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Enterprise Risk Management (ERM): A bibliometric review and future agenda

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Abstract: **This paper is a bibliometric review of 541 articles, from 1989 to 2022, on the concept of enterprise risk management (ERM). We employed a bibliometric citation and content analyses in analyzing the data using the biblioshiny application. We identified four research streams: (1) the determinants (firm characteristics) of enterprise risk management adoption and implementation, (2) enterprise risk management and firm performance, (3) the value of enterprise risk management, and (4) enterprise risk management in practice. Also, we identified "*sustainability risk management*" as the emerging future theme on the concept of ERM, and this should be the focus of future studies and development. We recommend that more future research on ERM be focused on the contingency perspective, and that a general theoretical contingency framework be developed to guide future contingency studies on ERM. We propose 10 future research questions.**

Keywords**: Enterprise Risk Management; Bibliometrics analysis; Content analysis; Citation analysis; Review.**

1. INTRODUCTION

Global interest in the area of risk management is on the ascendancy following a number of world-wide economic events. These economic events have been evident in several financial crises across the globe (Olayinka et al., 2017). Therefore, the need to manage risk has become a fundamental issue of interest in today's turbulent and fast-changing global environment (Gordon et al., 2009). However, in recent times, there has been a paradigm shift in the approach to risk management. Instead of the traditional approach to risk management where risks are viewed from an isolated and silo-based perspective, the modern course is to take a holistic approach to risk management. This holistic view of managing risks faced by an organization, is a concept commonly known as enterprise risk management (ERM) (Gordon et al., 2009). Enterprise Risk Management (ERM) suggests that organizations deal with their risks in a more comprehensive and coherent manner instead of addressing them individually (Bromiley et al., 2014).

Several studies (Callahan & Soileau, 2017; Florio & Leoni, 2017; Baxter et al., 2013; Hoyt and Liebenberg, 2011; Nocco and Stulz, 2006; COSO, 2004; Lam, 2003; Barton et al., 2002; Stulz, 1996, 2003) on the literature argue that firms may improve their performance by adopting and implementing an ERM system (Florio & Leoni, 2017; Bromiley et al., 2014; Gordon et al., 2009). The development and implementation of an ERM program is said to minimize direct and indirect costs of financial distress and earnings volatility, as well as adverse turbulences in financial markets. In effect, ERM may increase the value of a firm (Florio & Leoni, 2017; Ellul & Yerramilli, 2013; Paape & Spekle, 2012; Hoyt & Liebenberg, 2011; Beasley, Pagach, & Warr, 2008; Nocco & Stulz, 2006; Beasley, Clune, & Hermanson, 2005). As a fact, many firms have adopted ERM (Gates and Hexter, 2005), and this, in addition, buttress the view that ERM will improve firm performance (Gordon et al., 2009).

Despite the foregoing arguments, empirical evidence confirming the relationship between ERM and firm performance is limited (Florio & Leoni, 2017; Gordon et al., 2009). Some researchers (Gordon et al., 2009) argue that the performance of a firm is not a result of utilizing ERM, but contingent on the proper match between ERM and factors specific to the firm. Besides, other studies (Eikenhout, 2015; Quon et al., 2012) on the literature did not find any significant relationship between ERM and firm performance. Similarly, the findings of Pagach & Warr (2010) suggested that the adoption of ERM did not add to the value creation mechanism of a firm (Sajjad & Engku, 2017). The efficacy of ERM was exposed and cast in doubt during the 2008 financial crisis as it was evident in the adversities experienced by some early adopting firms. For instance, Countrywide Mortgage, commended in 2007 by the Institute of Internal Auditors as a leader and example of ERM, went bankrupt in 2008 (Bromiley et al., 2014).

Also, the direction of research on ERM has mostly focused on two dimensions: (1) the relationship between the determinants and quality of ERM systems and (2) the effects of ERM on firm financial and market Performance (Florio & Leoni, 2017). Certain authors have asserted that while many studies have been conducted pertaining to ERM, a preponderant number of such studies have largely dominated in advanced countries. Comparatively, developing economies have featured in fewer investigations (Anto & Nucu, 2020; Saeidi et al., 2020). There has been differing opinions on the potency of ERM to respond to unanticipated threats and improve performance. A body of scholars contend that ERM has a direct impact on firm performance (Callahan and Soileau 2017; Florio and Leoni 2017; Zou and Hassan 2017), while another school of thought argues that the association between ERM and firm performance could be contingent on some firm internal or contextual variables (Khan and Ali 2017; Wang et al. 2010).

As a result of the diverging views on the literature of the adoption of ERM, an appreciable amount of literature has been collected over the last 33 years (see Fig. 1). This literature is captured across diverse industries and fields and requires a systematic, in-depth, and both qualitative and quantitative forms of analysis. To comprehensively cover and transcend the literature on ERM, a bibliometric citation analysis is employed (Bahoo, 2020; Zhang et al., 2019; Helbing, 2019) and content analysis (Bahoo, 2020; Vigne et al., 2017; Garner et al., 2016) to analyze 541 articles spanning a 33-year period from 1989 to 2022. This review is distinct and addresses the following questions: (1) What are the key research streams in the literature on ERM? (2) What are the influential aspects of literature, such as journals, authors, articles, and networks among them? (3) What are the relevant future questions? One future theme and four research streams were identified through this qualitative and quantitative review and analysis (see Fig. 4 and 6 respectively). A summary analysis of the data sources, methods, and content of key papers was carried out (Tables 6 & 7). Besides, influential journals, authors, key research areas, articles, and networks among them were identified (Tables 3-5 and Figs. 2-6). Finally, Table 8 presents 10 systematically derived future research questions that are worth investigating.

Table 1. Descriptive analysis: Main information regarding the data set

Description	Results
Timespan	1989:2022
Articles	541
Average citations per documents	15.56
Authors	1164
Author Appearances	1383
Authors of single-authored documents	113
Authors of multi-authored documents	1051
Documents per Author	0.465
Authors per Document	2.15
Co-Authors per Documents	2.56
Collaboration Index	2.51

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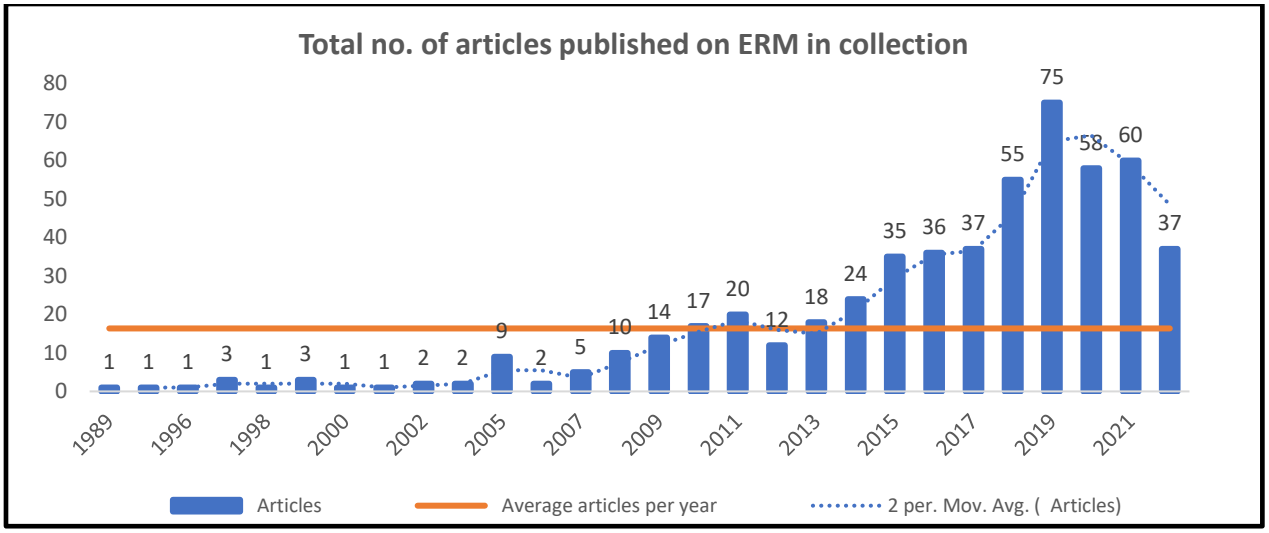

Fig. 1. Trend of literature on ERM. The Biblioshiny software is used to present year wise publications of ERM papers from 1989 to 2022. Annual growth rate = 14.31%

Table 2. Key methodological terminologies

(i) Key methodological terms	
Terms	Explanation/Details
Co-citation analysis	Co-citation means that other articles cite an article because they belong to the same concept or topic.
Cartography analysis	This analysis is based on the recurrence of keywords in the articles.
Biblioshiny software	An R-tool for bibliometrics analysis which accepts citation data of Scopus as input and provides several outputs.
(ii) Key Patterns of Biblioshiny Software	
P_{ERM}	Number of articles published on topic Enterprise Risk Management (ERM)
TLC	Total local citations mean how many times an article is cited by other articles in a sample of study; in our case sample of articles for bibliometrics analysis consists of 541 articles.
TGC	Total global citations represent how many times an article is cited by other articles, which are available on the entire Scopus database.
TLC/t	Total local citations per year means the average citations per year.
TGC/t	Total global citations per year means the average citations per year.
TGC/TLC	Total global citations divided by total local citations.
H-index	A metric that measures the relative quality of the journals based on their citation impact and productivity.

(iii) Sample Selection Process (articles searched from Scopus using the following keywords for Enterprise Risk Management)

Keyword for Enterprise Risk Management	**Results**
Enterprise Risk Management	1,148
Integrated Risk Management	560
Comprehensive Risk Management	273
Corporate Risk Management	268
Strategic Risk Management	155
Aggregated Risk Management	1
Risk Management Committee	153
Risk Committee	93
Chief Risk Officer	102

Initial Sample = 1,248. (This was obtained by applying the following filters: *(i) paper type*: Articles, *(ii) Publication stage*: Final, *(iii) source type*: Journal and (*iv*) *Language*: English)

Final Sample for Bibliometrics Analysis = **541** (This was obtained by manually screening out irrelevant material by reading titles and abstracts)

Note: The table shows details about key methodological terms, software's key terms, sample selection process, and search techniques.

Table 3. Influential journals

Rank	Name of journals[1]	TLC	Name of journals[2]	P_{ERM}	Name of journals[3]	H-index
1	Journal of accounting	500	Journal of risk and insurance	10	Journal of risk and insurance	10
2	Journal of finance	455	JRMFI[4]	9	JAPP[9]	6
3	Journal of risk and insurance	446	JHRM[10]	8	Journal of risk finance	6
4	Journal of financial economics	358	Journal of risk research	8	Journal of risk research	5
5	JAPP[9]	309	JAPP[9]	7	IJAIS[5]	4
6	JACF[11]	295	Journal of risk finance	7	Journal of information systems	4
7	RMIR[8]	248	RMIR[8]	6	Management decision	4
8	Journal of banking & finance	224	IJABER[6]	5	Managerial auditing journal	4
9	Strategic management journal	216	JCAF[7]	5	AOS[12]	3
10	Managerial auditing journal	203	Journal of information systems	5	Business horizons	3

Note: Table 3 shows the ranking of top 10 journals, which was created using the Biblioshiny software. 1 = ranking of journals sorted based on TLC. 2 = ranking of journals sorted based on $P_{ERM.}$ 3 = ranking of journals sorted based on h-index. For details of TLC, P_{ERM}, and h-index, see Table 2. The abbreviations are 4 = Journal of Risk Management in Financial Institutions, 5= International Journal of Accounting Information Systems, 6 = International Journal of Applied Business and Economic Research, and 7 = Journal of Corporate Accounting and Finance; 8 = Risk Management and Insurance Review; 9 = Journal of Accounting and Public Policy; 10 = Journal of Healthcare Risk Management; 11 = Journal of Applied Corporate Finance; 12 = Accounting, Organizations and Society

Table 4: Influential authors

Rank	Authors[1]	Articles	Authors[2]	TLC	Authors[3]	H-index
1	LOW SP	7	ALI W	142	HOYT RE	6
2	HOYT RE	6	RAMAYAH T	142	LOW SP	6
3	MOLOI T	6	ATHERLEY L	141	ZHAO X	6
4	ZHAO X	6	BOATRIGHT R	141	ARNOLD V	5
5	ARNOLD V	5	FISHER C	141	HWANG B-G	5
6	GATZERT N	5	ALI S	124	SUTTON SG	5
7	HWANG B-G	5	CHEAH J-H	124	ARENA M	4
8	SUTTON SG	5	HUSSAIN KHAN M	124	ARNABOLDI M	4
9	ARENA M	4	IBRAHIM ALASAN I	124	GATZERT N	4
10	ARNABOLDI M	4	GALLETTA S	123	SAEIDI SP	4

Note: The table depicts the ranking of top 10 authors, generated out of the Biblioshiny software. 1 = ranking of most relevant authors sorted based on P_{ERM}. 2 = ranking of authors sorted based on TLC. 3 = ranking of journals sorted based on h-index. For details of TLC, P_{ERM}, and h-index, see Table 2.

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Table 5: Influential papers

Rank	*Influential papers[1] based on TGC/t*			*Influential papers[2] based on TLC*		*Influential papers[3] based on TGC/TLC*	
	Paper	**TGC**	**TGC/t**	**Paper**	**TLC**	**Paper**	**TGC/TLC**
1	AEBI V, 2012	414	37.6364	HOYT RE, 2011	141	AEBI V, 2012	6.5714
2	HOYT RE, 2011	331	27.5833	BEASLEY MS, 2005	124	ARENA M, 2010	4.3404
3	BROMILEY P, 2015	177	22.125	GORDON LA, 2009	123	BROMILEY P, 2015	4.1163
4	GORDON LA, 2009	281	20.0714	MCSHANE MK, 2011	71	PAAPE L, 2012	2.8780
5	BEASLEY MS, 2005	327	18.1667	AEBI V, 2012	63	BEASLEY MS, 2005	2.6371
6	ARENA M, 2010	204	15.6923	BAXTER R, 2013	56	HOYT RE, 2011	2.3475
7	MIKES A, 2009	219	15.6429	ARENA M, 2010	47	GORDON LA, 2009	2.2846
8	MCSHANE MK, 2011	157	13.0833	BROMILEY P, 2015	43	MCSHANE MK, 2011	2.2113
9	WU DD, 2010	141	10.8462	PAAPE L, 2012	41	BAXTER R, 2013	2.1071
10	DICKINSON G, 2001	144	6.5455	ECKLES DL, 2014	39	ECKLES DL, 2014	1.5385

Note: This table represents the top 10 influential papers. 1 = Influential papers are sorted based on TGC/t. 2 = Influential papers are sorted based on TLC. 3 = Influential papers are sorted based on TGC/TLC ratio. For details about TLC, TGC, TGC/t and TGC/TLC see Table 2.

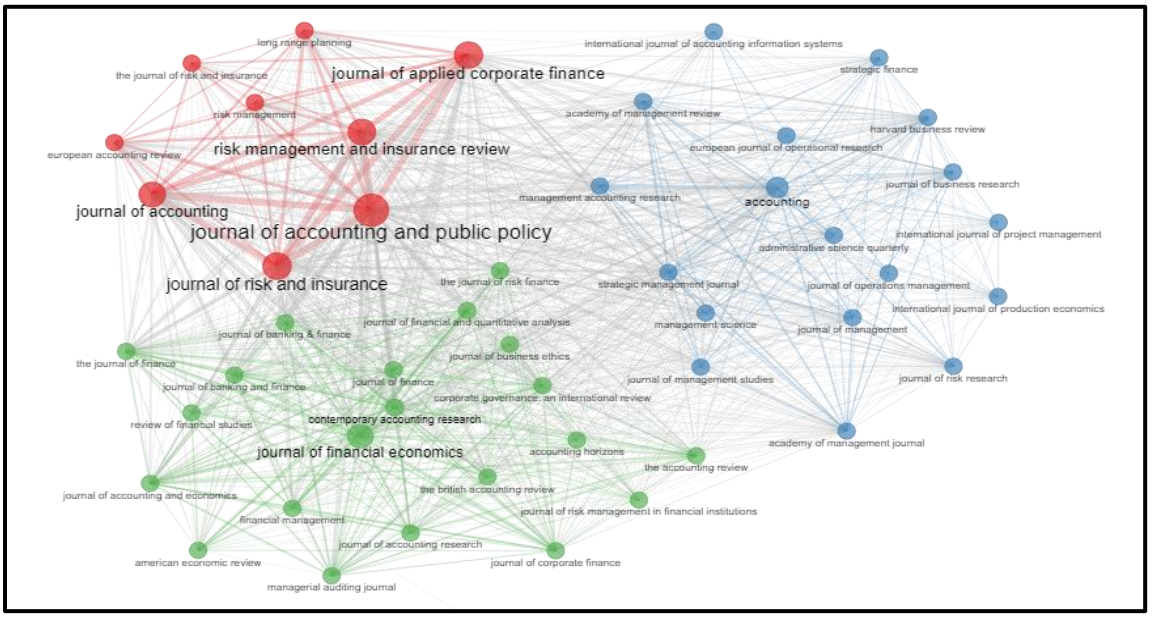

Fig. 2. Co-citation network among journals. The Biblioshiny software is used to create network.

2. METHOD

The method used in this work consists of bibliometric citation analysis and content analysis. The following tests were conducted under bibliometrics citation analysis using the Biblioshiny software: (1) citation analysis, (2) co-citation analysis, (3) citation network analysis, and (4) cartography analysis by following Bahoo, (2020), Paltrinieri et al. (2019) and Zamore et al. (2018). In addition, the traditional content analysis was deployed to explore the content of articles (Bahoo, 2020; Ahmed et al., 2019; French and Vigne, 2019; Carter et al., 2017). The Biblioshiny software accepts CSV-UTF8 (comma delimited) file, bibliometrix file (XLSX or R format) or a sample collection (a collection of scientific articles about the use of bibliometric approaches in business and management disciplines) as input data and generates several outputs as key results or findings. The Biblioshiny software also allows inputs from ISI Web of Science/Web of Knowledge (ISI WoS/WoK), Scopus, Dimensions, Lens.org, PubMed and the Cochrane Library. Table 2 provides a detailed explanation of the key terms of bibliometrics analysis, key software terms, search techniques, and sample selection process.

To carry out bibliometrics analysis on enterprise risk management (ERM), Scopus database was selected for two reasons: (1) it was the database my institution had license and access to at the time of this work, and (2) it is a repository of high-

quality journals. Following Hoyt and Liebenberg (2011) in the search process, 10 keywords (see Table 2) for enterprise risk management (ERM) were used to cover the entire literature on the subject. This search resulted in 1,248 articles. Subsequently, all article titles and abstracts were carefully read to identify documents that capture the concept of ERM. This was done primarily to winnow out irrelevant articles to a final sample of 541 articles between 1989 and 2022 for the analysis. Fig. 1 shows the year wise publication of articles in the literature of enterprise risk management (ERM) from 1989 to 2022. A growth in the literature since 2008 indicates a substantial increase in research on enterprise risk management (ERM). This observation is not surprising as the 2008 global financial crisis exposed the inherent weaknesses and flaws in the traditional risk management practices of financial institutions around the globe (Roberts, 2019; Bayoumi, 2017; Jensen and Johannesen, 2017). The key findings are explained in the next section.

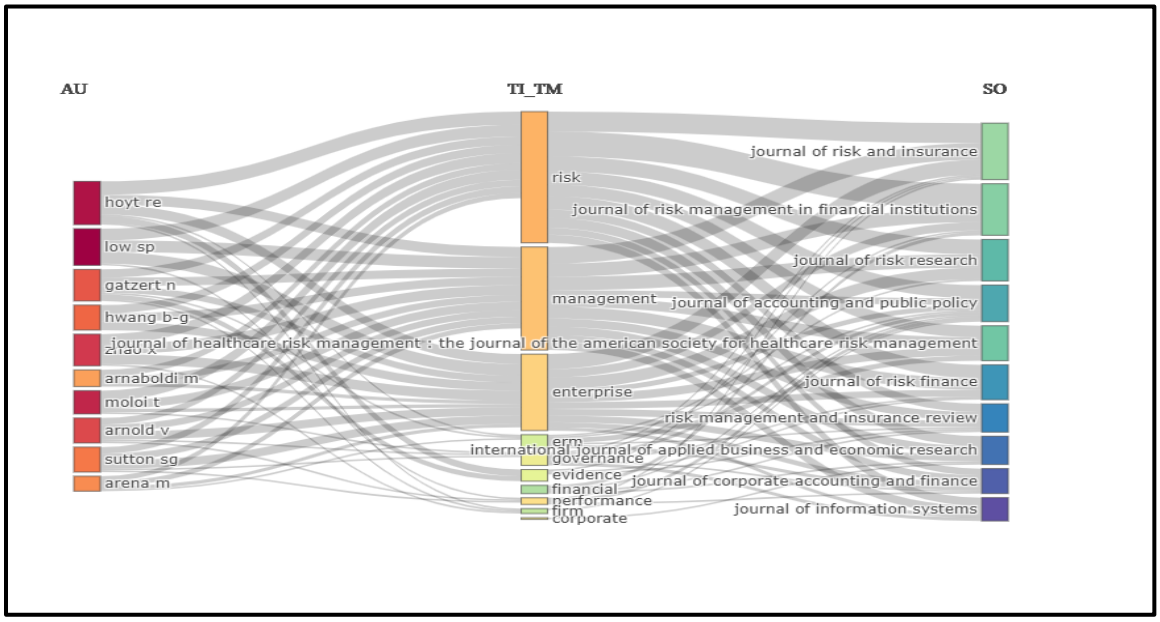

Fig. 3. Three-field plot

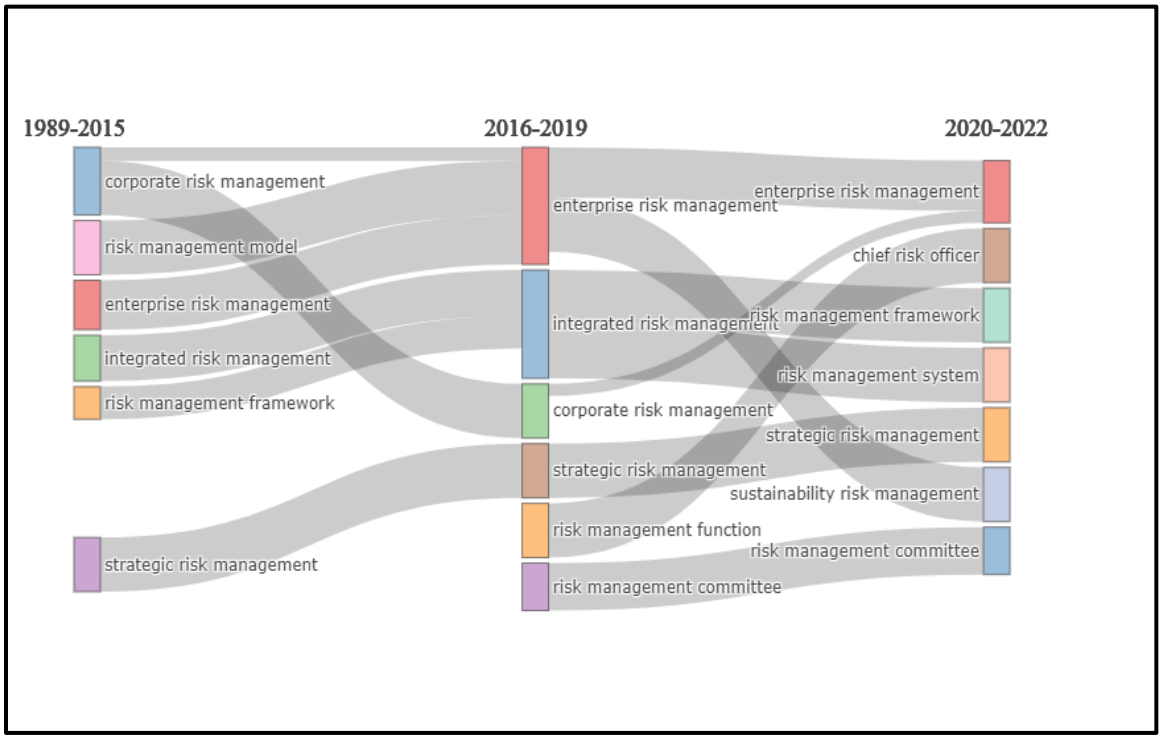

Fig. 4. Thematic evolution: Three-field plot

3. RESULTS

3.1. Influential aspects of literature

3.1.1.Key journals distribution and network

The journals distribution and networks were identified using the Biblioshiny software. The top 10 journals were ranked into three categories: first, those receiving a higher number of citations, second, those with a higher number of publications on the subject, and third, those with a higher source impact based on their h-index, as indicated in Table 3 (Table 1 explains the h-index). In the first category of rankings, accounting journals received the highest average citations of 405 followed by risk and insurance journals with an average citation of 347. Finance journals and management journals recorded average citations of 333 and 210 respectively. In both the second and third categories of rankings, risk journals dominated the top half of the table, with the Journal of risk and insurance being both the most relevant and impactful journal, receiving the highest number of publications and source impact on the topic. The Journal of Accounting and Public Policy was the only other journal to have made it in the top five for both the second and third categories of rankings. Also, Table 3 indicates that articles on ERM have largely appeared in risk, accounting and finance journals. It is therefore suggested that ERM presents an important arena of research for management journals and scholars to explore the managerial dynamics of ERM. Furthermore, the co-citation network analysis among journals shown in Fig. 2 indicates that the citation among journals is not skewed to a particular direction, and that top ranked journals are citing less prominent journals, which is indicative of no citation bias

3.1.2.Influential authors

The influential authors were determined using the Biblioshiny software. The authors were ranked based on the number of publications made, the total local citations received and the author impact on the topic (see Table 4). LOW SP, HOYT RE and ZHAO X are deemed the top three most relevant authors for publishing the highest number of articles on the topic (7, 6 and 6 respectively) (see Table 4). ALI W and RAMAYAH T received the highest number of local citations among the data set used for this research. However, both authors did not appear in the top 10 relevant and impactful authors category (see Table 4). Even though these two authors may not be publishing more on the literature, their high citation count among this data set may be partly or jointly attributed to their papers being either groundbreaking, core to the literature or unrestrictedly accessible. LOW SP, HOYT RE and ZHAO X are the joint three most impactful authors (see Table 4). The fact that LOW SP, HOYT RE and ZHAO X are the three most relevant and impactful authors suggests that they have contributed remarkably and immensely to the literature on enterprise risk management (ERM). Their output is a pivotal foundation to the development and thorough understanding on the concept of ERM.

3.1.3.Influential papers in the literature

The sample consists of 541 articles published by 331 journals that have 1,762 and 8,416 total local and global citations respectively. The influential papers are divided into three categories and ranked on the following measures: total global citation per year (TGC/t), total local citations (TLC), and ratio of total global citations and total local citations (TGC/TLC). This categorization was done with the aid of the Biblioshiny software. Table 5 shows the top 10 papers in the three categories. The top-ranked papers are mostly published by the accounting journals. The accounting journals have published at least 5 papers (50%) for each category of rankings.

3.2. Three-field plot

A Three-field plot (Fig. 3) shows the relationship between three fields using Sankey Plots. The size of the portions of each field is proportional to the value of the node (Ingale et al., 2021, Riehmann et al., 2005). The left field of the plot are the authors, middle field are the keywords in titles of articles, and the right field are the sources that were selected for analysis. All ten items depicted prominent keywords like risk, management, enterprise and erm, along with their prominent authors and sources. All the ten influential journals covered these keywords “enterprise”, “risk”, and “management” - the composite of them forming the topic under review, that is, “enterprise risk management”. “Governance”, “financial”, “performance”, and “evidence” emerged as important sub-words addressed by these influential authors and journals.

3.3. Keyword analysis: analysis for identifying research areas

A "Trigram" and "Bigram" analysis of the frequency of use of keywords in the articles were conducted by using the Biblioshiny software in order to identify areas and directions of research on enterprise risk management. Fig. 5 is a trigram visual word cloud based on the number of times keywords repeat in the literature on enterprise risk management (ERM). The frequency of repetition is indicated by the size of the word. It can be proxied for relevance of the word in literature. The term "enterprise risk management" occurred 414 times, followed by "risk management erm", "risk management practices", "risk management committee", "integrated risk management", "risk management system", "corporate risk management", "chief risk officer", "risk management framework", and "risk management process". These terms are the more prominent and predominantly used keywords in the literature on ERM. Other key terms such as "strategic risk management" and "effective risk management" may be seeing the limelight and are piecemeal gaining ground on the topic. "Holistic risk management" and "comprehensive risk management" are keywords that are less frequently used and may be said to be at the bud or inception stage. The term "aggregated risk management" seem never used and is alien to the concept of ERM.

Furthermore, a traditional content analysis conducted on the output of the bigram keywords analysis revealed that the keywords "firm performance", "financial performance", "organizational performance" and "business performance" are dominant and frequently used. Terms such as "firm characteristics" and "organizational characteristics" do not often occur in the literature on ERM. It can therefore be synthesized that, most of the studies on ERM are focused on the direct relationship between ERM programs and performance while overlooking the organizational context within which the ERM program is being implemented. It is recommended that future research on ERM and performance should focus on the contingency perspective.

Fig. 5. Word cloud

3.4. Thematic evolution analysis: analysis for identifying future themes

Thematic evolution of a field describes the changes that have occurred in the field over a period of time by partitioning the entire time period into different time segments. It shows how keywords, concepts and the field have evolved based on their centrality and density (Ingale et al., 2021; Chen et al., 2019; Della Corte et al., 2019). A 100-word count in "titles" field, trigrams in "N-Grams" field and a minimum cluster frequency of five, over three time slices with yearly cut points of 2015 and 2019 were used to generate a three-field thematic evolution as shown in Fig. 4. A careful look at Fig. 4 highlights the nexus among the themes across the three-time spans, which are 1989 to 2015, 2016 to 2019, and 2020 to 2022. In the first period (1989 to 2015), three major themes namely corporate risk management, risk management model and enterprise risk management converge into a major theme "enterprise risk management". In the second period (2016 to 2019) two major themes "enterprise risk management" and "corporate risk management" merge into a major theme "enterprise risk management". Also, the major theme "enterprise risk management" evolves into a new theme "sustainability risk management". This three-field thematic evolution indicates that the main theme currently at the core of the literature is *enterprise risk management* (ERM). However, it also suggests "*sustainability risk management*" as an emerging theme

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budding out of the central theme of the literature. Therefore, this is a future theme of the concept and should be the focus of future research and development regarding the literature. Further, another interesting and important revelation from the thematic evolution map is how the risk management function in the second time slice (2016 to 2019) evolves into chief risk officer (CRO) in current times (2020 to 2022). This suggests that in recent times organizations are hiring experts in the position of the chief risk officer to take charge and lead the risk management function. This observation is not surprising, but comes to support and justify the research approach of several studies (Lechner & Gatzert, 2018; Eckles et al., 2014; Aebi et al., 2012; Hoyt & Liebenberg., 2011; Pagach & Warr, 2011; Beasley et al., 2008; Liebenberg & Hoyt, 2003) that used the appointment, announcement, hiring or presence of chief risk officer as proxy for use of ERM. It can therefore be said that the chief risk officer is the new organizational role created for the risk management function in organizations.

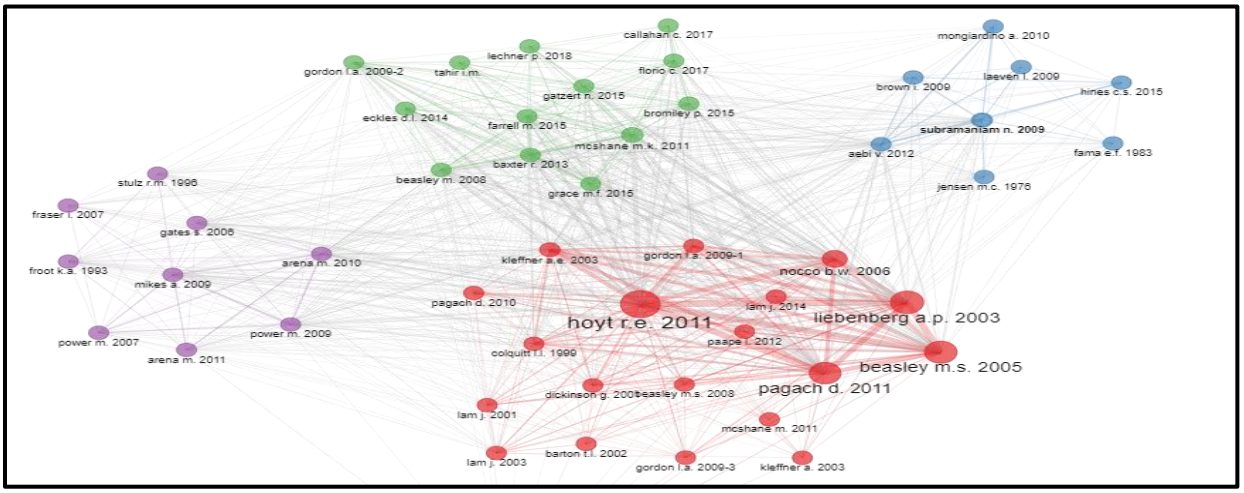

Fig. 6. Co-citation network among papers. The Biblioshiny software is used to create network.

3.5. Co-citation mapping: identification of research streams and analysis

Four research streams were identified by applying bibliometric citation analysis and content analysis (Bahoo, 2020). Following Bahoo (2020), these two steps were employed in identifying research streams. First, biblioshiny software was used to perform co-citation analysis amongst papers that generated citation mapping, as shown in Fig. 6. The mapping consists of 50 top-cited articles in the literature under review. Second, a detailed traditional content analysis was carried out on these 50 articles. After performing these two quantitative and qualitative analyses on the 50 articles, the following four research streams have been identified in the literature: (1) the determinants (firm characteristics) of enterprise risk management adoption and implementation, (2) enterprise risk management and firm performance, (3) the value of enterprise risk management, and (4) enterprise risk management in practice.

Each of these four identified research streams are co-dependent and interlinked with one another as depicted in the network map (see Fig. 6). The key determinants (firm characteristics) of ERM adoption can be synthesized into three categories: (1) factors relating to corporate governance; (2) firm-level (internal or contextual) factors; and (3) industry-level factors. Corporate governance factors such as the presence of a Chief Risk Officer (Beasley et al., 2005), top management (board of directors, CEO, CFO) apparent support (Beasley et., 2005; Kleffner et al., 2003), board independence (Beasley et al., 2005), board tenure (Baxter et al., 2013), audit committee risk oversight (Baxter et al., 2013), regulatory requirements (Paape et al., 2012; Kleffner at al., 2003) and international diversification (Lechner & Gatzert, 2018) are key influential determinants for ERM adoption and implementation in organizations. Also, firm-level factors including entity size (Pagach & Warr, 2011; Hoyt & Liebenberg, 2008, 2011; Beasley et al., 2005), firm complexity (Baxter at al., 2013; Razali et al., 2011), nature of auditor (e.g., Big Four auditor) (Beasley et al., 2005), financial leverage (Golshan & Rasid, 2012; Liebenberg & Hoyt, 2003), ownership structure (Paape et al., 2012; Pagach & Warr, 2011) and asset opacity (Liebenberg & Hoyt, 2003) influence the adoption and implementation of ERM. Another category of determinants of ERM adoption and implementation centers on factors relating to the nature and role of the industry. Industry-level factors such as regulatory requirements (Paape et al., 2012; Kleffner at al., 2003), nature of stock price and cashflow volatilities (Pagach & Warr, 2011), and the type of industry sector (for example, banking, insurance, energy, and education) (Lechner & Gatzert, 2018; Paape & Speklé, 2012; Beasley et al., 2005) are determining factors of ERM adoption and implementation.

Enterprise Risk Management has a positive and significant impact on both the financial performance and market evaluation of firms[1] (Callahan & Soileau; Florio & Leoni, 2017, 2017; Baxter et al., 2013; Aebi et al., 2012; Gordon et al., 2009). Also, of the adoption of ERM, systematic variations exist in the way ERM practices are implemented in various organizations, and that, alternative models of ERM co-exist among organizations. In other words, there is not a "one-for-all" model of ERM for all organizations, but ERM models adopted vary from organization to organization. These preferential variations in ERM may be attributed to differences in senior management philosophies on two grounds: (1) differing calculative cultures (calculative idealism or calculative pragmatism); and (2) differing approaches to corporate governance (the shareholder value drive or the risk-based internal control drive) (Mikes, 2009).

In addition to this, the data sources, methodology, and content of these key 50 articles that form the network of research streams in the co-citation mapping (see Fig. 6) are summarized in Tables 6 and 7, respectively. The summary of key articles shows that ERM may generally be used by organizations to improve performance and enhance value. However, systematic variations exist in ERM practices adopted and implemented in organizations. Corporate governance, as well as firm and industry related factors are influential determinants of ERM adoption and implementation. Based on the findings, it is suggested that future research on ERM should be more tailored on the contingency perspective. It is important that a general theoretical contingency framework is developed to guide future ERM-performance/value studies.

1 = except Beasley et al. (2008) who finds that the univariate average two-day market response to the hiring of CROs is not significant, suggesting that a general definitive statement about the benefit or cost of implementing ERM is not possible.

Table 6: Data sources and methods of key papers

Author	Data Source	Period	Methodology	ERM Proxy	Performance Measure
Stream 1: the determinants of ERM adoption and implementation					
(Beasley et al., 2005)	The IIA's GAIN survey in March 2004	2004	Ordinal logistic regression	ERM stage (survey)	N/A
(Kleffner at al., 2003)	The Canada RIMS survey in June 2001	2001	Univariate statistics; Wilcoxon rank-sum tests	ERM stage	N/A
(Liebenberg & Hoyt, 2003)	Lexis-Nexis, Dow Jones and PR Newswire databases	1997-2001	Logistic regression	CRO keywords	N/A
(Paape & Speklé, 2012)	Survey data of 825 firms located in the Netherlands	2009	Ordinal logistic regression	ERM level	N/A
(Pagach & Warr, 2011)	COMPUSTAT, CRSP, 13-F ownership, and ExecuComp databases	1992-2005	Hazard model	CRO keywords	N/A

Continued

Table 6 continued. Data sources and methods of key papers

Author	Data Source	Period	Methodology	ERM Proxy	Performance Measure
(Lechner & Gatzert, 2018)	The German stock indices: DAX, MDAX, SDAX and TecDAX	2009-2013	Logistic, linear regression, and Cox proportional hazard regression models	ERM/CRO keywords	N/A
(Baxter et al., 2013)	S&P Ratings Direct database	2006-2008	Linear regression	S&P's ERM rating	N/A
Stream 2: enterprise risk management and firm performance					
(Florio & Leoni, 2017)	Milan Stock Exchange; AIDA and Bloomberg databases;	2011-2013	Multivariate OLS regression	ERM score (created)	ROA; Tobin's Q ratio

	Corporate governance reports				
(Gordon et al., 2009)	US SEC's EDGAR database	2005	Linear regression	ERM index (created)	Excess stock market return
(Callahan & Soileau (2017)	Survey data of Internal Audit Function (IAF) management of 162 US Public firms; S&P's Compustat database	2006-2008	OLS panel estimate	ERM activity (survey)	ROA; ROE
(Baxter et al., 2013)	S&P Ratings Direct database	2006-2008	Linear regression	S&P's ERM rating	ROA
(Aebi et al., 2012)	EDGAR (SEC's), CRSP database, IRRC Governance Legacy, IRRC Directors Legacy, Standard & Poor's ExecuComp, Thomson Financial's CDA/Spectrum, and RiskMetrics databases	2006-2008	OLS regressions	CRO/RC activity	Buy-and-hold returns; ROA; ROE
Stream 3: the value of enterprise risk management					
(Baxter et al., 2013)	S&P Ratings Direct database	2006-2008	Linear regression	S&P's ERM rating	Tobin's Q
(Eckles et al., 2014)	CRSP, Compustat, and Compact Disclosure database	1992-2008	Probit regression; OLS regression	ERM/CRO keywords	Stock return volatility
(Farrell & Gallagher, 2014)	The RIMS RMM for Enterprise Risk Management survey; Thomson One Banker's Worldscope database	2006-2011	Probit regression; loglinear regression	ERM maturity level (survey)	Tobin's Q
(Grace et al., 2014)	NAIC, Bureau of Labor Statistics, the Federal Reserve Board, and A.M. Best database; Survey of 523 U.S. insurers	2004-2006	Linear regression	ERM activity (survey)	Cost and revenue efficiency (with DEA)
(Hoyt & Liebenberg, 2011)	CRSP/Compustat and NAIC Infopro database	1998-2005	Maximum-likelihood model	ERM/CRO keywords	Tobin's Q
(Lechner & Gatzert, 2018)	The German stock indices: DAX, MDAX, SDAX and TecDAX	2009-2013	Logistic regression, linear regression, and Cox proportional hazard regression models	ERM/CRO keywords	Tobin's Q
(McShane et al., 2011)	S&P's Ratings Direct database	2004-2008	Linear regression	S&P ERM rating (5 categories)	Tobin's Q

Continued

Table 6 continued. Data sources and methods of key papers

Author	Data Source	Period	Methodology	ERM Proxy	Performance Measure
(Tahir & Razali, 2011)	Osiris database	2007	OLS regression	Osiris database	Tobin's Q
(Pagach & Warr, 2010)	COMPUSTAT, CRSP, 13-F ownership, and ExecuComp database	1992-2004	Logit/matched sample model	CRO key words	Several financial variables
(Beasley et al., 2008)	Lexis-Nexis library; CRSP database	1992-2003	Linear regression	CRO keywords	Cumulative abnormal returns following CRO announcements

Stream 4: enterprise risk management in practice					
(Arena et al., 2011)	30 key informants (interviews); Public and internal documents	2006-2008	Multiple case study (semi-structured interviews)	Actual ERM	N/A
(Arena et al., 2010)	23 managers (interviews); organizational databases; Reports, publications, newspapers	2002-2008	Longitudinal case study (face-to-face interviews)	Actual ERM	N/A
(Mikes, 2009)	75 senior executives (interviews); Direct field observation; Reports and presentations	2001-2005	Longitudinal case study (interviews, field observations)	Actual ERM	N/A
(Fraser & Henry, 2007)	13 executives (interviews)	2007	Case study (free form interviews)	Actual ERM	N/A

Note: IIA = Institute of Internal Auditors; GAIN = Global Audit Information Network; RIMS = Risk and Insurance Management Society; ERM = Enterprise Risk Management; CRO = Chief Risk Officer; RC = Risk Committee; S&P = Standard & Poor; AIDA is the Italian company information and business intelligence database provided by Bureau van Dijk (http://www.bvdinfo.com/en-gb/our-products/company-information/national/aida); DEA = Data Envelopment Analysis; NAIC = National Association of Insurance Commissioner; CRSP = Center for Research in Security Prices; RMM = Risk Management Model; ROA = Return on Assets; ROE = Return on Equity; OLS = Ordinary Least Squares; RRC = N/A = Not Applicable

Table 7. Summary of key papers

Authors	Sample	RQs/Purpose	Findings
Stream 1: The determinants of ERM adoption and implementation			
(Beasley et al., 2005)	123 US and international organizations	What are the factors associated with the stage of ERM implementation in US and international organizations?	1. The stage of ERM implementation is positively related to the presence of a chief risk officer, board independence, CEO and CFO apparent support for ERM, the presence of a Big Four auditor, entity size, and entities in the banking, education, and insurance industries. 2. US organizations have less-developed ERM processes than international organizations.
(Kleffner et al., 2003)	118 companies listed as members of the Canada RIMS	1. What characteristics are associated with the use of ERM? 2. What are the challenges to ERM implementation?	1. The influence of the risk manager (61%), encouragement from the board of directors (51%), and compliance with Toronto Stock Exchange (TSE) guidelines (37%) were the reasons for adopting ERM. 2. The major deterrents to ERM were an organizational structure that discourages ERM and an overall resistance to change.
(Liebenberg & Hoyt, 2003)	26 U.S. firms that announced the appointment of a CRO	What factors determine the adoption of ERM?	More highly leveraged firms are more inclined to appoint CROs, as an indicator of the use of ERM

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Table 7 continued. Summary of key papers

Authors	Sample	RQs/Purpose	Findings
(Paape & Speklé, 2012)	825 organizations in the Netherlands with more than 30 employees and annual revenues in excess of €10 million	What factors account for the extent and differences in ERM implementation and adoption in firms?	The extent of ERM implementation is influenced by the regulatory environment, internal factors, ownership structure, and firm and industry related characteristics

(Pagach & Warr, 2011)	138 public traded U.S. companies that announced the appointment of a CRO	What are the characteristics of firms that adopt ERM?	1. Firms that are larger, more volatile, and have greater institutional ownership are more likely to adopt ERM. 2. A firm is more likely to hire a CRO when the CEO has the incentive to take risk.
(Lechner & Gatzert, 2018)	160 companies listed on the German stock indices DAX, MDAX, SDAX and TecDAX	What characteristics of a firm determine the implementation of an ERM system?	Size, international diversification, and the industry sector (banking, insurance, energy) have a significant positive impact on the implementation of an ERM system.
(Baxter et al., 2013)	165 firm-year observations in the banking and insurance industries with S&P ratings	What characteristics of a firm contributes to variation in ERM quality?	Companies with superior ERM programs are more complex, have greater financial resources, and better corporate governance.
Stream 2: enterprise risk management and firm performance			
(Florio & Leoni, 2017)	464 firm-year observations of non-financial Italian companies listed on the Milan Stock Exchange	What is the effect of ERM on firm performance?	Firms with advanced level of ERM implementation present higher performance, both as financial performance and market evaluation.
(Gordon et al., 2009)	112 US firms that disclose the implementation of their ERM activities within their 10Ks and 10Qs filed with the US Securities and Exchange Commission	Analysis of the impact of proper match between ERM and contingency variables on firm performance	1. There is a significant positive relation between ERM and firm performance 2. Relationship is contingent upon the appropriate match between firm's ERM system and five firm-specific factors
(Callahan & Soileau, 2017)	162 U.S. based publicly traded firms that provide an assessment of ERM maturity	Does enterprise risk management enhance operating performance?	There is a positive relationship between ERM process maturity and industry-adjusted operating performance (ROA and ROE)
(Baxter et al., 2013)	165 firm-year observations in the banking and insurance industries with S&P ratings	What is the impact of ERM quality on firm performance?	There is a positive relationship between ERM quality and firm's operating performance, as measured by accounting returns.
(Aebi et al., 2012)	372 banks in the CRSP/COMPUSTAT database	Analysis of risk governance characteristics on the performance of banks during the financial crisis	Banks whose CRO reports directly to the board of directors perform significantly better in the crisis, but banks whose CRO reports to the CEO perform significantly worse than other banks.
Stream 3: the value of enterprise risk management			
(Baxter et al., 2013)	165 firm-year observations in the banking and insurance industries with S&P ratings	Does ERM quality affect the value of a firm?	Firms that invest in higher quality ERM have higher market valuation, as measured by Tobin's Q
(Eckles et al., 2014)	354 publicly traded U.S. insurance companies in the CRSP/COMPUSTAT database	Analysis of the impact of ERM on the marginal cost of reducing risk	1. There is a reduction in stock return volatility which becomes stronger over time, for firms that adopt ERM. 2. Return per unit of risk (ROA/return volatility) increase post ERM adoption
(Farrell & Gallagher, 2014)	225 publicly listed firms, across various sectors that have completed the RIMS ERM Maturity Model assessment over the 2006–2011 period	What is the relationship between ERM maturity level and firm value?	1. There is a statistically significant positive relationship between ERM maturity level and firm value. 2. The magnitude of increase in value for firms with matured levels of ERM is 25%

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Table 7 continued. Summary of key papers

Authors	Sample	RQs/Purpose	Findings
(Grace et al., 2014)	523 U.S. insurers	What is the effect of ERM practices on firm value?	1. There is a significant positive impact of ERM on cost and revenue efficiency depending on ERM activity 2. CRO or risk committee has significant positive effect; but depends on headquarter being the United States or not; life insurers benefit from economic capital models
(Hoyte & Liebenberg, 2011)	117 public traded U.S. insurers	What is the effect of ERM on firm value?	1. There is a significant positive relation between firm value and the use of ERM 2. ERM increases shareholder value by approximately 20%
(Lechner & Gatzert, 2018)	160 companies listed on the German stock indices DAX, MDAX, SDAX and TecDAX .	What is the impact of ERM on firm value?	There is a significant positive impact of ERM on shareholder value
(McShane et al., 2011)	82 insurance companies	What is the impact of ERM on firm performance?	1. There is a significant positive relation between increasing traditional RM level (up to first 3 ERM categories) 2. There is no further increase in value as firms achieve ERM (ERM categories 4 and 5)
(Tahir & Razali, 2011)	528 Malaysian firms	What is the relationship between ERM and firm value?	There is a positive but not significant relationship between ERM and firm value
(Pagach & Warr, 2010)	106 U.S. companies	What is the impact of ERM on a firm value?	1. There is a significant decrease in stock price volatility after introduction of ERM; no further significant effect 2. There is a significant reduction in earnings volatility for firms with positive abnormal returns at CRO appointment date
(Beasley et al., 2008)	120 U.S. companies	Analysis of the impact of ERM on shareholder value/equity market reaction to CRO announcement	1. No general market reaction to CRO announcement; reaction is firm-specific; mainly for non-financial firms 2. Significant, positive relation of market reaction (non-financials) to firm size and earnings volatility, negative to leverage and cash ratio
Stream 4: enterprise risk management in practice			
(Mikes, 2009)	Gotebank and Fraser Bank	To explore the various variations in ERM practices and their underlying calculative cultures that exist in the financial services industry.	1. There are systematic variations in ERM practices in organizations. 2. Identifies two types of ERM models: a) ERM by the numbers (a shareholder value driven perspective characterized by risk-based management (RBM) b) Holistic ERM (a risk-based internal control demand driven perspective characterized by holistic risk management) 3. RBM is characterized by calculative idealism (enthusiasm for risk quantification, i.e., quantitative enthusiasts) whilst HRM is characterized by calculative pragmatism (skeptical attitude to risk quantification, i.e., quantitative skeptics)

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Table 7 continued. Summary of key papers

Authors	Sample	RQs/Purpose	Findings
(Fraser & Henry, 2007)	Five "big four" audited UK plcs	1. To explore avenues by which organizations identify risks and embed risk management, control and reporting in pre-existing structures	1. A multi-procedural approach, whereby internal audit/risk management functions hold risk workshops and/or conferences to identify risks, develop risk matrices, compile risk registers and carry out checks to ensure that systems are being maintained. 2. Internal audit plays an entrenched role through collaboration with the operating groups to define risks and are responsible for the prioritization of risks. 3. Audit committees form preliminary view of the quality of risk management and are responsible for collating information and reporting their findings to the parent board.
(Arena et al., 2010)	3 non-financial private Italian companies	To explore the organizational dynamics of ERM	1.**ERM rationalities**: a) A tool for building a sound and externally recognized image of corporate governance b) A pervasive performance instrument capable of enhancing the value of a firm c) A superficial instrument to satisfy regulatory requirements and portray compliance 2. **Uncertainty experts**: a) Creation of a new organizational role, the CRO, under the jurisdiction of the AFCU controller to spearhead ERM implementation b) The addition of a new expert as a CRO under the jurisdiction of the internal auditor dedicated to implementing ERM c) Pre-existing role, the internal auditor, to take charge of ERM implementation without a dedicated figure to the task 3. **Risk technologies**: a) Decoupling: ERM program is standalone, which does not challenge, influence and/or impact on pre-existing practices b) Slight embeddedness: ERM and some part of pre-existing practices intersect at the top level. c) Complete embeddedness: a new hybrid style which fully integrates ERM with pre-existing practices
(Arena et al., 2011)	9 non-financial Italian firms	1. To what extent is ERM actually used? 2. Is there any relation between ERM uses and different characteristics of the ERM tool implemented?	1. **Three (3) uses of ERM**: a) Responsive use of ERM: only used to paint an external picture and superficially demonstrate conformance to external requirements. b) Discoursive use of ERM: used to develop a better understanding of the risk profile of an organization, which forms the basis for subsequent debates and discussions across the entire organization. c) Prospective use of ERM: here output of ERM analysis is used to guide future action plans (budgets, long-term plans and investment decisions) 2. **Relationship between uses and characteristics:** a) The range of supported activities and the prospective use of ERM are deeply associated to the actual level of integration of the system. b) The organizational actors that are responsible for ERM implementation and management play a key role in determining the uses made by others actors.

Note: Big Four auditor = KPMG, Deloitte, Ernst & Young, and PwC; CRSP = Center for Research in Security Prices; RIMS = Risk and Insurance Management Society; CRO = Chief Risk Officer; ROA = Return on Asset; ROE = Return on Equity; AFCU = Accounting, Finance and Controlling Unit; HRM = Holistic Risk Management; CRM = Centralized Risk

Management; CFO = Chief Financial Officer; ERM = Enterprise Risk Management; Tobin's Q = the ratio of the market value of equity plus liabilities (at book value) and assets (at book value)

4. FUTURE RESEARCH AGENDA

A four-step approach was adopted to discover a future research agenda using bibliometrics and content analyses (Bahoo, 2020). First, 50 top-cited articles that create a network of clusters in a citation map were reviewed. Second, all the trending and influential articles between 2012 and 2022 were reviewed. Third, in order to eliminate the possibility of top citation bias, the remaining sample of the top-cited 50 articles were reviewed. Fourth, the identified prospective research agenda were converted into research questions while excluding questions that have already be worked on by researchers. The outcome of this systematic process was a 10-question future research agenda listed in Table 8.

5. CONCLUSION

Global interest and advocacy for the adoption and implementation of enterprise-wide risk management system is on the rise following a number of adverse economic events such as the 2007/2008 global financial crisis and the Enron scandal in 2000. Enterprise Risk Management, ERM, integrates and links the entire risks faced by an organization in a holistic manner and deals with them in a comprehensive and coherent fashion, instead of dealing with them in silos or individually. ERM is said to reduce an organization's overall risk of failure, and consequently increase the performance and value of the firm. Corporate governance factors, as well as firm and industry related factors are key determinants of ERM adoption and implementation. In practice, there are differing approaches to ERM, and that alternative models of ERM co-exist among organizations. Considering the fact that ERM adoption and implementation is contingent on several factors, it is recommended that more future research on ERM be focused on the contingency perspective, and that a general theoretical contingency framework be developed to guide future studies on ERM. Also, sustainability risk management (SRM) is a future theme that is developing out of the central theme, ERM. Further, articles on ERM have largely appeared in risk, accounting and finance journals. It is also recommended that ERM offers an important window of research for management journals and scholars to explicate the managerial dynamics of ERM. This research work attempts to present a bibliometric review of the literature on ERM. There are two possible limitations to this work: (1) data for the bibliometric citation and content analyses was limited to Scopus. It is recommended that bibliometric citation and content analyses be conducted on other databases such as ISI WoS/WoK or Google Scholar, subjective to access and software availability; (2) the biblioshiny software used for this work could not be used to generate network maps among authors' institutions, countries and affiliations. As a result, this work did not capture analysis on authors' institutions, countries of origin and affiliations. It is suggested that a complementary software such as the VOSviewer, be used in tandem with biblioshiny software in future studies.

Table 8. Future research agenda

S/No.	Reference	Research Questions/Explanations
1	(Gordon et al., 2009)	Is there any theoretical contingency framework that exists to explain the relationship between ERM and firm performance?
2	(McShane et al., 2011)	Why does a strong or excellent ERM rating not lead to higher firm value? As other firms adopt ERM systems, practices, and culture, will the advantages of ERM disappear?
3	(Florio & Leoni, 2017)	How does CRO centrality and RC as measures of ERM affect firm performance?
4	(Callahan & Soileau, 2017)	What relationship exists between ERM and firm performance in the long run?
5	(Kleffner et al., 2003)	What is the international consensus on what ERM really is?
6	(Paape et al., 2012)	In what effective ways can organizations integrate risk management in their management control structures?
7	(Pagach & Warr, 2011)	What are the processes involved in the implementation of ERM in organizations? What are the various stages in the evolution of ERM in organizations?
8	(Mikes, 2009)	To what extent are the two models of ERM; ERM by numbers and holistic ERM, mutually exclusive? What drivers influence the different risk management styles?
9	(Fraser et al., 2007)	What is the effect of board oversight of the risk management process on shareholder assurance?
10	(Beasley et al., 2008)	What is the long-term effect of CROs announcement on the value of a firm? What is the impact of ERM adoption on the extent of risk disclosure of firms?

Note: The table shows 10 future research questions. ERM = Enterprise Risk Management; CRO = Chief Risk Officer; RC = Risk Committee

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