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Digital Capabilities in Intellectual Capital for Financial Sustainability: Literature Review

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Abstract

Intellectual capital (IC) is gaining significant attention in research and practice. Digital capability refers to an organization's ability to adapt and use digital technology to improve performance, innovation, and competitiveness. Intellectual capital encourages companies to recognize and utilize their knowledge assets to improve performance, encourage innovation, and achieve financial sustainability. A significant theoretical framework for exploring knowledge management in an organizational context is a resource-focused view (RBV), which makes knowledge the basis for developing and maintaining a company's competitive advantage as well as long-term performance. The components of intellectual capital (IC) – human, structural, and relational – become essential to regulate these elements in the context of the dynamic and unpredictable business environment in which they operate. This study aims to find and research ways to measure IC in the context of business risk uncertainty. SLRs systematically identify, evaluate, and integrate all relevant research, allowing for in-depth investigation of existing research questions. This study uses a search strategy using the Pubilsh or Perish application and the PRISMA checklist methodology to narrow down to 30 research data to be analyzed. These SLRs also have some limitations and have some notes for future research.

INTRODUCTION

Intellectual Capital (IC) has gained significant attention in research and practice for over 30 years. The current economic conditions, which are highly competitive and digital-based, have focused on intangible assets as companies strive to outperform each other when it comes to innovation. Digital capabilities refer to an organization's ability to adapt and use digital technologies to improve performance, innovation, and competitiveness. In the banking industry, digital capabilities include the use of technology such as big data, cloud computing, blockchain, artificial intelligence (AI), internet of things (IoT), and various other digital applications that support banking operations and services. Digital capabilities are not just about the tools or technologies used by banks, but rather how these technologies improve the management and effectiveness of each component of ICs within

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the organization. In this context, digital capabilities will strengthen, improve, and encourage Intellectual Capital in a more productive and effective direction.

The current global economic conditions are full of business uncertainties arising from various factors, such as political uncertainty and trade tensions between the US and China (Boungou & Yatié, 2022), economic variations reflected in events such as the 2008 crisis and the recent collapse of banks (Pandey et al., 2023) as well as technological innovations (Brynjolfsson & McAfee, 2014). Deeper complexities arise from disruptions in supply chains due to climate change (Lee & Klassen, 2016) as well as increasing demand for socio-economic equality and fair practices in doing business (Cosa & Urban, 2023).

To address this complexity, strategically increasing an organization's intellectual assets is essential to minimize instability in business (Herremans et al., 2011; Khan & Ali, 2017). IC theory emphasizes that knowledge management is crucial to improve the ability and competitiveness of an organization (Bontis, 1998; Juma & McGee, 2006). A significant theoretical framework for exploring knowledge management in the context of an organization is the resource-focused view (RBV), which makes knowledge the basis for developing and maintaining a company's competitive advantage as well as long-term performance (Alavi & Leidner, 2001). RBV also conveys a knowledge-based perspective that considers knowledge as a crucial element to achieve sustainable excellence (Carneiro, 2000; Cohen & Olsen, 2015). Companies today rely heavily on knowledge resources to succeed in the execution of their products and services (Alavi & Leidner, 2001; Alegre et al., 2013). Within this framework, ICs become a crucial element, protecting the organization from uncertainty and emphasizing the importance of accurate IC measurement methods.

Current IC assessment methods present challenges. The direct intellectual capital (DICM) method allows for a thorough analysis of IC elements but can threaten reliability in unstable assessment situations. The market capitalization (MCM) method, which is based on a market view, is easily influenced by speculative behavior, especially during economic recessions. Simultaneously, the asset measurement method (ROA) and the scoreboard method (SC) emphasize the challenges in measuring ICs, revealing the difference between tangible and intangible assets in times of financial and market instability (G. Roos et al., 2007; K.-E. Sveiby, 2018). With these challenges in mind, there is an urgent need for resilient and uncertain IC measurement methodologies in global businesses.

IC evaluation helps companies understand the value of intangible assets more deeply, so that they can make more accurate strategic decisions (Bontis, 1998; Edvinsson & Malone, 1997). In addition, it allows companies to recognize and leverage their knowledge assets to improve performance, drive innovation, and improve collaboration (G. Roos et al., 2007; K. Sveiby, 2001). This makes the company more attractive to investors who have an interest in intellectual property and knowledge resources owned by the company (Stewart, 2010). Although there is no globally accepted definition of IC, the general literature recognizes that IC is made up of various elements (Asiaei et al., 2018; Hussinki et al., 2017; Pedro et al., 2018). This study refers to IC on the combination of three elements: human capital, structural, and relational (Edvinsson & Malone, 1997; J. Roos et al., 1997). Human resources refer to the knowledge, skills, and innovative potentials collected in organizational individuals (Bontis, 1998; Youndt et al., 2004). Structural capital includes the systems, procedures, and intellectual property of an organization, without regard to the human element (Edvinsson & Malone, 1997; G. Roos et al., 2007). Finally, relational capital refers to the valuable relationships and networks that an organization has established with external parties such as customers, providers, and stakeholders. This is often crucial in unpredictable market situations (Nahapiet & Ghoshal, 1998; K. Sveiby, 1997).

The components of Intellectual Capital (IC) – human, structural, and relational – become essential to organize these elements in the context of the dynamic and unpredictable business

environment in which they operate. As examined in this study, global conditions and rapid developments in business are related to a lack of clarity or ability to predict future market conditions, economic patterns, or other elements that may impact a company's operations or profits (Bennett & Lemoine, 2014). Previous research has recommended finding a more effective IC measurement model in the face of political, technological, social, economic, and environmental changes. For example, Ashton (2005) reports that traditional financial measurement and reporting methods have been inadequate in adapting to changes in the external business environment and the company's response to such shifts, as entrepreneurs face various challenges in an unstable and volatile environment. Regarding the existing phenomenon, measuring and utilizing IC is crucial to develop a resilient, growing, and sustainable business (Daou et al., 2019).

Various studies have examined various aspects of IC in the last ten years. For example, a systematic analysis by Jalonen (2012) shows that uncertainty is a comprehensive and inevitable element in the innovation process, which impacts various phases from idea development to commercialization. This research offers an important perspective on the relationship between ICs and innovation in companies. However, the authors did not find a methodology for IC evaluation. More recent research (Ali et al., 2021; Lin & Edvinsson, 2020; P. Paoloni et al., 2023) present a comprehensive view of IC issues and indicate several possible gaps in IC studies. However, they do not assess business conditions that tend to experience rapid changes today. While previous studies have provided valuable insights into the relationship between ICs and innovation that have shown gaps in IC research, they have not explicitly discussed or devised a methodology for evaluating ICs in unexpected situations that could result in negative impacts for companies. It offers areas of investigation that have not been explored in IC research. In this context, this study raises three main questions: Which factors are most appropriate to evaluate IC in supporting a company's financial sustainability? Which IC components – human, structural, or relational – are most effective in improving company performance? Furthermore, can a universal model for IC measurement be designed in the context of business turbulence?

METHOD

Referring to the Tranfield et al. (2003) guidelines, SLR systematically identifies, evaluates, and integrates all relevant research, allowing for in-depth investigation of the research questions we focus on (Tranfield et al., 2003). Compliance with the PRISMA checklist by Moher et al. (2015) improved the transparency and replicable of this study. In addition to SLR, bibliometric analysis is also a crucial element in research methodology (Moher et al., 2015). This allows researchers to track the development of IC discourse over time, effectively identifying shortcomings and upcoming research opportunities.

The search strategy uses the Pubilsh or Perish (PoP) application with sources in Google Scolar, Scopus, and Crossref. Search scope using the phrase "Intellectual Capital" then added the keyword "Risk Management", "Profitability", "Financial Sustainability" and "bank". Since IC is a broad concept with multiple meanings (Mustapha & Abdullah, 2004), referring to Evans et al. (2015), the search term used is: "Intellectual Capital*," "Intellectual Assets*," "intangible assets*," "invisible assets*," "Knowledge Capital," and "knowledge assets*" (Evans et al., 2015). Finally, referring to (P. Paoloni et al., 2023), the previously mentioned IC variation with the keyword "measurement*" paired (using wildcard "*" to include both singular and plural forms). Table 1 shows the search strings used and the number of documents found.

Acceptance and rejection criteria

Based on the article Shinde et al. (2022), we set the inclusion and exclusion criteria with the Population, Intervention, Context, Outcome, and Time methods.

Table 1. Database sources and search queries executed

Search Database	Search Queries	Number of Documents
Google Scholar	"intellectual capital", "intellectual assets", "intangible assets", "invisible assets", "knowledge capital" and "financial sustainability", "bank".	200
Scopus	"intellectual capital", and "financial sustainability".	172
Crossref	"intellectual capital", "risk management", "profitability", and "financial sustainability", "banks".	1000

Source: Processed by the researcher with notes: using a variety of search queries tailored to each bibliographic database tool. Each database has its own way of retrieving data, emphasizing the variations contained in the PoP bibliographic system.

In summary, the objectives are (1) to take a quantitative study that has gone through peer-review regarding IC measurement methods in companies; (2) only include papers that pay attention to elements of unstable environmental conditions and have a long-term impact on business (Brende and Sternfels, 2022), such as commodity market fluctuations, inflation spikes, global crises, risks, changes in consumer behavior, industrial demand, and digitalization (Banholzer et al., 2022); (3) only studies written in English will be included; and (4) papers that focus on the conceptualization of IC and FS, IC and FS research in the context of universities, education, health, non-profit organizations, will be excluded, as experiences on this theme have been comprehensively analyzed in other sources (Buonomo et al., 2020; Marr & Moustaghfir, 2005; N. Paoloni et al., 2020; Quarchioni et al., 2022).

To determine the method of measuring IC and FS in a company and its effect on financial and management performance, this selection does not include research that focuses solely on IC reporting and disclosure. Articles that focus on IC analysis at the global and regional levels are also not included. Finally, we determine the time frame to exclude research published before 1985, as significant contributions in the field of IC began to be published after that year (Marr & Moustaghfir, 2005). According to Dumay (2014), the most recent publications should be excluded from citation analysis because they require more time to be cited (Dumay, 2014). Therefore, the impact analysis of the article can present incorrect results in this situation. Figure 1 shows a flowchart for the article selection process. After applying the inclusion/exclusion criteria, the search resulted in 30 studies to be included in the review of researchers.

RESULT AND DISCUSSION

The study took the title, author, journal, year, citations and additional data from each article to assess the risk of bias, including the research question, quantitative method, sample size, time of observation, industry sector, company size, and key results. The researcher carried out a synthesis of issues and results related to uncertainty. To categorize the research, we apply the Webster and Watson method (Webster & Watson, 2002) which groups each work based on its main theme. In this way, we can incorporate the specific topics presented by each of the studies involved (Massaro et al., 2016), which are supportive in understanding their main objectives. This approach simplifies and

refines the researcher's comparative analysis, allowing researchers to unravel a variety of complex thinking in the field of IC measurement research.

A total of 30 studies evaluating alternative IC assessment models examined five areas: (1) digitalization, (2) environmental effects, (3) economic crisis, (4) social impacts, and (5) unstable environments. The following can be seen the process of selecting quantitative articles involved in a systematic review.

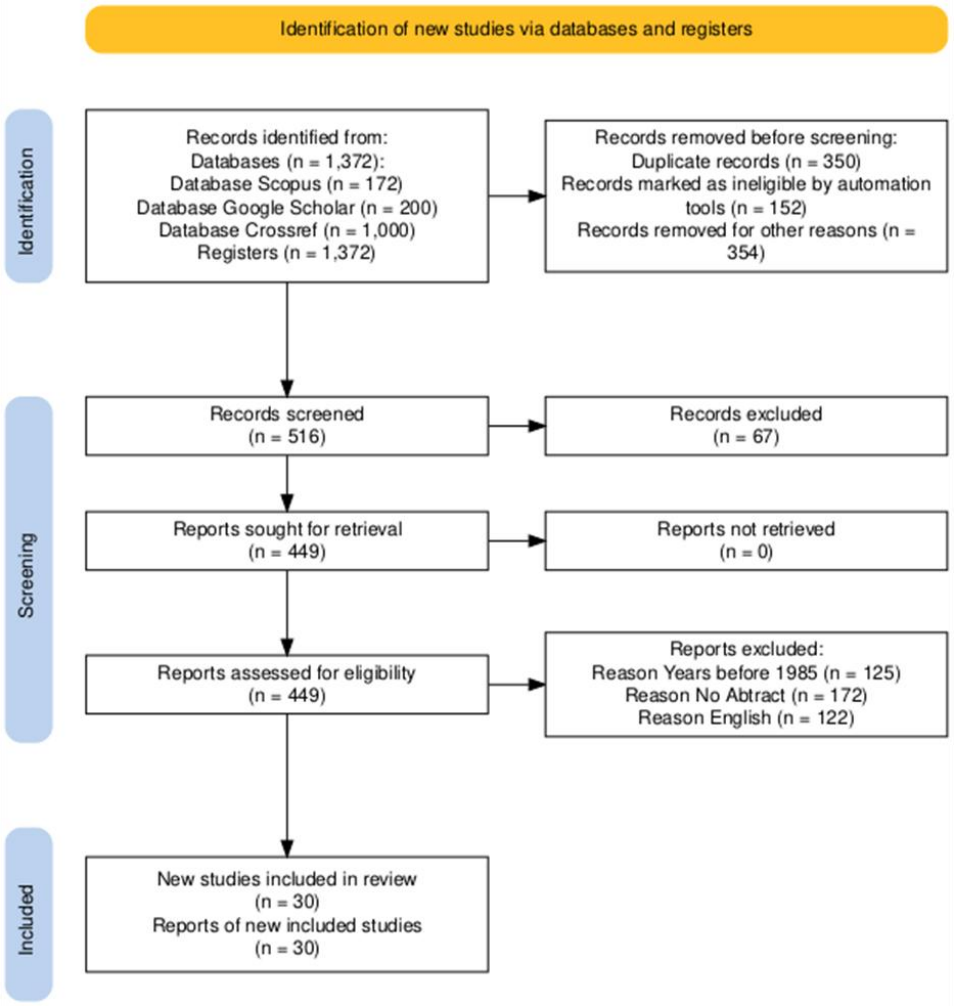

Figure 1. PRISMA Flowchart for filtering and participation
Source: Processed by the researcher

General characteristics of the included study

In order to give readers a thorough understanding of the key features of this sample article, we evaluated four elements of organizational arrangement: (1) the location of the company, (2) the country's economic growth, (3) the industrial sector, and (4) the size of the company. The researcher chose the first two organizational structures as the unit of analysis because cultural differences affect freedom and social interaction, so IC measurement models vary from country to country (Hofstede et al., 2010). In terms of the industrial sector, the influence of IC on the performance of companies varies according to the industry (Tan et al., 2007). Finally, the size of the company has an effect on the operational structure, with special needs for large and small businesses in gaining knowledge and organizing operations (Boungou & Yatié, 2022).

Of the articles analyzed by the researchers, 12 of them were conducted in Asia, 10 in Europe, 1 in Australia, the other studies did not provide such information. Regarding the economic development of a country, we refer to the World Bank's latest classification of countries by income category (2022–2023). The World Bank's classification defines a high-income economy as a country that has a gross national income (GNI) per capita exceeding $13,205 (e.g. the United States, Germany). Upper-middle-income economies have a GNI per capita between $4,256 and $13,205 (e.g. China, Brazil), lower-middle-income economies between $1,086 and $4,255 (e.g. India, Vietnam) and low-income economies below $1,085 (e.g. Afghanistan, Somalia). This category is updated annually. The study found 14 of the 30 studies conducted in high-income countries. Most articles analyze the industry cross-sectional, followed by banks and financial institutions. the biomedical sector, and investigating information and communication technologies, exploring manufacturing companies, others discussing agriculture, automotive, hospitality, and the maritime defense industry. Meanwhile, others did not convey information about the industrial sector.

Researchers adhere to World Bank standards in determining company size categories (International Finance Corporation, 2008). Research (Bozbura & Beskese, 2007; Ishaq, 2021) does not explore companies, but rather they conduct surveys of consumers or experts to test their hypotheses. Another study that examines companies, Campisi and Costa (2008) investigated small and medium-sized enterprises, studies on medium and large enterprises (Asiaei et al., 2022, 2023) and analyzed medium-sized enterprises (Kale, 2009). In the analysis co-occurrence against all keywords, forming three clusters (human capital, IC and corporate results). The researcher emphasizes that among the elements of IC, the most prominent is the human capital that forms the cluster. Finally, although many studies examine structural capital, sometimes called organizational capital, it should be noted that the included studies do not prioritize relational capital as the main factor.

Digital transformation theme

The advent of digital transformation brings important changes in IC measurement, moving away from traditional approaches to digital operations. Edvinsson et al. (2000) championed this change, providing a methodology for the Digital IC landscape used in 11 different companies. They describe how to visualize the complexity of ICs that can significantly impact strategic performance, drive knowledge transfer, and effective management of ICs. Research conducted by Turovets (2021) further emphasizes this change (Turovets, 2021), by analyzing the influence of intangible assets on manufacturing companies in Russia (2009–2018). Despite the currency crisis, collaboration between intangible assets and knowledge gathering improves technical efficiency, especially in high-tech companies.

Izzo et al. (2022) assessed the impact of digital industrialization on human resources in the Italian Fintech sector, by utilizing VAIC ™ Puli'c (Izzo et al., 2022). This methodology assesses how efficient the organization is in generating value by using tangible assets and ICs. This presents a metric to assess the extent to which IC plays a role in the performance and competitiveness of an organization (Pulic, 2004). Izzo et al. (2022) revealed that although VAIC™ does not have a significant effect on a company's profitability, human resources are seen as a crucial strategic asset for competitive advantage in knowledge-based companies. Bons'on et al. (2008) conducted a multinational study of 54 European banks, exploring the relationship between the existence of intangible assets and the level of sophistication of banking information systems. Interestingly, a higher intangible ratio is not in line with complex systems (BONSon et al., 2008). Finally, Peykani et al. (2022) developed VAIC™ by proposing a Robust Window Data Envelopment (RWDEA) model to evaluate decision-making in uncertain circumstances (Peykani et al., 2022). This study confirms that

RWDEA is reliable despite facing a lot of uncertain data. Overall, the study highlights the importance of creating IC measuring tools in line with the digital landscape, emphasizing the complex relationship between ICs, digitalization, and company performance.

Environmental impact theme

Three studies explored the relationship between ICs and environmental performance, outlining the interactions between ICs and environmental factors. Asiaei et al. (2022) examined how 105 different Iranian companies leveraged environmental performance measurements to convert green ICs into better economic and environmental outcomes. This research identifies that system technology, patents, and employee knowledge as assets improve environmental performance and influence performance appraisals. The role of the relationship between stakeholders in environmental performance will be clearly visible only when using ecological performance measurement. Furthermore, Asiaei et al. (2023) investigated the ability of green ICs, which reflect the company's potential in sustainable innovation, to improve green practices in the same example. Although there is no direct connection between green ICs and observed environmental performance, this study suggests that green resources, such as human, structural, and relational capital, can drive green innovation. Companies that show innovation have obtained excellent environmental performance. Finally, Ishaq (2021) created a new "Green Brand Equity" scale to measure the value of green brands from a consumer perspective. The scale leveraged an intercultural survey involving 980 consumers in Italy and Pakistan, covering elements such as company image, trust, repurchase intent and brand loyalty. The proven effectiveness of this scale gives managers an important tool to assess brand equity and improve resource allocation.

Overall, the study highlights the relationship between ICs and environmental performance, emphasizing the significance of ecological aspects in ICs. They revealed the benefits of IC measurement tools in supporting companies to balance economic performance with environmental aspects.

The theme of the financial crisis

Six articles examined the IC measurement values. methodology in the midst of an economic recession, emphasizing the strategic importance of ICs for companies. Tseng et al. (2013) examined how business tactics affect the relationship between IC performance and finance (Tseng et al., 2013). Analyzing 2,493 IT companies on the Taiwan Stock Exchange (2001-2009), they measured ICs using operating profit per employee, R&D intensity, capital turnover ratio, and revenue growth rate. This study confirms the significant impact of IC on strategic and financial performance. Patel and Guedes (2017) evaluated ICs in 1,647 Portuguese hospitality companies (2007–2014) using Return on Intangible Assets (ROIA) (Patel & Guedes, 2017). The results showed that the increase in fixed and intangible assets significantly affected operating profit. Four studies highlight the association of ICs with corporate performance in the banking sector, measured using VAIC. ™

Al-Musali and Ismail (2016) identified a significant positive relationship between VAIC™ and financial performance measures (ROE, ROA) in 224 GCC banks (2008–2010). Ousama et al. (2020) used VAIC™ to analyze ICs in 31 Islamic banks in the GCC (2011-2013) (Ousama et al., 2020). They observed a positive relationship between IC and financial results. However, the average IC is lower than that of studies on Islamic banks in Pakistan and Malaysia, which show the potential for a lack of IC use. Moutinho et al. (2021) leveraged the VAIC™ to evaluate 58 banks in Iberia (2013–2016) (Moutinho et al., 2021). Their study highlights the crucial role of human capital investment in building the whole. performance. Finally, S'ledzik (2013) used VAIC™ in 10 Polish banks and 10 banks

from Europe. (2005–2009), recognizing human resource efficiency as the main factor of IC (Śledzik, 2013).

Social impact theme

Six studies answer the question: Can investing in humans? Assessing the company's IC in an uncertain resource situation, social development goals, creating a more just and prosperous society? Iazzolino and Laise (2016) proposed an accounting framework based on VAIC™ to evaluate social sustainability in traditional and knowledge-based firms, drawing on data from 1,000 Italian companies (2010-2012) (Iazzolino & Laise, 2016). They found that knowledge-focused companies allocate more investment to human capital, which is crucial for value creation. Another study from Svebestov and Popescu (2022) conducted a survey of 278 Czech entrepreneurs to find out tactics related to investment management in human resources (Šebestová & Popescu, 2022). The results showed that companies (192) reinvested almost half (47.7%) of their profits, with only 20% going to human resources, generating roughly 14% annual returns. Research by Massingham et al. (2011) conducted a survey of 118 Australian Navy technical workers to reduce subjectivity in human resource evaluation. They implemented a methodology that combined self-reporting, 360-degree peer review, and personality assessment, allowing for more objective measurements. Two studies in low- to middle-income countries analyzed the influence of IC on performance, with an emphasis on asset creation and sustainability. First, Soetanto and Liem (2019) investigated the impact of IC on the market value and financial performance of 127 Indonesian companies (2010–2017) by applying modified VAIC™ (Soetanto & Liem, 2019). Although ICs substantially improve performance and structural capital plays an important role, there is no significant relationship with market value. However, the capital used has a positive and significant relationship in the high-knowledge sector. Second, Jain et al. (2017) survey of 384 SMEs in Rajasthan, India, examined the influence of corporate social responsibility on performance (Jain et al., 2017). They felt somewhat optimistic, with ICs playing an important role, although competitive advantage did not show a significant mediating impact. Finally, Kozera-Kowalska (2020) evaluated whether IC supports the agricultural transition towards sustainability, and proposed a new metric, Intellectual Value Added Sources (ISVA). Data from 120 farms in Poland (2005–2018) show that agricultural entities, despite being considered to have a low level of knowledge, effectively use ICs, so ISVA is more appropriate than VAIC™. In summary, this study highlights the potential of IC, especially in the field of human resources, to improve social well-being and equality. They also emphasized how important it is to choose the most appropriate IC measuring tools for various sectors, which contributes to a more complete understanding of the social impact of ICs.

Turbulent environmental themes

Seven studies on this theme examine how ICs affect companies in highly volatile and unpredictable market or economic conditions. Three of these studies investigated the effects of IC on financial performance. Juma and Payne (2004) assessed intangible assets in various technology industries using the Economic Value Added (EVA™) and Market Value Added (MVA™) methods, concluding that these measures do not provide any different benefits than traditional performance metrics. Campisi and Costa (2008) also found that increased investment in intangible assets does not necessarily improve business performance in Italian SMEs. In contrast, Tarn'oczi and Kulcs'ar (2021) found VAIC™ had a positive impact on company profitability in a study that compared companies in Hungary and Romania. The four remaining studies propose new IC measurement models for managing intangibles in volatile environments. Soheilirad et al. (2017) presented the Intellectual Capital Dual Criteria Decision Support System (ICMCDS) after finding IC increases productivity and

creativity in Iranian manufacturing companies (Soheilirad et al., 2017). Liao et al. (2010) underlined the importance of employee satisfaction and strategic alliances in biopharmaceutical companies (Liao et al., 2010). For the construction business, Kale (2009) introduced the Fuzzy Intellectual Capital Index (FICI) model to better understand the movement of intangible resources. Finally, Bozbura and Beskese (2007) identified "The level of implementation of new ideas" as an important indicator to measure organizational capital in uncertain situations. In summary, this study highlights the complexity of the measurement and utilization of ICs in environmental turbulence. They provide insights into IC's impact on financial performance and new models for managing ICs. As volatility and uncertainty continue to shape the business landscape, these findings and tools will become increasingly important for companies aiming to make optimal use of their intangible assets.

Discussion

This study aims to examine ways to measure IC in the context of business uncertainty. Researchers have not reached an agreement on the best IC measuring device. This lack of agreement appears to be related to significant differences in company location, industry sector, size, and performance dimensions (such as financial, social, and environmental). Different IC devices can provide highly variable performance results and, in some situations, conflicting patterns. Furthermore, there is a general recognition that human resources are a vital asset in the face of business volatility; however, some IC tools today integrate human resource metrics such as employee satisfaction, employee turnover rates, on-the-job training, and personality assessments. IC measurement is a complex challenge, requiring a deep understanding of the intangible assets of a company. Recognizing that no one IC measurement model is significantly superior to the other and the rapid changes due to the digital age, we set out to devise a comprehensive, flexible, and robust framework: Based on the understanding and advantages of the various IC measurement models, the researchers combined the best elements of the pre-existing IC measurement models listed in this review. Researchers seek to design models that understand the diverse characteristics of ICs, guarantee adaptability in the face of digital transformation, maintain flexibility for specific industries and utilize indicators both quantitative and qualitative, while maintaining resilience in the midst of uncertainty.

The following sections discuss how IICM models efficiently combine these elements, supporting a well-rounded, dynamic, and robust approach to IC evaluation. Análisis multidimensional. Taking inspiration from the VAIC™ model (Puli'c, 2000, 2004; Izzo et al., 2022), IICM recognizes that ICs have various types, which are grouped into human capital, structural capital, and relational capital. These components provide a holistic perspective on ICs, capturing a variety of intangible assets that can improve performance. IICM needs to be responsive to rapid changes in digital transformation, in accordance with the proposed IC Digital landscape model (Edvinsson et al., 2000). Models need to integrate mechanisms for this change, guaranteeing their constant relevance in an increasingly digital business environment. Taking lessons from the insights gained through the application of data envelopment analysis for IC management (Campisi & Costa, 2008) and Fuzzy Intellectual Capital Index (FICI), this model should be able to adapt to diverse industry contexts. A one-size-fits-all approach to all IC measurements can lead to omissions or inaccuracies; Therefore, a framework that is flexible and tailored to specific sectors and company sizes is essential.

IC components are crucial in business dynamics

The analysis of the study shows that human resources remain the main topic in IC research, which can be seen from the high frequency of occurrence and the variation of the grouping that exists. This emphasizes that human resources, which include the knowledge, skills, and innovative abilities

of employees, remain central to IC research (Bontis, 1998; Youndt et al., 2004). The high quality of human resources emphasizes the view that human strength in an organization is the basis of its intellectual property and is crucial to achieving the company's goals. Knowledge has a significant contribution to the overall IC and can trigger the performance of the company (Edvinsson and Sullivan, 1996; Bontis, 2001). This discovery indicates the importance of organizations in managing and utilizing their structural capital efficiently to improve performance. The emergence of relational capital that is considered lower shows its position that has not been widely researched in IC studies. The researcher's analysis revealed that although external communication has a crucial role in connecting a company with stakeholders and building its reputation (Nahapiet and Ghoshal, 1998), it seems that sufficient understanding in this area is still lacking when compared to other IC components. This highlights gaps in existing research and offers exciting opportunities for future IC research to deepen our understanding of the role and impact of relational capital in the context of IC.

Deficiency

Like all other SLRs, this SLR also has some important limitations. First, due to the variation between the studies related to the research question, the context of the research, and the methodology of the IC assessment analyzed, a meta-analysis cannot be performed. To overcome these limitations, we compiled reviews that focused on the context of business uncertainty in order to identify key patterns and themes across the research results. Second, this study does not include qualitative studies because we focus on the empirical application of IC measurement methods in practice. We also rule out research in the public or non-profit sectors that can contribute to the analysis.

Third, the search is dedicated to articles that have gone through the peer-review process. Excluding other sources may have led to the loss of some research. However, we overcome this obstacle by utilizing multiple databases and researching various article focuses. In addition, we do not narrow our search to only journals with specific topics or rankings. The research also has a number of shortcomings. We found only 30 studies that highlighted IC measurements in business situations. Dynamic times like this need to prompt more in-depth investigation into this issue. In addition, the majority of research is focused on the IT and financial sectors. There is a need in future research to explore other sectors, such as automotive, transportation, and hospitality companies, as these industries carry a number of social and environmental impacts. In addition, the study did not cover all important locations in a balanced manner; more than half involve high-income countries. Finally, among the IC elements, relational capital appears to be the least studied.

Future studies

This SLR shows an interesting approach for future studies in IC measurement. Sectors that have not been explored much such as automotive and tourism require a focus on IC management. Building on Secundo et al. (2020), a study of the United Nations Social Development Goals, especially related to sustainable development, fair work, and gender equality, can add to our insight into the impact of IC (Secundo et al., 2020). The impact of IC assets on digital transformation performance is another important area that has not received adequate exploration. Although innovative IC measurement models have been proposed related to digital transformation, these models still need to be evaluated or implemented through specific tools. In addition, Verhoef et al. (2021) propose the potential to assess performance improvement at various stages of digital transformation—an aspect that is often overlooked in existing research (Verhoef et al., 2021). The researcher's analysis provides an interesting avenue for future research in the field of IC. The prevalence of labor in IC highlights its crucial position in knowledge development and innovation (Massingham et al., 2011). Further

research can investigate the relationship between human resources and technology, as well as its contribution in strengthening industrial resilience and improving metrics in IC measurement models.

The dynamism of structural capital opens up a million research possibilities, such as its contribution to the implementation of ideas, knowledge exchange, and innovation in the digital environment (Bozbura and Beskese, 2007; Iazzolino and Laise, 2016; Moutinho et al., 2021; Asiaei et al., 2022). Research needs to investigate how ICs affect organizational resilience as well as interact with other elements to improve overall company performance. Innovative methods for measuring structural capital can strengthen IC models. Its interaction with other IC components under uncertain circumstances can prove valuable (Kianto et al., 2017; Soheilirad et al., 2017; Ishaq, 2021; Asiaei et al., 2023). Developing effective measurement methods and indicators for relational capital will improve our understanding of ICs, as well as help companies leverage their networks for resilience and success.

CONCLUSION

This research highlights the important role of digital capabilities in the management of Intellectual Capital (IC) for financial sustainability in an increasingly complex and uncertain business environment. In the era of digital transformation, ICs consisting of human capital, structural capital, and relational capital play a major role in improving company competitiveness, optimizing innovation, and ensuring long-term financial stability. The results of the study show that the use of digital technologies such as big data, artificial intelligence (AI), blockchain, and cloud computing can accelerate the management of ICs more efficiently, as well as enable companies to respond quickly to dynamic market changes.

However, the study also reveals that IC measurement is still a major challenge due to its intangible nature. Various measurement models, such as VAIC™, Direct Intellectual Capital Method (DICM), Market Capitalization Method (MCM), and Asset Measurement Method (ROA) have their own advantages and disadvantages. There is no one measurement model that can be universally applied to all industries and business conditions. Therefore, a more flexible approach is needed, which combines the best elements of existing methods to produce a more comprehensive and adaptive IC evaluation framework to digital change.

To improve the effectiveness of Intellectual Capital (IC) management in supporting financial sustainability, companies need to develop a more flexible IC measurement model, integrating quantitative and qualitative indicators to be more adaptive to market and technological changes. The use of digital technology, such as AI, machine learning, and big data analytics, is an important step to optimize business strategies and increase productivity. In addition, investment in human capital through digital skills training and talent retention policies is needed to ensure innovative and competitive human resources. Companies must also collaborate with educational and research institutions to strengthen the base of digital-based innovation. Given the increasing business uncertainty, strengthening risk management strategies, including digital risk mitigation and cyber security protection, is a crucial step in IC management. By implementing this strategy, companies can leverage ICs as a strategic asset to drive long-term growth, innovation, and financial resilience in the digital economy.

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