
PRELIMINARY REPORT

The Evolution of Intellectual Capital Research – a Bibliometric Analysis of Highly-cited Papers

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ABSTRACT

This study presents and evaluates the development of research on intellectual capital (IC) using bibliometric analysis of highly cited research papers. It also uses social network analysis (SNA) to decipher the complex patterns of collaboration, influence, and knowledge diffusion in the field of IC research. Data for the SNA were extracted from the top 1% of highly cited papers identified through bibliometric analysis. The extracted data were processed using BibExcel, which allowed for the extraction of important metadata, statistical calculations, and an in-depth examination of the selected documents. Pajek, a network analysis tool, was used to visualize and understand the complex network of these influential articles. Our analysis shows the evolution of intellectual capital from a niche interest in the mid-20th century to a dynamically growing field of study. The number of publications increased from double digits in the early 1990s to over a hundred publications per year in the early 2000s. From the mid-2000s to the present, the field experienced almost exponential growth, peaking in 2022 with 796 publications. Analysis of the 103 most cited papers in intellectual capital identified a total of 212 authors. Remarkably, 92% of these authors contributed to only one publication each. The co-authorship analysis unveils a decentralized structure characterized by several smaller research clusters embedded within the broader network. The results of this study enhance our comprehension of intellectual capital research by identifying influential authors, highly cited journals, and co-publication networks, thereby providing valuable insights into the field's dynamics.

Keywords: *intellectual capital, intangible assets, bibliometric analysis, social network analysis (SNA), human capital, structural capital, relational capital*

JEL Classification: O34

INTRODUCTION

In today's knowledge-based economy, intellectual capital (IC) is one of the most important factors in value creation. The competitiveness of developed countries is largely based on investments in IC, which is of particular importance for Serbia's economy, whose competitiveness is at a very low level.

The resource-based view of the firm looks at companies in terms of the resources they have. According to Barney (1991), not all resources that a firm possesses have the potential to create a sustainable competitive advantage, but only those that have the following four characteristics: (1) they must be valuable in the sense that they enable exploitation of opportunities and/or neutralization of environmental threats, (2) they must be rare among current and potential

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competitors, (3) they are difficult to imitate, and (4) there are no strategically equivalent substitutes that are valuable but, on the other hand, rare or difficult to imitate. As a result of considering the role and importance of a particular type of resource in achieving competitive advantage, the concept of IC was created (Janošević and Dženopoljac, 2013).

The purpose of this study is to present and evaluate the development of research on intellectual capital through the bibliometric analysis of highly cited articles. In addition to bibliometric analysis, this study employed social network analysis (SNA) to decipher the complex patterns of collaboration, influence, and knowledge diffusion in the field of intellectual capital research. The first part of the paper presents the relevant literature review, including the concept, definitions, importance, and classification of IC, as well as the development of IC research through the four phases. Then, the data (articles on IC) and methodology (bibliometric and social network analysis) are presented, followed by the presentation and discussion of the results. The main findings are summarized in the conclusion.

LITERATURE REVIEW/THEORETICAL BACKGROUND

The Concept and Importance of Intellectual Capital

The concept of intangible assets was first mentioned by Lawrence R. Dicksee in 1896 and IC by John Kenneth Galbraith in 1969. Although it was mentioned much earlier, the term IC did not become popular until 1991, when Tom Stewart published a paper titled "Brain Power: How Intellectual Capital is Becoming America's Most Valuable Asset" (Pedro, Leitão and Alves, 2018).

The term intangible assets is often used as a synonym for IC. However, some definitions in the literature distinguish between IC and intangible assets by considering IC to be a narrower term than intangible assets, i.e., they consider IC to be part of the company's intangible assets. It follows that IC consists of intangible assets that, in combination with tangible assets, contribute to the value creation of companies, regions or countries (Pedro, Leitão and Alves, 2018).

In the literature, there are many papers and studies from different disciplines that mention IC or intangible assets. There are also numerous definitions and classifications of IC and intangible assets. Some non-accounting authors define IC as the difference between the market value and the book value of the company, while accounting authors refer to this difference as goodwill, which is also used as a synonym for intangible assets (Choong, 2008). Goodwill can be internally or externally generated, although according to International Financial Reporting Standards (IFRS), in particular IFRS 3, only externally generated goodwill, i.e., goodwill acquired through purchase, can be recognized in the financial statements and subsequently amortized (IASB, 2008). Choong (2008) is of the opinion that IC or intangible assets cannot be equated with goodwill, as the concept of goodwill is too broad.

Although there is no unified definition of IC in the literature, most definitions state that IC is a non-monetary asset without physical substance that has value or can generate future benefits (Choong, 2008). Itami and Roehl (1987) define intangible assets as invisible assets that encompass a wide range of activities, such as technology, collected customer information, brand image, corporate reputation, and organizational culture.

Hall (1992, p. 136) considers intangible resources as "value drivers that transform productive resources into value-adding assets". According to this author, intangible resources can be divided into assets and skills. Assets are resources that a company owns. They include intellectual property rights (patents, trademarks, copyrights and registered designs), contracts, trade secrets, and databases. Reputation is also an asset because it has the quality of belonging to a company, although it is not a property right, such as a copyright that can be bought or sold. Skills include the know-how of employees (but also the know-how of suppliers and consultants) and the culture of the company.

Smith and Parr (1994) state that intangible assets are an element of a firm that exists alongside working capital and tangible assets. It is an element that, along with working capital and tangible assets, enables a company to function and is often the factor that contributes most to a company's earning power.

According to Brooking (1997, p. 13), IC represents a “set of marketable assets, human capital, intellectual property, and infrastructure”. Marketable assets are the potential of a company created in the market, such as brand, customer loyalty, repeat purchases, distribution channels, various agreements and contracts such as licenses, franchising and the like. Human capital consists of the collective experience of employees, their creativity, problem-solving ability, leadership skills, entrepreneurial skills, management skills, teamwork skills, and ability to work under pressure. Infrastructure includes technologies, methods and processes that enable the company to function, such as organizational culture, risk assessment methods, sales management methods, financial structure, market and customer databases and communication systems.

Edvinsson and Malone (1997) state that intangible assets are those assets that have no physical expression, but are essential for increasing the value of the company. Sveiby (1997) uses the term intangible value and states that IC has three dimensions: employee competencies, internal structure, and external structure. Nahapiet and Ghoshal (1998) use the term IC to consider the knowledge and learning capabilities of a social collective such as an organization, intellectual community, or professional association. According to Stewart (1998, p. 11), IC is a “collective brain power that includes knowledge, information, intellectual property, and experience that can be used to create wealth”. Brennan and Connell (2000) state that IC can be viewed as a company's knowledge-based capital, which includes employees' knowledge and expertise, customers' trust in the company and its products, brand, franchise, information systems, administrative procedures, patents, trademarks, and business process efficiency.

According to Harrison and Sullivan (2000), in the first half of the 1990s, many companies were interested in making profits based on IC. For this reason, in January 1995, a meeting of eight companies actively involved in the process of creating value based on their intangible assets was held. On this occasion, the representatives of all eight companies agreed, among other things, on the definition of IC, which is that IC is “knowledge that can be converted into profit”.

Lev (2001, p. 5) defines an intangible asset as a “right to future benefits that has no physical or financial expression”. Financial assets, such as stocks or bonds, also have no physical expression but are not intangible assets because they represent the right to the company's assets, which can be tangible or intangible (Lev, 2005). Intangible assets can also be defined by their value drivers, such as research and development, advertising (brand support), capital expenditures, information systems, and technology deployment (Gu and Lev, 2001).

The Organization for Economic Cooperation and Development (OECD, 1999, p. 17) defines IC as the “economic value of two categories of intangible business assets: organizational (structural) capital and human capital”. In this definition, structural capital includes assets such as software, distribution channels, and supply chains. Human capital includes human resources within the company as well as those outside the company, such as customers and suppliers. This definition also distinguishes between IC and intangible assets by treating IC as part of an intangible asset. For example, a company's reputation is an intangible asset, but not IC (Petty and Guthrie, 2000).

Funk (2003) links intangible assets to social responsibility, environmental responsibility, management credibility, innovation, brand, ability to attract talented employees, and research leadership. Pablos (2003) defines IC more comprehensively than other authors, explaining that IC is the difference between the market value and the book value of the company. It consists of knowledge-based resources that help to achieve a sustainable competitive advantage.

According to Rastogi (2003, p. 230), IC can be seen as the “holistic ability of an organization to coordinate, manage, and deploy its knowledge resources to create value in the future”. Organizations are expected to face constant challenges and exploit opportunities to create value.

Therefore, IC can be understood as the company's comprehensive ability to respond to challenges and exploit opportunities to achieve its goals. The author further states that a company's ability to provide superior value to customers depends on the collective efforts of highly motivated, well-trained, capable, and creative employees who make up the company's human capital. Employee cooperation and motivation derive from the company's social capital, which includes shared values, a common vision, and a sense of trust and concern among employees. In turn, employees' skills, abilities, creativity, and knowledge are shaped by the firm's continuous efforts to create, develop, share, integrate, and leverage its knowledge resources, which this author refers to as the knowledge management function. Human capital, structural capital, and the knowledge management function are interrelated, and IC can be understood as the result of a continuous synergistic interaction of these three elements (Rastogi, 2003).

The International Accounting Standards Board (IASB) defines an intangible asset in its Standard 38 (International Accounting Standard - IAS 38) as a non-monetary asset without physical substance that is held by an entity for use in production, procurement of goods or services, rental to others, or use for administrative purposes (IASB, 2004). Intangible assets can comprise various activities that are expected to generate future benefits in the form of cash flows. These include investments in marketing, research and development, and human resources, but also the value created on the basis of the brand, copyrights, franchises, licenses, patents, trademarks, and so on. From an accounting perspective, most of these activities are treated as period costs, and only those items that can be quantitatively identified or that are externally generated can be capitalized on the balance sheet (Choong, 2008).

The Financial Accounting Standards Board (FASB) defines an intangible asset as the right to future benefits, where it is not short-term and financial in nature. Intangible assets also have no physical or financial expression (FASB, 2001).

Table 1 summarizes the definitions and most commonly cited synonyms for IC. Although definitions of IC differ, they all have in common that intangible resources are the category of assets with the greatest potential to create value (Janošević and Dženopoljac, 2013).

Table 1. Overview of definitions and the most frequently cited synonyms for IC

Authors	Term	Definition
Itami and Roehl (1987)	Invisible assets	Invisible assets include intangible assets that encompass a wide range of activities, such as technology, collected customer information, brand image, corporate reputation, and organizational culture.
Hall (1992)	Intangible assets	Intangible assets are "value drivers that convert productive resources into value-creating assets".
Smith and Parr (1994)	Intellectual property	Intangible assets are an element of a company that exists alongside working capital and tangible assets. It is an element that, along with working capital and tangible assets, enables a company to function and is often the factor that contributes most to a company's earning power.
Brooking (1997)	Intellectual capital	IC represents a set of marketable assets, human capital, intellectual property and infrastructure.
Edvinsson and Malone (1997)	Intellectual capital and intangible assets	Intangible assets are assets that have no physical expression but are essential for increasing the value of the company.
Sveiby (1997)	Immaterial values	IC has three dimensions: employee competencies, internal and external structure.
Nahapiet and Ghoshal (1998)	Intellectual capital	IC is considered to be the knowledge and learning capacity of a social collective such as an organization, an intellectual community, or a professional association.

Authors	Term	Definition
Stewart (1998)	Intellectual capital	IC is the collective brain power that includes knowledge, information, intellectual property, and experience that can be used to create wealth.
Brennan and Connell (2000)	Intellectual capital	IC can be considered the knowledge-based capital of a company.
Harrison and Sullivan (2000)	Intellectual capital	IC is “knowledge that can be turned into profit”.
Lev (2001)	Intangibles	An intangible asset is a right to a future benefit that has no physical or financial expression.
Gu and Lev (2001)	Intangibles	Intangible assets are defined by their value drivers, such as research and development, advertising (brand support), capital expenditures, information systems, and technology deployment.
OECD (1999)	Intellectual capital	IC is the “economic value of two categories of intangible assets of the company: organizational (structural) capital and human capital”.
Pablos (2003)	Intellectual capital	IC represents the difference between the market value and the book value of the company. It consists of knowledge-based resources that help to achieve a sustainable competitive advantage.
Rastogi (2003)	Intellectual capital	IC can be seen as the “holistic ability of an organization to coordinate, manage and deploy its knowledge resources to create value in the future”.
International Accounting Standards Board (IASB, 2004)	Intangible assets	Intangible assets are non-monetary assets without physical substance that are held by the entity for the purpose of production, procurement of goods or services, rental to others, or use for administrative purposes.
Financial Accounting Standards Board (FASB, 2001)	Intangible assets	An intangible asset is a claim to a future benefit, where it is not short-term and financial in nature. Intangible assets also have no physical or financial expression.

Source: adapted from Choong (2008)

The importance of IC is demonstrated by the fact that in the United States, intellectual and informational processes create most of the value in companies that belong to service industries such as software, healthcare, communications, and education. These firms employ 79% of the labor force and generate 76% of the gross national product of the United States. In manufacturing, intellectual activities such as research and development, process and product design, logistics, marketing, market research, systems management, and technological innovation generate most of the value added (Quinn, Anderson and Finkelstein, 1996).

In a study that included 3,500 companies in the United States, the relationship between the market value and book value of these companies was observed over a 20-year period. At the beginning of the observation period, i.e., in 1978, the difference between the market value and the book value was not significant, as the book value was equal to 95% of the market value. However, 20 years later, the market value of the company was 2.2 times higher than the book value (Dess, Lumpkin, Eisner and McNamara, 2014). According to these authors, the difference between market value and book value is larger in knowledge-intensive companies than in companies that base their strategy on tangible assets. This difference becomes even greater in companies where knowledge and the management of a highly skilled workforce are key factors in product or service development, and material resources are less important factors.

Figure 1 shows the share of IC in the total assets of companies from the S&P 500 group. IC's share of total assets in 2015 is 84%, an increase of four percentage points compared to the period 10 years ago.

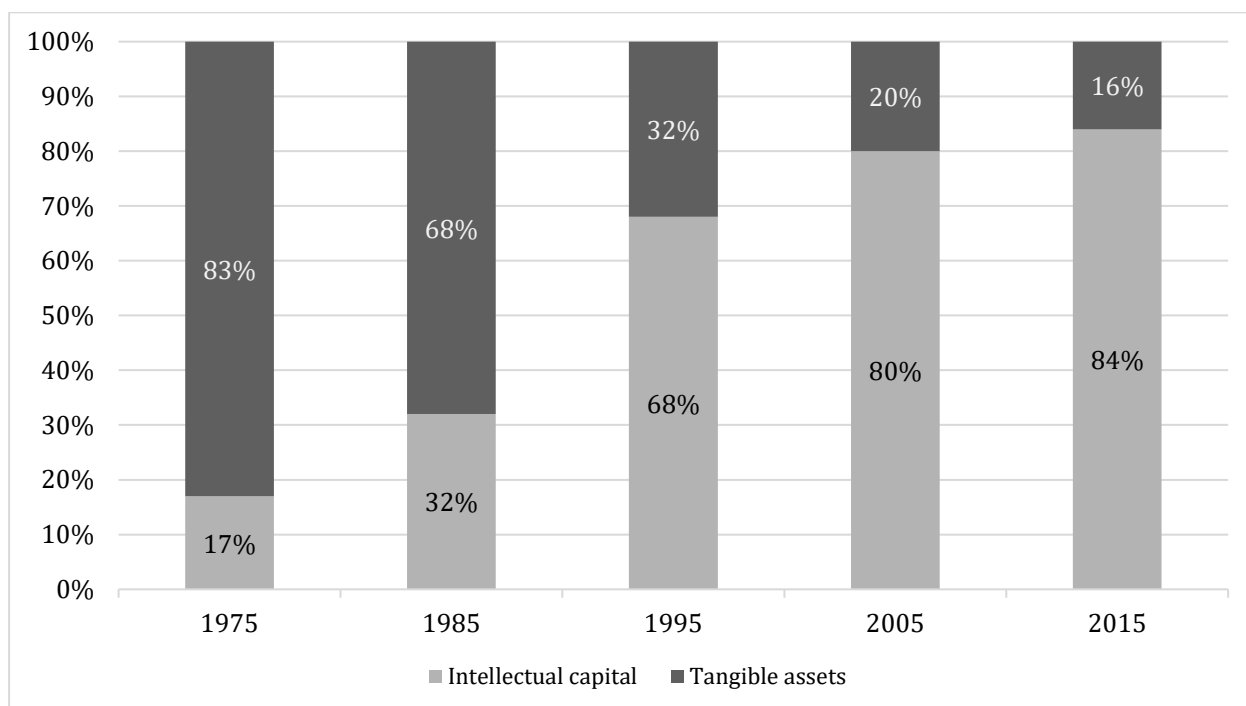


Figure 1. The share of IC in the total assets of companies

Source: Ocean Tomo (2017). *Intangible asset market value study*. Available at: <http://www.oceantomo.com/intangible-asset-market-value-study/>

In most OECD countries, investment in intangible assets is growing rapidly, and in some cases, it is approaching or even surpassing investment in tangible assets. It is estimated that annual investment in the United States ranges from \$ 800 billion to \$1 trillion, while the total value of intangible assets exceeds \$5 trillion. Increasing competition on a global scale, ICT, new business models and the growing importance of the service sector are the reasons that lead to a greater importance of IC for companies, industries and economies (OECD, 2011).

Classification of Intellectual Capital

Similar to the definition of IC, there are a variety of attempts in the literature to determine the constituent elements of IC. Modern concepts divide IC into external elements associated with customers, internal elements, and human capital (Janošević and Dženopoljac, 2013).

Sveiby (1997) uses the term intangible value and explains that IC consists of employee competencies, internal and external structure. Employee competencies represent the ability to act in a variety of business situations. The internal structure includes patents, business models, information systems, management, organizational culture, and organization in its broadest sense. The internal structure is created by the employees and represents the ownership of the company. The external structure includes the capital of established and maintained relationships with stakeholders (customers, suppliers, investors, partners, community, etc.) (Krstić, 2009).

Brooking (1997) divides IC into human capital, marketable assets, intellectual property, and infrastructure. According to Roos and Roos (1997), IC includes human capital and structural capital. Edvinsson (1997) and Bontis (1998) state that IC consists of human capital, organizational capital, and customer capital. Stewart (1998) summarizes human capital, structural capital, and customer capital at IC. Petty and Guthrie (2000) accept the OECD's definition of IC, according to which IC is divided into human and organizational capital. Gu and Lev (2001) state that intangible

assets consist of research and development, advertising (brand support), capital expenditures, information systems, and technology deployment. Mouritsen, Larsen and Bukh (2001) divide IC into human capital, organizational capital, and customer capital.

Khalique, Bontis, Abdul Nassir bin Shaari and Hassan Md. Isa (2015) consider IC as a set of six components: human capital, social capital, customer capital, structural capital, technological capital, and spiritual capital. According to them, human capital consists of employees' competencies (education, professional skills, know-how, and experimental knowledge), attitudes (motivation, leadership, behavioral patterns), and mental agility (innovativeness, creativity, flexibility, and adaptability). Social capital includes honesty, ethics, and corporate responsibility. Customer capital consists of customer loyalty and satisfaction, networks, and brand equity. Structural capital consists of procedures, databases, systems, processes and routines. Technological capital consists of research and development and property rights, while spiritual capital consists of ethical values and an understanding of religion.

Although there are various subdivisions of IC, the one that divides IC into human capital, structural capital, and relational capital is the most commonly used in literature. This classification of IC is defined in the "Guidelines for managing and reporting on intangibles", i.e., the MERITUM guidelines (MERITUM, 2002). Table 2 provides an overview of the different classifications of IC.

Table 2. Overview of the different classifications of IC

Authors	Term	Classification
Sveiby (1997)	Immaterial values	Employee competencies, internal structure and external structure
Brooking (1997)	Intellectual capital	Human capital, marketable assets, intellectual property and infrastructure
Roos & Roos (1997)	Intellectual capital	Human capital and structural capital
Edvinsson (1997)	Intellectual capital	Human capital, organizational capital and customer capital
Bontis (1998)	Intellectual capital	Human capital and organizational capital and customer capital
Stewart (1998)	Intellectual capital	Human capital, structural capital and customer capital
OECD (1999)	Intellectual capital	Human capital and organizational capital
Gu & Lev (2001)	Intangible assets	R&D, information systems, advertising, capital expenditure, and technology deployment
Mouritsen, Larsen and Bukh (2001)	Intellectual capital	Human capital, organizational capital and customer capital
Khalique, Bontis, Abdul Nassir bin Shaari and Hassan Md. Isa (2015)	Intellectual capital	Human capital, customer capital, structural capital, social capital, technological capital and spiritual capital
MERITUM Guidelines (MERITUM, 2002)	Intellectual capital	Human capital, structural capital and relational capital

Source: adapted from Choong (2008)

Human capital includes the knowledge that employees take with them when they leave the company (Janošević and Dženopoljac, 2016). This includes their experience, commitment, skills, motivation, talent, experience, creativity, ability to acquire new knowledge, and enthusiasm. The knowledge embedded in human capital can be explicit and tacit. Explicit knowledge, such as

technical drawings or program codes, is codified and documented so that it can be easily transferred and reproduced. Tacit knowledge is in the minds of employees and is based on their experience and education. This knowledge can only be passed on with the consent and participation of the person who possesses it, and through the constant interaction of explicit and tacit knowledge, new knowledge can be created (Dess, Lumpkin, Eisner and McNamara, 2014).

Building human capital in a company requires three activities (Dess, Lumpkin, Eisner and McNamara 2014). The first step is to hire talented employees with the right skills, abilities, values and attitudes. According to these authors, companies can identify the best candidates based on their mindset, attitudes and social skills. This does not mean that specific knowledge is not important for performing the job; it is a necessary condition, but not a sufficient one.

Hiring the best people is no guarantee that their skills and abilities will remain relevant throughout their careers, so the second step is to develop human capital. In addition to the various types of training and development, companies should encourage employee involvement at all levels, monitor their development and provide them with feedback.

The final step in building human capital is to create a work environment and incentive system that allows the best people to stay with the company. Challenging work and a stimulating environment can create intrinsic motivation in employees and a desire to stay with the company. On the other hand, financial incentives in the form of salaries, bonuses, options or otherwise can mean different things to different people. For example, it can mean security, recognition, independence or a sense of freedom. Although money is an important factor in attracting and retaining human capital, most surveys indicate that it is not the most important reason why people take or leave a job.

These three activities are interrelated and can be considered like a table with three legs, in the sense that if one leg breaks, the table collapses. Poor selection of candidates at the recruitment stage makes it difficult to develop and retain staff. On the other hand, the inability of the company to retain good employees increases employment costs and prevents human capital development.

Structural capital is the knowledge that remains in the company when the working day is over (Janošević and Dženopoljac, 2016). It is used to transform tacit knowledge into explicit knowledge. These include management processes, procedures, business strategies, routines, organizational learning and culture, databases, software, copyrights, licenses, patents, etc. Human capital is transformed into structural capital through management systems and processes, which ensure the integration of employees toward common goals (Janošević, 2019). Certain elements of structural capital can be legally protected, becoming the company's intellectual property. However, the best way to preserve and protect IC is to develop dynamic capabilities. Dynamic capabilities represent the ability of a company to build and protect competitive advantages. They are based on knowledge, resources, competencies, complementary means and technologies, the ability to seize and exploit new opportunities, acquire new knowledge and reconfigure existing resources and capabilities (Dess, Lumpkin, Eisner and McNamara, 2014). Examples of dynamic capabilities are product development, strategic decision-making, alliance building and acquisitions (Dess, Lumpkin, Eisner and McNamara, 2014).

Relational capital includes all resources associated with the relationships the company has with external stakeholders such as customers, suppliers, creditors, investors, partners, and the like (Janošević and Dženopoljac, 2016). It consists of elements of human and structural capital that occur in relationships with external stakeholders. It also includes those stakeholders' perceptions of the company. It represents the ability of the company to acquire and use new knowledge from the environment with the aim of achieving a sustainable competitive advantage (Janošević, 2019). Some examples include the reputation of the company, business networks, ability to attract new customers, brand, distribution channels, market position, and the like.

In the process of value creation, the starting point is human capital. Structural capital is created by codifying the knowledge contained in human capital and incorporating it into procedures,

routines, management processes, business strategies, plans and organizational culture. Human and structural capital together lead to the creation of value that is estimated in the marketplace through good relationships with customers and other stakeholders. In later stages, the value created through relational capital can be reinvested in further improving human and structural capital, leading to renewed value creation (Janošević and Dženopoljac, 2016).

The Evolution of Intellectual Capital Research

According to Pedro, Leitão and Alves (2018), the development of IC research can be analyzed in four phases. The first phase lasted from the end of the 1980s to the end of the 1990s. The main focus of most authors in this phase was to raise awareness of the importance of recognizing and understanding the potential of IC to achieve and manage sustainable competitive advantage. Certain guidelines and standards were also created to reveal invisible values. The work that emerged during this phase points to the importance of IC and the need for its measurement without referring to specific empirical research (Petty and Guthrie, 2000).

The second phase lasted from 2000 to the end of 2003. The main focus and research directions were different approaches to measuring, managing and disclosing IC in empirical studies. Interdisciplinary studies were conducted to investigate how labor and capital markets respond to the potential of value creation through IC at the organizational level. In this phase, different classifications of IC were created, which made it possible to identify the three main components of IC. Although they are referred to differently in different publications, they all refer to (1) human competencies, i.e., the knowledge of employees, (2) structural capital, i.e., the knowledge embedded in the organization, and (3) relational capital, i.e., the knowledge contained in customers and other links with the external environment (Guthrie, Ricceri and Dumay, 2012).

The third phase began in 2004 and continues to this day. The publication of a special issue of the Journal of Intellectual Capital entitled "Intellectual capital at the crossroads - theory and research" is considered its beginning (Guthrie, Ricceri and Dumay, 2012). This phase focuses on the use of IC in the process of corporate governance. IC is critically examined from a practical perspective at the organizational level.

The fourth phase began in parallel with the third in 2004 and continues to this day. IC is considered in the context of national and regional ecosystems. The work that belongs to this phase points to the need for a change in approach to understand the drivers of wealth creation, with the aim of obtaining a more comprehensive view of national innovation capacity (Pedro, Leitão and Alves, 2018). Table 3 shows the evolution of IC research through these four phases.

Guthrie, Ricceri and Dumay (2012) studied intellectual capital accounting (ICA) as a research area in the period from late 1999 to late 2009. These authors define IC accounting as a management and accounting technology that aims to understand, measure and report on knowledge resources such as employee competencies, relationships with customers, brands, financial relationships and ICT (Guthrie, Ricceri and Dumay, 2012). IC Accounting differs from intangible asset accounting, which focuses only on the elements of IC that are recognized in the financial statements, such as a brand, patents or copyrights, and does not take into account the intangible assets that are not capitalized on the balance sheet but treated as an expense in certain periods.

Table 3. The evolution of IC research in four phases

Phase	Period	Research focus	Research direction
First phase: Development of the theoretical framework	From the end of the 1980s to the end of the 1990s	Organizational IC	IC as a determinant of competitive advantage
Second phase: Development supported by empirical research	From 2000 to the end of 2003	Organizational IC	Approaches to measuring, managing and disclosing IC in empirical studies; how markets respond to the value creation potential of IC; IC Classification
Third stage: Use of IC in the process of corporate governance	From 2004 until today	Organizational IC	The role of IC from the practical point of view and IC management
Fourth phase: Development focused on IC of cities, regions and countries	From 2004 until today	National and regional IC	IC of regional and national ecosystems

Source: adapted from Pedro, Leitão and Alves (2018)

After 1999, there was a slight, constant increase in the number of publications in the field of IC accounting. The authors state the increase in the number of pages in specialist journals rather than the acceptance of this field of research in generalist journals as the reason for this (Guthrie, Ricceri and Dumay, 2012). Of the total 423 papers included in this study, 345 papers were published in two journals that specialize in this field: The Journal of Intellectual Capital - JIC (297 papers), published since 2000, and the Journal of Human Resource Costing and Accounting - JHRCA (48 papers), published since 1996 (Guthrie, Ricceri and Dumay, 2012).

In most publications, IC is considered at the industry level. In less than a third of the papers, IC is considered at the organizational level, suggesting that most authors have tried to generalize their conclusions to all companies rather than analyzing a single company. Guthrie, Ricceri and Dumay (2012) believe that this top-down approach to evaluating IC offers little information about how IC is implemented in practice and that more research needs to be done at the organizational level to understand the complexity of IC and to make visible the links between its components and the value created for managers in the company.

The most common type of organizations that were the subject of the study are large, publicly listed companies. This can be explained by the higher availability of financial reports and other information needed for analysis than for other types of organizations. A significant number of such papers have examined the impact of disclosure of IC information on financial markets. A smaller number of papers examined small and medium-sized enterprises and an even smaller number considered the public sector and non-profit organizations.

As far as the regions covered in the study are concerned, almost half of the articles refer to continental Europe. This is followed by North America (17% of the works) and Australasia (17% of the works). In Continental Europe, most of the papers refer to the Scandinavian countries, and in North America, more papers refer to Canada than to the United States, although the United States has a significantly larger academic population than Canada. A significantly smaller number of articles deal with countries such as South Africa, Russia, India, China and Latin American countries, suggesting that developing countries will most likely be the subject of research in this area in the future (Guthrie, Ricceri and Dumay, 2012).

Looking at the research methods used in the observed period, more than half of the papers refer to empirical research. Empirical works are followed by normative studies, and the smallest number of papers refers to theoretical studies. Looking at the trend, one can see a gradual increase

in the number of empirical papers and a gradual decrease in the number of normative studies. The number of papers proposing new theoretical models is also decreasing, indicating that IC accounting is maturing as a scientific field (Guthrie, Ricceri and Dumay, 2012).

Since the 1990s, the number of researchers in this field of science has increased considerably. This is especially true for the countries where the first phase of the development of IC research began, such as the European countries, Canada and Australia. Recently, the number of researchers in China and India has also increased. However, many researchers in this field feel excluded from the broader accounting research community for two reasons (Guthrie, Ricceri and Dumay, 2012). The first reason is that journals in this field are not yet recognized in business school rankings. This means that the publication of articles in these journals does not contribute to the ranking of the business school where the professors who published these articles are employed. Another reason is that the editors of high-ranking accounting journals often have a bias against IC accounting as a scientific field. They often view IC as a financial accounting problem rather than a problem of understanding how IC is linked to the value creation process.

For this reason, according to Serenko and Bontis (2009), researchers from the IC field have two options. The first option is to submit their work to one of the specialized journals that offer the greatest visibility to the target audience. However, the reputation of these journals is currently not high, which may raise doubts among other colleagues about the quality of their work. Another option is to submit their work to a high-ranking journal that deals with broader topics. This way, the quality of their work will be recognized, but on the other hand, the work will not be sufficiently noticed in the research community from the IC field, where many researchers focus on specialized journals.

Pedro, Leitão and Alves (2018) examined empirical papers in the field of IC during the period 1960-2016, covering 777 papers from 253 journals with an impact factor higher than 0.25. The largest number of papers was published in the following four journals: *Journal of Intellectual Capital* (23%), *International Journal of Learning and Intellectual Capital* (7%), *Knowledge Management Research and Practice* (4%) and *Management Decision* (2%). According to these authors, the number of articles published each year was about the same until 2001, and the greatest increase in articles began in 2004, when the third phase of the development of IC began. The authors also noted that in the majority of the papers, IC is observed at the level of an organization. The first empirical research on IC at the national level was published in 1972, but it was only after 2004 that a significant number of papers observing IC at the regional or national level were published.

Of the total number of papers that were included in the research of Pedro, Leitão and Alves (2018), 188 empirical papers examined the relationship between IC and performance. The first empirical paper addressing the relationship between IC and performance was published in 2000, and after 2007, the number of such studies increased significantly, reaching record levels in 2015.

Empirical studies that have observed IC at the organizational level have mostly examined the relationship between IC and overall performance, with a substantial body of work examining the relationship between IC and innovation performance, profitability, productivity, organizational, corporate, and business performance. The most commonly used classification of IC is the three-part classification of human capital, structural (organizational or process) capital and relational (social or customer) capital.

In the papers where IC was observed at the regional level, the relationship between relational capital and overall performance was most frequently examined. The studies that analyzed IC at the national level considered the relationship between IC and economic growth, productivity growth and innovation performance. A three-part classification of IC was used, and the research most commonly included groups of countries (Pedro, Leitão and Alves, 2018).

A recent bibliometric analysis of intellectual capital (Quintero-Quintero, Blanco-Ariza and Garzón-Castrillón, 2021) indicated that research in this field has experienced a significant and

accelerating increase since 2015, suggesting ongoing growth. The primary contributors to this research trend are notably found in the USA, the UK, Spain, and several other countries highlighted in the statistical findings of the analyzed data sources. Examination of keywords revealed that diverse facets of intellectual capital have been explored and scrutinized over the past 74 years. The latest prominent studies revolve around the intersection of intellectual capital and knowledge management, followed by considerations of societies and institutions. To a lesser extent, there is also attention given to clusters related to competition, education, and universities.

DATA AND METHODOLOGY

The analysis was based on data retrieved from Scopus, a reputable scholarly database, accessed on October 09, 2023. The search was narrowed down to documents with the keyword "Intellectual Capital," focusing on titles, abstracts, and keywords.

The initial search yielded a total of 10,267 published papers in the field. A filtering criterion was applied to delve deeper into the significant contributions. Specifically, the top 1% of highly cited papers were selected for further analyses, ensuring a focus on the most impactful research in the domain of intellectual capital research.

In addition to the bibliometric analysis, this study employed Social Network Analysis (SNA) to unravel intricate patterns of collaboration, influence, and knowledge dissemination within the domain of intellectual capital research. SNA is a robust methodological framework used to understand the relationships and interactions among entities within a network. In the context of this study, SNA was instrumental in uncovering the collaborative dynamics among researchers and countries focusing on the highest-impact papers in the field of intellectual capital. By visualizing these networks, key insights into the structure of collaborations and the flow of knowledge were obtained.

Data for the SNA were extracted from the top 1% of highly cited papers identified through bibliometric analysis. Information about authors, their affiliations, co-authorships, and citation patterns was collected. Institutional collaborations and co-authorship networks were explored, shedding light on the collaborative landscape in the field. The extracted data was processed using BibExcel, a versatile bibliometric software. BibExcel enabled the extraction of essential metadata, statistical calculations, and in-depth exploration of the selected documents. To visualize and comprehend the complex network of these influential papers, Pajek, a network analysis tool, was employed. Pajek facilitated the creation of visual representations, aiding in the exploration of patterns, connections, and collaborations within the selected papers.

RESULTS AND DISCUSSION

Figure 2 shows the development of intellectual capital from a niche interest in the mid-20th century to a dynamically growing field of study, demonstrating its central role in contemporary academic discourse. In the 1970s and 1980s, the number of papers published fluctuated between 1 and 8 per year, indicating a modest scholarly engagement with the topic. The 1990s and early 2000s saw exponential growth and a steady increase in the number of publications. The number increased from double digits in the early 1990s to over a hundred publications per year in the early 2000s, underlining the considerable scholarly interest and acceptance of intellectual capital as an important field of research. The following years, especially from the mid-2000s until today, show an impressive development. The field experienced almost exponential growth, peaking in 2022 with 796 publications. This increase reflects a deepening of engagement, probably fueled by the growing recognition of the importance of intellectual capital in various disciplines.

The number of top 1% cited papers in the field of intellectual capital has shown fluctuations over the years. The notable peaks were in 2004 (10 papers) and 2005 (11 papers). In the following years, the number of top publications fluctuated between 1 and 9 per year.

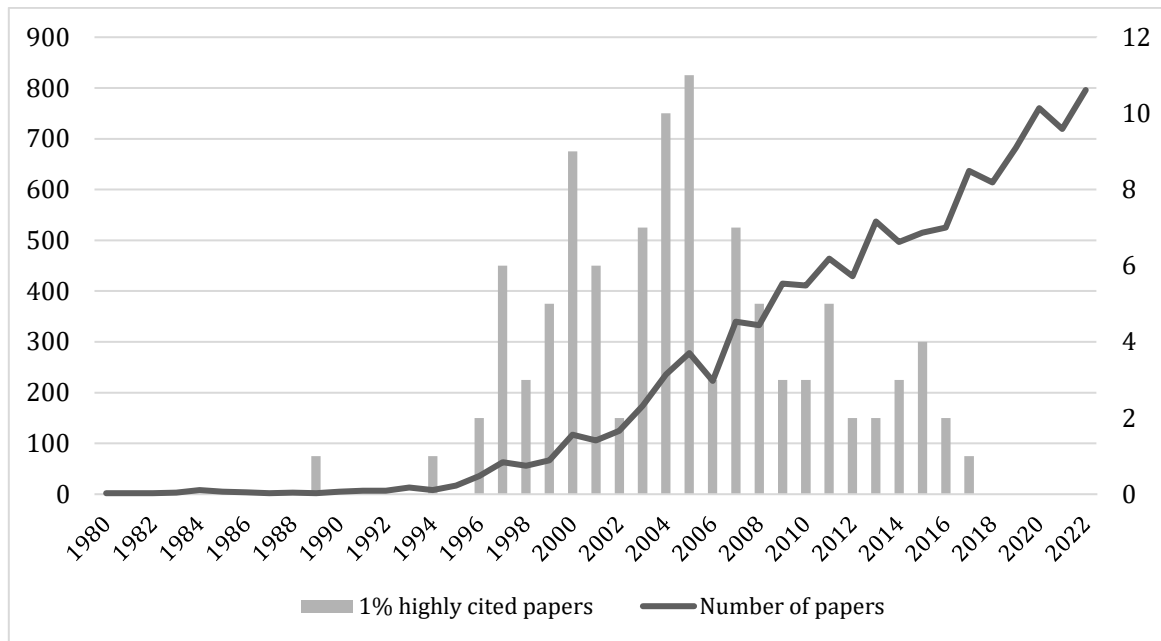


Figure 2. A comparative overview of published papers overall and 1% of highly cited papers in intellectual capital research over the period 1945-2022

Source: authors

Our analysis of the 103 most cited papers in the field of intellectual capital identified a total of 212 authors. Remarkably, 92% of these authors (195 authors in total) contributed to only one publication each. Figure 3 shows the leading authors in the field of intellectual capital. In particular, researchers Bontis, N. and Guthrie, J. stand out as the most influential authors with papers that received the most citations in the field.

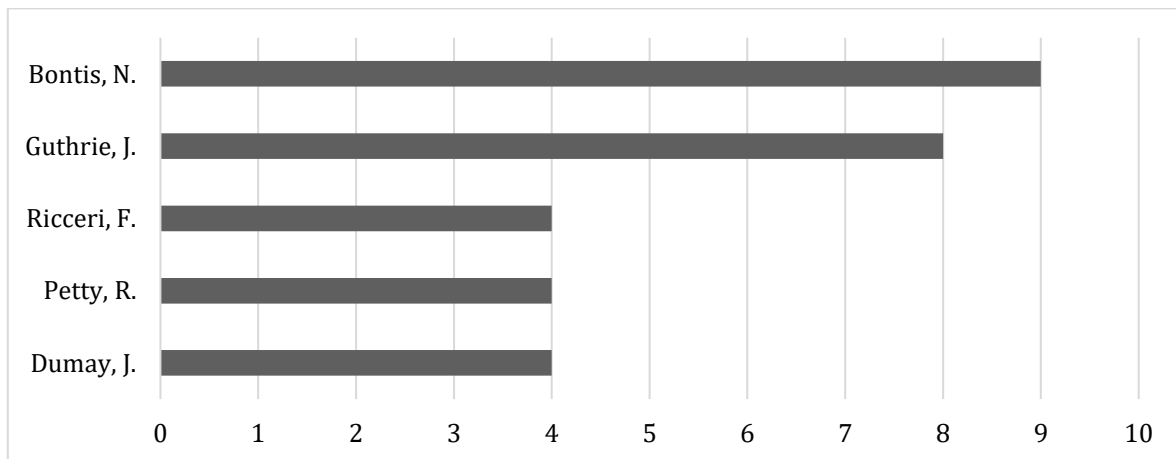


Figure 3. Authors with the highest number of top 1% cited papers in the field of intellectual capital research

Source: authors

In addition, our research found that a key journal, the 'Journal Intellectual Capital', is a focal point for the dissemination of significant research findings. This journal was the academic home for 23 of the 103 most cited papers, underlining its importance in shaping the discourse on intellectual capital (Figure 4).

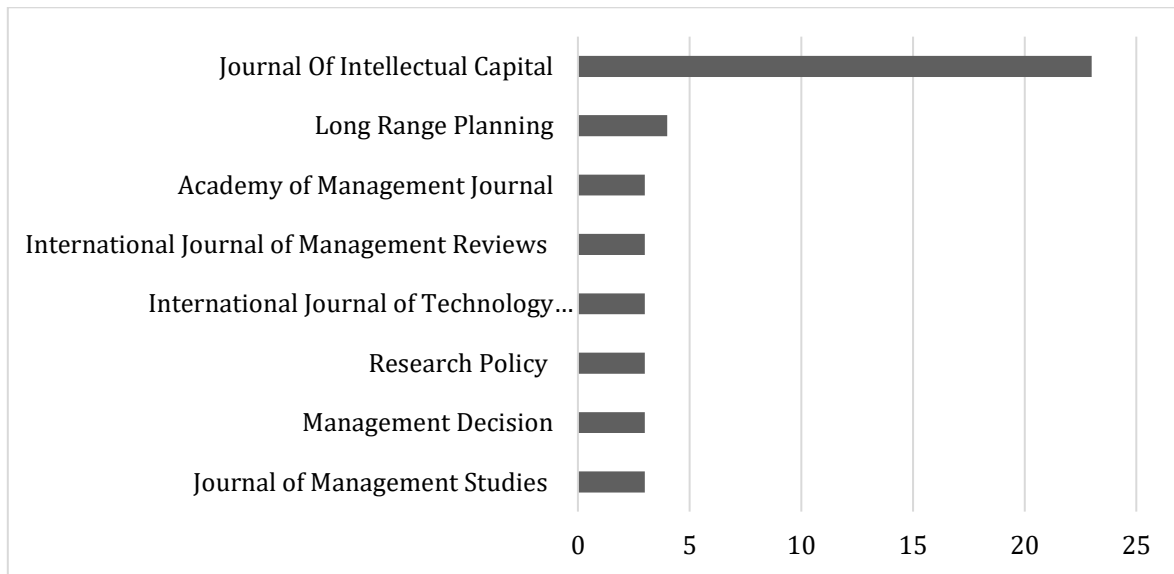


Figure 4. Source titles where the most highly cited papers were published
Source: authors

Figure 5 below illustrates the co-authorship relationships extracted from highly cited papers in the field of intellectual capital research, focusing on collaborations with at least four authors. A decentralized structure emerges, encompassing numerous smaller research clusters within the broader network. Our analysis identified nine different co-authorship networks with at least 4 authors, with the nodes representing individual authors and the connecting lines denoting the collaborative relationships between them. The size of the nodes corresponds to the authors' publication volume, while the thickness of the lines indicates the strength of the connections. Notably, the graph highlights two prominent clusters in particular: one with Bontis, N. and associated collaborations and another showing the interconnected networks of Guthrie, J., Petty, R. and Ricceri, F.

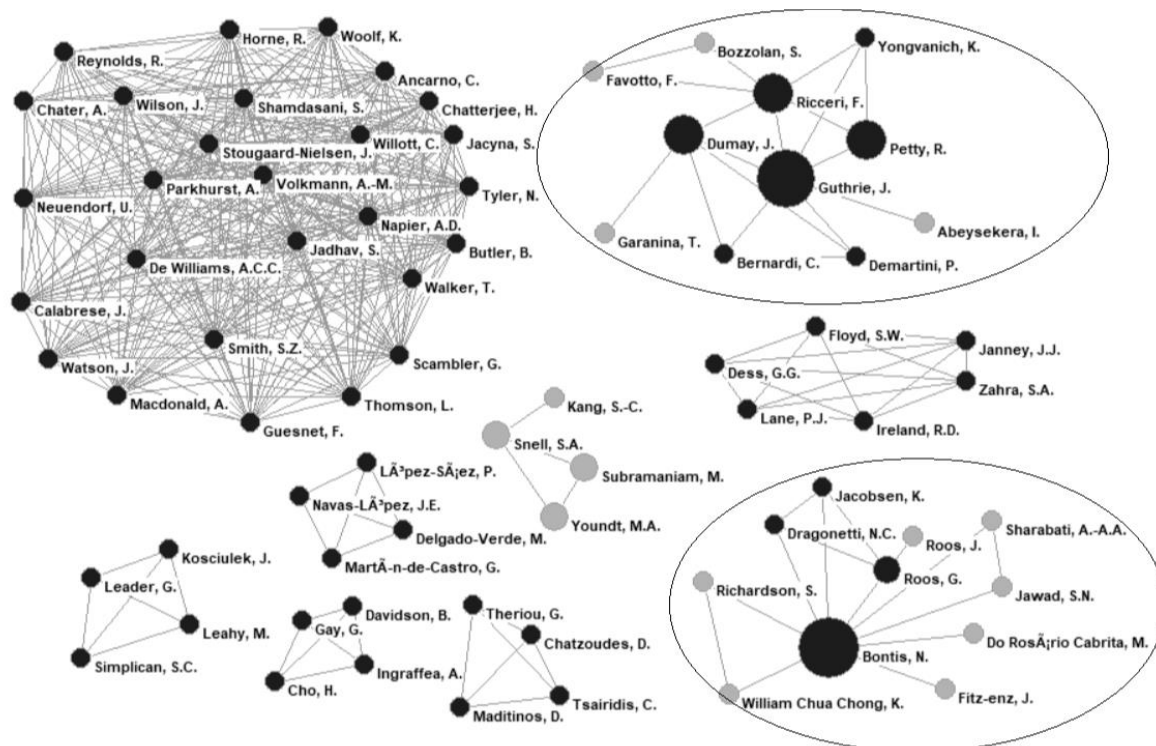


Figure 5. Co-authorship network of authors of the most cited papers in the field of Intellectual Capital Research

Source: authors

The authors of the most cited papers come from a total of 28 countries, with authors from 22 countries entering into international research collaboration. The research network consists of four different clusters, each characterized by a unique dynamic of collaboration. It is noteworthy that most of the highly cited articles are from the United States (39), with additional contributions from Canada (12), Australia (11) and the United Kingdom (10). The United States and Canada are the main players and play a central role throughout the network, highlighting their influential contributions to the field. In the second cluster, a compelling synergy emerges between Australian and Italian institutions, demonstrating close collaboration on joint research projects.



Figure 6. The network of co-authorship relations among 22 countries in producing the most-cited papers in the field of intellectual capital research

Source: authors

CONCLUSION

Intellectual capital is a cornerstone of value creation in the 21st-century economy. Organizations that recognize its importance and actively manage and develop their intellectual capital are better positioned to adapt, innovate, and succeed in an increasingly competitive business environment. A bibliometric analysis of intellectual capital research involves the quantitative examination of academic literature related to the subject of intellectual capital. It is a valuable tool for understanding the intellectual capital research landscape, recognizing influential research and authors, identifying emerging trends, and making informed decisions regarding research strategy, collaboration, and resource allocation. It plays a critical role in advancing the field and ensuring that research efforts are aligned with the evolving needs and challenges in the knowledge-based economy.

Our analysis shows the evolution of intellectual capital from a niche interest in the mid-20th century to a dynamically growing field of study. The 1990s and early 2000s saw exponential growth and a steady increase in the number of publications. The number increased from double digits in the early 1990s to over a hundred publications per year in the early 2000s, underscoring the considerable scholarly interest and acceptance of intellectual capital as an important area of research. The following years, especially from the mid-2000s to the present, show an impressive evolution. The field experienced an almost exponential growth, peaking in 2022 with 796 publications. These findings underline not only the remarkable expansion of the field, but also its continuing importance, reflecting the profound influence of intellectual capital on contemporary science and knowledge creation.

Analysis of the 103 most cited papers in the field of intellectual capital identified a total of 212 authors. Remarkably, 92% of these authors (195 authors in total) contributed to only one publication each. The results of our study on co-authorship relationships extracted from the most cited articles in the field of intellectual capital research reveal a decentralized structure that includes numerous smaller research clusters within the broader network. Nine distinct co-authorship networks with at least 4 authors were identified. Authors of the most cited articles come from a total of 28 countries, with authors from 22 countries engaging in international

research collaboration. The identification of 28 countries among those with highly cited intellectual capital publications indicates hotspots of research and expertise in this area. The concentration of highly cited intellectual capital research papers in only 28 countries shows that countries with well-established universities, research institutions and academic infrastructure are more likely to produce highly cited papers.

This paper sheds light on the development and global landscape of research on intellectual capital. It provides valuable insights into trends, collaborations and emerging hotspots that form the basis for future research. Although our approach aimed to identify and analyze the most influential research on intellectual capital through a rigorous selection process focusing on the 1% most cited papers, we must acknowledge certain limitations. One notable limitation is the potential bias due to the inherent temporal factor associated with the number of citations. The observed decline in citations for newer papers compared to earlier ones can be attributed in part to the limited time available for newer publications to accumulate citations. While focusing on the top 1% ensures a detailed examination of the most influential publications, it may miss valuable contributions from a larger pool of publications. A more comprehensive analysis that goes beyond the top 1% could provide a more holistic understanding of the field of intellectual capital research, including variations in topics, trends and impact across a broader range of publications. In addition, examining a larger number of research papers in future research would enable an investigation into how co-authorship networks have evolved over time, providing valuable insights into the changing dynamics of intellectual capital collaboration.

Our methodology relied primarily on quantitative measures, such as the number of citations. However, the lack of qualitative analysis, such as a detailed examination of abstracts or content, prevents us from providing insights into the specific nuances and thematic variations among the identified highly cited articles and may limit our understanding of the depth and focus of each publication. To address this limitation, future research efforts could incorporate qualitative analyses, such as reviewing abstracts, to provide a more nuanced perspective on the content and thematic relevance of the identified highly cited articles.

ACKNOWLEDGMENTS

The research presented in this paper was funded by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia under contract number 451-03-47/2023-01/200005.

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Article history:	Received: 19.10.2023.
	Revised: 2.12.2013.
	Accepted: 12.1.2024