Intellectual Capital: design science research supporting a novel IC framework

Capital Intelectual: a proposta de um *framework* de CI baseado em *design science research*

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ABSTRACT

Intellectual Capital provides an alternative to conventional accounting, tackling the hurdle of dealing with intangible assets. Over the past few decades, various measurement methods have been developed. However, these methods are primarily tailored to specific types of companies and are often unsuitable for micro and small businesses. Based on this context, the objective of this study is to propose a novel framework to assist readers, academics, and managers identifying the most suitable method for measuring Intellectual Capital by articulating the following traits: purpose, economic sector, and business size. This study adopts an exploratory-descriptive approach with a qualitative methodology, employing a Systematic Literature Review, Content Analysis, and Design Science to achieve its objectives. To determine the goals and methods of measuring Intellectual Capital, this study employed content analysis in the mixed category, with descriptors defined and adjusted as the research progressed. As a result, seven purposes, fifty-eight methods for measuring Intellectual Capital, four economic sectors, and five business sizes were identified, categorized, and incorporated into the proposed framework. Thus, the novel framework proposed by this study is primarily intended to guide stakeholders through the various possibilities for measuring and disseminating Intellectual Capital across corporations, cities, and even nations. As a final recommendation for future research, applying the framework to real-world situations in both the public and private sectors is encouraged.

Keywords: intellectual capital. purpose. measurement. business size. economic sector.

RESUMO

O Capital Intelectual proporciona uma alternativa à contabilidade tradicional ao lidar com ativos intangíveis. Nos últimos anos, foram desenvolvidos diversos métodos de mensuração, porém, a maioria é adequada apenas para tipos específicos de empresas, sendo geralmente inadequados para micro e pequenas empresas. Com base no exposto, este estudo tem como objetivo propor um novo modelo que ajude leitores, acadêmicos e gestores a encontrar o método mais apropriado para medir o Capital Intelectual, considerando os seguintes aspectos: propósito, setor econômico e porte empresarial. Este estudo é caracterizado por sua natureza exploratória-descritiva, abordagem qualitativa e pela utilização da Revisão Sistemática da Literatura, Análise de Conteúdo e *Design Science* para alcançar o objetivo proposto. A análise de conteúdo na categoria mista foi empregada para determinar os objetivos e métodos de mensuração do Capital Intelectual, com os descritores sendo definidos e ajustados ao longo da pesquisa. Foram identificados e categorizados sete propósitos, cinquenta e oito métodos de mensuração do Capital Intelectual, quatro setores econômicos e cinco portes empresariais, que foram articulados no *framework* proposto por este estudo. Dessa forma, o novo modelo visa orientar as partes interessadas sobre as diversas possibilidades de mensuração e disseminação do Capital Intelectual em empresas, cidades e até mesmo países. Como recomendação para futuras pesquisas, sugere-se a aplicação do *framework* em situações reais nos setores público e privado.

Palavras-chave: capital intelectual. propósito. mensuração. porte empresarial. setor econômico.

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1 INTRODUCTION

Intellectual Capital (IC) emerges as an approach oriented toward intangible assets, such as knowledge, patents, trademarks, customers, and distribution channels. It represents an alternative to traditional accounting, which historically focuses on tangible assets such as machinery and physical facilities (Stewart, 1997; Edvinsson & Malone, 1997; Roos et al., 1997; Bontis, 1998; Guthrie, 2001; Cikrikci & Dastan, 2002; Bozzolan et al., 2003; Ricceri, 2008; Curado, 2008; Denicolai et al., 2015; Morris, 2015).

In line with the above, the relevance of the field of Intellectual Capital (IC) is reinforced by the prominence of the knowledge economy, in which companies increasingly exhibit a growing volume of intangible assets relative to tangible ones. Over the years, various measurement methods have been developed in response to the pervasiveness and growing importance of intangible assets. However, not all methods are suitable for companies of different sizes. For instance, the Skandia Navigator™ (Edvinsson & Malone, 1997) appears impractical when applied to micro, small, and even medium-sized enterprises, as its model comprises 164 metrics, with 91 focused on intellectual aspects and 73 on traditional ones. Nonetheless, it is important to note that many organizations still lack standardized administrative procedures to effectively address accounting needs, particularly in relation to IC.

Furthermore, according to Marr et al. (2003), an organization must first determine its purpose regarding IC before selecting a specific method or report. For instance, a public report may be more appropriate if the organization intends to showcase its IC to stakeholders. In contrast, dynamic measurement methods might be better if the goal is to drive sales, purchases, or mergers.

Besides the orientation between the organization's purposes and measurement methods, some approaches may still be unattainable due to other features, such as the economic sector in which the company operates or its size, as exemplified earlier. Thus, a multidimensional relationship delineates the entanglement of method, purpose, economic sector, and business size. Based on these constructs, this research seeks to delineate a framework that allows organizations to decide the most relevant method for their IC accounting needs.

As Eccles et al. (2002, p. 127) aptly state, "What is easy to measure is not important, and what is important is not easily measured." This statement underscores the challenge of measuring IC and the crucial task of selecting the proper method. Accordingly, this research aims to provide a novel framework for determining the most suitable method and equip readers, managers, and academics with practical knowledge and a tool that can be applied in real-world scenarios considering variables like purpose, sector, and size of organizations.

Based on the preceding, this research is structured as follows: Section 1 introduces the study, followed by Section 2, which outlines the theoretical foundations that support it. Section 3 details the methodological procedures adopted, while Section 4 presents the analysis of the results obtained from data collection. Finally, Section 5 provides the conclusion, summarizing the key findings, offering suggestions for future research, and discussing the limitations encountered during the study.

2 THEORETICAL BACKGROUND

Capital, in the corporate context, refers to any asset that has the ability to generate future cash flows. As a result, tangible assets are an integral part of the common categories of assets, which include physical and financial items. Companies periodically disclose the value of these assets, which are readily accessible in their balance sheet and financial records (Sherif & Elsayed, 2016). From another perspective,

intangible assets such as information, knowledge, workforce skills, and organizational structure are the cornerstone of the knowledge economy and are increasingly important in determining corporate value and profits (Werlang et al., 2019; Smith et al., 2020; Santos & Silva, 2020).

Thus, the existence of intangible assets, such as IC, has been recognized for years within organizations. Still, these assets were not considered significant in the past, as the resources deemed relevant for profit generation were primarily tangible. However, over the last three decades, global economies have witnessed a significant shift in focus. The knowledge economy has driven this change from traditional tangible resources to technology-intensive sectors (Guthrie, 2001; Gamerschlag & Möller, 2009). Several recent studies have emphasized the importance of raising awareness among individuals and organizations regarding the significance of IC in value creation (Marr and Chatzkel, 2004; Petty and Guthrie, 2000; Tan et al., 2005).

In reality, the Knowledge Economy has gradually shifted intellectual resources to the center of the debate, revealing the limitations of the traditional ones (i.e., physical and financial resources) as essential contributors to corporate wealth development (Chen et al., 2005). Currently, IC is considered a critical factor that influences performance, competitiveness, success, value creation, and the long-term survival of organizations. Although numerous studies over the past decades have emphasized the importance of IC and proposed approaches to address it, measuring IC remains a significant challenge for many organizations and their managers (Kogut & Zander, 1992; Bierly & Chakrabarti, 1996; Brennan & Connell, 2000; Bontis & Fitz-enz, 2002; Cronje & Moolman, 2013; Bontis et al., 2015; Xu & Wang, 2018).

The literature on intangible assets features significant contributions from scholars across various fields. Remarkably, Karl Erik Sveiby has emerged as a prominent figure in this research area, providing relevant contributions to IC research. According to Sveiby (2010), this field of study has produced a plethora of methods and theories over the years. However, it has also brought with it the dilemma of measuring social phenomena with scientific precision. As a result, the degree of uncertainty inherent in measuring and determining the lifecycle of intangible assets makes it difficult to define a single consistent proposal that serves to accomplish such intent.

Moreover, empirical studies have sought to identify not only methods but also the underlying purposes for measuring IC. Findings indicate a lack of a clear definition of the goals for measuring this intangible asset, leading to a limited understanding of organizational structures. Accordingly, decision-making around IC management is often characterized by confusion and uncertainty among administrators. This suggests that, despite numerous models and tools for IC management available in the literature, identifying their purpose and operationalizing them in practice remains uneasy (Carlucci & Kujansivu, 2014). To improve the understanding of IC measuring, Marr et al. (2003) regarded purpose as a crucial criterion for evaluating IC, thereby establishing foundational elements for its determination (Table 1).

Table 1

Purposes for Measuring Intellectual Capital.

Purpose	Author(s)	Description
Strategic planning	Di Vaio et al., 2020; Salvi et al., 2020ª ; Marr et al., 2003	Corporate strategy is determined by analyzing the decision-making process, which provides a clear understanding of the organization's objectives and purposes. It defines what the firm intends to give to its shareholders, employees, consumers, and other stakeholders. Recent studies on the measurement of IC have shown that gaining a clear grasp of business strategy helps to identify and manage risks more effectively, leading to improved allocation of corporate resources.
Strategy evaluation and implementation	Alfiero et al., 2021; Marr et al., 2003; Kaplan and Norton,1996	Successful strategy implementation requires continuous evaluation and the integration of learning into its cycle. Additionally, investors closely relate the process of operationalizing strategy to the quality and adequacy of information about intellectual assets.
Assisting in diversification and expansion decisions	Vitolla et al., 2020 ; Marr et al., 2003	Strategic partnerships, joint ventures, mergers, and acquisitions are practical ways through which organizations achieve inorganic growth. In this context, ensuring that non-financial information is consistent, relevant, reliable, and comparable over time and across companies is mandatory.
Support compensations	Kelchevskaya et al., 2021; Marr et al., 2003	Creativity, personnel training, expertise, research and development, and customer satisfaction are quickly becoming inputs for corporate value creation. These factors support financial compensations for talents and personal skills and sustain financial returns for investors in business value generation.
Communication with stakeholders	Alfiero et al., 2021; Marr et al., 2003	Recognizing stakeholders' significant influence over company resource management fosters better interaction with them, decreasing information asymmetries and positively impacting corporate reputation.

Also relevant to IC accounting is the fact that the modern economy comprises a complex intertwining of economic activities. It consists of the relationship in the production of all goods and services intended for society's needs (Tomiato et al., 2010). However, due to its magnitude and inherent complexity, individually accounting for each operation becomes unfeasible. Therefore, to achieve accounting objectives, the economy must be divided into interconnected sectors based on the similarities and core nature of activities (Tomiato et al., 2010).

Following the approach of other authors, this research classifies economic sectors as the product trading sector (industry), where there is the sale of self-produced products; the merchandise trading sector, which refers to the sale of products acquired from third parties; the service trading sector, which trades services performed by contract or task (Rodrik, 2016; Silva et al., 2016; De Almeida et al., 2013; Oreiro & Feijó, 2010; Kupfer, 2009); and the public sector (Pereira, 1989), whose primary function is to protect public assets.

In accordance with the above, selecting the purpose and measurement method for IC appears to first require an understanding of the economic sector and the company's size. Still, regarding the company's size, in contrast to other countries where the number of employees and operational revenue

primarily moderate its definition (Meyer et al., 2020; Kweh et al., 2021), understanding and defining a company's size remains somewhat confusing, at least in Brazil.

In the literature, there is a diversity of criteria adopted to classify companies, including number of employees, revenue, sector of activity, profit, net worth, and fixed assets. Depending on the purpose, other criteria or even multiple criteria may be applied (Martins et al., 2016). It is noted that quantitative criteria tend to be more commonly used due to their ease of definition, collection, manipulation, measurement, and parameter definition (Leone & Leone, 2012). In Brazil, there is a lack of standardization in classifications regarding company size, as the Federal Government, companies, agencies, institutes, scholars, and funding agencies use different classification models to meet their research objectives.

The Brazilian Micro and Small Business Support Service (SEBRAE, 2010) adopts the number of workers and economic activity sector as criteria for classifying the size of firms. The Brazilian Development Bank (BNDES, 2013) defines the company's annual revenue and economic segment to which the company belongs as a criterion. Additionally, the Brazilian Institute of Geography and Statistics (IBGE) and the Ministry of Labor and Employment (MTE) also use the data of employed people and the sector of activity as criteria to characterize the size of the company (Dias, 2012). The company's gross annual revenue establishes its size for the National Health Surveillance Agency (ANVISA) (Secretaria da Receita Federal, 2005). Finally, for the Ministry of Development, Industry, and Foreign Trade (MDIC), the number of employees, exported value, and sector of activity in the defined period determine the company's size.

In 1996, Nick Bontis, when discussing the importance of selecting methods to measure IC, pointed highlighted the challenges posed by the vast array of options, diverse benefits, and multiple purposes in finding the ideal method for measuring intangible assets. Supporting this perspective, Tóth and Kövesi (2008) stated the following:

> *In reality, there is no method that can be applied broadly and universally, but there are a series of methods and tools that are effective in specific situations and for specific types of corporations. Furthermore, most experts disagree with the identification of a single common denominator (p. 3).*

Recognizing that not only the purpose, but also the company size and economic sector, influence the choice of method for measuring IC (Užienė & Stankutė, 2015), this research has made every effort to understand the current dynamics and propose a framework that articulates these variables (purpose, economic sector, company size, and methods), either simultaneously or individually.

The intent to develop a novel IC framework is based on the perceived shortcomings of academic theory in establishing a shared language for conceptualizing IC, the lack of clarity among companies in defining objectives for measuring this asset, and, most importantly, the absence of integration between monetary and non-monetary models for measuring IC. The formation of this understanding has been the subject of scholarly debate for several decades (Sveiby, 2010; Guthrie et al., 2012; Smith et al., 2020).

3 METHODS

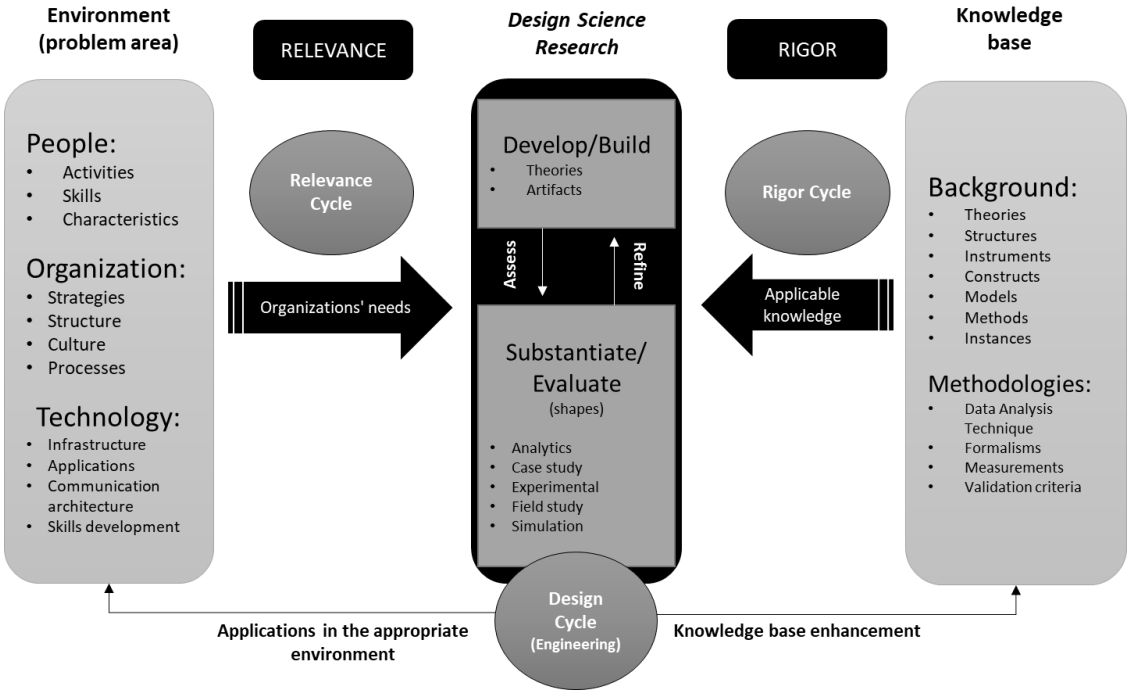
In this work, research is comprehended as a methodical investigation, primarily aimed at generating or refining ideas and, occasionally, solving problems (Gough et al., 2012). Accordingly, this study employs the Design Science (DS) methodology using the Design Science Research (DSR)

framework to effectively align with these objectives. To apply DS principles in practice and guarantee the execution of thorough investigations that incorporate these concepts, it is essential first to evaluate a suitable research methodology for this implementation (Hevner et al., 2004; Manson, 2006).

Research adopting DS is not limited to exploring, describing, or explaining problems, but also with unfolding frameworks that contribute to better human performance, whether in society or organizations. In this sense, prescribing the solution or designing a system generates knowledge with relevance and rigor (Dresch et al., 2015; Hevner et al., 2004). Therefore, due to the limitations of traditional scientific methods in constructing software, frameworks, and technological systems, the approach used in this study follows the precepts of DSR (Figure 1). This methodology aims to structure the development of artifacts as a means to produce epistemological scientific knowledge.

Figure 1

Design Science Research framework considered in this work.



Note: Adapted from Hevner et al., 2004, p.80.

The success of the DSR approach to crafting meaningful artifacts (e.g., IC frameworks) hinges firstly on the researchers' meticulous understanding of the environment and the selection of relevant problems or opportunities (the relevance cycle). Simultaneously, the method rigor (the rigor cycle) is ensured through the efficient use of theoretical foundations of knowledge and research. The artifact's engineering (the design cycle), aligned with the other cycles, is responsible for building and validating the solution, as well as moderating the relationship between the other cycles, ensuring that the process is repeated as many times as required (Hevner et al., 2004).

This research is exploratory, motivated by the indispensability of an initial understanding of the problem under study. At the same time, its descriptive characteristic seeks to deepen the detailed presentation of the investigated phenomenon (Perovano, 2016). A qualitative methodological approach is adopted to identify causal relationships, predictions, and generalizations of results (Hoepfl, 1997). It also allows an interpretive exploration of the subject of interest, promoting a more in-depth analysis (Mascarenhas, 2012).

For the definition of population and sample, the former is determined by the extent of research related to IC, while the latter consists of studies aligned with the objectives of this research, encompassing articles that address the purposes for measuring IC, covering the diversity of economic sectors in question. The chosen data collection method, the Systematic Literature Review (SLR), is a comprehensive tool that identifies the need for review, evaluates study quality, and presents findings. This choice is based on the SLR's suitability for a comprehensive evaluation and interpretation of all relevant and available research related to a specific research question, topic area, or phenomenon of interest (Kitchenham, 2004).

As a result, data collection stems from an SLR planned to be conducted on the Scopus and Web of Science (WoS) databases. The selection of these databases is aligned with Falagas et al. (2008), who state that the SCOPUS database covers research from 1966 onwards and indexes 12,850 journals, and Guz and Rushchitsky (2009), who indicate that the WoS database comprises about 10,000 journals and consists of seven distinct citation databases. These are considered relevant compared to other databases, as reported by the same authors.

For data analysis, Bardin's Content Analysis method (1977) was used, which involves the "[...] analysis of communications aiming to obtain, by systematic and objective procedures of messages content description, indicators (quantitative or not) that allow the inference of knowledge" (Bardin, 1977, p. 42). Applying this method requires defining categories, which relies on the investigation of content segments from the original text for subsequent ordering, categorization, and frequency counting. This study will employ a mixed category, recognizing that the current understanding based on existing evidence may face adjustments throughout the research's evolutionary process.

4 RESULTS AND DISCUSSIONS

Firstly, it is worth noting that this research primarily focuses on the impact of intangible assets on business value, as well as the inherent difficulties in capturing, quantifying, and disclosing the performance and value of IC in companies. Observations suggest that evaluating intangible assets is a complicated task, mainly due to constraints in data availability, uncertainties, and the absence of impartiality and verifiability of information (Bandeira & Andrade, 2018). Consequently, professionals and scholars have raised doubts about the accuracy and effectiveness of the measurement frameworks used in recent years due to the limits observed in many existing approaches.

However, given that accounting IC is crucial for the growth of businesses and scientific advancements, its complexity should not deter firms and scientists from studying it. Hence, this study endeavors to elucidate the objectives behind the measurement of IC by micro, small, medium, and big firms across different economic sectors. Here, it is believed that by identifying the purpose of IC, one can obtain a more effective experience in selecting measurement methods that are more suitable for different economic sectors and organizational sizes.

When discussing the importance of measuring IC, Marr (2008, p. 4) stated: "To positively impact their future value, organizations need a better understanding of Intellectual Capital and its latest tools available to identify, measure, and report this important driver of corporate value." Corroborating this view, Sveiby (2010, p. 1), one of the leading researchers on IC theory, was categorical: "Rarely is the question: why measure intangibles? asked. The answer is not self-explanatory. Intangibles are difficult and expensive to measure, and the results are uncertain, so the reason better be good." Therefore, in response to Bernard Marr and Karl-Erik Sveiby's call, this research aims to support the construction of a framework that articulates the variables of purpose, economic sector, business size, and measuring

methods in order to better guide readers, academics, and managers through the still challenging accounting of IC.

The research protocols, as detailed in Table 2, were meticulously implemented to investigate the purposes and methods of IC measurement. In order to ascertain the purposes of measuring IC, a comprehensive collection of 1,231 scientific studies, spanning the years 1998 to 2022, was gathered. Similarly, a thorough investigation of the methods used for measurement was conducted, resulting in the identification of 677 scientific studies published between 1995 and 2022. Together, these studies amount to a total of 1,889 scientific articles. Both systematic literature reviews (SLRs) included an extraction stage, during which publications were reviewed in their entirety and followed specific criteria to ensure the quality of data extraction, thereby providing a thorough appraisal of the available literature on the topics of interest.

Table 2

Result of protocol application.

Stage	Procedure	Quantity Purposes	Quantity. Methods
Protocol Processing	Study Collection	1,231	677
Selection (exclusion criteria)	Criterion 1 - Not containing descriptors in keywords	- 454	- 361
	Criterion 2 - Not discussing purposes of measuring IC	- 155	- 123
	Criterion 3 - Not being a scientific article	- 23	-24
	Criterion 4 - Duplicates	- 514	- 64
	Criterion 5 - Unavailable for download	- 12	- 25
Partial Result		73	80
Extraction (quality assessment)	Extraction of objective results from studies: Introduction, theoretical framework, methodological procedures, analysis and discussion of results, and conclusion.	N/A	N/A
Final Result		73	80

Note: Adapted from Kitchenham,2004, p 3.

Consequently, the extraction phase encompassed a final tally of 153 scientific papers, all of which underwent careful review. The quality extraction was conducted based on the following criteria: (1) The research question and study objective are adequately explained; (2) The study context is clearly evident and appropriate; (3) The theoretical framework provides support for the research; (4) The sampling strategy is described and justified; (5) The data collection methods are clearly and systematically explained; (6) The data analysis is clearly described and organized; (7) The conclusion aligns with the research objectives and motivates the reader to further explore the research topic. As a result, all papers satisfied the extraction requirements.

Regarding the analysis of data on motivations for measuring IC, we followed the classification framework suggested by Marr et al. (2003). This framework includes the following purposes: a) aiding organizations in formulating their strategy; b) evaluating the implementation of the strategy; c) assisting in decisions related to diversification and expansion; d) supporting compensation decisions; and e) communicating the measurements to stakeholders.

Nevertheless, our findings highlight the introduction of innovation (Zhu et al., 2020; Mkumbuzi, 2015; González-Loureiro & Dorrego, 2012; Tóth & Kövesi, 2008) and the significance of the public sector's wealth (Fazlagic & Szczepankiewicz, 2018; Nevado Peña, 2017; Sun, 2014; Pucar, 2013; Ståhle & Ståhle, 2012; Alfaro, Lopez, & Nevado, 2011) as additional objectives for measuring IC. Therefore, based on the findings of this research and focusing primarily on purpose as a key criterion for evaluating IC, the current study proposes a revised framework, building upon the structure suggested by Marr et al. (2003).

Furthermore, building upon the categorization of IC measurement methods proposed by Luthy (1998), Williams (2001), and Sveiby (2001, 2010), it is suggested to group these methods into at least four categories:

- Direct Intellectual Capital Methods (DIC): Evaluate the monetary value of intangible assets by identifying their various components. The components are assessed either individually or as an aggregated coefficient.
- Market Capitalization Methods (MCM): Calculate the difference between a company's market capitalization and its equity as the value of its IC or intangible asset. They take a holistic approach.
- Return on Assets Methods (ROA): Use the average profit before taxes for a given period divided by the total tangible assets of the company, compared to the industry average. It is assumed that the difference represents the average annual gain of intangible assets. Thus, it is possible to estimate the value of intangible assets or IC by dividing the higher profits by the average cost of capital or interest rate of the company.
- Scorecard Methods (SC): Take into account the various components of intangible assets or IC, which are identified and measured through indicators or scorecard charts. These methods are generally not based on monetary values.

Methods that provide monetary evaluations (DIC, MCM, and ROA) are valuable in merger, acquisition, and stock market valuation situations. They can also be applied to compare companies within the same industry, as well as to attract management attention, as they effectively highlight the monetary value of intangible assets. However, these methods may lack depth when their structures are translated into monetary terms. Assumptions related to interest and discount rates (in ROA methods) and segmented measurements at certain organizational levels (in MCM methods) limit their effectiveness in operational spheres and reveal weaknesses in these models.

Among the advantages of Scorecard Methods is their capacity to provide a more comprehensive view of a company's health, extending beyond financial metrics. Their ease of implementation allows for broad organizational coverage, making them a valuable tool for nonprofit organizations, internal departments, and public sector organizations. Moreover, because they do not rely on financial metrics, they can be applied to environmental and social objectives. Nevertheless, customizing indicators for each organization and purpose makes comparisons extremely challenging. Additionally, the broad scope of these methods often generates large volumes of data, which can be difficult to analyze and communicate effectively.

In response to Sveiby's call (2010) – which identified 42 methods – the findings of the present research contributes an additional 50 methods to the scope of 2010, namely 34 new Scorecard Methods

(SC); 4 new Direct Intellectual Capital Methods (DIC); 8 new Return on Assets Methods (ROA); and 4 new Market Capitalization Methods (MCM). It is worth noting that 8 methods (Balanced Scorecard –BSC–, EFQM Excellence Model, EVA Model, Intangible Assets Monitor –IAM–, Skandia Navigator Model, Tobin's Q, Value Added Intellectual Coefficient –VAIC–, and Value Chain Scoreboard) were identified in both this research and in Sveiby (2010). Together, these studies suggest a total of 92 IC measurement methods.

In addition to the scenario outlined above, the success of this work in its proposal development hinges on defining the appropriate methodological approach. Design Science (DS) thus plays a crucial role in developing a framework that links methods to purposes, while also taking into account the economic sector and company size within an IC measurement flow. The pursuit of a logical design is supported by the process proposed by Hevner et al. (2004), which defines seven consistent steps to ensure the impartiality, rigor, and reliability of results. Therefore, as accomplished by this study, the research in Design Science, which led to the Design Science Research (DSR) applied to the field of IC, adhered to the following instructions (Table 3).

Table 3

DSR methodological approach - rigor and relevance.

Guidelines (Hevner et al., 2004)	**Description of the guideline (Hevner et al., 2004; Dresch et al., 2015)**	**Approach in this research (The Author)**
1- Artifact design (project)	Research using DSR should produce a viable artifact in the form of a construct, model, method, or instantiation.	The artifact will be the framework aimed at articulating the variables economic sector, company size, purposes for measuring IC, and methods of measuring IC.
2- Problem relevance	The objective of DSR is to develop solutions that solve important (relevant) problems for organizations.	The IC theory lacks models to guide users in choosing IC measurement methods. Therefore, the proposed solution aims not only to aggregate methods for measuring IC but also to articulate variables (methods, purpose, company size, and economic sector) that influence the choice of the best option for organizations.
3- Project evaluation	Methods of evaluation should be employed to demonstrate the utility, quality, and effectiveness of the artifact. According to Hevner et al. (2004), one of these five types of evaluation methods can be used: analytical, experimental, test, descriptive, and observational.	In this research, the descriptive evaluation method was chosen, which can be articulated in two ways: • Informed argument: Using information from knowledge bases (e.g., relevant research) to construct a compelling argument about the utility of the artifact. • Scenarios: Building detailed scenarios around the artifact to demonstrate its utility.
4- Research contributions	The design principles should be clear and verifiable, either by adding to the current knowledge base or by applying knowledge in new ways to existing ones. Research	The present research adds knowledge in several aspects: • Updating the list of IC measurement methods proposed by Sveiby (2010);

	conducted through DSR should provide contributions in the specific areas of the developed artifacts.	• Including two new purposes for IC measurement, added to Marr et al.'s 2003 list; • Classifying the economic sector and company size, essential for the development of the artifact; • Generalizing the solution to the class of problems; • Introducing new knowledge that can be applied in similar situations; • Immersing the researcher in the construction of the artifact evaluation method; • Designing the original construction of the artifact in spreadsheets, among others.
5- Research rigor	Rigorous methods must be applied in research utilizing DSR, both in the construction and evaluation of artifacts.	In constructing the framework for measuring IC, the rigor of the protocol (Kitchenham, 2004) applied in Systematic Literature Reviews (SLRs) was used, resulting in the consolidation of the articulated variables (methods, purpose, company size, and economic sector).
6- Project as a research process	One should seek to design an effective artifact that utilizes available means to achieve the desired results, while respecting the rules of the problem environment.	This article aims to deliver a framework that addresses the challenge faced by readers, academics, and managers in the search for IC measurement methods that best suit each organizational reality.
7- Research communication	Research using DSR should be presented to audiences in both the technology and management fields.	Given that this article is based on a doctoral thesis, the simulations conducted by the researcher and the subsequent evaluation by the professors present on the thesis defense committee aimed to validate the artifact. However, there is a recognized need for validation with managers and expansion within the academic community.

Note: Adapted from Hevner et al., 2004, p. 83.

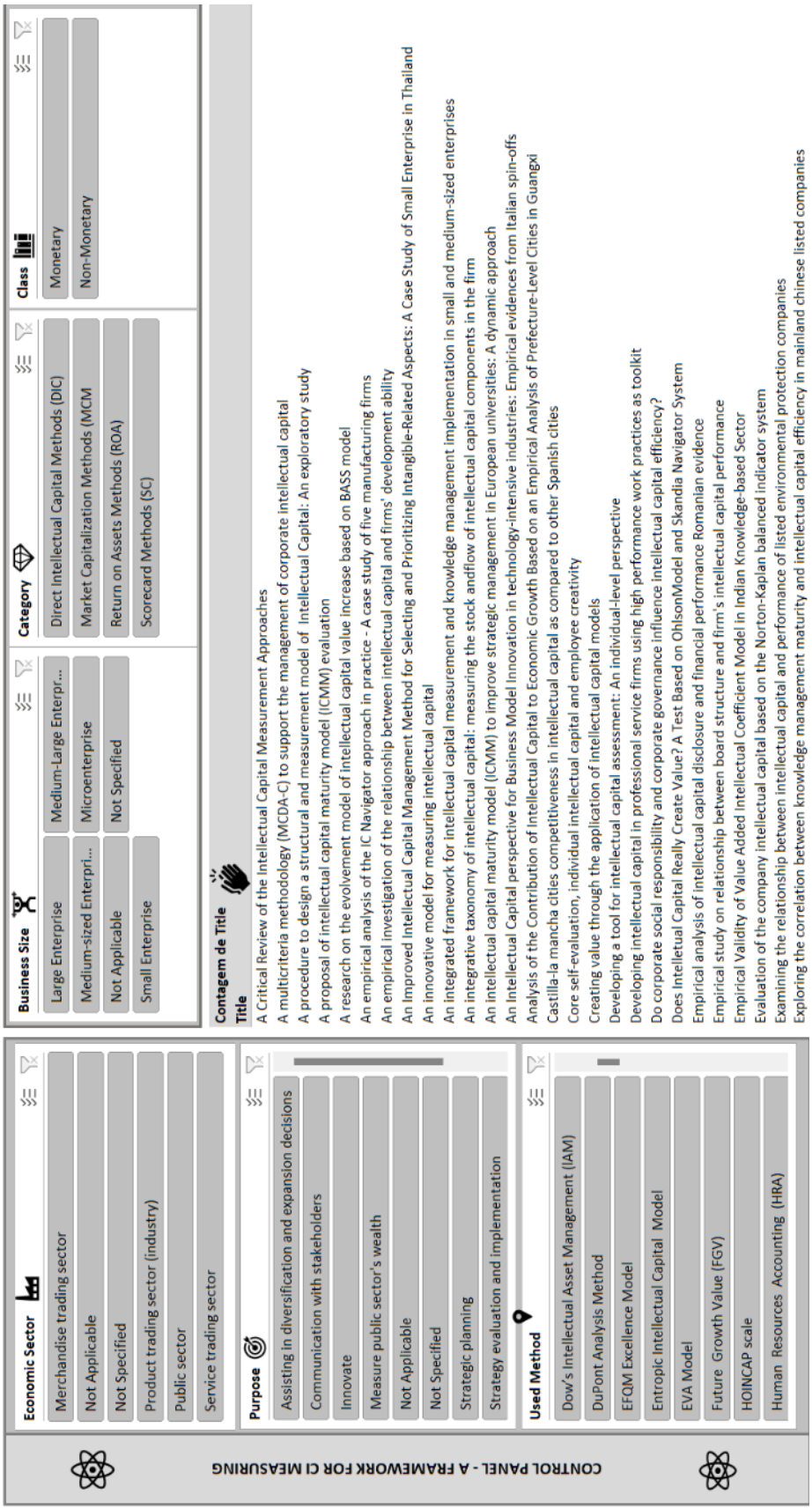
Regarding the above, it is observed that the framework developed is both applicable and capable of generalization; premises of DS that involve the efficient use of theoretical foundations, knowledge base, and research procedures. However, the success of this research depends concomitantly on the researcher's ability to select relevant procedures to construct the framework and on the selection of acceptable methods to justify this proposal. The proposal for developing the framework is based not only on the academic community's failure to define a common language for conceptualizing IC and on companies' lack of understanding in determining their purposes, but, primarily, on the lack of consolidation of IC measurement models.

Thus, this research presents a novel framework for measuring IC in both public and private organizations. Developed through a systematic review of 80 scientific articles focused on IC measurement methods, the framework aids in selecting appropriate methodologies based on specific needs. So, the proposed framework addresses the problem of selecting suitable IC measurement methods by integrating various variables (IC measurement purpose, business size, economic sector, IC measurement category, IC method and IC measurement class) (Figure 2) and offering a user-friendly solution for readers, managers, and academics alike.

As a result, this final delivery addresses and rectifies one of the major deficiencies observed in the IC literature: the lack of a framework that assists users in choosing IC measurement methods for specific purposes, economic sectors, and business sizes. This outcome acknowledges that "[...] there is no method that can be applied broadly and universally, but there are a series of methods and tools that are effective in specific situations and for specific types of corporations"` (Tóth & Kövesi, 2008, p. 3). Thus, the framework is available at the link https://zenodo.org/records/11061996/files/FRAMEWORK%20FOR%20CI%20MEASURING.xlsx?download=1. For optimal use, it is recommended to download the file.

Figure 2

Proposed Framework for IC Measuring.



Note: Research data (2023).

The proposed framework records a total of 35 studies addressing business size, containing various methods, purposes, and economic sectors. In proposing an integrated model for measuring IC in small and medium enterprises, Montequín et al. (2006) clarify that transitioning to a company that efficiently manages all aspects of knowledge is not simple, particularly for businesses of this size. In line with this, observing the evolution of studies in small and medium firms, especially over the past decade, is noteworthy. This academic growth can be attributed to the development of the knowledge economy and the recognition that these companies play a crucial role in national economic development by providing substantial employment, social infrastructure, and an increasing contribution to Gross Domestic Product (GDP) (Hina et al., 2020; Matos et al., 2020; Khalique et al., 2018; Montequín et al., 2006).

Regarding medium-large and large companies, most of the research is monetary in nature and directed towards the industry and service trade. These studies highlight sustainable growth (Zhang & Wang, 2022; Xu et al., 2020), the generation of additional value (Xu et al., 2022; Mohammad & Bujang, 2019; Yao et al., 2019; Silvestri & Veltri, 2014), and the improvement of financial performance of companies (Obeidat et al., 2021; Yousaf, 2021; Zhu et al., 2020; Phusavat et al., 2011) as the major differentiators for measuring IC.

An important aspect identified by this research is the growing use of IC measurement methods in the public sector. Secundo et al. (2017) propose a method focused on public universities, which presents a strategic approach segmented into maturity stages. Zeng et al. (2021) analyze the contribution of IC to the economic growth of cities, associating IC with individuals, families, groups, and communities. The performance of health organizations within the Italian public healthcare system is the focus of the study by Alfiero et al. (2021). The proposal by Fazlagic and Szczepankiewicz (2018) introduces the concept of a "knowledge city" and uses four dimensions of IC (human capital, structural capital, relational capital, and renewal and development capital) to measure IC in counties.

Furthermore, Marr et al. (2003) considered purpose a fundamental basis for measuring IC. Thus, when analyzing the articulation of purposes for IC measurement, 38 studies were identified as formulating and executing strategy. The strategic aspect is cross-cutting in research, permeating various sectors, sizes, methods, and categories of IC measurement. However, studies by Wudhikarn and Pongpatcharatorntep (2022), Garafiev and Garafieva (2021), Mohd Ariff et al. (2016), and Gogan (2014) consolidate the Balanced Scorecard (BSC) (Kaplan & Norton, 1992) as a strategic management method for IC. However, the development and improvement of methods in the "scorecard methods" category demonstrate that the BSC, despite being consolidated, does not suit all business sizes.

Regarding the aspect related to influence on behavior, 39 studies are concerned with aiding diversification and expansion decisions. At the same time, 33 studies address the basis for compensations, whether in the form of returns to investors or employees. Among the studies focusing on strategic decision-making, notable works include the article by Wang et al. (2021), which investigates the impact of investment decisions in information technology on Industry 4.0. Similarly, the study by Matos et al. (2020) addresses a wide range of variables aimed at assisting decision-making by strategic managers, while Garcia et al. (2018) analyze the determining factors for decision-making related to Knowledge Management and Intellectual Capital.

Furthermore, when addressing the relationship with stakeholders, Nupap et al.'s (2016) research points out communication as an important pillar for adequately developing the organizational environment. However, the asymmetry of published information and the lack of standardization and regulation in IC reports make their correspondence among varying publics a chimera. In an attempt to reduce this gap, the research by Matos et al. (2020), Heryana et al. (2020), and Bogdan et al. (2017) strive

to find consensus in this regard, as evidence shows that the degree of disclosure of annual IC reports directly relates to organizational performance.

Lastly, the purposes "innovate" and "measure the wealth of the public sector" were added by this research to the other purposes found by Marr et al. (2003). However, it is known that they still require acceptance and consolidation by the academic community. Despite this, their use in specific IC measurement methods highlights their contemporary importance. Thus, innovation emerges not as a trend but as a necessity for the sustainable development of organizations. Furthermore, in the studies by Amran et al. (2021), Zhu et al. (2020), Burton et al. (2013), and González-Loureiro and Dorrego (2012), innovation is treated as a variable in IC measurement, given its relevance.

In regard to the public sector, Fazlagic and Szczepankiewicz's (2018) research proposes an original concept for measuring IC in counties and introduces the dimension "renewal and development capital" as a measurement variable. Additionally, Nevado Peña et al. (2017) present a model that incorporates knowledge sources in various domains (human resources, infrastructure efficiency, mobility, accessibility, business, image, quality of life, tourism, innovation, and environmental sustainability), enabling the smart and sustainable growth of cities.

Finally, it is important to highlight that this analysis was designed to provide the reader with a comprehensive overview of the variety and development of IC measurement, aligning with the primary goal of this research. Nearly all the studies examined establish a correlation between IC, value creation, competitive advantages, and wealth generation. These studies cover various business sizes and sectors of the economy, including the public sector. This approach underscores the strategic significance of IC.

5 CONCLUSION

One of the most important issues observed during the development of this work concerns the fact that users of IC measurement methods themselves often struggle to understand the motivation for their application (i.e., what problem they want to solve). The debate among researchers about the role of intangible assets in fostering sustainable competitive advantages in organizations is ongoing. An additional concern in the IC research field is the desire among academics to standardize techniques for measuring intangible assets, which could potentially prevent organizations from revealing their unique competitive advantages.

Furthermore, setting standards for intangibles is problematic, mainly due to the absence of specific laws or recognized criteria for evaluating these assets. Thus, disregarding the dependence of IC measurement on the uniqueness of organizational strategy, as well as the diversity of forms of these intangible assets, seems unreasonable.

Notably, the existing conceptual challenge in the field of IC research has spurred this study, which aims to identify the methods and purposes of IC measurement. This research has also sought to understand the theoretical foundations that support scientific exploration in this context. Moreover, it has sparked interest in examining the relationship between methods and purposes and their application in different economic sectors and business sizes.

To meet the requirements established for this research, a total of 1,889 scientific articles were collected and analyzed. Each document was subjected to rigorous content analysis following the appropriate systematic literature review (SLR) protocol To distinguish the purposes for measuring IC, 73 studies were selected for inclusion in the final scope. Meanwhile, 80 documents remained in the final selection of studies for identifying IC measurement methods, all of which adhered to the same rigorous protocol.

The full reading of these articles not only brought the foundation of purposes for measuring IC proposed by Bernard Marr and collaborators but also added two new purposes to the previous scope. As a result, 7 purposes (1: aiding in strategy formulation; 2: facilitating strategy execution; 3: assisting in diversification and expansion of decision-making; 4: supporting compensation; 5: guiding communication to stakeholders; 6: innovating; 7: measuring public sector wealth) began to guide the efforts of individuals embarking on an IC measurement initiative. Concerning the search for IC measurement methods, 58 IC measurement methods were identified, with 50 representing new findings that should be added to Sveiby's 2010 list (Sveby, 2010). Thus, a scope of 92 IC measurement methods is now available to readers, academics, and managers.

In developing the framework, identifying a relevant theoretical foundation proved essential. This research employs Design Science (DS) methodology within the Design Science Research (DSR) process from the outset. However, in the studies analyzed, no models in the IC literature were found to have been developed using DS and DSR. Nevertheless, the framework's design, aimed at bridging theory and practice, successfully captured the reality structure and transformed it into a useful representation as a meaningful tool, thereby reinforcing the initial methodological choice.

Throughout this research, as conceptual understanding deepened, it became increasingly clear that the debate surrounding the use of intangible assets remains a major issue for academics and managers. Even today, the absence of a universal definition for IC not only reflects the magnitude of the challenges established by this work but also makes IC measurement susceptible to manipulation and direction according to the interests of researchers and managers. The amount of 58 models and 7 purposes for measuring IC, in addition to the 4 economic sectors and the 5 company sizes, underscores the importance of this research within the field of IC.

Considering the breadth of this research, the challenge of integrating numerous variables into a single framework becomes evident. This framework aims to provide readers, academics, and managers with a new perspective on available IC measurement methods, as well as guide them toward relevant studies on the subject. However, the final delivery of this research is not complete without users of the framework understanding its application and recognizing its importance.

Nevertheless, one of the limitations observed in the development of the framework is related to its evaluation and validation. The final version of the artifact was informally reviewed by the author, a few researchers, and potential users. In this sense, assessing the framework´s use by a more significant number of readers, academics, and public and private managers could reveal opportunities for improvement.

Finally, as a suggestion for future research, it is recommended to apply the framework in real-life situations in both the public and private sectors. Evaluating the model across various company sizes will also benefit the artifact's development. Furthermore, maintaining rigor in the use of RSLs in future research is suggested, facilitating the identification of new purposes and new methods for measuring IC and promoting the updating and maturation of this research field.

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