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# The relationship between enterprise risk management and managerial judgement in decision-making: A systematic literature review

Jason Crawford<sup>1</sup>  | Mirna Jabbour<sup>2</sup> 

<sup>1</sup>Department of Business Studies, Uppsala University, Uppsala, Sweden

<sup>2</sup>Sheffield University Management School, University of Sheffield, Sheffield, UK

## Correspondence

Jason Crawford, Department of Business Studies, Box 513, Uppsala University, SE-751 20 Uppsala, Sweden.  
Email: [jason.crawford@fek.uu.se](mailto:jason.crawford@fek.uu.se)

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## Abstract

Enterprise risk management (ERM) promises to improve decision-making and help organizations avoid wicked problems. Consequently, risk artefacts may play a significant role in managers' decision-making processes, but little is known about the relationship between ERM and managerial judgement in decision-making (MJDM). The purpose of this paper is to present a systematic literature review of ERM, thereby filling this knowledge gap and providing an evidence-based foundation for improving practice and advancing knowledge and theory development. Based on an analysis and synthesis of 33 articles published between 2009 and 2021, we identify four contextual, five technical, three social and five cognitive factors that interact with MJDM. We find that *regulation and corporate governance*, *ERM artefact design reconfiguration and use*, *social capital interactions and spaces* and *perceptions* have the most support. We distinguish between three different modes of judgement: *risk measurement*, *risk envisionment* and *risk qualculation*. We find that risk qualculation, which employs quantitative and qualitative data and social interpretations of risks and uncertainties, is more likely to be useful in managerial decision-making, particularly when attempting to address wicked problems. We also find that human cognition significantly impacts ERM design, implementation and use, and how those change over time. This paper also develops a new narrative and conceptualization of the relationship between ERM and MJDM, which is presented in an integrative framework. Finally, we encourage researchers to adopt cognitive theories and related concepts that are better suited for examining the ERM–MJDM relationship and to take a cognitive turn in future ERM research.

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## INTRODUCTION

Enterprise risk management (ERM) has grown in prominence and is now regarded as a leading paradigm for good corporate governance (Anton & Nucu, 2020), especially in the current business environment's high degree of uncertainty. As the range of risks and uncertainties that must be managed has grown (Klein & Reilley, 2021; Soin & Collier, 2013), the Treadway Commission's Committee of Sponsoring Organizations (COSO)<sup>1</sup> has expanded the capacity of their ERM framework further by issuing practitioner guidance on how to apply ERM to some of the most complex risks organizations currently face, including environmental, social and governance (ESG) risks, cybersecurity risks (Eling et al., 2021), cloud computing risks and artificial intelligence (AI) risks. This expansion creates an expectations gap where promises contained in ERM frameworks are difficult to realize in practice (Beasley et al., 2015, 2017; Eling et al., 2021; Lundqvist, 2014) as it entails both technical and social components, the latter having received scant attention from scholars (Jeitziner et al., 2017).

Some researchers continue to cast doubt on ERM's ability to articulate and comprehend critical risks in a holistic and integrated manner (Arena et al., 2017; Power, 2009) in a way that aligns risk, strategy and performance (Anton & Nucu, 2020; Arena et al., 2010), thereby assisting management in better understanding and managing uncertainty (as ERM promotes) (Bromiley et al., 2015). This creates an intriguing puzzle requiring more knowledge. Thus, this paper reviews ERM literature to consolidate and evaluate existing knowledge on the relationship between ERM and managerial judgement in decision-making (MJDM).

In ERM, judgements regarding the level of risk associated with strategic and operational decisions are made continuously (Crovini et al., 2021; Jabbour & Abdel-Kader, 2015), and risk artefacts can improve judgements

in certain, but not all, scenarios. This depends on data availability and quality, perceived artefact usefulness and risk experts' willingness to share artefacts with the wider organization or use them to create actionable insights that managers can use to make judgements and decisions (Crawford & Nilsson, 2021; Jollineau & Durkin, 2018).

The relationship between ERM and MJDM is bidirectional. Artefacts used in ERM processes influence and are influenced by managerial judgements. Artefacts can facilitate and frame communication between groups to foster innovation, knowledge accumulation and organizational learning (Hall et al., 2015), influencing managerial judgement. Managers also alter artefact design and application to address specific decision problems based on their perceptions of artefact usefulness (Nasteckienė, 2021).

Every major decision involves risk considerations, but the biggest risks are strategic and lack relevant historical data (Bromiley et al., 2015). As a result, the potential to use risk artefacts is limited. These risks present decision-makers with wicked problems (Rittel & Webber, 1973), with no obvious solutions. Wicked problems are less amenable to the use of risk artefacts commonly used in the assessment of tame problems, which are definable and calculable (Rittel & Webber, 1973). Instead, organizations need to rely on the cognitively skilled and mindful judgements of all decision-makers (Harris, 2014; Williamson, 2007), especially when decisions are made under tight time constraints (Adam & Dempsey, 2020). Accordingly, 'human freedom to act' is very important in MJDM (Butler et al., 2016).

Since strategically important decisions are frequently made in groups, and these decisions present cognitive challenges, researchers must consider not only the economic perspectives from which technical approaches to risk management have evolved, but also the sociological and psychological perspectives that are important in MJDM (Jeitziner et al., 2017; Vasvári, 2015). Human perceptions of risk and uncertainty are not only constructed technically by risk artefacts, but also socially (Nasteckienė, 2021) and cognitively in the contexts and minds of decision-makers (Gendron et al., 2021; Vasvári, 2015), as they leverage their expertise (Bailey, 2022) and intuition (Adam & Dempsey, 2020). Therefore, future ERM research should no longer denounce risk as a psychological process (Hardy et al., 2020) and should instead catch up with the cognitive revolution (Butler et al., 2016<sup>2</sup>) occurring elsewhere in the accounting, management and strategy literatures.

<sup>1</sup>ERM components based on COSO framework (2004) are as follows: -Internal environment—risk management philosophy, risk appetite of the firm, integrity and ethical values. -Objective setting—objectives are needed before events that potentially affect their achievement can be identified. -Event identification—the identification of internal events (e.g., workplace accidents, process execution errors) and external events (e.g., price movements, floods) that may affect the achievement of a company's objectives. -Risk assessment—to analyse risks and consider their likelihood along with their impact in order to determine how they should be managed. Examples of assessment techniques are benchmarking, probabilistic models and non-probabilistic models. -Risk response—management need to respond by deciding whether to avoid, reduce, share or accept the risk in line with its tolerance and appetite. -Control activities—policies and procedures that are implemented to ensure the risk responses are effectively carried out. -Information and communication—relevant information is identified, collected and communicated to enable people to undertake their tasks and meet their responsibilities.

<sup>2</sup>It may be worth noting that Butler et al. (2016) chose three areas of literature for their search, including economics, marketing and organizational behaviour, but not management control for example.

Although risk artefacts may significantly influence managers' decisions, little is known about this role in ERM processes (Jeitziner et al., 2017). Therefore, we conducted a five-stage systematic literature review to fill this knowledge gap (Briner & Denyer, 2012). A rigorous systematic review is required to identify existing evidence, improve existing ERM practices (Tranfield et al., 2003) and advance knowledge and theory development (Breslin et al., 2020).

This study searched five academic databases, including Web of Science (WoS), Scopus, Business Source Premier (BSP), ProQuest Social Science Premium Collection (PQSSP) and Business Source Complete (BSC). By analysing and synthesizing the extant research, we consolidate and evaluate the current state of knowledge on the relationship between ERM artefacts and MJDM as part of the broader processes reported in accounting and management research. We do so by identifying relevant empirical-based studies in accounting and management journals that capture the relationships, interactions and evolution of ERM artefacts and organizational actors. To guide the review, we pose and set out to answer the following research question:

How do the introduction and use of ERM artefacts relate to managerial judgements in decision-making in accounting and management research?

## Study motivations and contributions

The rise of ERM and increasing use of risk artefacts has spawned empirical research, including studies published in a stream of literature devoted to the artefactual turn (Power, 2016). Prior literature also tended to focus on the impact of ERM implementation on firm performance, value and other firm-level variables (e.g., Anton, 2018; Chairani & Siregar, 2021; Jurdi & AlGhnamat, 2021; Krause & Tse, 2016; Otero González et al., 2020, 2022). Since the mid-2000s, studies on ERM have increased, accelerating significantly since 2009 (Metwally & Diab, 2021), a trend attributed to the 2008 global financial crisis (Choi et al., 2015). This crisis revealed to some the limitations of economics-based risk artefacts used to quantify risks by applying theories and modelling techniques, which were highly revered up to that point. To others, the crisis was an opportunity to blame organizations for not doing more to enhance managerial decision-making by dealing more effectively with complexity, rather than doing more to address psychological biases which can skew MJDM (Jeitziner et al., 2017). These various perspectives highlight competing conceptions of risk, where understanding risk in terms of probability and decision-

making under certain conditions fails to relate to and include individuals' subjective meaning and interpretation of risks (Ben-Ari & Or-Chen, 2009).

While we support calls for future research to focus on the relationship between ERM and behaviour, which Jeitziner et al. (2017) refer to as the accounting literature's 'missing link' and which Bromiley et al. (2015) argue management scholars can help close, such calls fail to draw attention to the relationship between ERM artefacts and MJDM. Understanding this relationship is essential to our understanding of ERM and behaviour, as ERM governance and management frameworks promote 'tool-rich environments' (Hall et al., 2015; Maffei, 2021) where ERM artefacts are increasingly embedded in all types of managerial decisions. In addition, these calls do not address the suitability of theories currently employed in ERM studies.

A few theories dominate ERM research. Agency theory is extensively used in risk management research (Acharyya & Houston, 2022; Jankensgård, 2019), focusing researcher attention on agency conflicts and deviations in human behaviour from expectations based on rational behaviour models. Studies examining the relationship between ERM and MJDM frequently employ contingency theory (Nielsen & Pontoppidan, 2020) and institutional theory (Jabbour & Abdel-Kader, 2016). However, none of those theories on their own have the capacity to address cognitive factors like conceptualization, perception and awareness, which significantly impact ERM design, implementation and use (Braumann, 2018; Crovini et al., 2021; Diab & Metwally, 2021).

Over-reliance on a few theories reveals a theoretical gap that must be addressed. This can be accomplished either by combining established theories with theories that have a behavioural dimension (Kim, 2019; Nielsen & Pontoppidan, 2020) or by employing new theoretical lenses and concepts better suited to studying MJDM in ERM. Cognitive fit theory (Stoel et al., 2017), decision-making theory (Crovini et al., 2021) and practice theory (Klein & Reilley, 2021) are under-utilized but can offer new insights into risk perception and awareness, and how risk artefacts alter the individual and collective mindsets of organizational actors. Distributed cognition theory and agency theory could also be incorporated into the ERM literature to fill this theoretical gap.

ERM-specific literature reviews are uncommon (Anton & Nucu, 2020; Choi et al., 2015). While we discovered nine previous literature reviews (Anton & Nucu, 2020; Bromiley et al., 2015; Choi et al., 2015; Fujita et al., 2018; Krause & Tse, 2016; Lima et al., 2020; Olson & Wu, 2010; Vasvári, 2015; Verbano & Venturini, 2013), only two follow a transparent and systematic research protocol (Anton & Nucu, 2020; Lima et al., 2020). While Fujita et al. (2018) and Verbano and Venturini (2013) follow systematic literature

review approaches, the method sections are limited and thus transparency about the review process is low. In addition, Fujita et al. (2018) reviewed accounting research only, and Verbano and Venturini (2013) reviewed risk management literature prior to 2009. Furthermore, none of the aforementioned reviews examine the relationship between ERM artefacts and MJDM.

Our review differs from existing reviews in several ways. First, it includes articles published between 2009 and 2021, providing the latest knowledge and evidence from this area. Second, we searched five academic databases, significantly more than previous reviews (Rojon et al., 2021). Third, only our review includes a third-party search to locate studies. This increases the rigour of our search and reduces researcher bias, which is common in traditional literature reviews (Rojon et al., 2021). Fourth, while previous systematic reviews examined the determinants and consequences of integrated risk management processes (Anton & Nucu, 2020) or the development of state-of-the-art risk management in small and medium enterprises (SMEs) (Lima et al., 2020; Verbano & Venturini, 2013), this paper takes a more comprehensive and novel approach by utilizing the systematic review as a tool to develop a new narrative and conceptualization of the relationship between ERM and MJDM (Fan et al., 2022). This approach is consistent with our aim of broadening the scope of ERM research to include socio-cognitive aspects as part of a cognitive turn, thus challenging the established narrative and underlying assumptions in the extant literature (Breslin et al., 2020; Fan et al., 2022; Gatrell & Breslin, 2017).

Our study's contribution to existing ERM knowledge and practice is threefold. First, based on our analysis and synthesis of the selected articles, we identify four contextual, five technical, three social and five cognitive factors that affect and are affected by MJDM. We find that *regulation and corporate governance, ERM artefact design reconfiguration and use, social capital interactions and spaces* and *perceptions* have the most support when interacting with MJDM. Thus, we draw scholars' and practitioners' attention to the relationship between these factors that make ERM implementation so difficult (Jeitziner et al., 2017). In addition, we argue that a better understanding of these relationships could support ERM development/implementation processes.

Second, our review identifies three distinct modes of judgement in decision-making (mathematical/statistical-based, qualitative expert-based and hybrid). We find that for ERM to influence decision-making, a third hybrid mode of judgement, known as *qualculation*, is required (Tekathen & Dechow, 2013). These three modes of judgement present actors with different cognitive demands in decision-making, in calculating risks, envisioning uncertainties and, in the hybrid mode, combining quantitative

and qualitative data with social interpretations of risks (tame problems) and uncertainties (wicked problems). These contributions provide insights that can improve decision-making and advance ERM research in accounting and management, thereby helping organizations tackle wicked problems and other increasingly complex challenges (Breslin et al., 2020).

Third, we suggest theoretical and methodological development opportunities for future research. Some researchers were early to recognize the importance of cognition in ERM, but cognitive theories that improve our understanding of risk, uncertainty and decision-making remain under-utilized. Thus, we propose using distributed cognition theory, activity theory and concepts such as mediated sensemaking to take a cognitive turn in ERM research. We also highlight the limited variety of research methods used and encourage researchers to use other methods such as cognitive mapping, ethnography and exploratory statistical methods, which are better suited to studying cognitive phenomena. Finally, we develop a new conceptualization of the relationship between ERM and MJDM, illustrated in an integrative framework.

The remainder of the paper is structured as follows. First, we describe the research method, concept definitions, planning and how studies were located and appraised. Following that, we present a critical analysis and synthesis of the findings from selected studies connected to the research question to report the best evidence on the outer boundary of current knowledge on the relationship between ERM artefacts and MJDM (Rojon et al., 2021). The paper concludes with a discussion and directions for future research.

## RESEARCH METHOD

We conducted a systematic review of the literature using Briner and Denyer's (2012) five-stage methodology (Figure 1). Systematic reviews minimize bias and increase review process rigour and transparency, distinguishing them from narrative and integrative reviews (Briner & Denyer, 2012; Fan et al., 2022; Rojon et al., 2021; Tranfield et al., 2003). They also utilize a well-defined methodology to identify, analyse and interpret all relevant evidence in an unbiased and, to some degree, repeatable manner (Fan et al., 2022). The degree of repeatability is influenced by a number of aspects, such as transparency concerning the search strings used in different database searches and the date when the search was run. It is also influenced by how well the authors have balanced innovation, novelty and rigour in theorizing central relationships (Breslin et al., 2020; Fan et al., 2022), without compromising the 'systematicity' of the search or losing sight of creating

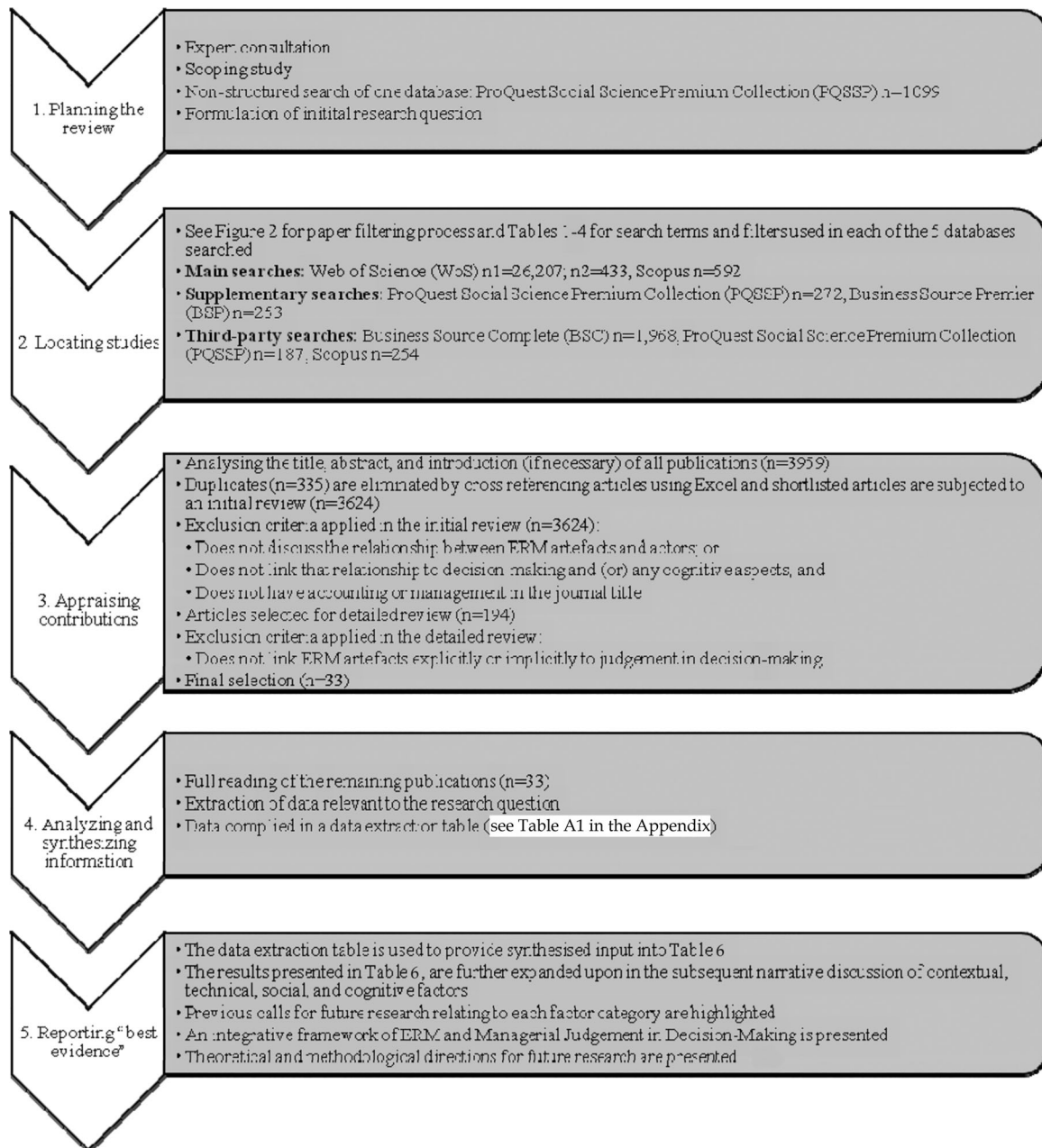


FIGURE 1 Overview of the systematic review process.

a complete picture that presents the evidence cohesively (Rowe, 2014). Taking a prospector’s approach (Breslin et al., 2020), we have been mindful to balance generativity and rigour during the review process (Fan et al., 2022).

A systematic review is particularly advantageous in ERM, as the existing literature is fragmented and lacks coherence (Fujita et al., 2018). Consequently, narrative and integrative reviews are less likely to ‘identify, analyse, and interpret all available evidence’ relevant to our specific research question in the way a systematic review can (Fan et al., 2022, p. 4). Thus, it enables a more coherent and consolidated overview of current knowledge of the relationship between ERM and MJDM than would be possible

otherwise, allowing us to establish an evidence base to improve research knowledge and management practice (Rojon et al., 2021).

Prior to guiding the reader through the review’s five stages presented in Figure 1, we clarify how we define the main concepts to increase transparency.

### Definition of main concepts

Several definitions of ERM exist because of the variety of frameworks in existence (Bromiley et al., 2015, p. 267). These frameworks are not theoretically derived but have

emerged through the interactions of sponsoring bodies and practitioners. They also contain different components, producing multiple inconsistent definitions of ERM (Lundqvist, 2014), thus various forms of ERM have been observed in practice (Mikes & Kaplan, 2014, 2015). Comparing ERM across organizations is difficult, leading to challenges in measuring and comparing the performance and effectiveness of ERM. While drawing attention to these definitional challenges, we use COSO's (2004) definition of ERM below, because it is the best known and most widely applied.

ERM is a process, effected by an entity's board of directors, management, and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives.

Artefacts are defined as anything made by humans for a practical purpose and include physical objects, processes, tools and theories (Arena et al., 2017; D'Adderio, 2011). Different perspectives view the properties of artefacts differently, which has implications for how the role of risk artefacts is theorized and understood, as well as how the relationship between artefacts and human actors is reported in the literature (D'Adderio, 2011). Despite differing perspectives, researchers are increasingly committed to investigating and better understanding the socio-technical relationship between artefacts and actors when examining the relationship's influence on issues such as coordination, knowledge management and the transformation of actions (D'Adderio, 2011).

Judgements are defined as evaluations or predictions regarding a specific target. Decisions are defined as actions usually following judgements. A central aspect of judgement-making is understanding how actors search and process information to render a judgement and how those judgements translate into decisions (Jollineau & Durkin, 2018). Grounded in cognitive psychology, research on judgement in decision-making has evolved from focusing on judgement deficits/biases and poorly applied heuristics to identifying factors that influence judgements, including technologies used as decision aids (Jollineau & Durkin, 2018).

In order to further improve the quality and transparency of this systematic review, we have included a PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) flow diagram in Figure 2 to detail the paper's filtering process.

## Stages of the review

In *stage 1*, we planned the review. We became interested in the relationship between ERM artefacts and MJDM because risk artefacts gained prominence in academic conferences, publications and practitioner forums without being linked to human cognition to understand how they affect and are affected by managerial judgements. We became increasingly perplexed by the theoretical and practical disconnect between ERM artefacts and cognition, and committed to investigating this important relationship (Breslin et al., 2020). Based on expert advice and the merits of a systematic review (Fan et al., 2022), we determined that a systematic literature review was the best way to establish a comprehensive evidence base from which we could craft a new narrative and advocate for a cognitive turn in ERM research to improve research knowledge and management practice (Rojon et al., 2021).

In August 2020 we conducted a scoping study (Briner & Denyer, 2012) in PQSSP (also used by John & Lawton, 2018) using broad search terms, for example, ERM, risk management, tools, actors, artefacts, risk, decision-making, uncertainty and gradually adding various filters (e.g., scholarly journals, peer review, full text, case study, editorials) to identify as many potential results as possible. This provided us with an initial understanding of the quantity and relevance of potential articles, the development of theoretical arguments (Tranfield et al., 2003) and insights into the black box of automated searches (Fan et al., 2022).

We found that adding secondary search terms such as actors, artefacts, along with ERM, produced increasingly irrelevant results because many ERM articles do not use those terms. We also found that risk management and ERM are often used interchangeably with loose definitional and conceptual boundaries. In several results, we observed that ERM was included in the keywords even though the content was unconnected to the concept of risk. This indicated that the automated filtering process used by some databases may not be entirely reliable, which was later confirmed by the WoS search; therefore, we decided that all database results should be screened to ensure their relevance, and hence the search terms are included.

Exploratory searches in PQSSP showed that few articles were published on ERM prior to the mid-2000s, an observation that is consistent with earlier reviews (Choi et al., 2015; Fujita et al., 2018). They also revealed that ERM research is fragmented, also observed in earlier reviews (Fujita et al., 2018). The final exploratory search ( $n = 1099$ ) included books, conference papers and proceedings, scholarly journals and working papers. Just four relevant results were found, which were later excluded in stage three.

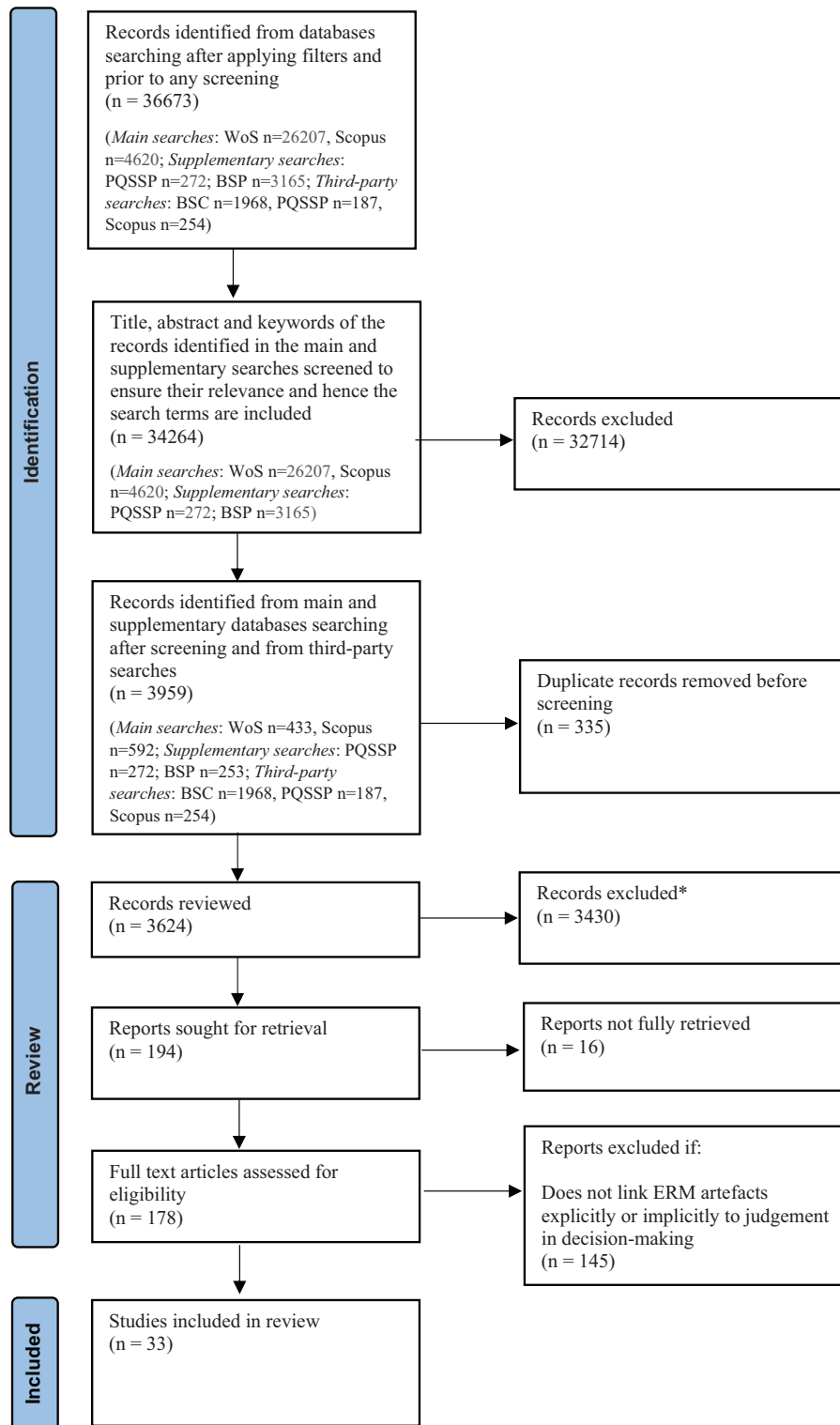


FIGURE 2 PRISMA flow diagram.

\*Exclusion reasons: does not discuss the relationship between ERM artefacts and actors; or does not link this relationship to decision-making and (or) any cognitive aspects; and does not have accounting or management in the journal title.

[Colour figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]



TABLE 1 Web of Science (WoS) search (15 November 2021)

Search number	Search terms and filters	Number of references	Comments
1	Enterprise risk management or ERM or Integrated risk management* (Field: Topic)	39 495	Topic: Searches title, abstract, author keywords and keywords plus
	+ Articles	28 287	
	+ 2000–2021	27 170	
	+ English	26 207	
	<b>Search terms in the title, abstract or keywords</b>	<b>433</b>	

\*Search terms were initially applied based on a ‘title, abstract and keywords’ search to create the first row of the table. The resulting articles (26 207) were screened to ensure their relevance and hence the search terms are included.

Insights from the scoping study and advice from other experts helped us to reformulate our initial research question, which was revised several times to ensure it was both well-defined and answerable (Fan et al., 2022). A third-party expert was asked to conduct independent searches of three academic databases (see Table 4 later), an advantage given the complicated and technical nature of conducting searches in the social sciences (Briner & Denyer, 2012). The insights also led us to choose WoS and Scopus, respectively (see Tables 1 and 2 later) for our main database searches, given that both are interdisciplinary databases that are well attested, considered reliable and have been used by other authors who have conducted systematic reviews previously published in IJMR (e.g., Kohtamäki et al., 2022; Menghwar & Daood, 2021; Zha et al., 2022).

As searches should be carried out in both subject-specific databases and interdisciplinary databases, we supplemented our main searches by conducting searches in PQSSP and BSP (see Table 3 later). The decision to extend the scope of our search further by using multiple databases (Creevey et al., 2022) was taken to make every possible effort to identify results within and across domains (Fan et al., 2022). Author and third-party searches occurred between September 2020 and July 2022.

In *stage 2*, we conducted an exhaustive search for potentially relevant studies using main, supplementary and third-party searches in subject-specific and interdisciplinary databases; the results are reported in the following sub-sections.

## Main searches

The WoS ( $n_1 = 26\,207$ ) search was carried out in mid-November 2021 by the corresponding author (Table 1). The search terms (ERM, integrated risk management) were applied, followed by filters including document type (article), publication years (2000–2021) and language (English). The raw data results were saved to a ‘marked

list’ on the WoS platform. Even though the ‘topic’ field was selected and the database search engine should have identified search terms in the title, abstract, author keywords and keywords plus, the corresponding author discovered—after sifting through the raw data—that many of the results ( $n = 26\,207$ ) did not have the search terms in the title, abstract or keywords.

When the corresponding author conducted an ‘inside the results’ search (which searches ‘all fields’) for ‘enterprise risk management’, the database returned 1827 results. However, when those results were checked most of them did not actually have ERM in the title, abstract or keywords. When the inside search results for ‘ERM’ were examined, the acronym ‘ERM’ frequently referred to something other than ERM, such as empirical risk minimization, primary epiretinal membrane, exchange rate mechanism or enterprise resource management. In addition, when the inside search results for ‘integrated risk management’ were examined, it was clear that the database search engine did the same thing as in the other ‘inside the results’ searches. It included any result that had any word included in the search term, for example, integrated, risk, management. At that stage, we understood, based on peering into the ‘black box’ (Fan et al., 2022), that to identify all relevant studies with the search terms included as they relate to ERM would necessitate manually screening each result in turn, a task that took the corresponding author over 3 weeks to complete, resulting in 433 identified articles.

The shortlisted results ( $n_2 = 433$ ) were uploaded to an EndNote folder and then shared with the second author in preparation for stage 3 ‘initial review’, where both authors individually appraised the contributions according to the initial and detailed review exclusion criteria (Figures 1 and 2). Of the 33 articles included in this review, 10 of those were identified in this search.

A brief analysis of the raw data ( $n = 26\,207$ ) using WoS platform tools confirms that the literature is fragmented, and publications have increased significantly since 2009. This is reflected in the raw data, which spans a wide

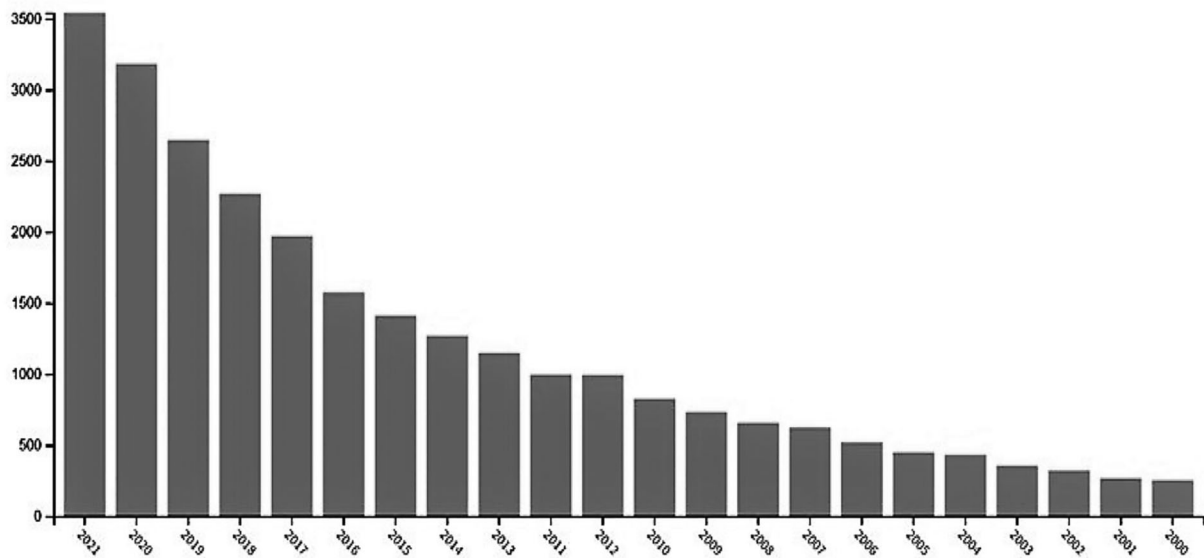


FIGURE 3 Web of Science (WoS) bar chart visualization of publication years for raw data.

variety of fields, reflecting the interdisciplinary nature of ERM research. Environmental Sciences (14.8%) received the highest percentage of results, followed by Water Resources (6.3%) and Management (5.1%). The fact that ERM has become so pervasive in the field of environmental sciences is perhaps an indication of a shift in researcher attention to the growing challenges organizations face in managing and reporting ESG risks (Shad et al., 2019).

The results also spanned several research areas, which explains why the concept and acronym (ERM) have multiple definitions that appear in database searches. Environmental Science Ecology received the most results (18.5%), followed by Engineering (13.5%) and Business Economics (10.5%). The results also spanned diverse countries/regions. The United States accounted for the highest proportion of the results (28.3%), followed by China (14.2%) and the United Kingdom (9%). In Europe, Italy (6.2%) had the highest percentage of the results, followed by Germany (6.1%) and France (4.5%). The distribution of results by year has risen steadily since 2009, accelerating from 2016 onwards (Figure 3).

The second author performed a final database search in Scopus in July 2022 (Table 2) at their institution to ensure our call for a cognitive turn was based on the most extensive and critical literature review possible (Fan et al., 2022). The details of the shortlisted results ( $n = 592$ ) were assembled in an Excel sheet and individually appraised by both authors (initial and detailed screening). This search discovered 26 articles (management journals  $n = 22$ , accounting journals  $n = 4$ ) that were subjected to a detailed review and had not been identified in previous searches. Even though most of these articles were excluded in stage 3 ( $n = 20$ ), this finding validates our decision to conduct multiple aca-

demically database searches over time because databases are continuously updated, some do not include specific journals (Kotthamaki et al., 2022) and subscription policies can change, all of which can affect the results. Of the 33 articles included in this review, 6 were identified in this search.

### Supplementary searches

In October and November 2021, the corresponding and second authors carried out independent supplementary searches in two academic databases at their institutions: PQSSP ( $n = 272$ ) and BSP ( $n = 253$ ), respectively, updating their September 2020 searches (Table 3). The search results were uploaded to separate EndNote folders, assembled in separate Excel sheets and shared between the authors for individual appraisal. Each author identified potentially relevant articles and then compiled a shared list for detailed review. Of the 33 articles included in this review, 1 was identified in the PQSSP search and 5 were identified in the BSP search.

### Third-party searches

In late November 2021, an independent third-party search of BSC ( $n = 1968$ ), PQSSP ( $n = 187$ ) and Scopus ( $n = 254$ ) was conducted (Table 4), updating a previous search conducted by the university library in September 2020. Updating searches improves comprehensiveness and mitigates any biases (Rojon et al., 2021). The WoS database, Scopus database and university library searches did not employ a full-text filter. In addition, the search period

TABLE 2 Scopus search (1 July 2022)

Search number	Search terms and filters	Number of references	Comments
1	TITLE-ABS-KEY (ERM OR Enterprise AND risk AND management OR Integrated AND risk AND management)*	12 698	Searches title, abstract and keywords
	+ Articles	6 960	
	AND (LIMIT TO (DOCTYPE, "ar"))		
	+ 2000–2021	6 698	
	AND (LIMIT TO (PUBYEAR, 2021) ... or LIMIT TO (PUBYEAR, 2000))		
	+2009–2021	5 130	
	AND (LIMIT TO (PUBYEAR, 2021) ... or LIMIT TO (PUBYEAR, 2009))		
	AND (LIMIT TO (LANGUAGE, "English"))	4 620	
	<b>Search terms in the title, abstract or keywords</b>	<b>592</b>	

\*Search terms were initially applied based on a 'title, abstract and keywords' search to create the first row of the table. The resulting articles (4620) were screened to ensure their relevance and hence the search terms are included.

TABLE 3 Supplementary searches

	Search number	Search terms and filters	Number of references	Comments
<b>ProQuest Social Science Premium Collection</b> (29 October 2021)	1	Enterprise risk management or ERM or Integrated risk management*	297 864	Searches 'anywhere'
		Full text	223 980	
		+ Scholarly journals	121 430	
		+ Peer review	114 510	
		+ Articles (Academic journals)	74 084	
		+ 2000–2021	68 384	
		+ 2009–2021	55 455	
		+ in English	54 534	
	<b>Search terms in the title, abstract or keywords</b>	<b>272**</b>		
<b>Business Source Premier via EBSCO</b> (24 November 2021)	1	Enterprise risk management or ERM or Integrated risk management*	53 601	Searches 'all text'
		Full text	24 939	
		+ Scholarly (Peer-reviewed) journals	7 641	
		+ Academic journals	6 707	
		+ 2000–2021	5 421	
		+ 2009–2021	3 192	
	+ in English	3 165**		
	<b>Search terms in the title, abstract or keywords</b>	<b>253</b>		

\*Search terms were initially applied based on a search 'anywhere' in ProQuest (PQSSP) and in 'all text' in Business Source Premier (BSP) to create the first row in each search of the table (no limiters applied).

\*\*The resulting articles (272 + 3165) were screened to ensure their relevance and hence the search terms are included.

in the WoS database and the university library searches was 2000–2021. This provided extra assurance that no non-full-text or pre-2009 items were removed. In all the searches, there were no relevant pre-2009 studies, which is unsurprising given that risk-based management controls were extremely uncommon before 2009 (Metwally & Diab, 2021). The records of the searches were sent to the

corresponding author as PDF documents and ENLX files, which were imported into EndNote and shared with the second author for individual appraisal. Of the 33 articles included in this review, 9 were identified in third-party searches.

Two additional articles are included in the review. These were not found in any of the database searches but were

TABLE 4 Third-party searches (29 November 2021)

	Search number	Search terms and filters	Number of references
<b>Business Source Complete</b>	1	ST: “risk management in business” OR “enterprise risk management” OR “integrated risk management”	51 032
	2	ST: “decision making” OR judgement OR behaviour	320 286
	3	1 AND 2	2 410
	4	3 AND Filter 2000–2021	<b>1 968</b>
<b>ProQuest Social Science Premium</b>	1	ST: (risk management in business) OR (enterprise risk management) OR (integrated risk management)	1 833
	2	ST: (behaviour) OR (judgement) OR (decision making)	1 073 852
	3	1 AND 2	208
	4	3 AND Filter 2000–2021	<b>187</b>
<b>Scopus</b>	1	TITLE-ABS-KEY (“risk management in business”) OR TITLE-ABS-KEY (“integrated risk management”)	1 620
	2	TITLE-ABS-KEY (“decision making”) OR TITLE-ABS-KEY (“behaviour”)	6 115 698
	3	1 AND 2	260
	4	3 AND PUBYEAR>2000	<b>254</b>

identified manually by snowballing (Wahlström, 2009; Woods, 2009).

In *stage 3*, we appraised the contributions by first removing duplicates ( $n = 335$ ) and then conducting initial ( $n = 3624$ ) and detailed reviews on all remaining fully retrieved articles ( $n = 178$ ). The initial reviews were aimed at applying the exclusion criteria to the search results by each author independently, and hence identifying articles discussing the relationship between ERM artefacts and actors, or linking this relationship to decision-making and (or) any cognitive aspects, which also have accounting or management in the journal title ( $n = 194$ ). The number of articles subjected to detailed review was significantly higher for journals with management in the title ( $n = 123$ ) than for journals with accounting in the title ( $n = 71$ ). Each author independently screened the remaining full-text articles ( $n = 178$ ) to identify those relevant to our research question and hence link ERM artefacts explicitly or implicitly to judgement in decision-making. Both authors compiled a selection list, which they then shared in order to compare and reconcile any differences in follow-up meetings. This calibration exercise was important as there is always some element of researcher judgement involved (Rojon et al., 2021). The selected articles ( $n = 33$ , Table 5) were accepted at the conclusion of this stage and advanced to the fourth stage.

Twenty-two articles came from ten accounting journals, one from an interdisciplinary journal and ten from management journals. Interestingly, 7 of the 33 articles are published in *Management Accounting Research* (MAR), a journal that previously acknowledged in one of its edito-

rials (Soin & Collier, 2013) the need for a much broader conceptualization of risk, one encompassing the risks arising from the actions of actors (i.e., decisions) and systems (i.e., risk artefacts) in an increasingly complex environment. Several of the referenced researchers (Corvellec, Hall, Jordan and Mikes) have since taken up this call in studies as part of the artefactual turn (Power, 2016).

In *stage 4*, we analysed and synthesized the selected articles ( $n = 33$ ), which were read in depth by both authors. The corresponding author then created the initial draft of the data extraction table (see Table A1 in the Appendix), recording each study's theory, aim, context, methodology, results and findings, and future research recommendations. The data extraction table structured the descriptive statistics and research question-related data from each article. It also provides a transparent account of the evidence supporting our results and directions for future research, allowing the reader to assess its reliability and validity. These categories were predetermined based on an expert's suggestion and met systematic literature review standards. Both authors cross-validated the table.

As prospectors (Breslin et al., 2020), we needed to critically evaluate the literature in order to develop a new conceptualization of the ERM–MJDM relationship. This requires going beyond identifying patterns of consensus using established frameworks (Breslin et al., 2020); it necessitates challenging and advancing the building blocks upon which the field has developed (Post et al., 2020) by interrogating the evidence. In the first step of the synthesis, four main thematic categories emerged inductively from the literature. In the second step, 17

TABLE 5 Final selection of articles

Journal name	Discipline/sub-discipline	Impact factor	Year	Number of articles	References
<i>Accounting Organizations and Society</i>	Interdisciplinary	4.0 (2020)	2010	1	Arena et al. (2010)
			2011	1	Mikes (2011)
			2017	1	Arena et al. (2017)
			2020	1	Posch (2020)
<i>Management Accounting Research</i>	Accounting/Management Accounting	3.688 (2020)	2009	3	Mikes (2009), Wahlström (2009), Woods (2009)
			2013	2	Jordan et al. (2013), Tekathen and Dechow (2013)
			2015	1	Hall et al. (2015)
<i>European Accounting Review</i>	Accounting	3.208 (2020)	2016	1	Giovannoni et al. (2016)
			2019	1	Tekathen (2019)
<i>Critical Perspectives on Accounting</i>	Accounting	5.538 (2021)	2021	1	Klein and Reilley (2021)
<i>Journal of Management Accounting Research</i>	Accounting/Management Accounting	Not provided	2018	1	Braumann (2018)
			2020	1	Ittner and Oyon (2020)
<i>Accounting Horizons</i>	Accounting	Not provided	2017	1	Stoel et al. (2017)
<i>Managerial Auditing Journal</i>	Accounting/Auditing & Assurance	1.905 (2020)	2011	1	De Zwaan et al. (2011)
			2015	1	Rooney and Cuganesan (2015)
<i>British Accounting Review</i>	Accounting/Interdisciplinary	5.77 (2020)	2017	1	Meidell and Karrbøe (2017)
<i>Accounting Forum</i>	Accounting/Interdisciplinary	2.875 (2020)	2015	1	Jabbour and Abdel-Kader (2015)
<i>International Journal of Accounting Information Systems</i>	Accounting/Information Systems	5.111 (2021)	2011	1	Arnold et al. (2011)
<i>Qualitative Research in Accounting &amp; Management</i>	Interdisciplinary/Accounting & Management	1.489 (2020)	2016	1	Jabbour and Abdel-Kader (2016)
<i>Journal of Enterprise Information Management</i>	Information Management	5.396 (2020)	2019	1	Kim (2019)
<i>Management Decision</i>	Management/Interdisciplinary	4.957 (2020)	2021	1	Crovini et al. (2021)
<i>Management Research Review</i>	Management	Not provided	2020	1	Nielsen and Pontoppidan (2020)
<i>Risk Management</i>	Management/Financial Risk Management	2.231 (2020)	2009	1	Kallenberg (2009)
			2012	1	Donnelly et al. (2012)
<i>Scandinavian Journal of Management</i>	Management	2.433 (2020)	2014	1	Christiansen and Thrane (2014)
<i>Journal of Contingencies and Crisis Management</i>	Management	4.391 (2020)	2010	1	Corvellec (2010)
<i>Journal of Contemporary Management Issues</i>	Management	Not provided	2021	1	Nasteckienė (2021)
<i>International Journal of Energy Sector Management</i>	Management	Not provided	2010	1	Muralidhar (2010)
<i>International Journal of Customer Relationship Marketing and Management</i>	Management	Not provided	2021	1	Diab and Metwally (2021)

(1) The following articles were identified in the main searches. In WoS: Arena et al. (2017), Caldarelli et al. (2016), Christiansen and Thrane (2014), Crovini et al. (2021), Ittner and Oyon (2020), Jordan et al. (2013), Mikes (2009), Nielsen and Pontoppidan (2020), Posch (2020), Tekathen and Dechow (2013). In Scopus: Arnold et al. (2011), De Zwaan et al. (2011), Diab and Metwally (2021), Klein and Reilley (2021), Muralidhar (2010), Nasteckienė (2021).

(2) The following articles were identified in the supplementary searches. In PQSSP: Kallenberg (2009). In BSP: Braumann (2018), Giovannoni et al. (2016), Jabbour and Abdel-Kader (2015), Stoel et al. (2017), Tekathen (2019).

(3) The following articles were identified in the third-party searches: Arena et al. (2010), Corvellec (2010), Donnelly et al. (2012), Hall et al. (2015), Jabbour and Abdel-Kader (2016), Kim (2019), Meidell and Kaarbøe (2017), Mikes (2011), Rooney and Cuganesan (2015).

factors emerged, which further disaggregated these themes and thus improved the detail, quality and value of the synthesis.

In *stage 5*, extracted data was synthesized and is presented at the beginning of the results section (see Table 6 below), reflecting the most prominent thematic categories and factors, in accordance with established review guidelines (Gruner & Soutar, 2021). This is followed by a discussion of contextual, technical, social and cognitive factors. The synthesis serves as the basis for advocating for a cognitive turn in future research.

## RESULTS

This systematic review assesses the current state of knowledge regarding the relationship between ERM artefacts and MJDM as a subset of the broader processes examined in accounting and management research. Our review identifies four distinct yet related categories of factors relevant to the relationship between ERM and MJDM, which when integrated (Briner & Denyer, 2012) answer our research question, help us argue for a cognitive turn in ERM and suggest future research directions. Table 6 summarizes the four categories, their factors and examples from the selected literature illustrating the relationship between ERM and MJDM.

In the remainder of this section, we explore these categories further, to identify the outer boundary of current knowledge (Rojon et al., 2021).

### Contextual factors

We identified four contextual factors relevant to the relationship between ERM and MJDM: *country location, regulation and corporate governance, sector and industry affiliation* and *environmental uncertainty and strategic change*. Our analysis and synthesis indicate that contextual factors appear to have an effect on the relationship between ERM and MJDM; however, insights are limited.

It is difficult to determine the extent to which country location affects MJDM because the majority of studies in this review were conducted in a few European countries (Italy, Norway and Sweden) and the United Kingdom. In studies conducted outside Europe, and in contexts where ERM as a concept and practice is still in its infancy, there are concerns about ERM's ability to care for vulnerable constituencies where a long-term emphasis on environmental and social values, as opposed to short-term economic goals, is vital. While this suggests that country location may impact MJDM, this is merely speculation

and thus warrants future research, as called for by Diab and Metwally (2021), Klein and Reilley (2021) and Nasteckienė (2021). Notably, managerial decision-making styles in Scandinavian countries favour inclusive and decentralized decision-making in managing risks (Kallenberg, 2009; Meidell & Kaarbøe, 2017; Wahlström, 2009). Although these studies shed light on how culture affects control and decision-making, they do not explicitly discuss the relationship between specific cultures or their implications for MJDM.

We find sufficient evidence to suggest that regulatory and corporate governance regimes, particularly those governing the financial industry (which is influenced by economic imperatives), promote judgement and decision-making practices that rely heavily on the implementation and use of highly technical risk calculation and modelling artefacts (Diab & Metwally, 2021; Jabbour & Abdel-Kader, 2015, 2016; Mikes, 2009, 2011; Wahlström, 2009). However, these artefacts are rarely used outside the financial industry. When organizations combine economic and social imperatives (Caldarelli et al., 2016), the way artefacts are used in judgement and decision-making changes. This is because the social value of any potential investment becomes more prominent, expanding the scope of unquantifiable risks and necessitating a greater reliance on experience-based judgement (Caldarelli et al., 2016).

Environmental uncertainty and strategic change also seem to have an effect on MJDM in relation to the choice of artefacts and to risk decisions (Kim, 2019; Meidell & Kaarbøe, 2017; Muralidhar, 2010), as they are associated with wicked rather than tame problems; they necessitate the use of alternative judgement and decision-making approaches, as wicked problems do not readily lend themselves to the application of highly technical risk artefacts. According to studies included in this review, problems characterized by a high degree of uncertainty and strategic change may necessitate distinct modes of judgement and higher levels of social interaction and cognitive effort when making judgements and decisions (Donnelly et al., 2012; Kim, 2019; Meidell & Kaarbøe, 2017; Posch, 2020).

The prevailing forms of ERM emerging in individual organizations, even within the same industry, are not solely determined by a single contextual factor, but rather by the dynamics between contextual factors and technical, social and cognitive factors (Muralidhar, 2010). In practice, established and unique forms of ERM frequently result from an ongoing and tension-filled compromise between external drivers of change and the diverse preferences of different groups of actors within the organization. The contextual factors identified in this review provide a fertile departure point for future research, as previously called for by Ittner and Oyon (2020).

TABLE 6 Synthesis of selected studies

Factor category	Factors identified in the literature	Illustrative examples of the factor's relationship to managerial judgement in decision-making
Contextual	Country location	National preferences promote certain managerial and decision-making styles (Diab & Metwally, 2021; Kallenberg, 2009).
	Regulation and corporate governance	Regulation and corporate governance can influence ERM design and implementation (Caldarelli et al., 2016; Jabbour & Abdel-Kader, 2015, 2016; Mikes, 2009; Woods, 2009) and risk rationalities (Arena et al., 2010). In addition to regulators, ratings agencies and reinsurance firms can also push firms to adopt ERM, with a strong compliance orientation (Diab & Metwally, 2021).
	Sector and industry affiliation	Sector and industry affiliation have an impact on how, and in relation to what, risk impacts are judged (Woods, 2009), as well as whether formal or informal risk management processes are implemented (Crovini et al., 2021).
	Environmental uncertainty and strategic change	Environmental uncertainty and strategic change affect the ability to predict and quantify risks (Donnelly et al., 2012), they promote the introduction of new ERM artefacts (Meidell & Kaarbøe, 2017) and they also affect risk management knowledge (Kim, 2019) and risk-focused information sharing (Posch, 2020). ERM is essential to managing uncertainty and builds business resilience (Muralidhar, 2010).
Technical	Organizational structure	Organizational structure (i.e., bundles of arrangements and practices) contributes to prefiguring certain courses of action (Tekathen, 2019). ERM structures influence human awareness and perception (Muralidhar, 2010).
	Pre-existing control systems	Pre-existing control systems can lead to the emergence of tensions between management accounting and ERM, thus affecting the urgency of understanding and controlling future threats (Arena et al., 2010; Giovannoni et al., 2016). Pre-existing control systems can be superseded by new risk technologies when the latter is perceived as important for restoring the reputation of the organization (Diab & Metwally, 2021).
	Centralized vs. decentralized ERM	Centralized vs. decentralized ERM affects the level of decision-making autonomy that lower-level management has (Kallenberg, 2009; Wahlström, 2009).
	ERM framework sophistication	More sophisticated ERM facilitates information sharing across distributed actors (Woods, 2009), increases the level of information and knowledge required to construct accurate risk statements (Donnelly et al., 2012), can be used to manage different information processing boundaries (Arena et al., 2017) and can be used to gain influence on decision-making (Meidell & Kaarbøe, 2017). Strategic ERM processes necessitate the ability to share broad information (Arnold et al., 2011).
	ERM artefact design, reconfiguration and use	Experts and technologies continually evolve together via circular dynamic interactions (Arena et al., 2010). Complex risk artefacts used to calculate and model risks are black-boxed and less malleable in their design and use when compared to risk artefacts used for risk envisionment (Jordan et al., 2013; Mikes, 2011). Information produced or represented by highly technical and quantitative risk artefacts tends not to generate organizational action (Christiansen & Thrane, 2014), unless it includes information and knowledge from other managers that is considered relevant for decision-making (Hall et al., 2015) and such risk artefacts are embedded into daily managerial activities (Nastekiené, 2021). For strategic risks, artefacts that provide qualitative data increase the perceived relevance and reliability of that information (Stoel et al., 2017). Decision uncertainty can be increased or decreased by using risk measurement artefacts (Mikes, 2011), and certain risk artefacts can increase risk awareness amongst distributed actors (Braumann, 2018; Woods, 2009). Risk artefacts can also be used to enhance dialogue and define boundaries, facilitating coordination amongst distributed actors (Jordan et al., 2013).

(Continues)

TABLE 6 (Continued)

Factor category	Factors identified in the literature	Illustrative examples of the factor's relationship to managerial judgement in decision-making
Social	Risk cultures	Risk cultures shape managerial preferences for ERM practices (Diab & Metwally, 2021), including risk measurement vs. risk envisionment. The value of human judgement varies depending on the risk culture (Mikes, 2009, 2011). Differences between risk cultures may lead to tensions between risk and business managers concerning the usefulness of risk artefacts in forming judgements and making decisions about risk and uncertainty (Kallenberg, 2009; Wahlström, 2009). These tensions may serve as a catalyst for actors to exercise their agency to change how risk artefacts are designed and used in the future (Arena et al., 2010; Jabbour & Abdel-Kader, 2015). Risk culture also has a pervasive effect on shifting cognition and redefining identities so that they may be aligned with the risk management system (Diab & Metwally, 2021).
	Social capital, interactions and spaces	Risk artefacts and interpersonal relations can facilitate risk managers' ability to increase their social capital as a means to gain access to decision-makers (Hall et al., 2015) and strengthen their strategies of justification for why some events should be treated as risks and not others (Corvellec, 2010). Social interactions characterized by flexible and reflexive discussions (Tekathen & Dechow, 2013) are an important prerequisite for information and knowledge sharing and for gaining wider organizational support in decision-making (Donnelly et al., 2012) via influence activities, such as issue-selling and sense-giving (Meidell & Kaarbøe, 2017). Social interactions (e.g., meetings) are also important for managers to be able to align their perceptions of risk (Nasteckienė, 2021).
	Individual or distributed risk ownership	Individual or distributed risk ownership influences the number of business functions participating in cross-functional decision-making. It also affects the number of risk planning tools that are used, as well as whether risk communication is narrow (focused on hard metrics) or broad (focused on soft information) (Ittner & Oyon, 2020). Individual risk ownership is more aligned to siloed risk management, while distributed risk ownership is aligned to holistic and integrated risk management (Mikes, 2009).
Cognitive	Cognition and culture	Cognition and culture are linked through individual and group beliefs and value systems, which can be intentionally altered to institutionalize new risk ideas in the minds of employees (Diab & Metwally, 2021). Beliefs influence the intentions of actors towards risks (Kim, 2019) and artefacts (Wahlström, 2009), for example, if actors believe that ERM will improve decision-making or not (Jabbour & Abdel-Kader, 2016). Risk awareness is conceptualized as a cultural concept (Braumann, 2018), but it is also a cognitive concept in that it is related to risk knowledge (Kim, 2019, 'awareness-knowledge') at the individual and group level (Crovini et al., 2021).
	Cognition and professional attributes	Technical and social skills, expertise and knowledge, facilitated by education, professional background and training, influence actors' cognitions, which in turn influence toolmaking and activities (Hall et al., 2015), for example, risk experts assisting others' cognitive endeavours when conducting risk assessments (Donnelly et al., 2012). Fluid professional boundaries can result in professionals engaging in activities that influence ERM processes and managerial decision-making in a manner that was not intended or sanctioned (De Zwaan et al., 2011).
	Conceptualizations	Organizations, groups and individual actors vary in their conceptualizations of what risk is. These conceptualizations may be based on risk rationalities (e.g., what risks regulators focus on) (Arena et al., 2010) or values based on the notion that risks emerge when something of value is threatened. Values evolve and emerge from the interactions between humans and risk artefacts in managerial practice (Corvellec, 2010). Tensions emerge between short- and long-term values in practice, tensions which ERM may not be able to reconcile (Klein & Reilley, 2021).

(Continues)



TABLE 6 (Continued)

Factor category	Factors identified in the literature	Illustrative examples of the factor's relationship to managerial judgement in decision-making
	Perceptions	Perceptions affect the level of acceptance for ERM implementation (Kallenberg, 2009) and ERM artefacts (Diab & Metwally, 2021), based on pre-existing frames of reference (Wahlström, 2009). Perceptions are influenced by risk information format (Stoel et al., 2017) and perceptions determine how risks will be treated (Kallenberg, 2009). Tensions can emerge when ERM framework priorities are in conflict with actors' perceptions, leading to resistance (Donnelly et al., 2012). When making decisions, actors make trade-offs between their own interests and organizational goals. Those trade-offs are influenced by actors' perceptions of their role in implementing risk strategies (Rooney & Cuganesan, 2015). Perceptions are closely linked to risk management knowledge, as actors perceive and judge their own skills and knowledge (Kim, 2019).
	Awareness	Changes in risk awareness can shift conceptualizations of risk from narrow risk–return metrics to broader holistic strategic risks (Giovannoni et al., 2016), thus enabling managers to identify and evaluate risks that must be considered in the corporate strategy (Braumann, 2018). Risk awareness can be embedded in business management, even if formal ERM systems are not implemented (Kim, 2019).

## Technical factors

We identified five technical factors relevant to the relationship between ERM and MJDM: *organizational structure, pre-existing control systems, centralized versus decentralized ERM, ERM framework sophistication and ERM artefact design, reconfiguration and use.*

According to the literature, organizational structure influences judgement in decision-making by creating a space for artefact and actor interactions. While, ideally, this space should be conducive to intelligible thought to establish intelligent and reflexive forms of risk management (Power, 2004; Tekathen & Dechow, 2020), this is not always the case (Jordan et al., 2013; Wahlström, 2009). Organizational structure prefigures rather than determines paths to action (Tekathen, 2019), therefore the structure is understood to have both an enabling and a constraining effect on actions (decisions), as certain actions are rendered intelligible in relation to a particular goal or objective, and others are not. The capacity of organizational and indeed ERM structures (Muralidhar, 2010) to create intelligible rather than tension-filled spaces warrants further attention, especially research aiming to understand how the interaction of risk artefacts and actors can create mindful awareness in decision-making situations characterized by high levels of uncertainty (Jordan et al., 2013).

The presence of pre-existing control systems provides an opportunity to explore ERM's relationship with other control systems in terms of tensions and complementarities. While it is evident from the literature that tensions emerge when ERM is implemented alongside established

management control systems (Diab & Metwally, 2021; Giovannoni et al., 2016), little is known about the potential complementarities between ERM and other control systems. Evidence suggests the distance observed between ERM and strategic decision-making could be reduced by integrating risk information generated by ERM into planning and budgetary controls, making organizational actors more cognisant of the relationship between risk, strategy and performance, and making risk more pervasive by raising risk awareness in decision-making (Arena et al., 2010; Nasteckienė, 2021). This warrants further investigation, and several researchers have called for research examining the integration of risk management into business and decision processes (Arena et al., 2017; Meidell & Kaarbøe, 2017).

Centralized versus decentralized ERM practices have received little explicit attention in the literature. However, Kallenberg (2009) highlights how country location and industry affiliation influence in-practice preferences for centralized or decentralized decision-making. Both Kallenberg (2009) and Wahlström (2009) observe that Swedish companies prefer decentralized decision-making, usually resulting in increased autonomy for lower-level managers, an observation that has been confirmed by other Swedish-based studies (Crawford & Nilsson, 2021). This issue warrants further research, as it is unclear what the benefits and challenges of decentralized decision-making are in relation to managing risk and uncertainty. One could assume it may lead to higher levels of organizational agility when responding to local risks, but it could also create coordination and information-gathering

problems at the entity level, as well as tensions between different groups when implementing ERM (Wahlström, 2009).

ERM framework sophistication is found to be important for increasing risk information and knowledge, as well as information-sharing capacity across distributed actors and boundaries. Yet, the determinants of ERM sophistication are unclear. Current conceptualizations of ERM sophistication focus on information system integration for risk data-sharing. However, according to accounting scholars, an integrated data infrastructure is the minimum level of integration a system must possess in order to be considered integrated (Chapman & Kihn, 2009). ERM practices are shown to oscillate between technical IT-based representations containing quantitative and qualitative data about risk and uncertainty (dubbed 'qualification') and social interpretations based on purposeful dialogue between groups in different parts of the organization (Tekathen & Dechow, 2013). Given limited insights, we argue that future research on the sophistication of ERM frameworks requires a broader conceptualization, which considers a much broader set of integrating devices (Arena et al., 2017) and social and cognitive factors identified in this review.

ERM artefact design, reconfiguration and use are central to the ERM–MJDM relationship. The dynamic interactions between artefacts and actors demonstrate how varied the effects of those interactions are on how actors evaluate risk and uncertainty and what actions they decide to take, if any. While attempts are sometimes made by tool-makers (Hall et al., 2015) to front-load judgements into artefact designs for various reasons (e.g., to exert control or to reduce cognitive dissonance in decision-making), there is always a space between risk identification, assessment and action, exposing the non-linear and complex relationship between ERM and MJDM (Christiansen & Thrane, 2014; Nasteckienė, 2021). This space also exposes an underlying fallacy, common in accounting research, that tools will be used as designers intended and influence actors in obvious and desirable ways (Bromiley et al., 2015). ERM artefacts that are designed, reconfigured and used for enabling rather than controlling management are repeatedly shown in the literature to be more widely accepted and embedded in decision-making (Hall et al., 2015). Therefore, this is yet another area warranting further research.

## Social factors

We identified three social factors relevant to the relationship between ERM and MJDM: *risk cultures, social capital interactions and spaces* and *individual or distributed risk ownership*.

The identification of two distinct risk cultures over a decade ago significantly contributed to our understanding of social factors in ERM. From an MJDM perspective, it is important to observe how the choice of risk culture alters the dynamics between artefacts and actors. This is best illustrated by how different risk cultures have different implicit benchmarks for evaluating human judgement performance, that is, based on economic or psychological frameworks (Hogarth, 1991). While Mikes' (2009) identification of two distinct risk cultures in the financial industry suggests that organizations tend to choose one or the other based on factors other than their exposure to strategic uncertainty, this conceptualization understates the pluralistic nature of risk cultures beyond calculation and envisionment that can be observed in other types of organizations, such as SMEs (Crovini et al., 2021). Given the importance of balancing technical and social factors in identifying and managing risk and uncertainty effectively (Jean-Jules & Vicente, 2021), additional research into how cultural elements of ERM (Braumann, 2018) contribute to this balance is warranted.

Social capital, interactions and spaces are found to be critical for gaining influence and broad organizational support for strategic decisions. While risk artefacts mediate and coordinate relations between different groups of actors (Jordan et al., 2013), their limitations in the face of uncertainty require the mobilization of social competencies to erode the barriers between different roles, knowledge domains and political agendas. Recognition of these factors has resulted in calls for research on social interaction and social network structures in ERM (Arena et al., 2010), and the extrinsic and intrinsic factors influencing risk management participants' behaviours and decisions (Rooney & Cuganesan, 2015). Individual and distributed risk ownership is closely connected to the aforementioned aspects because different risk ownership models influence who participates in decision-making, what risk tools are used and what is included or excluded in the risk talk (Arena et al., 2017; Klein & Reilley, 2021; Mikes, 2016) taking place in those social interactions and spaces. Thus, it is expected that distributed risk ownership is aligned with an integrated risk management approach (Jabbour & Abdel-Kader, 2015; Mikes, 2009).

## Cognitive factors

We identified five cognitive factors relevant to the relationship between ERM and MJDM: *cognition and culture, cognition and professional attributes, conceptualizations, perceptions* and *awareness*.

Individual and distributed cognitive engagement with risk and uncertainty is found to be shaped by technical

and social factors to varying degrees (Arena et al., 2017; Diab & Metwally, 2021; Hall et al., 2015; Mikes, 2011). However, cognitive factors such as human conceptualization, perception and awareness have a significant effect on the design, implementation and use of ERM, and how use changes over time (Arena et al., 2010; Braumann, 2018; Kim, 2019; Klein & Reilley, 2021; Rooney & Cuganesan, 2015).

The relationship between cognition and culture is significant in that beliefs influence actors' intentions towards risk (Kim, 2019), including how they perceive different types of risk and risk artefact usefulness (Nasteckienė, 2021; Wahlström, 2009). Much of our understanding of the relationship between cognition and culture comes from studying organizations in the financial industry, where regulators pushed banks to implement cultural changes following the financial crisis in order to improve organizations' ability to balance risk-taking and control in decision-making (Power et al., 2013), as reflected in the ERM literature (Mikes, 2009). However, many of these organizations have been compelled by regulators to adopt a risk culture, making it difficult to assess the generalizability of insights about the relationship between cognition and culture in terms of effects on awareness (Braumann, 2018) outside of the financial industry.

The relationship between cognition and professional attributes is also found to be significant. Professional background, education, expertise and training are all found to shape the dynamics between technical and social factors. This is especially salient in the approach risk experts take when designing and implementing risk tools (Hall et al., 2015), and if and in what ways they help business managers in the cognitively demanding work of risk identification and evaluation (Donnelly et al., 2012). It is also evident in situations where actors such as internal auditors cross the boundaries of their professional role to implicate themselves in managerial decisions concerning risk and uncertainty (De Zwaan et al., 2011). These examples show how professional attributes can shape actors' cognitions, impacting the technical and social aspects of ERM in practice (Jabbour & Abdel-Kader, 2016).

How risk and uncertainty are conceptualized is critical to ERM practice and we find that conceptualizations, like perceptions, are diverse. Conceptualizations may emerge from contextual factors such as regulation (Arena et al., 2010), or from organizational, group or individual values, which sometimes materialize from the interactions between artefacts and actors (Corvellec, 2010).

Accounting and management scholars recognized the importance of human perception for ERM practice early on (Donnelly et al., 2012; Kallenberg, 2009; Wahlström, 2009). However, the theories and methodologies used

limited further investigation beyond how actors perceive risk artefacts in the relationship between risk and uncertainty—conceptualization, perception, evaluation and action. Subsequent research using cognitive (Stoel et al., 2017) and behavioural theories (Kim, 2019) has enhanced our understanding of the ERM–cognition relationship. Similarly, research exploring how shifts in awareness expand managerial conceptions to include a much broader range of strategic risks into corporate decision-making (Braumann, 2018; Giovannoni et al., 2016) has also been conducted. Researchers have emphasized the importance of linking contextual, technical and social factors to cognition as part of a future research agenda (e.g., Crovini et al., 2021; Nielsen & Pontoppidan, 2020). Therefore, we would argue the foundation for a cognitive turn in ERM research already exists, but must be made explicit and supported. Before concluding this review, we will discuss in greater detail how this can be accomplished in the following section.

## DISCUSSIONS AND DIRECTIONS FOR FUTURE RESEARCH

Our review identifies four distinct but linked categories of ERM-related factors associated with judgement in managerial decision-making. Insights from these categories demonstrate a range of inconsistencies between the ideological notions of ERM promoted by sponsoring organizations, as assisting management in better understanding and managing uncertainty, and the diverse practices reported in individual organizations.

While much of the early literature emphasized tensions rather than complementarities between ERM artefacts and actors, these insights come from organizations that implemented ERM early on. These tensions possibly resulted from, for example, resistance to change, power redistribution and internal/external pressure. Therefore, several papers have called for additional research to investigate changes in these tensions and dynamics (Arena et al., 2010; Mikes, 2009), including studies to determine under what conditions ERM artefacts are applicable in decision-making situations involving strategic uncertainty (Mikes, 2011). This call lends itself well to the further exploration of wicked problems (Rittel & Webber, 1973), which, in comparison to tame problems, are less amenable to the application of artefacts used to calculate risks (Mikes, 2011; Tekathen & Dechow, 2013).

As ERM research has progressed, we find that ERM artefacts are increasingly mobilized in the cognitively demanding work of risk management, where they are valued not for their fact-generating capabilities but for their capacity to engage distributed actors (Jordan et al., 2013) in

reflexive and dynamic social spaces where individual opacity about risk and uncertainty can be overcome (Tekathen & Dechow, 2013). This, we argue, demonstrates that ERM practices are significantly affected by social and cognitive factors, and these factors interact with MJDM (Jeitziner et al., 2017; Vasvári, 2015).

There is significant variation in the literature concerning the relationship between ERM and human cognition. This variation is most salient in debates about whether ERM artefacts reduce or amplify cognitive uncertainty in decision-making (Meidell & Kaarbøe, 2017; Tekathen & Dechow, 2013). This is an important issue that warrants further attention, as ERM has an important role in integrating competing conceptions of risk (Ben-Ari & Or-Chen, 2009). According to our analysis, artefacts mitigate cognitive uncertainty in situations where the artefact's representation of risk and the actor's conceptualization of risk are consistent, and thus there is no fundamental challenge to how actors perceive certain risks (Stoel et al., 2017). Yet, artefacts can also increase cognitive uncertainty by pushing information into decision situations where it is not perceived as useful, accurate or relevant to the decision at hand (Tekathen & Dechow, 2013). This is best illustrated by the emergence of competing views on why certain events are classified as risks and others are not (Corvellec, 2010). Artefacts used to calculate and represent risks, and actors' mental models, both contribute to framing the decision problem and the identification of potential solutions (Birnberg et al., 2006; Oblak et al., 2018). However, when multiple competing mental models and risk artefacts are present in the same decision situation, and when the level of uncertainty relative to risk increases, things become more complicated. Probabilistic judgements and the usefulness of artefacts in decision-making become limited, and there is an increased risk of inter-group conflict that can pose barriers to knowledge sharing and learning (Tekathen & Dechow, 2013; Wahlström, 2009)—particularly if those artefacts are only used to support information processing at the syntactic boundary and ignore the semantic and pragmatic boundaries (Arena et al., 2017).

Unfortunately, we find that the existing literature pays scant attention to these issues, or even makes a distinction between individual and group judgements in decision-making. This is not uncommon in social studies of finance and accounting, which commonly lack a collective or systems-oriented perspective (Harris et al., 2016; Jack & Kholeif, 2007). Therefore, future research on ERM must broaden to include other types of judgement based on intuition, experience and expertise, as well as other types of decisions, such as those involving the resolution of wicked problems, which require intelligent forms of judgement in the face of increased ambiguity (Jollineau & Durkin, 2018).

The early distinction between risk measurement and envisionment cultures in the literature has framed judgement in two distinct modes: mathematical/statistical-based judgement and qualitative expert-based judgement. Organizations are portrayed as preferring one mode of judgement over the other and are rarely able to integrate the two. For ERM to influence decision-making, a third, hybrid approach, referred to as 'qualculation' is required (Tekathen & Dechow, 2013), if knowledge and other boundaries are to be overcome. If, and how, these syntactic, semantic and pragmatic boundaries to information and knowledge sharing can be overcome is highly contested in the literature (Arena et al., 2017; Jordan et al., 2013; Meidell & Kaarbøe, 2017; Mikes, 2011), highlighting a recurrent underlying theme in the literature—ERM integration.

In contrast to earlier studies, researchers have become increasingly curious about the socio-cognitive aspects of ERM. Different types of fit are discussed which address the relationship between risk artefacts and human cognition in more detail. Information fit emphasizes the importance of matching information format to specific users. Cognitive fit illustrates the relationship between human perceptions of information usefulness and judgement. Closely related to perceptions is the role of mindset towards ERM and resultant effects, that is, the capacity for ERM to make actors more aware of risk. The fluidity of ERM, as illustrated in so many of the studies included in this review, leaves the question of ERM's capacity to integrate the entire organization, as COSO suggests, unanswered.

While the extant literature has provided some early indications of contextual, technical, social and cognitive factors relevant for the further exploration of the relationship between ERM and MJDM, further work is needed to explore these factors in greater detail and how they may be related to each other. This, we believe, can be achieved by taking a cognitive turn in ERM research. It may also be worth noting that the insights gained from the analysed studies are reached using a limited variety of research methods (see Table A1 in the Appendix). However, studies have recently used methods/approaches that could be more useful when studying cognitive phenomena (e.g., observations, experiments, ethnographic approaches and exploratory statistical methods).

### Directions for future research: Theoretical development

This review reveals that little is known about ERM's influence on human judgement in decision-making, yet organizations are littered with artefacts commonly used

in ERM processes. While considerable progress has been made in developing and applying risk artefacts to predict risk based on probability calculations and applied to tame problems, we find few examples of risk artefacts used to envision wicked problems characterized by uncertainty and ambiguity. This is concerning, as ‘many of the biggest risks confronting humanity cannot be well defined, much less neatly quantified’ (Hardy et al., 2020, p. 1055).

Some researchers were early in identifying the importance of cognition in ERM, by highlighting how cognitive factors influence human perceptions. This was an important development, one we interpret as reflecting the wider ‘cognitive revolution’ (Butler et al., 2016 quoting Hannah et al., 2013), evident in accounting, management and strategy literatures (Eggers & Kaplan, 2013; Ferreira et al., 2016; Hall, 2008, 2016; Hockerts, 2015; Libby, 2001; Michel, 2007; Narayanan et al., 2011; Oblak et al., 2018; Okamoto, 2014). This revolution has resulted in a greater understanding of how mental processes account for human behaviour. Studies conducted in the context of organizational cognitive neuroscience have advanced our understanding of financial risk in decision-making, calling into question several long-held tenets of economic decision theory (Butler et al., 2016).

Growing interest in cognition has recently drawn accounting and management researchers to evaluate what developments<sup>3</sup> in other fields (e.g., social psychology and cognitive neuroscience) can contribute to resolving current issues in their respective areas (e.g., auditor scepticism; Olsen & Gold, 2018 and conceptualizing uncertainty regulation; Griffin & Grote, 2020). These examples support our call for using a greater variety of research methods (i.e., laboratory experiments, verbal protocols and theoretical models; Birnberg & Ganguly, 2012).

This review also revealed that the cognitive revolution visible elsewhere in accounting and management research has yet to make a significant impact on shaping the future of ERM research. We find a limited variety of theories useful for studying cognition in articles included in this review, limiting insights into the cognitively demanding work managing risk entails. Researchers from accounting and management need to engage with developments in the cognitive sciences (Miller, 2003) to advance understandings of actors’ judgements in ERM decision-making.

We already see evidence of proposed shifts in that direction, for example, Trotman et al. (2015) call for researchers to examine within-firm group interactions concerning shared mental models as part of a future research agenda in auditing. Bromwich and Scapens (2016) have suggested

incorporating psychological theories into contingency-based research. Additionally, the emergence of the institutional logics perspective in institutional theory opens new links to cognitive psychology, which researchers will undoubtedly find useful (Thornton et al., 2012). Some ERM researchers are already taking steps in this direction (Kim, 2019; Tekathen, 2019).

Building on insights from this review, we conceptualize ERM as a system shaped by contextual factors and composed of technical, social and cognitive factors, some of which are already identified in the literature (Table 6). Our findings demonstrate that human cognition, above all else, significantly impacts ERM design, implementation and use, and how those change over time. In conceptualizing ERM in this way, we view cognition as distributed across artefacts, social interactions and time. While this view recognizes the processes of interpretation individuals use to give meaning and make sense of organizational life, it also acknowledges that cognition is distributed and recognizes that the cognitive capabilities of groups engaged in decision-making differ from those of individuals (Jollineau & Durkin, 2018)—an important distinction not evident in the extant literature on ERM.

Adopting theories suitable to study the relationship between ERM and MJDM could complement and extend previous work by shifting the focus away from individual artefacts towards the relationships and interactions between technical, social and cognitive factors that make up the ERM system, which have been found to be related to MJDM. So what options are available?<sup>4</sup>

Several studies draw on the sensemaking literature, and opportunities exist for theoretical development (Sandberg & Tsoukas, 2015). New insights into the cognitively demanding work of risk management can be gained by shifting from a retrospective to a prospective view on sensemaking (i.e., expectations of the future under ambiguity) by developing new concepts that investigate ‘more genuine forms of prospective sensemaking, such as strategic discussions’ (Sandberg & Tsoukas, 2015, p. 36). In addition, the analytical separation of perceptions from thought and action needs to be addressed (Sandberg & Tsoukas, 2015). Some researchers are contributing to this development by incorporating concepts such as sense-giving and issue-selling into their theoretical frameworks (Meidell & Kaarbøe, 2017).

Concepts such as mediated sensemaking (Strike & Rerup, 2016) can also advance our understanding of the

<sup>3</sup> In terms of identifying new research questions, determinants and theories.

<sup>4</sup> It is beyond the scope of this paper to give a comprehensive overview of each perspective, however, we will highlight certain features of each perspective below and how they can be useful in understanding ERM as a cognitive system comprising technical and social elements, as a basic introduction.

ERM role in decision-making under uncertainty, especially where groups engage across boundaries and use risk artefacts to make judgements and take decisions about future events on an ongoing rather than an episodic basis. Extending the view of sensemaking to something that is adaptive (i.e., actors continually reframing their view of risk and uncertainty) and unfolds across, and not just within, boundaries (Strike & Rerup, 2016) is in line with our arguments. The application of such developments to the sensemaking perspective (and underlying notions such as sense-giving and issue-selling), along with mediated sensemaking, can provide a more appropriate theoretical basis and hence analytical tools to examine MJDM. So too can research investigating how technologies influence organizational sensemaking, an area where studies are currently lacking in the sensemaking literature (Sandberg & Tsoukas, 2015). Providing an understanding of these matters is key, as organizations attempt to integrate ERM with strategy and performance. Developing sensemaking as suggested would follow the 'strong cognitivist origins' of sensemaking (Sandberg & Tsoukas, 2015, p. 8).

The sensemaking perspective could also be developed by drawing inspiration from distributed cognition theory and activity theory. Distributed cognition theory proposes that sensemaking extends to material settings (e.g., organizational structure), artefacts (e.g., risk maps), social interactions (e.g., committee meetings) and across time (e.g., captured in verbal stories and written accounts of past events). Distributed cognition (DCog) focuses on knowledge representation from a systems perspective, rather than from an individual human or artefact perspective. This shifts the burden for researchers in understanding how knowledge manifests at the individual level, providing a better understanding of the holistic effect of ERM as having the capacity to implement knowledge about risk in groups of individuals. DCog focuses on understanding coordination between individuals and artefacts, how they are aligned to achieve pre-defined goals and how well the system is functioning. DCog recognizes that groups have cognitive properties that differ from individuals and treat the relationship between artefacts and actors as conceptually equivalent, while drawing attention to artefacts' capacity to amplify (rather than compete with) human cognitive abilities. Given that distributed cognition calls for detailed analysis of artefacts, it can produce understandings useful for ERM artefact design, building on what researchers have already achieved under the artefactual turn. Additionally, it can serve as a theoretical framework for collecting comparable data on work practices in the various contexts identified in the review as significant (for additional reading, see Halverson, 2002; Heavey & Simsek, 2017; Hutchins, 1995a, 1995b; Michel, 2007; Nardi, 1996; Okamoto, 2014).

Activity theory, which emerged from psychology and focuses on human action, is closely related to DCog but has more theoretical constructs. It examines the historical development of, and change in, activities over time and therefore suggests that context must be considered in the analysis of human action (O'Leary, 2010). It, like DCog, also treats the mind as 'extended' and transformed by artefacts. Activity (composed of subject, object, actions and operations) rather than the system is the central unit of analysis, providing more analytical precision. A central proposition of activity theory is that activity cannot be understood without understanding the relationship between actors and their environment, and therefore artefacts are considered important (O'Leary, 2010). Activity theory encourages researchers to treat human actors as conscious, moral, sentient beings and treat artefacts as having a mediating role. Both distributed cognition and activity theory view the relationship between artefacts and actors as one of collaborative manipulation, with slightly different interpretations, capturing the dynamics between the two, which is an important aspect in ERM research (Giovannoni et al., 2016). Activities (and the objects contained within them) can be identified and distinguished from each other (unlike situations). The study of human intentionality is encouraged by activity theory, which views an activity as '... a goal-directed system where cognition, behaviour, and motivation are integrated and organized by a mechanism of self-regulation towards achieving a conscious goal' (O'Leary, 2010 citing Bedny & Harris, 2005, p. 130). This, too, is important, having the potential to link cognition and behaviour in ERM research, rather than relying on assumptions about the relationship between the two.

Activity theory provides a useful framework (Engeström, 1987) to advance the analysis of the relationship between contextual, technical, social and cognitive factors, and when combined with action research may assist researchers in identifying and examining the dynamics and change between these factors by bringing researchers into close proximity with actors in focus groups (for additional reading, see Halverson, 2002; Harris, 1999; O'Leary, 2010; Virkkunen & Kuutti, 2000).

Each of the perspectives presented above, individually or in some combination, offers a potential way forward to direct future ERM research towards a cognitive turn. To assist researchers in conceptualizing the relationship between ERM and MJDM, we present and discuss a nascent framework (Figure 4), which is derived from an analysis and synthesis of the literature in this review. This new narrative and conceptualization is in line with Breslin et al.'s (2020) prospector metaphor, where we attempt to shift the dial of ERM research towards cognition by calling for a cognitive turn.

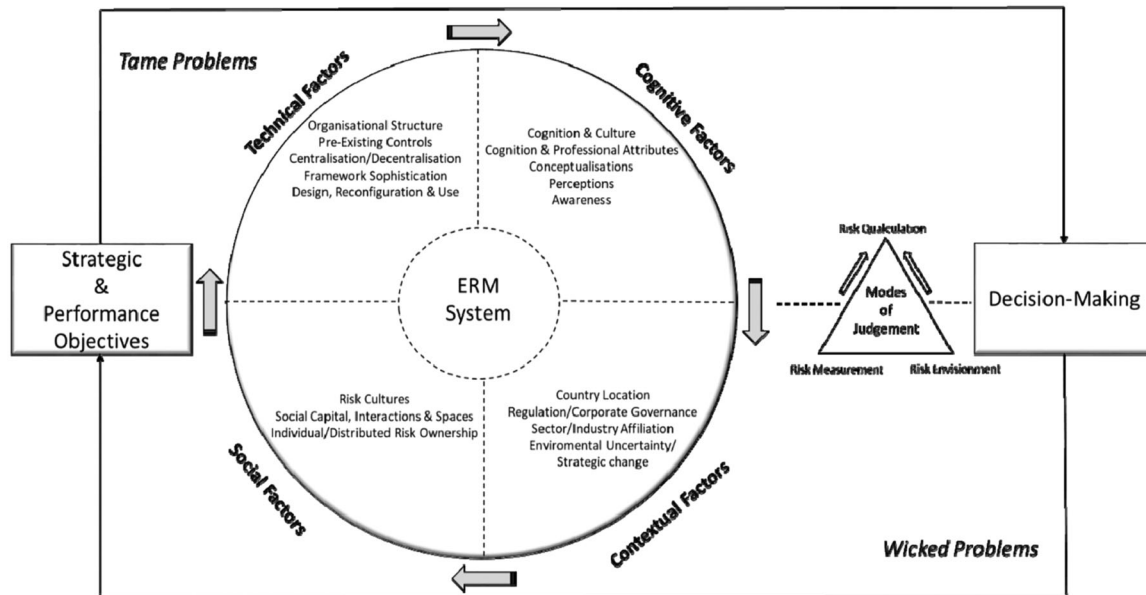


FIGURE 4 An integrative framework of ERM and managerial judgement in decision-making.

We identify and discuss several contextual, social, technical and cognitive factors that contribute to the ERM system's overall composition and where interactions between these factors shape the mode of judgement used in managerial decision-making. We identify two distinct modes of judgement in the literature: risk measurement and risk envisionment. The former, heavily reliant on calculative processes, the latter, reliant on socio-cognitive processes. Additionally, we identify a third hybrid mode, referred to in the literature as qualculation. These modes place different cognitive demands on actors, and we connect those modes to a discussion on tame and wicked decision problems. We discover that qualculation, which considers both quantitative and qualitative data, is likely to be more useful in managerial decisions concerning wicked problems.

We also discuss how risk culture affects the capacity of organizations to balance the technical and social factors required for effective identification and management of risks (Jean-Jules & Vicente, 2021) and how culture has a significant influence on actor cognition. Together, these insights and suggestions for future theoretical development provide researchers with a path towards a cognitive turn in ERM research.

Despite progress in ERM research in the last decade, many questions concerning cognition remain unanswered. We now know that the relationship between artefacts and actors is dynamic and influenced by contextual, technical, social and cognitive factors. We do not know, for instance, how the design and use of risk artefacts can support individual and distributed cognition, which has significant implications for improving human judgement and strategic decision-making (Boland et al., 1994).

Examining the relationship between the aforementioned factors (cognition in particular) and emotions can also be interesting (Nielsen & Pontoppidan, 2020). Researchers could examine such questions as part of a cognitive turn, but this requires engagement with new methodologies, an issue we turn to next.

### Directions for future research: Methodological development

Our analysis shows that a limited variety of research methods are used (see Table A1 in the Appendix). Recently, studies have emerged which include observations as part of mixed-data collection methods (Jordan et al., 2013; Meidell & Kaarbøe, 2017; Mikes, 2009), experiments (De Zwaan et al., 2011; Stoel et al., 2017) and ethnographic approaches (Tekathen, 2019). These approaches provide new opportunities to explore a variety of socio-cognitive interactions and the use of ERM artefacts therein. Exploratory statistical methods are also used (Braumann, 2018), demonstrating the usefulness of quantitative methods in studying cognitive phenomena.

Future studies aimed at examining ERM influence on judgement and decision-making in an organizational setting, as this review deems necessary, will require a greater variety of suitable methodologies. ERM researchers could extend their methodologies to include mapping human cognition (Ferreira et al., 2016; Harris & Woolley, 2009), action research (Harris, 1999) or ethnography. More quantitative and mixed-method approaches are needed. There is also a need to study ERM in new contexts, in SMEs,

non-government organizations and non-profit organizations, as many of the extant studies focus on financial sector organizations.

## Concluding remarks

Risk artefacts are often implemented with the view that risk measurement modes of judgement based on mathematics and statistics provide a superior basis for decision-making. As this review reveals, this mode alone is insufficient as uncertainty increases. Successful ERM depends as much on intelligent judgement as it does on the implementation and use of risk artefacts. ERM is cognitively demanding, not just for those working in risk functions but for those managers dealing with non-routine problems with little available information and no obvious solutions.

By reviewing the existing empirical studies capturing the relationships, interactions and evolvement of ERM artefacts and actors, this paper underlines the need for further research addressing the cognitive aspects of ERM (i.e., cognitive turn), particularly the relationship between ERM artefacts and MJDM.

We have evaluated the extent to which judgement is treated in prior ERM research published in accounting and management journals. Based on that evaluation, we show that researchers continue to focus on the technical aspects of ERM, and give little attention to the social and cognitive aspects, which are key to decision-making because risk-based decisions often use both modes of judgement. We also find that little is known about the relationship between ERM and human judgement, although risk artefacts should support/enhance decision-making within the ERM process.

Our study provides a new research agenda, complementing existing research on risk artefacts and contributing to the development of ERM research in the accounting and management fields. Insights from this review also have important implications for policymakers and practitioners. It is important that sponsoring bodies such as COSO understand and address the gap between ideological notions of ERM in theory and what is happening in practice by viewing the challenges of implementing ERM through a socio-cognitive lens. Integrated holistic approaches to managing risk and uncertainty are cognitively demanding, and those demands are increasing as ERM frameworks extend their promise to manage new and increasingly complicated risks. Practitioners, especially those designing and implementing ERM, need to understand that ERM is not just comprised of technical factors; social and cognitive factors can play a significant role in the relationship between ERM and managerial decision-

making, which can potentially facilitate the challenging ERM implementation process.

We acknowledge several shortcomings in this review. First, all the articles included in the review have been published in academic journals. Therefore, we may have excluded important papers available in grey sources (Rojon et al., 2021), which could provide further insights into the ERM–MJDM relationship. Second, we are aware that by using search terms, we may have missed articles that do not explicitly discuss ERM yet could provide some insights into the relationship between artefacts and actors and the implications for judgement in decision-making. Third, we utilized a full-text filter in the scoping study and in the supplementary searches conducted on PQSSP and BSP, however, no full-text filter was applied in the WoS and Scopus searches. Fourth, even though we have carried out an extensive search of five databases and used WoS and Scopus for our main searches, the risk of omitting some articles due to database point-of-access limitations, subscription limitations or other issues remains.

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## ORCID

Jason Crawford  <https://orcid.org/0000-0003-2092-6196>

Mirna Jabbour  <https://orcid.org/0000-0002-7078-5726>

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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