowledge mobilisation. Saeidi et al. (2023) identified knowledge management as a moderator in the ERM-results relationship. These studies support the following information chain: raw risk data – validated information – aggregate exposure representation – contextual interpretation – linkage to objectives and alternatives – managerial decision – result – feedback.

A system may be mature in the early stages but weak in later ones. Information can be technically correct but delivered too late, insufficiently contextualised, or disconnected from the relevant decision points.

Enterprise-level integration cannot be achieved by simply adding individual risk register entries. Jankensgård (2019) recognises aggregation as a key ERM mechanism, while Gleißner and Berger (2024) emphasize the importance of quantitative aggregation and decision support. Another limitation is the level of temporal granularity. Quarterly or annual review cycles may be sufficient for slowly changing exposure, but not when the risk profile changes faster than the formal process. In this study, anticipatory capability is operationally associated with observable mechanisms such as emerging risk identification, horizon scanning, early warning indicators, scenario analysis, stress testing, anomaly detection, threshold triggered escalation and higher frequency monitoring.

McGrath, Hevner and de Vreede (2025) identify gaps in conventional ERM for AI ethical risk and incorporate real-time monitoring into their enhanced design. Monazzam and Crawford (2024) demonstrate how ERM governance culture and artefacts can impact resilience capabilities. Hussain (2026) defines dynamic ERM as sensing, strategic integration and reconfiguration. Such logic is consistent with a dynamic-capabilities perspective, in which the relevant issue is not only whether there are formal ERM processes in place, but whether the organization is able to recognise changing conditions, integrate new information and adjust its responses accordingly.

Artificial intelligence (AI) has a dual relationship with risk management. Tanbour et al. (2025) demonstrate the benefits of AI-enabled risk management through increased decision accuracy, automation and real-time anomaly detection. McGrath, Hevner and de Vreede (2025) view AI as a source of new ethical risks that necessitate an improved ERM architecture. The distinction between AI-enabled risk management and AI-risk governance is thus critical. Sustainability-related risks extend the functional boundaries of risk management. These exposures frequently include longer time horizons, indirect transmission mechanisms, business model implications and value chain dependencies. Regulators formalized related governance, strategy and monitoring expectations.

Conceptually, contemporary risk-management research increasingly integrates known methods for exposure identification and assessment with multi-horizon resilience and adaptive analysis.

The above literature indicates that ERM research has been gradually moving from comprehensive integration and governance to strategic decision-making support, risk aggregation, resilience, adaptive reconfiguration and sophisticated analysis. At the same time, previous evaluations and bibliometric analysis have summarized major aspects of ERM evolution. Bromiley et al. (2015) analyze the conceptual and theoretical basis of ERM and suggest ways to improve its integration with strategic and management studies. Oti-Frimpong and Gyedu (2023) analyzed 541 publications from 1989 to 2022 using Biblioshiny and found four major research streams related to ERM adoption and implementation, organizational performance, corporate value and practical applications. Jaber and Shah (2024) apply Bibliometrix to analyze the evolution of publications and themes in ERM research, emphasizing the increasing volatility and uncertainty in organizational contexts. These studies highlight the significance of bibliometric science mapping in identifying the intellectual structure, thematic development and emerging directions within the discipline of ERM.

This study extends previous work by exploring a specific research gap: the extent to which the current evolution of ERM can be considered as a diversification of the functional capabilities supported by an enterprise-wide continuous risk framework. Earlier studies have mapped out ERM adoption, implementation, firm performance and valuation, broad research areas and emerging themes. Less attention has been paid to differentiating ERM architecture, process maturity and the development of functional capabilities and the question of whether the strategic, adaptive, analytical and decision-making dimensions follow different temporal directions.

In the present study, we address this issue by combining bibliometric science mapping with thematic analysis, statistical assessment of temporal changes and an independent analysis of some key professional and regulatory frameworks. This integrated approach provides a basis for evaluating whether contemporary risk management is moving forward mainly through developing more effective ERM capabilities or being replaced by a new paradigm.

2. Research methodology

The analysis performed has three dimensions: a bibliometric analysis, a thematic content examination at the level of abstracts and a comparative high-level review of selected professional and regulatory frameworks. In this analysis, each element has a different purpose. The academic bibliometric stream highlights the performance, conceptual structure and evolution over time of the risk management paradigm in the literature. The thematic stream analyzes the presence and evolution over time of these organizational and capability-related dimensions in titles, abstracts and author's keywords. The normative stream considers the extent to which similar elements are reflected in selected standards, requirements and supervisory expectations, which are usually a driver for the evolution of the discipline. The three elements are interpreted jointly, evidence from one stream is not treated as confirmation of another and similarities or differences are assessed independently in the final conceptual interpretation.

The bibliographic database used was Scopus due to its extensive coverage of peer-reviewed research and compatibility with Bibliometrix/Biblioshiny. The search was

done in the Scopus title field with the following query: TITLE ("risk management"). The final dataset was exported on 6 September 2026 and contained 3445 records in English (3262 articles and 183 reviews). Records were then screened using clear inclusion and exclusion rules. A rule-based approach was used to analyze the 3445 retrieved records, based mainly on titles and author's keywords. Studies were included if they explicitly addressed risk management as a discipline, including its paradigms, frameworks, processes, governance structure, elements, practices and capabilities. These included, for example, enterprise risk management, corporate or strategic risk management, risk governance, risk appetite, risk culture, risk reporting, risk intelligence, decision support, organizational resilience, risk management competences and closely related topics such as strategy, performance and risk information. Studies were excluded where risk management was used in a technical or highly specialized area with no evident impact on the broader field of risk management. These included clinical and medical research, engineering and construction safety, natural hazards and environmental risk, actuarial and portfolio modelling, derivatives, purely technical cybersecurity analysis and other highly specialized applications. The screening reduced the original 3445 entries to 704. A final check of the records showed two duplicates that were eliminated. The final bibliometric collection consisted of 702 documents (673 articles and 29 reviews).

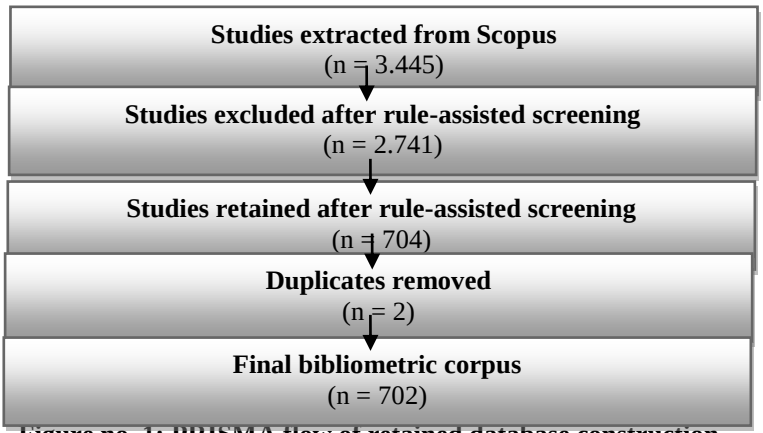


Figure no. 1: PRISMA flow of retained database construction

Source: author's own work

The final bibliometric collection covers the period 1997-2026. Four publications (2 from 1997, 1 from 1998 and 1 from 1999) were included in the descriptive bibliometric analysis but were excluded from the temporal analysis, because the small number of documents did not allow for a meaningful timeframe to be established, therefore, this was set to 2000-2026. The temporal statistical analysis covers the period 2000-2026 and includes 698 documents: 34 from 2000 to 2008, 179 from 2009 to 2016, 192 from 2017 to 2021 and 293 from 2022 to 2026. The pre - processing of keyword was deliberately conservative; some variants have been harmonized and others differentiated to avoid artificial fragmentation of the network (e.g. – ERM and enterprise risk management

(ERM) were grouped, while organizational resilience and supply chain resilience have been kept separate).
Bibliometric analysis was carried out by importing the Scopus records into Bibliometrix/Biblioshiny (Aria and Cuccurullo, 2017). The available metadata consisted of bibliographic information, abstracts, authors' keywords and indexed terms. Bibliometric scope covers performance analysis, source productivity, keyword frequency, co-word network analysis, thematic clustering, thematic evolution and trend-topic analysis.

The analytical tool for the examination of Thematic Evolution was the author's keywords because they show the concepts that the authors selected in their studies. The final parameters were kept constant across all the temporal iterations: 50 words, minimum cluster frequency of 5 per thousand documents, $\alpha = 0.5$, minimum weight index of 0.1, three labels per cluster and the Louvain clustering algorithm available in Biblioshiny. These settings were chosen as a balance between thematic coverage and readability. The 50-word limit minimizes excessive fragmentation while preserving less frequent themes. The minimum cluster frequency eliminated very rare terms, $\alpha = 0.5$ balanced occurrence and centrality, and the minimum weight index of 0.1 eliminated very weak connections. To ensure clarity of the thematic framework, three labels were used per cluster. Louvain was chosen because it detects communities of strongly related terms and is available directly in Biblioshiny. No additional stop-word or synonym lists were used because lexical harmonization was performed prior to the analysis. The same configurations were maintained for all temporal iterations to ensure consistency.
The thematic-evolution methodology proposed by Cobo et al. (2011) was applied to three different cutting years (2008, 2016, and 2021) in separate Biblioshiny sessions. The 2008 split was used to analyze the first stage of development of the discipline, the 2016 split offered a mid-term view of the stabilization and diversification of the discipline, while the 2021 split is the main contemporary reference point, as it separates the literature from 2022-2026 from the previous developments in the field. The splits from 2008 and 2016 were kept as sensitivity analyzes to test whether the overall interpretation was dependent on a particular temporal benchmark.
The second examination was a thematic content analysis of titles, abstracts and authors' keywords. The categories were developed using a combined deductive-inductive approach, starting with themes identified in the ERM literature and the study's initial conceptual framework but also including other themes that emerged repeatedly from the studies. The final structure included 15 themes. Each theme was defined and had a documented list of lexical-conceptual indicators. An article was associated with a theme if at least one documented indicator was found in the title, abstract or author's keywords. For example, the theme of "anticipatory monitoring and emerging risks" included indicators such as "emerging risks", "early warning", "forward-looking", "scenario analysis", "stress testing" and "proactive monitoring". Classification is multilabel, so one publication can be classified in multiple topics, therefore the sum of percentages does not sum to 100%, with the values indicating the presence of themes. The analysis was not a full manual coding exercise but was rule-based. This manuscript acknowledges that a second, independent coder was not used.

Thematic prevalence was calculated for each period, and temporal variations were assessed for four periods: 2000-2008, 2009 – 2016, 2017 – 2021 and 2022 – 2026. The Pearson chi-square test was employed to test for significant difference of thematic presence across the four periods for each of the 15 themes. Cramer's V was calculated to demonstrate the strength of the association.

Finally, an examination of professional standard setting and regulatory structures was performed. The selected sources were chosen to provide complementary perspectives on dimensions of contemporary risk management, such as corporate governance, risk appetite, resilience, sustainability, digital risk and technology governance. The analysis looked at six dimensions: governance, temporal evolution, organizational boundaries, information needs, resilience aspects and linkage with decision making processes and this structure was used to compare the findings with the capabilities identified in the academic literature The following sources were explored: COSO ERM (COSO,2017), ISO 31000 (ISO,2018), FSB Risk Appetite Framework (FSB,2013), OECD (Organization for Economic Cooperation and Development) Governance Principles (OECD,2023), DORA (Digital Operational Resilience Act) (2022), NIS 2 (Network and Information Systems Directive) (2022), ESRS (European Sustainability reporting standards) (European Commission, 2023), EU AI Act (European Union Artificial Intelligence Act) (2024). These frameworks were not considered to be of similar scope and applicability like sector specific ones. FSB framework or DORA were consulted only in relation to relevant areas and not generalized to all organizations but as ideas of good practice. The purpose of the examination was to evaluate the level of alignment between these frameworks and the capabilities identified in academic literature and was not aimed at being an evaluation of their empirical effectiveness.

3. Results and discussion

3.1. Scientific growth and journal dispersion

The unit of analysis consists of 702 documents from 363 sources and spans the period 1997 – 2026. Biblioshiny analysis shows an annual growth rate of 11.66% and an average document age of 7.13 years and 34.97 citations per document. The annual growth rate should be interpreted with caution, as publication activity was very low in the early years of the collection and 2026 is an incomplete publication year. The research production is very recent: 293 documents are included between 2022 – 2026, which amounts to about 41.7% of the total number of documents, and 485 between 2017 and 2026, i.e. roughly 69.1%. The output increases from 48 publications in 2022 to 56 in 2023, 66 in 2024 and 74 in 2025. The 49 publications registered in 2026 should not be interpreted as a decline since the year is not yet complete. The literature is very widely scattered across journals. The top 10 most productive sources contribute only 109 documents (15.5% of the corpus) and the top 20 have 166 documents (23.6%).

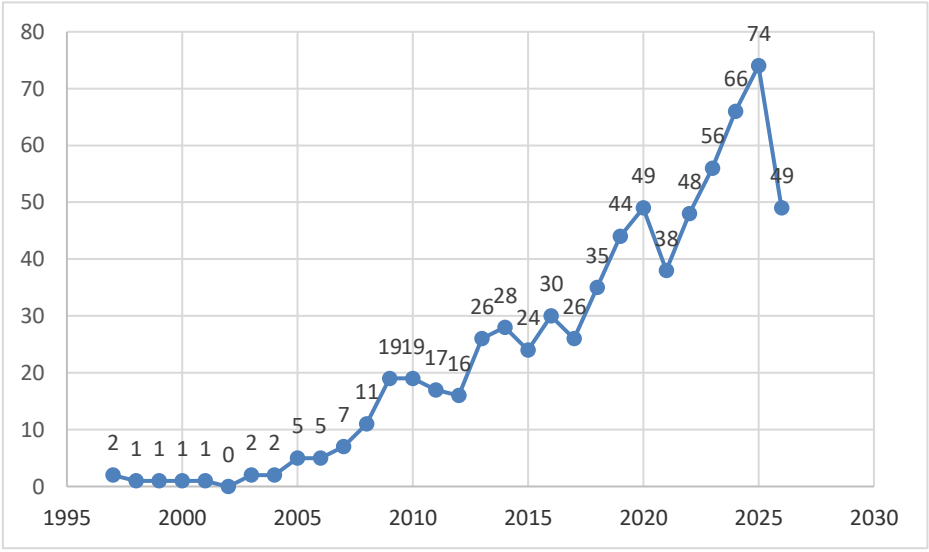


Figure no. 2: Annual Scientific Production, 1997 - 2026

Source: Biblioshiny export, author's own work

3.2. Differentiation of themes and conceptual structure

The most used terms in the normalised vocabulary are risk management (453 times), enterprise risk management (280), risk assessment (104), corporate governance (60), decision making (50) and supply chain management. Artificial intelligence appeared 20 times and resilience 15 times. This paradigm is a mixture of a permanent risk management / ERM core with smaller, maybe newer, capability-oriented notions. The final co-word network is composed of three principal clusters. The first one is about the general risk management process: risk management, risk assessment, decision making, risk analysis, and artificial intelligence. The second one looks at ERM and links it to corporate governance, performance, firm value, strategy, risk governance and risk culture. The third encompasses supply chain management, risk management, information management and resilience. This structure connects generic risk management, enterprise governance and interorganizational / adaptive exposure in the same field.



Figure no. 3: Co-occurrence Network

Source: Biblioshiny export, author's own work

Thematic clusters are divided in four structures: a theme of risk management/ ERM-governance-strategy-performance; a risk assessment theme that includes risk analysis, risk identification and project management; a theme of decision-making including AI, decision-support systems, machine learning and organizational learning and a theme of supply chain tied to resilience, information management and adaptive capabilities. The finding is of particular importance, showing that decision-making is more than a descriptive term, it is a specific conceptual structure connected with analytical tools. The fact that project management is present in the risk-assessment cluster is suggestive of the application of risk management processes in project contexts and these items were retained only if they met the selection criteria.

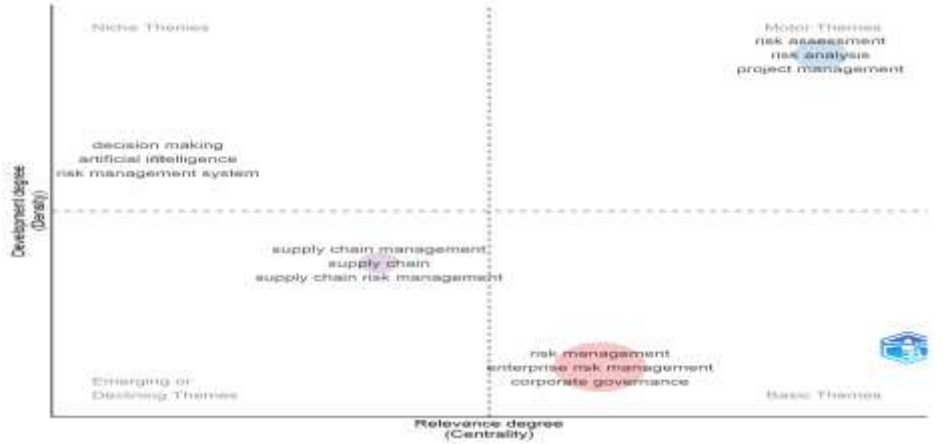


Figure no. 4: Thematic clusters

Source: Biblioshiny export, author's own work

3.3. Evolutions of themes in time

The figure below highlights the latest outlook provided by the 2021 thematic evolution split. In 2022-2026, artificial intelligence forms a distinct cluster that also includes machine learning, risk analysis, big data and deep learning. A resilience cluster includes risk assessment, risk governance, dynamic capabilities, decision making, digital transformation, organizational resilience, crisis management, risk identification and risk aggregation. At the same time, ERM remains very active. The pattern suggests continuity and distinctiveness and not replacement. This finding is supported by the additional sensitivity splits in 2008 and 2016, which also demonstrate a consistent pattern of ERM persistence and increased thematic differentiation.

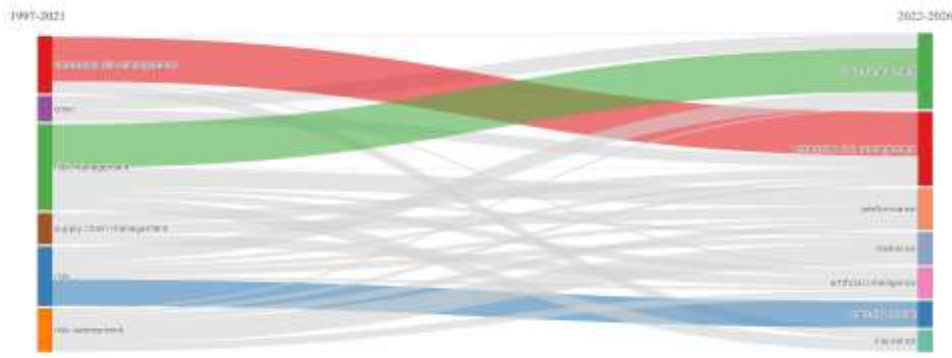


Figure no. 5: Thematic evolution using 2021 cutting year

Source: Biblioshiny export, author's own work

The trend topics reinforce this interpretation. Risk management, ERM and decision making have medians around 2020 and risk assessment has a median around 2019. Recent medians are resilience (2024), governance (2024) and digital transformation (2025). Supply chain risk management has an earlier median, around 2018. This means that the temporal structure is one of layers: established concepts persist and new analytical and adaptive themes are structured around them and become increasingly visible.

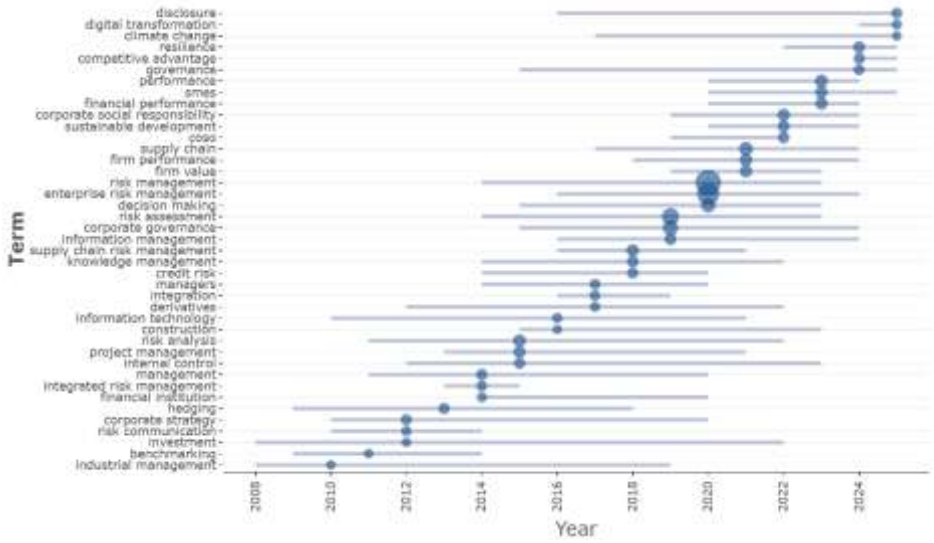


Figure no. 6: Trend Topics

Source: Biblioshiny export, author's own work

3.4. Thematic analysis

The thematic analysis counted if a document title, abstract or author's keywords contained one or more documented indicators for a broader analytical category. The most common category identified is enterprise-wide integration / silos topic which appears in 58.4% of the documents. Risk-strategy-performance-value integration is reported in 44.2% of the documents, implementation/maturity in 37.6% and governance/accountability in 28.1%, resilience/adaptation in 17.2%, sustainability/ESG in 14.7%, supply chain / network risks in 13.7% and information to decision support in 12.7%. Risk intelligence topic was only found in two documents.

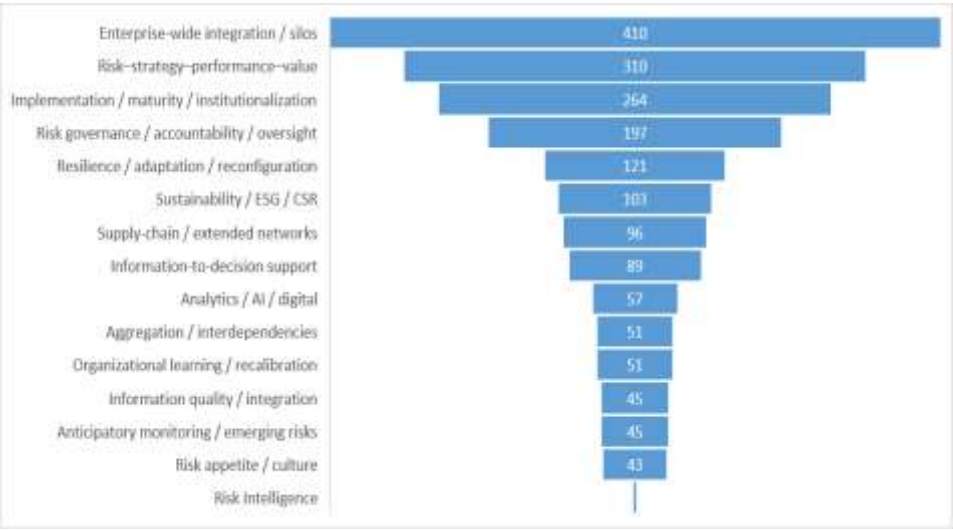


Figure no. 7: Thematic prevalence (N=702)

Source: Author's own research

Table below shows the evolution of themes over four-time clusters showing that there are some topics of theoretical importance that are constant over time. Enterprise-wide integration is still common baseline infrastructure rather than a developing frontier. The descriptive statistics indicate increases in several themes such as decision support, anticipatory monitoring and supply-chain/network risk, but these are not statistically significant over the intervals studied. Statistically significant temporal variation is observed for the risk-strategy-performance integration, resilience/adaptation, analytics/AI/ digitalization and sustainability/ESG.

As shown in *Figure.no.8* there are some topics that show a strong increase over time, and increasing frequency during the more recent periods. However, caution is needed in the interpretation of these results. P1 has only 34 publications, so percentage changes during this period are sensitive to small changes in documents number; in addition, the year 2026 was incomplete at the time of data retrieval and is treated as an incomplete final year in P4.

Table no. 1. Temporal statistics of key mapped themes

Theme	P1 (2000-2008) %	P2 (2009-2016) %	P3 (2017-2021) %	P4 (2022-2026) %	χ^2	p-value	Cramer's V
Enterprise-wide integration / silos	41.2	58.7	60.9	58.7	4.6774	0.197	0.0819
Risk–strategy–performance–value	32.4	36.3	43.2	51.2	12.3297	0.0063	0.1329
Implementation / maturity /	35.3	43.6	38.5	34.1	4.3528	0.2258	0.079

institutionalization							
Risk governance / accountability / oversight	23.5	26.3	27.1	30.7	1.7338	0.6294	0.0498
Risk appetite / culture	2.9	3.9	6.2	7.8	3.626	0.3048	0.0721
Information-to-decision support	8.8	11.2	12.5	14.3	1.5432	0.6723	0.047
Information quality/integration	5.9	8.4	5.2	5.8	1.8315	0.6081	0.0512
Aggregation/interdependencies	14.7	6.7	4.2	8.9	6.7019	0.082	0.098
Anticipatory monitoring / emerging risks	2.9	5	5.7	7.8	2.4373	0.4867	0.0591
Resilience / adaptation / reconfiguration	8.8	5.6	14.6	27.3	40.2931	<0.001	0.2403
Analytics/AI/digital	0	3.4	4.7	14.3	26.519	<0.001	0.1949
Sustainability / ESG / CSR	11.8	6.1	12	22.2	24.8227	<0.001	0.1886
Supply-chain / extended networks	11.8	13.4	13	14.7	0.4284	0.9343	0.0248
Organizational learning / recalibration	2.9	6.7	6.8	8.5	1.7841	0.6184	0.0506
Risk Intelligence	0	0.6	0	0.3	1.1441	0.7664	0.0405

Source: Author's own work

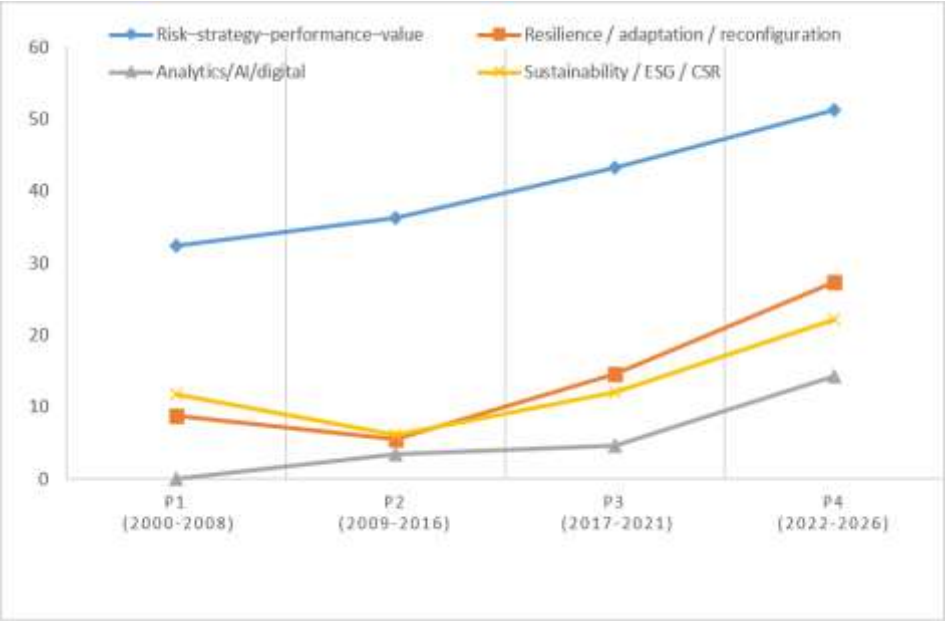


Figure no. 8: Themes with robust temporal variation
Source: Author's own research

3.5. Discussion: Evolution of the discipline from ERM maturity to capability development

The evidence we have does not support the idea that a single new construct replaces ERM. Risk Management and ERM remain the most frequent and structurally important concepts in the analyzed database. But the functional distinction of these concepts

changes. The strategy-performance link, resilience/adaptation, sustainability and advanced analytics show significant temporal changes, while decision support and anticipation are structurally important but do not show statistically significant differences across examined periods. Therefore, the evidence supports an interpretation of capability extension rather than concept replacement. In this context, enterprise-wide integration is the foundation of this infrastructure. Its high incidence and temporal stability suggest that literature is more considering integration as a necessary condition rather than the final goal. The questions that should be addressed are about what an integrated architecture can actually deliver. Can it connect risk to strategy, can it articulate interdependencies, can it refresh exposure faster than formal cycles, can it enable decisions, or can it adjust when previous assumptions change?

Some limitations have emerged from the literature as basic functional weaknesses.

- The implementation-effectiveness gap separates the existence of formal process from behavioural or decisional influence.
- The risk-strategy gap refers to the situation where risk is considered only after developing strategic directions.
- The information to decision conversion gap refers to the situation where the information technically valid is not useful for decision.
- The aggregation – dependency gap is the inability to articulate aggregate exposure and propagate it in the organization.
- The temporal monitoring gap is the difference between review frequency and the risk profile velocity.
- The adaptive reconfiguration gap refers to the predefined actions that are not modifiable with changing conditions.
- The residual integration gap is where a common ERM framework exists, but risk knowledge, data, ownership and escalation are not sufficiently integrated across functions.

The identified limitations are the interpretative basis for the synthesis of capabilities. The following capabilities arise from the combination of bibliometric, thematic and normative data, which is an author-level integration. These constraints are summarized into eight higher-level capabilities: when functional integration is good across the whole enterprise, it aligns risks, data, ownership and escalation across functions. Integrating risk, strategy and performance links exposure to goals, alternatives, value drivers and resource allocation. Dependency risk aggregation considers combined exposure, common risk drivers, concentration and cascade effects. Anticipatory monitoring uses emerging-risk identification procedures, early warning signals, scenarios, stress testing and more frequent data analysis to identify material changes. The process of converting information to decision places risk in the context of objectives and alternatives. Resilience and adaptive reconfiguration change controls, resources, assumptions and responses as business conditions change. Advanced analytics improves detection, prediction and monitoring and ensures data and model governance. Organizational learning refers to all lessons learned, such as incidents, near misses, forecast errors, realized outcomes used to calibrate indicators, assumptions and business responses.

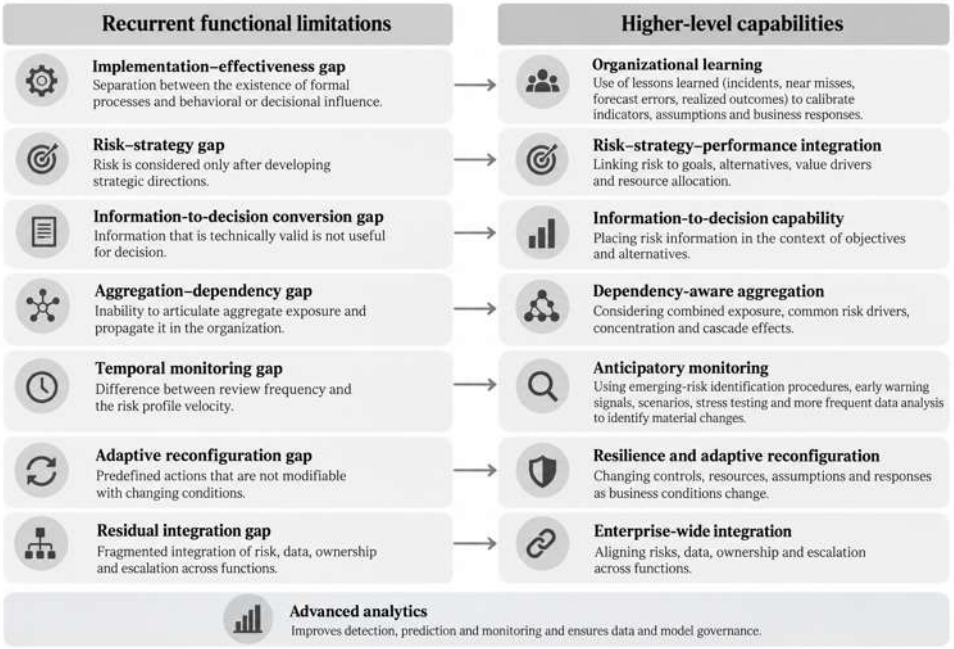


Figure no. 9: Link between limitations and capabilities

Source: Author's own research

The high-level review performed on the normative environment supports the idea that the evolution of risk management discipline is mainly a capability extension advancement. For example, COSO (2017) formalizes ERM, strategy and performance. ISO 31000 (2018) standardizes the baseline for a risk integrated process. The FSB Risk Appetite Framework (FSB, 2013) translates appetite and limits into operational terms for strategic and financial planning. OECD (2023) corporate governance guidelines link board oversight, sustainability and resilience. DORA (2022) and NIS2 (2022) expand the scope to digital operational resilience and cybersecurity risk. ESRS (European Commission, 2023) frameworks related to ESG extend the temporal horizon and include multi-horizon and scenario-based requirements. The AI Act (2024) provides lifecycle governance, monitoring and systematic updates requirements for AI-related risks.

In principle, this suggests a three-dimensional analytical framework. The ERM architecture deals with the governance of risk, division of functions and management of enterprise-wide collaboration. ERM process maturity refers to the level of formality and consistency of risk identification, evaluation, monitoring, treatment and reporting. Risk management capability development defines what the system can deliver in the face of uncertainty and change. A company can have high process maturity and a low anticipatory capability, or advanced analytics but poor decision integration, or strong governance but weak modelling of interdependencies. This difference also makes the framework measurable. To be operational, integration requires cross-functional ownership, taxonomy consistency, data integration and quality of escalation. Strategy

integration can be assessed using explicit risk assumptions in strategic objectives, KRI-KPI relationships and risk-adjusted alternatives. Aggregation/interdependencies capabilities can be described in terms of concentration measures, dependency maps and portfolio scenarios. Indicators of anticipatory capabilities include emerging-risk coverage, early warning indicators timeliness, update frequency and scenario/stress tests. Evidence of adaptation capability might be recovery indicators and evidence of control changes. Analytics capability requires model validation, data quality and human monitoring. Learning ability requires documented feedback on risk events, near misses and actual outcomes.

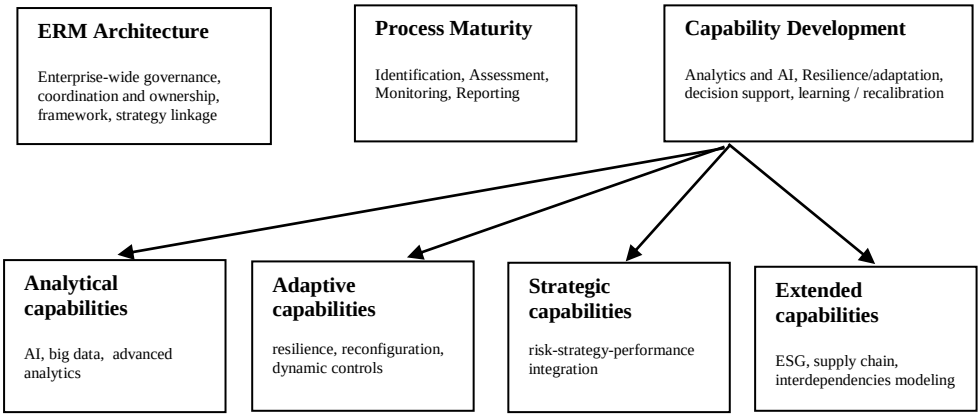


Figure no. 10: Conceptual synthesis – functional extension of ERM through capability development

Source: Author's own research, based on integrated evidence

Conclusions

This study concludes that modern risk management is currently placed as an extension of ERM and not as a replacement for the discipline. Enterprise Risk Management continues to be the dominant enterprise level design in the field. Nevertheless, formal frameworks do not guarantee decision support, predictive capability, interdependence modelling or adaptive reconfiguration. The biggest evolutions in recent years have been incremental around the core, not within its fundamentals.

Bibliometric analysis identified three main conceptual structures: a wide risk management process cluster focusing on assessment and decision making, a governance-strategy-performance cluster associated with ERM and a supply-chain / resilience cluster that extends risk management across organizational boundaries. Thematic evolution after 2021 shows emergence of two distinct AI/digital transformation and resilience themes. This is also confirmed by Trend Topics analysis, which additionally proves the core themes – risk management / ERM concepts. Abstract-level thematic analysis highlights the dominance of enterprise-wide

integration, but the four most important temporal changes are attributed to strategy-performance integration, resilience – adaptation, analytics/AI/digitalization and sustainability/ESG.

Conceptually, decision assistance and anticipative monitoring are essential, but we do not find a statistically significant period difference in our study. The distinction between structural importance and temporal emergence is essential for meaningful interpretation.

The synthesis of capabilities highlights the necessity for holistic integration across the enterprise: risk-strategy-performance integration, recognition of dependencies in aggregation, translation of information into decisions, resilience and adaptive reconfiguration, advanced analytics and organizational learning. Many of the professional and regulatory frameworks selected reflect some of these same capabilities, particularly in areas like governance, strategic alignment, resilience, information needs and ongoing oversight.

The main theoretical contribution of the paper is the differentiation between ERM architecture, process maturity and risk management capability development. The next generation risk management system is defined by its ability to:

- Integrate enterprise-wide information functionally
- Connect risk to strategy and performance
- Aggregate dependencies
- Monitor emerging changes
- Translate information into decision support
- Reconfigure and adapt
- Use advanced analytics
- Learn from outcomes

From a practical perspective, the research gives organizations a clearer view of how risk management is evolving, identifying which capabilities are gaining importance and where gaps remain in current practices. This can help risk functions, boards and risk and audit committees to focus their resources on earlier risk detection, better analysis of interdependencies, more relevant information for decision making and faster adaptation to changing conditions. Such prioritization could, in volatile circumstances, increase preparedness and reduce the impact of negative events. The findings can also help regulators and standard setters by highlighting the areas where current risk management elements may need to be improved.

The study has some limitations as it is limited only to the Scopus database, thematic classifications are based on titles, abstracts and authors' keywords, and both corpus selection and thematic coding involve researcher judgement. In addition, 2026 is an incomplete year, and the normative stream was examined at a high level, showing mostly institutional expectations rather than empirical effectiveness. These limitations can determine the future research steps: full text validation of the selected core literature, inclusion of the complete 2026 publication year in the analysis and the development and empirical testing of a capability-based measurement and decision-support architecture.

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