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A Comprehensive Review of Information Technology in Enterprise Risk Management at Higher Education Institutions

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ABSTRACT

Enterprise risk management (ERM) is a comprehensive framework that effectively manages and mitigates risks across various industries, ensuring efficient risk management and mitigation strategies. This study aims to examine the existing literature and find common patterns and approaches to determine the most effective strategies for enhancing information technology (IT) in ERM at higher education institutions (HEIs). The methodology utilized in this investigation involved the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), which encompassed a rigorous approach to gathering and examining data. The research utilized a series of sophisticated search methodologies, notably focusing on the keywords; "information technolog*" OR "digital technolog*" OR "computerized technolog*" OR technolog* AND "risk management" OR "enterprise risk management" OR "integrated risk management" OR "corporate risk management" AND "higher education*" OR education OR universit* OR college*. The search phrases were utilized in the SCOPUS and Web of Science (WoS) databases to attain an extensive and all-encompassing compilation of pertinent scholarly works. The investigation encompassed the period from 2019 to 2023, leading to a comprehensive examination of the extant literature on the subject matter. The study implemented specified inclusion and exclusion criteria to ascertain pertinent research, leading to a final sample size of articles (n = 30). The final analysis report thoroughly examines the results obtained, highlighting the rigorous verification of the data by experts in the field. The data underwent a thematic analysis methodology to categorize and consolidate it. The study yielded the successful identification of three distinct themes, specifically (1) digitalization in educational management, (2) Strategies and approaches, and (3) impacts and changes. These themes provide a complete understanding of the intricate landscape that forms the focus of our study. This detailed analysis underscores the importance of IT in ERM at HEIs, digitalization, strategies, and impacts. The benefits include improved strategic decision-making, effective allocation of resources, and a strong foundation for managing risks. There is a growing imperative for the cultivation of aptitudes and the dissemination of information.

Keywords:
Enterprise risk management; Information technology; Higher education

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1. Introduction

Information technology (IT) plays a more and more crucial role in the efficient risk management of businesses in today's dynamic business environment [4,12]. Enterprise Risk Management (ERM), a holistic framework for discovering, analysing and managing risks, has witnessed a growing reliance on IT tools to facilitate its execution [7,16]. This comprehensive introduction establishes the groundwork for a detailed analysis that delves into the delicate relationship between IT and ERM, analysing how IT solutions are applied to enhance risk management processes within higher education institutions (HEIs). Furthermore, the integration of IT into ERM marks a major paradigm shift, as HEIs acknowledge the need for real-time risk visibility, data-driven decision-making, and seamless collaboration among stakeholders [27,41,42]. In this setting, ERM's conventional manual and compartmentalized procedures have given way to creative IT-driven solutions that promise to alter the way HEIs discover, assess, and mitigate risks [13].

This comprehensive analysis tries to provide a detailed and up-to-date synthesis of the available literature on the connection between IT and ERM at HEIs. It tries to uncover how IT solutions are used to strengthen ERM processes, both in terms of risk identification and assessment, as well as in the ongoing monitoring and management of risks [18,43,47]. Moreover, IT tools and technologies that have been utilized for ERM deployment, ranging from data analytics, artificial intelligence, and machine learning to integrated risk management software. These tools enable HEIs to acquire a comprehensive perspective of risks, make data-driven decisions, and improve the whole risk management process [14,36,39]. Furthermore, the assessment will look into the obstacles and constraints connected with the integration of IT into ERM, evaluating problems such as data security, the cost of implementation, and the need for change management. By examining these impediments, the review intends to provide insights into ways for successful IT-driven ERM implementation [1,5,49].

In an increasingly complex and interconnected HEIs world typified by global uncertainty, the relevance of IT in ERM cannot be underestimated [25,45]. By combining the existing body of information, this thorough study strives to give significant insights to both scholars and practitioners in the subject of risk management. In addition, it intends to contribute to a greater knowledge of how IT may be utilized to maximize ERM procedures, ensuring firms can more effectively discover, assess, and mitigate risks in a dynamic and data-rich context [2,50]. Ultimately, this research aims to strengthen the resilience and long-term success of companies by utilizing the revolutionary potential of IT in ERM at HEIs.

2. Methodology

2.1 Identification

Three main procedures are used in the systematic review approach to select a number of good publications for this investigation. The first step is to identify keywords and investigate related concepts using thesauri, dictionaries, encyclopaedias, and previous research as resources. Next, search strings were created for the Scopus and Web of Science (WoS) databases after identifying relevant terms (Table 1). In the first phase of the systematic review process, 1,558 papers from Scopus and 1,829 from WoS were successfully retrieved from the databases.

Table 1
The search strings

Scopus	TITLE-ABS-KEY ((“information technolog*” OR “digital technolog*” OR “computerized technolog*” OR technolog*) AND (“risk management” OR “enterprise risk management” OR “integrated risk management” OR “corporate risk management”) AND (“higher education*” OR education OR universit* OR college*))
Web of Science	(“information technolog*” OR “digital technolog*” OR “computerized technolog*” OR technolog* AND “risk management” OR “enterprise risk management” OR “integrated risk management” OR “corporate risk management”) AND (“higher education” OR education OR “universit*” OR “college*”)

2.2 Screening

Duplicate papers should be disregarded in the first screening step. While 3,254 papers were rejected in the first round, 133 articles were reviewed in the second round. The researchers specified particular inclusion and exclusion criteria followed during this screening process. Since research papers are the main source of useful information, literature was the first criterion for this investigation. Furthermore, the current investigation includes publications that have been excluded in the past, including reviews, systematic reviews, bibliometric literature, conceptual, meta-analyses, meta-syntheses, book series, books, chapters, and conference proceedings. Furthermore, only academic articles written in English were included in the analysis. It is absolutely necessary to recognize that the schedule’s selected term is five years long, from 2019 to 2023. Only studies conducted in HEIs have been selected to align with the analysis’s goals. A total of 3,254 publications were eliminated due to business, management and accounting, economics, econometrics, and finance as subject areas.

2.3 Eligibility

There are 133 articles produced for the eligibility phase, which is the third step. At this point, the titles and important content of every article were carefully examined to ensure that the inclusion criteria were met and that the papers fit within the current study and its goals. As a result, 103 reports were excluded since they were not constituted due to the out-of-field, title not significantly, and abstract not related to the objective of the study. Lastly, Table 2 indicates that 30 articles are accessible for examination.

Table 2
The selection criterion is searching

Criterion	Inclusion	Exclusion
Language	English	Non-English
Timeline	2019 – 2023	< 2019
Literature type	Journal (Article)	Conference, Book, Review
Publication Stage	Final	In Press
Subject Area	Social sciences, Business, Economics, Management and Business Finance	Besides Social sciences, Business, Economics, Management and Business Finance

2.4 Data Abstraction and Analysis

This study analysed and synthesized multiple research designs, including mixed, qualitative, and quantitative approaches, using integrative analysis as one of the evaluation tools. Expert research is

mostly concerned with developing appropriate topics and subcategories. The collection of data was the first step in the topic's development. The authors have meticulously scrutinized a set of 30 academic articles to find any claims or information relevant to the current study concerns. In the second stage, the writers and specialists analyse the current IT in ERM of HEIs before defining and creating logical categories. Three main elements emerged from the approach: issues, digitalization, education management, strategies, approaches, impact and changes. The writers then summarized each extended concept, including any linked themes, ideas, or opinions. In this study, the principal author worked in tandem with other co-authors to determine and create themes based on the collected data. A meticulous journal was kept throughout the data analysis process to document any relevant analysis, viewpoints, riddles, and other ideas important to understanding the data. The writers also performed a comparison analysis of the results to address any discrepancies that might have emerged during the theme development process. Furthermore, it should be mentioned that the writers converse to resolve any inconsistencies that may arise from their thoughts. In the end, the established motifs were modified to preserve consistency. To determine the validity of the evaluations, the tests were administered by two experts with a background in risk management. By guaranteeing domain validity, the expert review phase in the study improved each sub-theme's sufficiency, clarity, and significance. The author has made changes in response to criticism and suggestions from specialists.

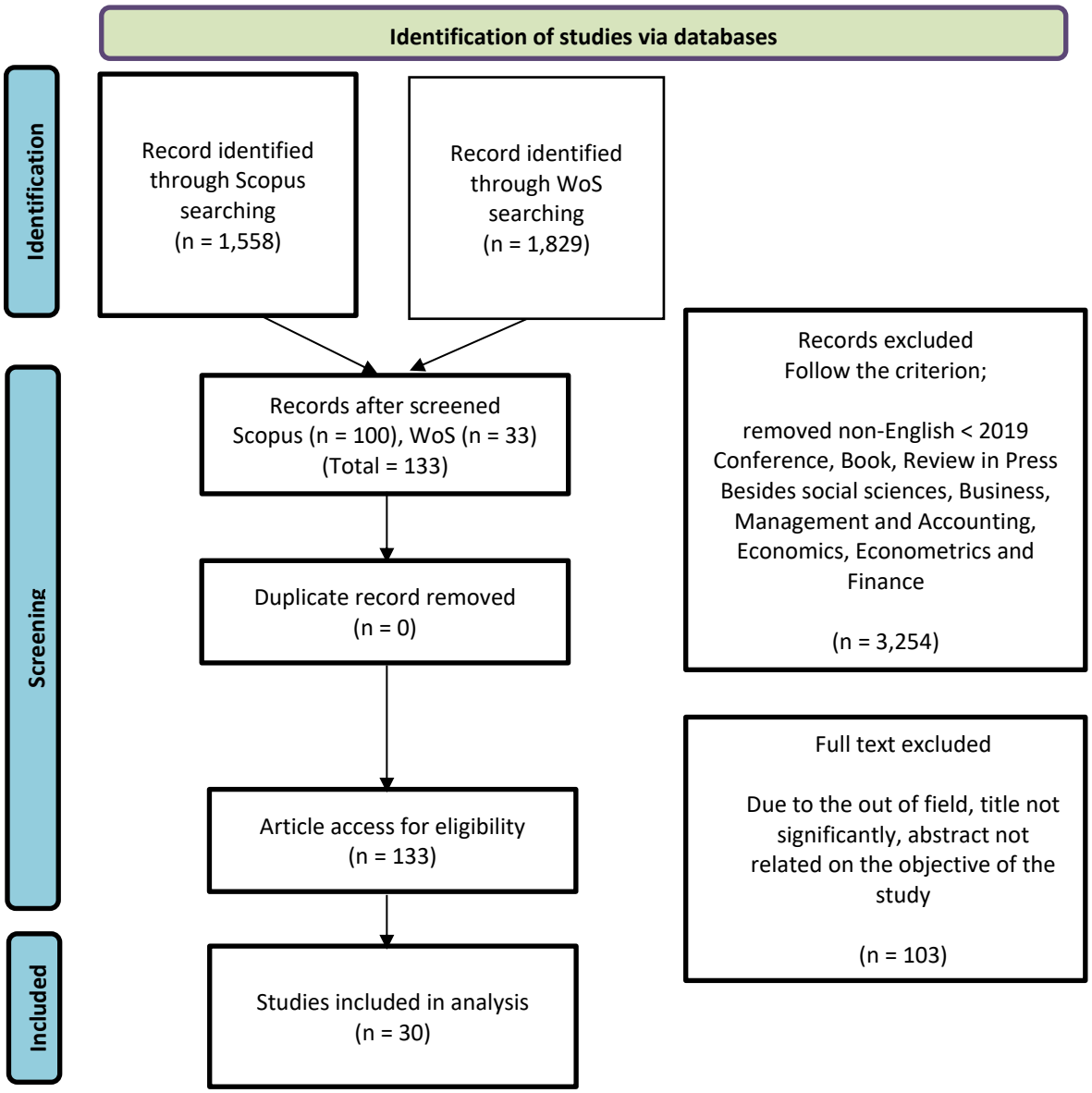

Fig. 1. Flow diagram of the proposed searching study

3. Results

3.1 Digitalization in Educational Management

Globally, the COVID-19 epidemic has irreversibly changed how higher education is taught. As a result, HEIs must quickly implement digital learning platforms, such as the Blackboard platform [33]. Although necessary, this shift increases the inherent dangers related to online data security and necessitates an evolution of ERM and IT governance techniques, especially in light of previously unheard-of difficulties like a global health catastrophe [28,29]. In order to understand the factors influencing teachers' and students' use of these e-learning tools, researchers at Jazan University in Saudi Arabia used an extended Unified Theory of Acceptance and Use of Technology (UTAUT) model that integrated new variables like perceived risk and self-efficacy [33]. Concurrent studies emphasize the importance of strong IT governance in higher educational settings and call for a responsive, practical strategy that prioritizes resource optimization and crucial threat mitigation [29]. Additionally, the intersection of these academic endeavours draws attention to the intricacy of digital transformation in higher educational settings, highlighting the necessity of an all-encompassing

approach that strengthens institutional resilience against privacy breaches and other digital vulnerabilities. It also promotes technological assimilation and user acceptance, particularly in times of crisis like the COVID-19 pandemic [28].

Within the wider organizational context, the utilization of contemporary IT encompasses not just administrative tasks but also plays a substantial role in managing HEIs. Vujović *et al*., [48] argued in favour of adopting a professional approach to the integration of IT. The authors highlight that both enterprises and HEIs frequently overlook the importance of conducting thorough professional analysis and employing project management approaches. Furthermore, the impact of advanced technologies, such as big data analytics, on the strategic agility and overall performance of HEIs is a topic of considerable importance. This influence highlights the role of strategic agility as a mediating factor between technological capabilities and HEIs' performance. Additionally, the significance of ERM becomes evident as a critical factor that enhances the influence of strategic agility on HEIs' performance [23]. The field of cybersecurity, which is of utmost importance in the sphere of IT, requires the implementation of stringent measures and higher educational programmes to protect the cyber environment. This is evident in the behaviour of academicians towards cybersecurity, as highlighted by Karagozlu [22]. The utilization of comprehensive risk assessment methodologies, such as those derived from the National Institute of Standard and Technology 800-30 framework, plays a crucial role in identifying and mitigating potential risks inside the information systems of universities. This ensures that these institutions can function without being excessively vulnerable to digital attacks [19]. Hence, these findings support the idea of implementing a planned and informed approach to the adoption and governance of information and IT in higher educational contexts. The summarization of digitization in educational management is shown in Table 3.

Table 3
Summary of digitalization in educational management

Authors	Title	Journal	Methodology	Result and Advantages
Mangundu [23]	Information Communication technology governance practices in universities: A case study of a university of technology in Durban, South Africa	African Journal of Science, Technology, Innovation and Development	The university is utilizing technology, particularly communication technology, to enhance its governance practices, ensuring efficient use and effective communication among decision-makers.	The university effectively manages risks through a combination of pragmatism, practicality, and prioritization, ensuring a balanced approach to resource expenditure and risk management.
Malinao and Sotto [28]	Home quarantined: Privacy at risk in technologically-oriented learning amidst COVID-19 pandemic	International Journal of Evaluation and Research in Education	Students face risks in utilizing online platforms during the COVID-19 pandemic, potentially compromising their privacy and ability to continue their education post-physical closures.	Management practices in online learning involve a comprehensive strategy to safeguard data and protect students' privacy, demonstrating good behaviour and value creation.
Vujović *et al.,* [48]	Project planning and risk management as a success factor for IT projects in agricultural schools in Serbia	Technology in Society	Communication technologies are revolutionizing businesses by improving processes and providing a competitive advantage, but often without proper analysis and project management methodology.	Risk management in IT projects is crucial for ensuring the success of technology. This paper provides a new approach to research, focusing on concrete IT management solutions for education organizations.

Mujalli, Khan, and Almgrashi [33]	University Accounting Students and Faculty Members Using the Blackboard Platform during COVID-19; Proposed Modification of the UTAUT Model and an Empirical Study	Sustainability (Switzerland)	UTAUT model reveals factors influencing Blackboard platform usage in Jazan University, Saudi Arabia, highlighting technology's importance in counteracting sustainability risks during pandemics and enhancing learning experiences.	The UTAUT model provides insights into factors influencing Blackboard platform usage, mobility, self-efficacy, and self-managed learning, offering practical implications for policymakers, practitioners, online learning providers, and teaching staff.
Khaw and Teoh [23]	The influence of big data analytics technological capabilities and strategic agility on the performance of private higher education institutions	Journal of Applied Research in Higher Education	The study explores the impact of technological capabilities, strategic agility, and ERM on the performance of private HEIs in Malaysia, using data from an online survey and SmartPLS 3.3.9 software.	Technological advancements play a crucial role in strategic performance, enhancing the efficiency and effectiveness of educational institutions like Malaysia's PHEIs.
Karagozlu [22]	Determination of cyber security ensuring behaviours of pre-service teachers	Cypriot Journal of Educational Sciences	The study explores pre-service teachers' cyber security behaviours using the Personal Cyber Security Ensuring Scale, involving 144 participants from two universities.	Participants often take precautions when observing unreliable individuals or situations online but occasionally prioritize privacy, precautions, and avoiding traces.
Johan, Rizqon, and Suroso [19]	University information system security risk assessment using NIST 800-30	International Journal of Recent Technology and Engineering	The University's XYZ University Information System faces risks due to its outdated technology, posing challenges for students, lecturers, and staff. To mitigate these risks, a risk assessment is conducted to identify potential threats and implement effective risk management.	The research identifies 32 risk scenarios, prioritizing them for management and guiding processes to mitigate them, utilizing National Institute of Science and Technology 800-30 standards to prevent organizational losses.

3.2 Strategies and Approaches

When examining ERM in HEIs, scholars underscore diverse tactics, emphasizing the crucial significance of customized risk management methodologies in distinct academic settings. The need to employ a probabilistic model to address information risks in the higher educational sector effectively is emphasized by Boyarov *et al*., [8]. Moreover, they argued in favour of utilizing scenario-based approaches incorporating well-defined concepts such as asset, vulnerability, threat, and damage to develop complete security policies. The proposed methodology is in accordance with the perspectives proposed by Marx and de Swardt [30], advocating for a curriculum centred around competencies for risk managers. This curriculum emphasized developing abilities in areas such as business and financial management, governance, compliance, and communication. In addition, the approach employed by the researchers is based on Interactive Qualitative Analysis. It aims to develop a robust scholarly framework that effectively satisfies the changing requirements of ERM as a scientific field. In his recent work, Anyim [6] explored the significance of internal control and ERM systems, specifically focusing on university libraries. The author highlighted the importance of

implementing strong control mechanisms to address various risks, such as financial, academic, IT, and human resources-related risks, in order to mitigate them effectively.

The incorporation of technical improvements and digital tools in higher educational risk management techniques has become a key focus in current academic research, particularly in addressing emerging concerns such as the COVID-19 pandemic. The novel telehealth curriculum developed by Jonas *et al.,* [20] was essential in showcasing the effectiveness of this approach in improving students' competencies and preparedness for participating in telehealth practises. Furthermore, the present advancement in education aligns with the research conducted by Wooldridge *et al.,* [51], which investigated the strategies employed by HEIs to address the dangers posed by the pandemic. The study highlighted the importance of internal initiatives, benchmarking, and IT assistance in ensuring the uninterrupted delivery of academic programmes and minimizing potential risks. Similarly, Mehta and Ali [32] and Catyanadika and Isfianadewi [10] concentrate their research efforts on examining the level of responsiveness exhibited by HEIs in the face of the pandemic. They specifically highlight significant technological vulnerabilities, including insufficient internet connectivity and the necessity for resilient IT systems. Consequently, they advocate for the implementation of strategic policies aimed at fortifying the infrastructure supporting online learning.

Several studies provide insights into the practical aspects of adopting ERM techniques within higher educational settings by analysing their efficiency and ramifications. In the study, Olariu and Brad [37] employ the Data Envelopment Analysis technique to assess the efficiency of study programmes. They proposed that enhancing quality in accordance with socio-economic developments is a recommended course of action. Perera *et al*., [38] examined the effects of ERM on HEIs' performance, recognizing the difficulties posed by substantial implementation expenses and inconclusive results concerning the effectiveness of ERM. Moreover, the quantitative analysis conducted in this study further validated the dependability of specific indicators in evaluating the impact of ERM. According to Ghafar and Jamal [17], blended learning is advocated as an effective approach to risk management education due to its ability to enhance student motivation and comprehension. In contrast, the study conducted by Al Mawadieh, Al-Badawi, and Al-Sarairah [31] revealed that ERM practice in Jordanian universities is only at a moderate level. This finding highlighted the need for improved training and strategic planning in implementing ERM protocols. The findings collectively emphasized the importance for HEIs to implement comprehensive ERM strategies tailored to unique contexts. Therefore, these strategies should incorporate technological, pedagogical, and managerial components in order to navigate the intricate landscape of risks in HEIs effectively. The summarization of strategies and approaches is shown in Table 4.

Table 4
Summary of strategies and approaches

Authors	Title	Journal	Methodology	Result and Advantages
Boyarov *et al.,* [8]	Analysis of information risks in education	Perspektivy Nauki i Obrazovania	The information risk analysis in educational settings is based on theory and system methods, utilizing a probabilistic model for assessing security and identifying contributing factors.	The educational environment is a complex space with evolving risks, requiring a scenario-based approach to address these risks in educational processes, ensuring a secure and efficient learning environment.
Jonas *et al*., [20]	An Interdisciplinary, Multi-Institution Telehealth Course for Third-Year Medical Students	Academic Medicine	The university actively teaches telehealth principles, providing students with an innovative telehealth training experience to enhance their medical education.	Technology has significantly improved students' knowledge and engagement in telehealth, with 80% planning to practice this method, demonstrating its effectiveness and potential for future enhancements.
Marx and de Swardt [30]	An interactive qualitative analysis of academics' views of a competency-based undergraduate qualification in risk management	Qualitative Research in Financial Markets	Risk managers play a crucial role in risk management, ensuring safety and efficiency within organizations, and their competencies are essential for determining suitable undergraduate courses and modules.	The Institute of Risk Management of South Africa and the Council for Higher Education are developing a comprehensive undergraduate curriculum in risk management.
Olariu and Brad [37]	Preventive Risk Management of Resource Allocation in Romanian Higher Education by Assessing Relative Performance of Study Programs with DEA Method	Sustainability (Switzerland)	HEIs in Romania continuously monitor investments in people, high technology, and innovation. This study evaluates the efficiency of 38 study programs using the data envelopment analysis method, implementing the bootstrap method to correct efficiencies.	The study demonstrates that quality improvement in HEIs is crucial in a socio-economic environment, with efficient programs demonstrating this.
Wooldridge *et al.,* [51]	Educational Risk: Lessons Learned during the COVID-19 Pandemic	Marketing Education Review	Students in higher education are at risk due to the significant disruption caused by COVID-19, necessitating marketing academicians to respond effectively to ensure future success.	Technological support and internal efforts are crucial in mitigating the risk associated with the COVID-19 pandemic, ensuring the smooth functioning of teaching plans and job placements.

Anyim [6]	Internal Control and Risk Management System in University Libraries: Applications, Techniques and Limitations.	Library Philosophy and Practice	The university's risk management system effectively manages risks, ensuring the organization's objective achievement and mitigating potential obstacles.	The university's system effectively manages research risks and technologies, ensuring the safety and effectiveness of its libraries.
Mehta and Ali [32]	Risk management amidst COVID-19 by Pakistani universities: A study of the University of Punjab	Journal of Management Information and Decision Sciences	Universities worldwide are addressing pandemic risks by developing solutions to detect and control the virus. This study examines the responsiveness and management of the University of the Punjab in Pakistan, the largest state university.	Universities are leveraging technology to enhance academic activities, streamline operations, and address financial risk and staff training challenges.
Ghafar and Jamal [17]	Students' perceptions of the principle of risk management and insurance as a blended learning course	International Journal of Recent Technology and Engineering	Risk management is a critical aspect of education, requiring effective strategies and effective blended learning methods, particularly in the Principles of Risk Management and Insurance course.	The study confirms that students prefer a blend of traditional classroom and online learning, highlighting its benefits, positive impact on motivation, and enhanced understanding of the course.
Catyanadika and Isfianadewi [10]	Project risk assessment of higher education online learning project during the COVID-19 crisis	World Journal on Educational Technology: Current Issues	The research identified 11 technological risks in Indonesian HEIs during the COVID-19 crisis, primarily focusing on inadequate internet connection and inconducive learning environments.	The study emphasizes the importance of prioritizing technology risk mitigation and strategic strategies for Indonesia's online learning initiatives post-COVID-19 resolution.
Perera *et al.,* [38]	Reliability Assessment of Indicators Measuring the Impact of Enterprise Risk Management on the Performance of Higher Education Institutions in Sri Lanka	Asian Journal of University Education	HEIs in Sri Lanka are implementing ERM to mitigate risks, including strategic, operational, financial, compliance, technological, and reputational issues.	The study validated the reliability of indicators used to measure latent variables in a survey instrument, with each variable's Cronbach's alpha value exceeding 0.70, indicating their suitability for the construct.

Al Mawadieh, Al-Badawi, and Al-Sarairah [31]	The reality of risk management in private Jordanian Universities from the viewpoint of faculty members	International Journal of Higher Education	Technology plays a crucial role in risk management, and universities like Aqaba University of Technology, Zarqa University, and the University of the Middle East are actively implementing effective strategies to mitigate risks.	The study discovered that risk management practice in Jordanian universities is medium, with no significant differences in teaching staff due to factors like sex, academic experience, rank, and college type. The study recommends training courses for risk management planning.

3.3 Impacts and Changes

The development of ERM, specifically within higher educational settings, can be considered a crucial reaction to the complex obstacles posed by IT progress and unexpected emergencies like the COVID-19 epidemic. Research findings suggested that implementing an IT strategy is crucial in improving ERM practises within higher educational directorates. This underscores the significance of strategic planning, effective utilization of IT, and the presence of competent human resources in attaining institutional objectives [40]. Likewise, the transition to digital learning platforms requires a certain level of flexibility. This is indicated by research that recommends incorporating comprehensive ERM strategies and easily accessible higher educational materials to address the difficulties associated with distance education [35]. In addition, in the context of widespread digital transformation in various sectors, the concept of techno-entrepreneurship assumes significant importance. It has been observed that techno-entrepreneurship directly impacts entrepreneurial aspirations and, therefore, calls for the implementation of improved educational approaches aimed at nurturing technopreneurial abilities among students [24].

Simultaneously, the process of digitization in diverse sectors highlights the importance of recognizing and adjusting to emerging trends through strategic research and planning [9]. The proficient administration of Health, Safety, and Environmental risks within higher educational environments, particularly regarding chemical risks, necessitates the use of rigorous procedures for assessing risk prioritization and implementing risk reduction strategies [3]. Promoting multidisciplinary collaboration and reflection is crucial in ERM as it contributes to deeper comprehension and mitigation of ethical, participatory, and power dynamics. This is particularly important for practitioners working in various risk contexts [26]. Furthermore, the importance of implementing focused ERM techniques that address the unique vulnerabilities to ecological, social, technical, and biological risks in disaster-prone locations is highlighted by the perception of safety among educators [11]. Thus, this comprehensive perspective promotes a more nuanced, technology-informed, and collaborative strategy for managing risks in diverse educational and professional contexts.

The development of ERM emphasizes the utilization of transdisciplinary approaches and adaptive IT to address current difficulties [15,44]. The significance of logical methods to IT governance, which bolster institutional resilience against technology vulnerabilities, is emphasized in the Control Objectives for IT 2019 framework developed by the International Professional Association [15]. The importance of integrated strategies across many corporate functions is demonstrated by the effectiveness of convergent security risk management, which recognizes the interconnectedness of physical and information security risks [44]. In the financial domain, equity crowdfunding is a novel and somewhat unexplored method within the financial sector that holds potential for university spin-offs. Despite its inherent dangers, this new approach offers a range of advantages, indicating the

involvement and exploitation of research results and knowledge transfer mechanisms [46]. Furthermore, incorporating culturally sensitive intelligent virtual advisers, specifically within higher educational environments, showcases the capacity of digital technology to alleviate student stress. Through customized interactions, these interventions are able to enhance their effectiveness [34]. Moreover, the function of governance in risk resiliency is of utmost importance, as it exerts influence on economic sustainability by implementing strategic leadership and cooperative initiatives. This highlights the complex and multifaceted character of ERM systems, as emphasized by [21]. The studies collectively indicate a notable change in the way ERM is approached, highlighting the importance of comprehensive, technologically advanced, and collaborative strategies in effectively dealing with the intricate nature of modern organizational ecosystems. The summarization of impacts and changes is shown in Table 5.

Table 5
Summary of impacts and changes

Authors	Title	Journal	Methodology	Result and Advantages
Sabit, Ghadhban, and Abbas [40]	The techno-strategy of the management information system and its role in enhancing risk management in the general directorate of school and sports activity	International Journal of Innovation, Creativity and Change	The research investigates the role of the IT system in risk management in general directorates for sports and school activities in the Ministry of Education. It examines the relationship between IT and risk management and the contribution of IT to education. The study involved 20 individuals.	The General Directorate of Sports and School Activities emphasizes the importance of strategic planning in technology, emphasizing the relationship between IT efficiency, human resource skills, and risk management. Adopting techno-strategy enhances performance and aims to achieve the directorate's vision and mission.
Novikov [35]	Impact of COVID-19 emergency transition to online learning on international students' perceptions of the educational process at Russian University	Journal of Social Studies Education Research	The study examines the challenges international first-year students face, their academic performance, and attendance, highlighting the significance of psychological and technological factors in facilitating this transition.	The study highlights the risk associated with remote teaching, highlighting the need for effective risk management plans, user-friendly content, and quality-of-life improvements to mitigate its disadvantages and enhance the learning experience.
Koe, Krishnan, and Alias [24]	The Influence of Self-Efficacy and Individual Entrepreneurial Orientation on Technopreneurial Intention among Bumiputra Undergraduate Students	Asian Journal of University Education	Students at a Malaysian university are exploring the potential of technology, particularly in the realm of technopreneurship, to address the challenges posed by the fourth industrial revolution.	The theory suggests that technology self-efficacy and risk-taking positively influence technopreneurial intention. At the same time, innovation does not significantly impact this intention, suggesting higher learning institutions focus on developing competitive technopreneurs.

Bzhalava *et al.,* [9]	Mapping the Wave of Industry Digitalization by Co-Word Analysis: An Exploration of Four Disruptive Industries	International Journal of Innovation and Technology Management	The paper delves into the global digital landscape, examining top startups in education, finance, healthcare, and manufacturing, identifying emerging business areas and subsector collaborations.	Digital technologies are revolutionizing risk management, enhancing management efficiency and reducing the risk associated with various sectors like education, finance, healthcare, and manufacturing.
Ali *et al*., [3]	HSE hazard ranking of chemicals related to Petroleum Drilling Laboratory of University using Fuzzy TOPSIS	OPSEARCH	Risk management is critical to maintaining a safe and healthy academic environment, addressing complex operations, hazardous materials, and personnel expertise, and utilizing Fuzzy Technique for hazard ranking.	The study discovered Methylene chloride, benzene, and isopropanol as the most dangerous chemical products, while ethylenediaminetetraacetic acid solution was the least dangerous. Sensitivity analysis revealed acetone and algae oil as the most sensitive.
Krishnan *et al*., [26]	Cross-country use of participatory research methods in practice to enhance inclusive decision-making	Disaster Prevention and Management: An International Journal	The risk management process in disaster management necessitates a multidisciplinary approach involving ethics, participation, and power, fostering an inclusive and effective approach.	The authors' diverse working group discussed participation, ethics, and power in disaster risk management, enhancing professional education for engineers and physical and social scientists.
Christina *et al.,* [11]	Assessing school teachers' perception of disasters: Insights from a socio-environmentally stressed Mediterranean area (Attica, Greece)	International Journal of Disaster Risk Reduction	This study explores teachers' perceptions of multiple hazards in Southern Europe, revealing unique vulnerability in urban and rural regions due to increased disaster impact.	Technological hazards have a less intense impact on teachers' safety than natural hazards like earthquakes and crime, highlighting the need for careful consideration in risk management plans for school communities.
Schneller, Porter, and Wakefield [44]	Implementing Converged Security Risk Management: Drivers, Barriers, and Facilitators	Security Journal	Converged security risk management effectively addresses interdependencies between security-related business functions, addressing both physical and information security challenges, thereby reducing the risk and threats faced by organizations.	Digital technologies pose significant risks to organizations, necessitating effective converged security risk management, addressing traditional barriers and focusing on training and education.

Troise *et al*., [46]	Equity crowdfunding for university spin-offs: Unveiling the motivations, benefits, and risks related to its adoption	Journal of Small Business Management	This qualitative study explores the use of equity crowdfunding by a few Italian university spin-offs and its motivations for bypassing traditional funding models, highlighting both benefits and risks.	Universities face risky technologies and uncertainties in equity crowdfunding despite the benefits of crowd participation and strategic resources.
Nelekar *et al*., [34]	Effectiveness of embodied conversational agents for managing academic stress at an Indian University (ARU) during COVID-19	British Journal of Educational Technology	The paper presents an embodied conversational agent (ECA) adapted for Indian university students to reduce stress and improve mental health, particularly in developing countries.	Students are increasingly using technology to address mental health issues, enhancing their stress reduction and trust, but further cultural relevance is needed.
Kalogiannidis *et al*., [21]	Role of Governance in Developing Disaster Resiliency and Its Impact on Economic Sustainability	Journal of Risk and Financial Management	The study investigates the role of governance in enhancing disaster resiliency and economic sustainability in Western Macedonia, Greece, utilizing data from 180 local leaders.	Technological advancements are revolutionizing the field of sustainability, enhancing the efficiency and effectiveness of various sectors, including governance.
Elizabeth Haywood [15]	Teaching Case Making the Grade: Using COBIT to Study Computer Crime at Bucks County Community College (Pennsylvania)	Journal of Information Systems Education	Students are utilizing technology and IT risk management strategies to mitigate potential risks, enhancing their understanding of IT security and governance thereby reducing potential cyber threats.	Technologies are being utilized in educational institutions to enhance security, enhancing the understanding of Control Objectives for Information and Related Technologies.

4. Conclusions

The integration of digitalization in education management, particularly in HEIs, has emerged as a prominent strategy for addressing worldwide concerns. The integration of platforms such as Blackboard in the process of digital transformation has highlighted the importance of adapting ERM approaches to effectively safeguard online data and provide effective governance of IT resources. The swift transition to e-learning platforms has brought attention to both the possible risks involved and the necessity for a comprehensive comprehension of user behaviour and technological acceptability, particularly in times of upheaval. Therefore, the need for strong IT governance in higher educational environments has become apparent, requiring flexible and effective techniques that distribute resources effectively and address key risks. The aforementioned collective insights emphasize the intricate nature of digital transitions in higher educational domains, necessitating a comprehensive strategy that enhances institutional resilience against digital risks while promoting technological adaption and user involvement.

The strategic methods used in ERM at HEIs have changed over time to better deal with the unique problems that come with living in the digital age. The need to implement ERM approaches tailored to address the unique requirements and susceptibilities of HEIs is steadily growing. The integration of scenario-based techniques, curricula centred on competencies, and enhanced internal controls

collectively contribute to developing a more resilient higher educational setting. Moreover, the global health crisis has expedited the incorporation of digital resources in ERM methodologies, emphasizing the significance of being technologically equipped and possessing resilient IT. This includes implementing strategic policies to facilitate the development of online higher educational environments. Furthermore, research examining the effectiveness of different ERM strategies emphasizes the need for these systems to be thorough, adaptable to specific circumstances, and encompass technological, educational, and administrative components. This ensures that HEIs can effectively navigate the complex landscape of risks.

The significance of these changes and the subsequent adoption of ERM methods inside HEIs is a crucial reaction to the complex problems presented by technological progress and unanticipated events such as global health crises. The integration of IT and the adaptability of digital learning platforms highlight the importance of implementing comprehensive ERM techniques, specifically in the context of improving remote higher education. Additionally, the increasing prevalence of techno-entrepreneurship, the widespread adoption of digital technologies in various industries, and the imperative for rigorous health and environmental safety protocols in higher educational environments necessitate an all-encompassing, technologically proficient, and cooperative strategy for managing risks. The complex and diverse characteristics of contemporary ERM systems, as evidenced by research conducted in numerous academic fields, indicate a notable transformation in the prevailing risk management paradigms. The aforementioned transition underscores the necessity of using comprehensive, technologically advanced, and collaborative approaches to navigate the intricacies of modern organizational contexts successfully.

It is advisable for future research endeavours to undertake a more comprehensive exploration of the dynamic cyber risks and their ramifications for the safeguarding of institutional data security. This is particularly crucial given the escalating integration of online learning platforms and digital databases. The analysis of the adaptability and resilience of IT infrastructure in addressing growing risks is crucial. Furthermore, it would be advantageous to conduct an inquiry into the efficacy of existing ERM tools and technologies, as well as to examine the possibilities presented by developing technologies such as artificial intelligence for augmenting ERM capabilities. Ultimately, gaining a comprehensive perspective on the role of IT in ERM within HEIs necessitates an appreciation for the human factor, encompassing staff training requirements and the influence of organizational culture.

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References

[1] Ahmed, Sajjad, Mohamed Elsholkami, Ali Elkamel, Juan Du, Erik B. Ydstie, and Peter L. Douglas. "Financial risk management for new technology integration in energy planning under uncertainty." *Applied Energy* 128 (2014): 75-81. https://doi.org/10.1016/j.apenergy.2014.03.058

[2] Al-Farsi, Hamdan Abdul Hafidh. "The influence of chief risk officer on the effectiveness of enterprise risk management: evidence from Oman." *International Journal of Economics and Financial Issues* 10, no. 1 (2020): 87. https://doi.org/10.32479/ijefi.8932

[3] Ali, Syed Imran, Shaine Mohammadali Lalji, Javed Haneef, Mohsin Yousufi, Kanza Bashir, Saman Sohail, and Laiba Sajid Cheema. "HSE hazard ranking of chemicals related to Petroleum Drilling Laboratory of University using Fuzzy TOPSIS." *OPSEARCH* 60, no. 3 (2023): 1386-1406. https://doi.org/10.1007/s12597-023-00666-9

[4] Alshahrani, Haya Mesfer, Saud S. Alotaibi, Md Tarique Jamal Ansari, Mashael M. Asiri, Alka Agrawal, Raees Ahmad Khan, Heba Mohsen, and Anwer Mustafa Hilal. "Analysis and ranking of IT risk factors using fuzzy TOPSIS-based approach." *Applied Sciences* 12, no. 12 (2022): 5911. https://doi.org/10.3390/app12125911

[5] Anand, Sanjay. "Technology and the Integration of Governance, Risk Management and Compliance." *Financial Executive* 26, no. 10 (2010).
[6] Anyim, Wisdom Okereke. "Internal Control and Risk Management System in University Libraries: Applications, Techniques and Limitations." *Library Philosophy and Practice (e-journal)* 4167 (2020).
[7] Berman, A. "Risk management and business continuity: Improving business resiliency." *Risk Management* 2 (2015).
[8] Boyarov, E N, S V Abramova, P V Stankevich, and I V Korneeva. 2021. "Analysis of Information Risks in Education." *Perspectives of Science & Education* 51, no. 3 (2021). https://doi.org/10.32744/pse.2021.3.32
[9] Bzhalava, Levan, Sohaib S. Hassan, Jari Kaivo-oja, Bengt Köping Olsson, and Javed Imran. "Mapping the wave of industry digitalization by co-word analysis: An exploration of four disruptive industries." *International Journal of Innovation and Technology Management* 19, no. 02 (2022): 2250001. https://doi.org/10.1142/S0219877022500018
[10] Catyanadika, Putra Endi, and Dessy Isfianadewi. "Project Risk Assessment of Higher Education Online Learning Project during the COVID-19 Crisis." *World Journal on Educational Technology: Current Issues* 13, no. 4 (2021): 602-616. https://doi.org/10.18844/wjet.v13i4.6232
[11] Christina, Papavasileiou, Kourou Asimina, Mavrakis Anastasios, and Salvati Luca. "Assessing school teachers' perception of disasters: Insights from a socio-environmentally stressed mediterranean area (Attica, Greece)." *International Journal of Disaster Risk Reduction* 79 (2022): 103134. https://doi.org/10.1016/j.ijdrr.2022.103134
[12] Chung, In Bae, and Carlos Caldas. "Applicability of Blockchain-Based Implementation for Risk Management in Healthcare Projects." *Blockchain in Healthcare Today* 5 (2022). https://doi.org/10.30953/bhty.v5.223
[13] Dharwal, Mridul, Vijai Pal Singh Arora, and Animesh Singh. 2020. "Framework of Comprehensive Risk Management for the Science and Technology for Defense Purpose." Journal of Critical Reviews 7 (3).
[14] Dubosson, Magali, Emmanuel Fragnière, Nathalie Junod, Samuele Meier, Sacha Varone, and Arnaud Fournier. "Integration of a human risk module into a risk management software." *Informatica economica* (2019). https://doi.org/10.12948/issn14531305/23.3.2019.01
[15] Haywood, M. Elizabeth. "Making the grade: Using COBIT to study computer crime at Bucks County Community College (Pennsylvania)." *Journal of Information Systems Education* 32, no. 2 (2021): 115-118.
[16] Ewers, Robin B. *Enterprise Risk Management in Responsible Financial Reporting*. Walden University, 2017.
[17] Ghafar, N M A, and N F Jamal. 2019. "Students' Perceptions on Principle of Risk Management and Insurance as a Blended Learning Course." International Journal of Recent Technology and Engineering 8 (2 Special Issue 11): 602–5. https://doi.org/10.35940/ijrte.B1093.0982S1119
[18] Hasan, Nida Nadya, Fatiah Rahmadini, and Dariyah Dariyah. "Application of Enterprise Risk Management to Banking Risk." *MIZANIA: Jurnal Ekonomi Dan Akuntansi* 1, no. 2 (2021): 67-84. https://doi.org/10.47776/mizania.v1i2.245
[19] Johan, Monika Evelin, Moh Fahrur Rizqon, and Ir Jarot S. Suroso. "University information system security risk assessment using NIST 800-30." *Int. J. Recent Technol. Eng* 8, no. 3 (2019): 8380-8385. https://doi.org/10.35940/ijrte.C6511.098319
[20] Jonas, Christopher E., Steven J. Durning, Catherine Zebrowski, and Francesca Cimino. "An interdisciplinary, multi-institution telehealth course for third-year medical students." *Academic Medicine* 94, no. 6 (2019): 833-837. https://doi.org/10.1097/ACM.0000000000002701
[21] Kalogiannidis, Stavros, Dimitrios Kalfas, Fotios Chatzitheodoridis, and Efthymios Lekkas. "Role of governance in developing disaster resiliency and its impact on economic sustainability." *Journal of Risk and Financial Management* 16, no. 3 (2023): 151. https://doi.org/10.3390/jrfm16030151
[22] Karagozlu, Damla. "Determination of cyber security ensuring behaviours of pre-service teachers." *Kıbrıslı Eğitim Bilimleri Dergisi* 15, no. 6 (2020): 1698-1706. https://doi.org/10.18844/cjes.v15i6.5327
[23] Khaw, Tze Yin, and Ai Ping Teoh. "The influence of big data analytics technological capabilities and strategic agility on performance of private higher education institutions." *Journal of Applied Research in Higher Education* 15, no. 5 (2023): 1587-1599. https://doi.org/10.1108/JARHE-07-2022-0220
[24] Koe, Wei Loon, Ramesh Krishnan, and Nurul Ezaili Alias. "The influence of self-efficacy and individual entrepreneurial orientation on Technopreneurial intention among bumiputra undergraduate students." *Asian Journal of University Education* 17, no. 4 (2021): 490-497. https://doi.org/10.24191/ajue.v17i4.16196
[25] Kör, Burcu, and Bilgin Metin. "Understanding human aspects for an effective information security management implementation." *International Journal of Applied Decision Sciences* 14, no. 2 (2021): 105-122. https://doi.org/10.1504/IJADS.2021.113532
[26] Krishnan, Sneha, Robert Soden, Bhen Aguihon, Rongkun Liu, and Pradip Khatiwada. "Cross-country use of participatory research methods in practice to enhance inclusive decision-making." *Disaster Prevention and Management: An International Journal* 31, no. 2 (2022): 115-123. https://doi.org/10.1108/DPM-03-2021-0097

[27] Kwateng, Kwame Owusu, Christopher Amanor, and Francis Kamewor Tetteh. "Enterprise risk management and information technology security in the financial sector." *Information & Computer Security* 30, no. 3 (2022): 422-451. https://doi.org/10.1108/ICS-11-2020-0185
[28] Malinao, Client William Melchor, and Mark Mata Sotto. "Home quarantined: Privacy at risk in technologically-oriented learning amidst COVID-19 pandemic." *International Journal of Evaluation and Research in Education* 11, no. 1 (2022): 224-238. https://doi.org/10.11591/ijere.v11i1.22059
[29] Mangundu, John. "Information Communication technology governance practices in universities: A case study of a university of technology in Durban, South Africa." *African Journal of Science, Technology, Innovation and Development* 15, no. 3 (2023): 300-310. https://doi.org/10.1080/20421338.2022.2088045
[30] Marx, Johan, and Cecilia Jacoba de Swardt. "An interactive qualitative analysis of academics' views of a competency-based undergraduate qualification in risk management." *Qualitative Research in Financial Markets* 15, no. 3 (2023): 471-494. https://doi.org/10.1108/QRFM-03-2022-0039
[31] Al Mawadieh, Reda SM, Mohammed Al-Badawi, and Khaled Al-Sarairah. "The Reality of Risk Management in Private Jordanian Universities from the Viewpoint of Faculty Members." *International Journal of Higher Education* 9, no. 5 (2020): 274-282. https://doi.org/10.5430/ijhe.v9n5p274
[32] Mehta, Ahmed Muneeb, and Fouzia Hadi Ali. "Risk management amidst COVID-19 by Pakistani universities: a study of university of the Punjab." *Journal of Management Information and Decision Sciences* 23, no. 3 (2020): 150-157.
[33] Mujalli, Abdulwahab, Tehmina Khan, and Ahmed Almgrashi. "University accounting students and faculty members using the Blackboard platform during COVID-19; proposed modification of the UTAUT model and an empirical study." *Sustainability* 14, no. 4 (2022): 2360. https://doi.org/10.3390/su14042360
[34] Nelekar, Shreeya, Amal Abdulrahman, Manik Gupta, and Deborah Richards. "Effectiveness of embodied conversational agents for managing academic stress at an Indian University (ARU) during COVID-19." *British Journal of Educational Technology* 53, no. 3 (2022): 491-511. https://doi.org/10.1111/bjet.13174
[35] Novikov, Philipp. "Impact of COVID-19 emergency transition to on-line learning onto the international students' perceptions of educational process at Russian university." *Journal of Social Studies Education Research* 11, no. 3 (2020): 270-302.
[36] Oduoza, Chike F., Onengiyeofori Odimabo, and Alexios Tamparapoulos. "Framework for risk management software system for SMEs in the engineering construction sector." *Procedia manufacturing* 11 (2017): 1231-1238. https://doi.org/10.1016/j.promfg.2017.07.249
[37] Olariu, Gabriela Vica, and Stelian Brad. "Preventive risk management of resource allocation in romanian higher education by assessing relative performance of study programs with dea method." *Sustainability* 14, no. 19 (2022): 12527. https://doi.org/10.3390/su141912527
[38] Perera, Angage Anoma Samanthi, Abdul Khabir Rahmat, Ali Khatibi, and SM Ferdous Azam. "Reliability assessment of indicators measuring the impact of enterprise risk management on performance of higher education institutions in Sri Lanka." *Asian Journal of University Education* 18, no. 1 (2022): 300-321. https://doi.org/10.24191/ajue.v18i1.17252
[39] Rice, John F. "Adaptation of Porter's five forces model to risk management." *Defense AR Journal* 29, no. 2 (2022): 126-139. https://doi.org/10.22594/dau.21-890.29.02
[40] Sabita, H. S., S. Q. Ghadhbanb, and R. A. Abbasc. "The Techno-Strategy of the Management Information System and its Role in Enhancing Risk Management in the General Directorate of School and Sport Activity." *International Journal of Innovation, Creativity and Change* 13, no. 3 (2020): 139-151.
[41] Saeidi, Parvaneh, Sayyedeh Parisa Saeidi, Leonardo Gutierrez, Dalia Streimikiene, Melfi Alrasheedi, Sayedeh Parastoo Saeidi, and Abbas Mardani. "The influence of enterprise risk management on firm performance with the moderating effect of intellectual capital dimensions." *Economic Research-Ekonomska Istraživanja* 34, no. 1 (2021): 122-151. https://doi.org/10.1080/1331677X.2020.1776140
[42] Saeidi, Parvaneh, Sayyedeh Parisa Saeidi, Saudah Sofian, Sayedeh Parastoo Saeidi, Mehrbakhsh Nilashi, and Abbas Mardani. "The impact of enterprise risk management on competitive advantage by moderating role of information technology." *Computer standards & interfaces* 63 (2019): 67-82. https://doi.org/10.1016/j.csi.2018.11.009
[43] Salaudeen, Yinka M., Taibat A. Atoyebi, and Bamidele A. Oyegbile. "Enterprise risk management and performance of selected listed consumer goods companies in Nigeria." *Applied Finance and Accounting* 4, no. 1 (2018): 112-121. https://doi.org/10.11114/afa.v4i1.2918
[44] Schneller, Louisa, Cody Normitta Porter, and Alison Wakefield. "Implementing converged security risk management: Drivers, barriers, and facilitators." *Security Journal* 36, no. 2 (2023): 333-349. https://doi.org/10.1057/s41284-022-00341-6
[45] Sukumar, Arun, Hannan Amoozad Mahdiraji, and Vahid Jafari-Sadeghi. "Cyber risk assessment in small and medium-sized enterprises: A multilevel decision-making approach for small e-tailors." *Risk Analysis* 43, no. 10 (2023): 2082-2098. https://doi.org/10.1111/risa.14092

[46] Troise, Ciro, Stefano Bresciani, Alberto Ferraris, and Gabriele Santoro. "Equity crowdfunding for university spin-offs: Unveiling the motivations, benefits, and risks related to its adoption." *Journal of Small Business Management* 62, no. 4 (2024): 1907-1941. https://doi.org/10.1080/00472778.2023.2182443

[47] Viscelli, Therese R., Dana R. Hermanson, and Mark S. Beasley. "The integration of ERM and strategy: Implications for corporate governance." *Accounting Horizons* 31, no. 2 (2017): 69-82. https://doi.org/10.2308/acch-51692

[48] Vujović, Vuk, Nebojša Denić, Vesna Stevanović, Mališa Stevanović, Jelena Stojanović, Yan Cao, Yasir Alhammadi *et al.,* "Project planning and risk management as a success factor for IT projects in agricultural schools in Serbia." *Technology in Society* 63 (2020): 101371. https://doi.org/10.1016/j.techsoc.2020.101371

[49] Pieket Weeserik, Bram, and Marco Spruit. "Improving operational risk management using business performance management technologies." *Sustainability* 10, no. 3 (2018): 640. https://doi.org/10.3390/su10030640

[50] Whittle, Christopher E., and Danielle Nel-Sanders. "The regulatory framework for enterprise risk management in South African local government." *Africa's Public Service Delivery & Performance Review* 10, no. 1 (2022): 8. https://doi.org/10.4102/apsdpr.v10i1.610

[51] Wooldridge, Barbara Ross, Kyung-Ah Byun, Zhi Pei, JungHwa Hong, and Krist R. Swimberghe. "Educational risk: Lessons learned during the COVID-19 pandemic." *Marketing Education Review* 31, no. 4 (2021): 340-351. https://doi.org/10.1080/10528008.2021.1957939