

Review

# Intellectual capital and human resources: A 26-year thematic systematic review

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## CITATION

Guedes TdA, Rezende BRPd. (2024). Intellectual capital and human resources: A 26-year thematic systematic review. *Human Resources Management and Services*, 6(2): 3461. <https://doi.org/10.18282/hrms.v6i2.3461>

## ARTICLE INFO

Received: 26 February 2024  
Accepted: 25 March 2024  
Available online: 16 April 2024

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**Abstract:** Intellectual capital is the sum of whatever organizational resources contribute to the value and competitiveness of a company. Though some metrics have been developed for measuring individual and collective capabilities, from a human resources point of view, it is difficult to translate the concept of “intellectual capital” into, for example, financial terms. To better understand the field, the aim of this study is to draw a thematic analysis on the relations between intellectual capital and human resources. We provide an overview of publications and their courses on this subject. We accessed two widely used databases (Scopus and Web of Science) to produce the review. We set a period of 26 years, marked by the subject’s theme entry. In order to handle duplicates, we used RStudio Software, and to manage the data, we used the Bibliometrix package tools (biblioshiny and thematic map). Our analysis revealed how intellectual capital and human resources are important for generating value in organizations. Some results explore innovative ways of managing these resources, such as integrating technological, commercial, organizational, and cultural aspects, using dynamic systems modeling, investing in long-term strategies and in education and training, and studying the relationship between green intellectual capital and green human resources management.

**Keywords:** intellectual capital; human resources; systematic review

## 1. Introduction

Intellectual capital (IC) shapes the results of companies (Adelman, 2010; Ahuja et al., 2013; Olander et al., 2015; Liu et al., 2022). It is conceptualized as the total stock of intangible assets, knowledge, capabilities, and relationships associated with organizational valuation (Nahapiet and Ghoshal, 1998; Rehman et al., 2020). Some authors order IC through its dimensions, such as structural capital, innovation capital, and process capital. These dimensions are considered alongside traditional production resources: capital, labour and land (Cappellin, 2003; Ștefănescu-Mihăilă, 2015). On top of that, IC plays a crucial role in human resource management. Human resources (HR) deal with a large amount of resources, with different measuring tools to convey as many facets as possible in understanding and setting IC (Tinelli et al., 2016).

According to Adelman (2010), an essential and strategic role of human resources management is to capture the IC and the organizational insights that derive from it. The author suggests that IC involves different types of knowledge, such as data definitions, business processes and rules, specialized technical procedures, fit with the organizational culture, management styles, relationship history with customers and suppliers, and information flow in the organization. So, to further explore this relationship between IC and HR through a chronological and thematic approach, we take Donthu et al.’s (2021) contributions to propose a thematic analysis of a systematic

review carried out on two databases. We accessed Scopus for emphasis on research papers specific to the management field and Web of Science for a broader approach that encompasses the human and social sciences in general. We used a group management method proposed by Cobo et al. (2011), in which we created a graphical representation that displays thematic elements based on the density of the network's strength in terms of keywords or themes and the centrality of the level of interaction between the networks. This enabled "core themes" identification, which includes the most studied themes and the ones that generated more scientific output.

Our aim is to draw a thematic analysis on the relations between intellectual capital (IC) and human resources (HR), by which we can provide an overview of publications and their course in the last 26 years. This review contributes to highlighting and delineating a growing field of research that involves the challenges and possibilities of the understanding and management of IC through HR practices.

In the following Methods section, we describe the processes of data gathering, filtering, and thematic analysis. We also describe the tools used to operate the data. The results section is divided into two parts. We start by presenting an overview of the research field, its main contributors, and the most cited papers. Then we engage in a thematic and chronological analysis of the research papers, which makes the cut for our aim at the intersection between IC and HR. The final section summarizes the findings, highlighting the value-generation ability of the theme.

## **2. Method**

Scopus and WoS (Web of Science) databases are frequently used in bibliometrical studies (e.g., del Barrio-García and Prados-Peña, 2019; Rojas-Lamorenna et al., 2022). Scopus is a reliable source for research in the field of management, while Web of Science approaches more broadly the human and social sciences fields. By this, we understand that the bibliometric research involving both of these databases provides an interesting combination for the purpose of this review. We were able to reach the theme in its specific relation to management and, further, in its appraisal by a more general approach in the human and social sciences. We used a survey overview query in the main collections of WoS and Scopus, considering the entire reference period of the database. For this, the WoS "ALL" field and the Scopus "TITLE-ABS-KEY" field were used. And through the existing literature on the subject, we defined the following boolean argument:

("intellectual capital") AND ("human resource\*")

We used an 'asterisk' to include both singular and plural mentions of "human resources", also for disambiguation and broadening of the results. Our goal is to work with "intellectual capital" and "human resources" intersection points. The results show that the first publication enlisted in the query dates from 1997. With that, we established the period for the analysis from 1997 to 2023, the last 26 years. We filtered the results to show only peer-reviewed journal papers. We believe the journal papers represent the most up-to-date source of information in the academy (del Barrio-García and Prados-Peña, 2019). The obtained data consists of 284 articles on WoS and 329 articles on Scopus. To check for duplicates in the merging of the WoS and Scopus bases, we used the R language through the RStudio interface. Doing so, we removed

94 articles, and the remaining articles were exported into a single XLSX file containing 480 documents. As scanning may not be fully efficient, the spreadsheet was manually checked using the DOI link. The final selection consisted of 475 scientific articles with 1170 authors and 1026 keywords; both refined results and individual results per database are available for readers ([https://osf.io/h8ewv/?view\\_only=a291fb78bc28495792db7736b2c331fc](https://osf.io/h8ewv/?view_only=a291fb78bc28495792db7736b2c331fc)).

### **Analysis tools**

The bibliometrics research brings together a variety of studies that address a specific topic within the limits of more than one domain of knowledge. When it comes to big data, the bibliometrics technique is best for making quotation analyses, exploring the intellectual structure of domains, and providing a subjective and objective analysis (Donthu et al., 2021). We used biblioshiny through Bibliometrix on R Studio software to create the list of analytic items.

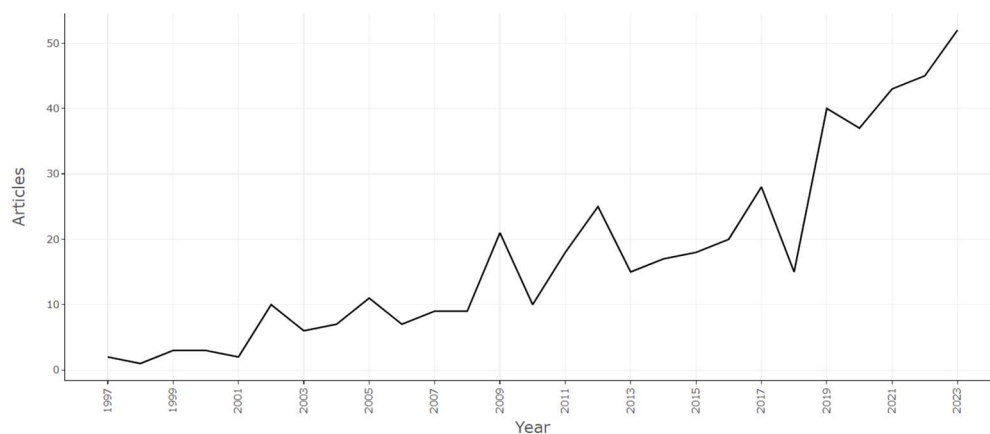
After reviewing the field's chronological and descriptive perspectives, we used thematic mapping to generate a thematic structure. We then applied a group management method suggested by Cobo et al. (2011). The methodology consisted of creating a graphical scheme that shows the thematic elements based on density (quantity of articles), disposed vertically, and, horizontally, centrality (quantity of quotes). Density shows the strength of the network in terms of keywords or themes, while centrality shows the amount of interaction between the networks. This allows for capturing "motor themes", which sets, in the high density and high centrality quadrants, both the most researched and the ones that attract more scientific production, and, in the low density and low centrality quadrants, the emerging problems and less frequent issues. The upper left quadrant has high density and low centrality. It presents problems developed internally but isolated or without connection to other networks. Core themes covering multiple areas of knowledge are also represented in the lower right quadrant, which is central and low density.

In addition, we also applied co-word analysis, a tool capable of identifying, describing, and visually illustrating the interactions between keywords in a scientific field. This tool enables the evaluation of the frequency with which two keywords are viewed together. It calculates the number of documents, like our articles, with which these words are associated.

## **3. Results**

### **3.1. Course of the scientific production**

From its first entry in 1997, according to the gathered data, the subject of IC in relation to HR remained active throughout the years, with overall growth, especially in the last five years. **Figure 1** confirms what was mentioned above.



**Figure 1.** Graph of production by year.

Five authors published the most over the period. The list, hierarchically starting with the one who contributed the most in volume, consists of: (1) Nick Bontis of the De Groote School of Business, McMaster University, Hamilton, Ontario, Canada; (2) Yuzliza Mohd of Universiti Malaysia Terengganu, Kuala Terengganu, Malaysia; (3) Tanya Bondarouk from Universiteit Twente, Enschede, Netherlands; and (4) Nadeem Akhtar Khan of the University of Kashmir, India. Finally, (5) Eric Kong from the School of Management and Enterprise, Faculty of Business, Education, Law, and Arts, University of Southern Queensland, Toowoomba, Queensland, Australia.

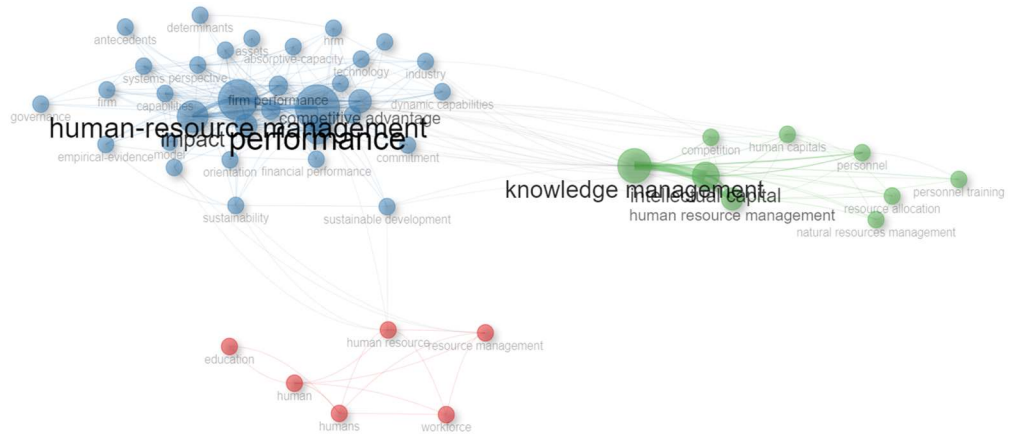
Among the five most quoted articles (**Table 1**), only Nick Bontis is listed. He is the second, third, and fourth most cited. Bontis studies intellectual capital, knowledge management, human capital measurement, disruptive technology, and knowledge worker productivity. Among the most cited papers, his contributions lean toward the management field, focusing mainly on intellectual capital. The first most cited study approaches an investment and return perspective, while the fifth discusses human resources management and intellectual capital through an ambidexterity learning approach.

**Table 1.** 5 most cited works (2002–2022).

Document	Title	Citations
Youndt MA, 2004, J MANAGE STUD	Intellectual Capital Profiles: An Examination of Investments and Returns	770
Bontis N, 1999, INT J TECHNOL MANAGE	Managing organisational knowledge by diagnosing intellectual capital: framing and advancing the state of the field	612
Bontis N, 1999, EUR MANAGE J	The knowledge toolbox: A review of the tools available to measure and manage intangible resources	569
Bontis N, 2002, J INTELLECT CAP	Intellectual capital ROI: a causal map of human capital antecedents and consequents	480
Kang SC, 2009, J MANAGE STUD	Intellectual Capital Architectures and Ambidextrous Learning: A Framework for Human Resource Management	441

The co-occurrence of thematic terms (**Figure 2**) provides a comprehensive overview of the possible areas and most researched topics. In this case, three thematic groupings have been identified over twenty-six years. Although “human resources”

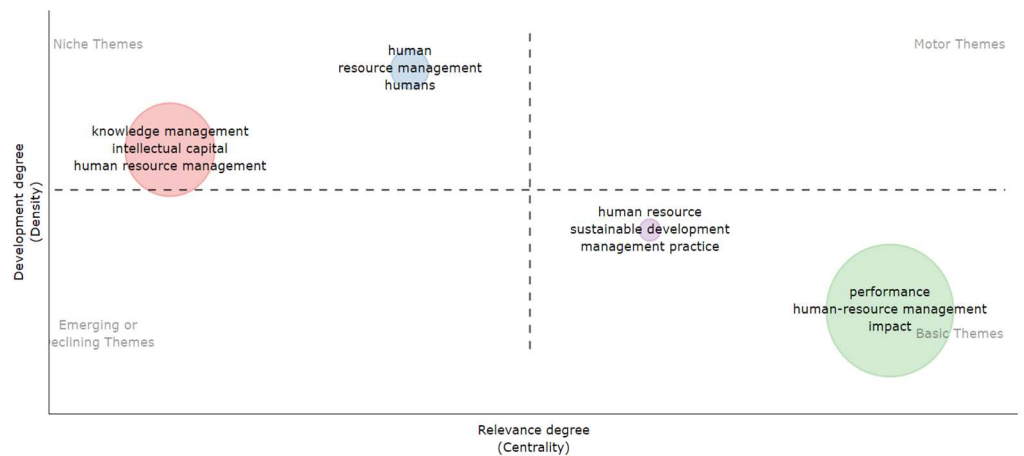
appears in the three groups, the blue cluster (top-left) focuses on companies, while the green cluster (middle-left) focuses on issues related to human capital. The red cluster (bottom-right) focuses mainly on educational issues.



**Figure 2.** Co-occurrence of thematic terms.

### 3.2. Thematic analysis

We used the visual information provided by Biblioshiny tool to present a timeline of the topics throughout the period, as illustrated in **Figure 3**.



**Figure 3.** Thematic map of the total period (1997–2023).

The pink cluster located in the “Niche themes” quadrant, top left, indicates that the intersection between IC and HR is still an isolated subject, as it deals with two very specific themes. However, the cluster is also well placed in terms of density, indicating a good audience for the topics (Cobo et al., 2011). Its position in the scheme highlights a strong debate, more noticeable when associated with human resources management. Since the aim of this paper is to investigate the relationship between IC and HR, the pink cluster represents the basis for the thematic analysis. Out of the 475 articles, 45 are associated with this cluster. We filtered and read all the content of 23 articles, including the title and summary, specifically directed to the theme of the present review.

We opted for a chronological analysis to verify the thematic fluctuations and innovations throughout the years. We assume that if the interest in a topic presented

in the initial years reappears in recent years, it could indicate a development to meet new demands. Also, if a topic appears only in recent years, it indicates innovation in the field. Since 1999, there have been papers on the relationship between IC and HR scattered throughout the years, with a peak of three articles in 2021. During the specified years of 2000, 2001, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2013, and 2019, the topic remained unexplored in the literature.

The 1999 article analyzed is titled “Managing organizational knowledge by diagnosing intellectual capital: framing and advancing the state of the field”. This research shows intellectual capital as a diverse field encompassing several perspectives, including balance sheet measurement, system coding, power balance, mental development, ROI calculation, and construction through training and development. According to this study, human capital is a crucial component of intellectual capital as it contributes to innovation and strategic renewal. The authors also show that human resources are an important component of intellectual capital, contributing to innovation and strategic renewal. Human capital, represented by the intelligence, skills, and experience of the organization’s members, is a fundamental aspect of human resources. It is difficult to measure and codify human capital, but in return, it provides a sustained competitive advantage because it adds value and uniqueness and cannot be easily imitated or replaced by concurrent companies. Human capital is considered a source of strategic innovation and renewal, and it plays a crucial role in organizational success. The article also highlights the contributions of human capital to individual learning, which is a prerequisite for organizational learning and human resource management (Bontis, 1999).

In 2002, the article titled “Practical Aspects of Knowledge Management” placed a more specific emphasis on intellectual capital and human resources and their contributions to knowledge management. The authors suggest that organizations in the “Internet age” should take advantage of their highly qualified, skilled, and experienced employees to enhance intellectual capital. The authors argue that next-generation business solutions should focus on adding knowledge-rich components to the workflow to create value. The paper also emphasizes the need for strong human resource management practices to integrate technological and commercial sides and tackle organizational and cultural issues.

“Dynamics of Human Resource and Knowledge Management” is a 2003 article that discusses the importance of intellectual capital and human resources to the knowledge economy. It shows that intellectual capital is identified as a valuable resource for the knowledge economy, contributing significantly to organization evaluation. According to this paper, companies are recognizing their employees as the most valuable asset and are finding ways to measure and manage the intangibles of skills, knowledge, and information. The study proposes an Analytical Hierarchical Process (AHP) method to help companies identify their key capabilities using financial and non-financial measures, such as learning and innovation. The dynamics of recruitment, training, and management of skills and knowledge are illustrated in the form of a causal cycle, and strategies for human resources management are developed using dynamic systems modeling. The article suggests that understanding the dynamics of recruitment and training is essential to developing an effective strategy

for managing intellectual capital. Modeling system dynamics can help organizations develop efficient human resource management strategies.

Another study published in 2003 titled “Territorial knowledge management: towards metrics of the cognitive dimension of agglomeration economies” discusses intellectual capital as knowledge and information within the organization but outside the individual employees. It is also closely linked to organizational capital, which is external to individual companies but internal to a cluster or region. The authors apply a three-dimensional categorization, differentiating structural capital, innovation capital, and process capital. These dimensions are considered alongside traditional resources of production, such as capital, labor, and land. In this paper, intellectual capital is mainly produced by companies for their internal use, and its value is measured based on the cost of replacement or the additional contribution it brings to the company’s returns. In this sense, human capital, which refers to the knowledge and skills of each employee, is an important component of intellectual capital, leading to innovation gains. In conclusion, efforts to strengthen human resources through transfer and learning can be an effective way to stimulate knowledge and innovation (Cappellin, 2003).

Published in 2011, the article “The effect of intellectual capital on employees’ satisfaction and retention” examines the effect of intellectual capital on employee job satisfaction and then identifies two human resource management practices that have a positive influence on intellectual capital. The research conducted a survey involving 1117 employees within an Italian corporation operating in the food market. The structural equation modeling results showed that intellectual capital positively affects employee professional attitudes, although differences have been observed between the three dimensions. Specifically, human capital and relational capital did not directly affect employee satisfaction and retention in the work, according to the hypothesis; these relationships were entirely mediated by structural capital. The study also identified two measures of human resources management practices: communication and alignment, which positively influenced intellectual capital and contributed to improved employee satisfaction and retention at work. The study provides understanding for managing, designing, and implementing intervention programs and policies for effective management of intellectual capital (Longo and Mura, 2011).

“Prioritization of intellectual capital indicators in knowledge-based industries: Evidence from the Pharmaceutical Industry,” published in 2012, deals with intellectual capital and human resources in knowledge-based industries. The discussion proposed states that intellect-based capital (IC) and intangible assets are considered critical tools for successful business in know-how industries. It highlights the importance of prioritizing intellectual capital indicators in knowledge-based industries and that human capital is a key component of intellectual capital, playing a crucial role in innovation, organizational competitiveness, and economic performance in knowledge-based environments. In the paper, we also find that human capital includes knowledge, skills, innovation, and the ability to perform tasks. The authors suggest that organizations need to recruit, cultivate, and retain talent to expand their knowledge base and improve overall productivity. They mention there is a need for reliable indicators to measure and report information on human capital, and effective management of human capital creates and sustains the wealth and competitive

advantage of a company. In conclusion, the paper suggests that the development of a robust human capital indicator can provide value for a company and its stakeholders and encourage greater private investment, contributing generally to human resource management (Mehralian et al., 2012).

Also from 2012, “Cloud computing and human resources in the knowledge era” states that intellectual capital refers to the sum of the knowledge, skills, and experience of employees, which contribute to the achievement of competitive advantage, and is considered an asset when employees use their specific knowledge to create economic value for organizations. The study proposes a conceptual framework that combines cloud-based HRMS, knowledge management (KM), intellectual capital (IC), innovation, and performance. This structure aims to enhance organizational innovation and increase intellectual capital by leveraging cloud computing in HRMS. The author points out that cloud computing, as a new trend in information technology, offers innovative solutions to help companies make significant savings in managing human resources; however, this also creates challenges for human resources professionals, requiring them to change their skill sets and tasks. The article emphasizes the importance of knowledge networks and IT-supported interaction to increase intellectual capital and promote innovation (Yeh, 2012).

In 2014, “A multi-criteria method for environmental management system selection: an intellectual capital approach” introduced a decision-making approach that integrates and quantifies financial and non-financial value creation criteria. The goal is to identify the alternative that maximizes the total market value of a company. The evaluation method combines four sources of value creation inherent to profit-oriented firms. It draws upon the tripartite dimensions of intellectual capital value—human, structural, and relational. The objective is to prioritize the array of alternatives within the environmental management system. This prioritization is based on the market value each alternative generates. In this paper, intellectual capital (IC) includes all non-monetary and non-physical resources that are fully or partially controlled by the organization and contribute to its value creation. These intangible assets related to knowledge have a positive impact on competitiveness, business performance, and market value. Because of that, human resources are considered a key component of intellectual capital and are recognized as a crucial indicator for future financial performance (Guerrero-Baena et al., 2014).

The article “Social Investment, Economic Growth, and Labor Market Performance: Case Study—Romania” published in 2015, states that intellectual capital includes three elements: human capital, structural capital, and relational capital. It claims that human capital is a component of intellectual capital, which is defined as “knowledge existing in an organization that can be a competitive advantage” or “knowledge that may be converted into value”. The research also highlights the importance of human resources to production processes and to the success of a company. It emphasizes that modern organizations need to rethink their strategies, make long-term investments, and invest in people. This suggests that success and survival in the market depend heavily on understanding the importance of human resources and that managers should be aware of this. Furthermore, the article mentions that education is considered a means for accumulating human capital, and a



higher level of training can increase the flexibility of the workforce and facilitate better adaptation to the conditions of the labour market (Ștefănescu-Mihăilă, 2015).

Also published in 2015, “Prioritizing (ranking) of indexes for measuring intellectual capital using FAHP and fuzzy TOPSIS techniques” states that human resources are considered strategic competitive resources, invested in similar tangible assets, and an essential component of intellectual capital, covering knowledge, skills, intellect, relationships, attitude, talent, and behavior of employees. Human resources means that human capital is the main body of intellectual capital and includes the knowledge, experience, and special skills of the staff employed in a commercial entity to create economic value. It is also a holistic concept that represents the resources and assets related to the people of a company. In the context of measuring intellectual capital, the paper argues that human resources are categorized into several sub-scales, such as staff competence and communication values and skills. The authors suggest that the priority of human resources is important and that different studies have identified various factors, such as knowledge and competence, experience, teaching, leadership ability, problem-solving ability, and more.

Published in 2016, “Embedding semantics in human resources management automation via SQL” shows that intellectual capital plays a crucial role in human resource management. Human resources management processes deal with a large amount of resources; among them, the peculiarities of intellectual capital require expressive representation languages to convey as many facets as possible. The approach presented in the article combines the representation power of a logical language with the efficiency of a DBMS for information processing to deal with human resources management tasks. With the information available, it can be inferred that intellectual capital is an important asset in human resources management, and the approach proposed by the authors aims to effectively manage and use intellectual capital in human resources processes (Tinelli et al., 2016).

The 2017 “Impact of the Educational Attainment of the Knowledge Management Process in Serbian Textile Enterprises” research paper discusses that intellectual capital, including knowledge and information, is considered crucial for economic development and national progress. In fact, this research defends intellectual capital as more important than tangible assets, such as capital or labour. The authors state that human resources play a significant role in the development and application of knowledge management in Serbian textile companies. Furthermore, they mention that the educational level of employees has a significant impact on dimensions such as organizational culture, knowledge acquisition process, and competitive advantage. It also shows that inadequate knowledge and skills among employees are identified as common problems in the Serbian textile industry. In addition, they emphasize that the proper management of staff characteristics, including their educational level, is important for the development and application of knowledge management, leading to increased productivity and competitiveness. According to the paper, organizational culture is a key factor in supporting cooperative innovation and knowledge sharing. They also suggest that overcoming cultural barriers is essential for effective knowledge management, and organizational culture is considered a significant obstacle to this (Zakin et al., 2017).

In 2018, the article titled “Developing a measurement instrument of knowledge management implementation in the Iranian oil industry” also discussed that intellectual capital is an important component of the implementation of knowledge management, but this paper aimed at Iran’s oil industry instead of the textile market. According to Ghasemi and Valmohammadi (2018), intellectual capital consists of human capital, market capital, structural capital, and social capital for the organization. That is, for the authors, human capital is considered unique in each organization and depends on educational level, experiences, professional skills, attitudes, values, and the ability to learn and adapt to change. The article states that human resource management is identified as one of the critical success factors in implementing knowledge management in the Iranian oil industry, with the success of it depending on the constituent elements of intellectual capital, including human capital. Therefore, the proposed measurement instrument for the implementation of KM in the Iranian oil industry includes factors such as human resource management, indicating the importance of human resources in the context of knowledge management (Ghasemi and Valmohammadi, 2018).

Also published in 2018, “Nexus Between Green Intellectual Capital and Green Human Resource Management” examines the relationship between green intellectual capital and green human resource management. The paper uses a quantitative research approach and a mailing survey to gather information from 112 large manufacturing companies in Malaysia. The results indicate that green human capital and green relational capital have a significant influence on green human resource management. However, green structural capital is not significantly related to green human resource management. The article identifies three dimensions of green intellectual capital: green human capital, green structural capital, and green relational capital. This suggests that these dimensions have an impact on green human resource management. The study uses the Intellectual Capital-Based Vision Theory as a theoretical basis to explore the link between green intellectual capital and green human resource management (Yong et al., 2018).

In 2020, we have another pair of papers. The first, titled “Analyzing the relationship between green innovation and environmental performance in large manufacturing firms”, deals with green intellectual capital and green human resources management. The study suggests that green intellectual capital is described as the total stock of intangible assets, knowledge, capabilities, and relationships associated with environmental protection or green innovation observed at the individual and organizational levels of a company. It is expected to be positively related to green innovation and environmental performance in enterprises. On the matter of green human resources management, the authors state that advanced practices can motivate an organization to develop and leverage its green intellectual capital and enhance its green innovation. Thus, green human resources management includes practices such as post analysis, recruitment, selection, training, rewards, and performance evaluation. Therefore, they conclude that the relationship between the constructs and environmental performance is more complex than previously suggested, with green innovation mediating the relationships between green intellectual knowledge, green human resources management, and ambient performance (Rehman et al., 2020).

The other research published in 2020, “Managing employee engagement in the strategy implementation process: The case from the natural gas industry” states that intellectual capital is a set of non-monetary and intangible resources that directly influence the growth of the value of an organization. It includes elements such as human capital, structural capital, relationship capital, and organizational culture. Chadam and Turkyilmaz (2020) suggest that the development of all intellectual capital elements—including human resources—is strongly associated with a high level of employee engagement in the business of the company. The article emphasizes the importance of employee engagement to the company’s goals, including the effective implementation of a new investment strategy and plan, and that positive changes in employee involvement are translated into excellent financial results and opportunities for further development. The analysis of the results of the survey in the present case concludes that the implementation of innovative projects, such as the company strategy, would not have been possible without a significant increase in employee engagement in the organization. This highlights the crucial role of human resources in achieving organizational goals. Therefore, the article suggests that future projects should consider employee diversity, mainly in terms of age and gender, to identify appropriate human resources practices and further increase employee engagement.

Moving to 2021, the research paper “An inclusive systematic investigation of human resource management practice in harnessing human capital” reports that intellectual capital is identified as one of the main business problems that companies are currently facing, along with technology, globalization, and profitability through expansion and change. It suggests that human resources management is responsible for solving these business problems and collaborating with companies to create new skills. The study states that new human resource management involves bringing together the management of the organization and the workers, merging their knowledge reservoirs for joint success. Thus, it is seen that human resources experts aim to influence the business world and take on a proactive role in addressing globalization challenges. The study aims to understand the role of human resource management in the development of national talents for global success, indicating the importance of human resources in the exploitation of intellectual capital (Rajput et al., 2021).

The study “Green human resource management practices and environmental performance in Malaysian green hotels: The role of green intellectual capital and pro-environmental behavior”, published in 2021, discusses green human resource management practices such as ecological training and development and ecological disciplinary management. According to the authors, these are significant predictors of green intellectual capital and pro-environmental behavior in Malaysian green hotels. The study suggests that ecological training and development are key practices for building intellectual capital and promoting pro-environmental behavior. It also cites that green intellectual capital plays a significant role in mediating the relationship between green discipline management and pro-environmental behavior, as well as between green recruitment and environmental behavior. In addition, it mentions that pro-environmental behaviors are significantly related to hotel environmental performance and also mediate the relationship between green intellectual capital and environmental performance. Overall, the article highlights the importance of

integrating green human resource management practices with green intellectual capital and pro-environmental behaviors to improve hotel environmental performance (Nisar et al., 2021).

The 2021 article is titled “A study on intellectual capital management over cloud computing using analytic hierarchy processes and partial least squares”. Wang (2021) discusses intellectual capital as the overlap of all assets, intangible resources, and non-physical resources of an organization, including processes, innovation capacity, and implicit and explicit knowledge of its members and network of partners, and that is considered a vital resource for the competitive advantage of organizations. The author suggests that human capital is a component of intellectual capital and refers to the organization’s employee knowledge and skills; this includes the competence, attitude, and intelligent thinking of employees. It also states that competence reflects the knowledge, skills, talents, and mastery of employees, while attitude is the value created by the behavior of employees in the workplace, and that intelligent thinking involves personal innovation and adaptability. In conclusion, Wang (2021) proposes human capital as the source of innovation for strategic revitalization of the organization that contributes to the good management of human resources.

Published in 2022, “Impact of Knowledge-Based HRM Practices on Organizational Performance: Mediating Effect of Intellectual Capital” proposes intellectual capital (IC) as a mediator variable between knowledge-based HRM practices and organizational performance in the context of the Indian service sector. This means that HRH practices lead to the creation of intellectual capital, and the relationship between HRH and performance is positively mediated by IC components. Thus, organizational capital is considered the most contributing component of IC, followed by human and relational capital. Gupta (2022) states that knowledge-based HRM practices positively affect human capital, which is a component of intellectual capital, and that HRM practice promotes the implementation of knowledge systems, IT structures, and cultural change strategies, which are linked to the potential of companies to acquire, store, and record knowledge. The study reports that human capital is an important aspect of organizational capital, which includes innovation, advancement, knowledge management, systems, and other processes, and that human resources (HR) are recognized as tangible and intangible assets that can promote organizational performance. The article discusses that organizations use various evaluation techniques and adopt different human resource management practices to motivate employees, increase confidence, engagement, and motivation, as well as that human resource management practices are also associated with high-performance work programs that enhance employees’ knowledge of the organization’s products or services, customers, and workplace culture (Gupta, 2022).

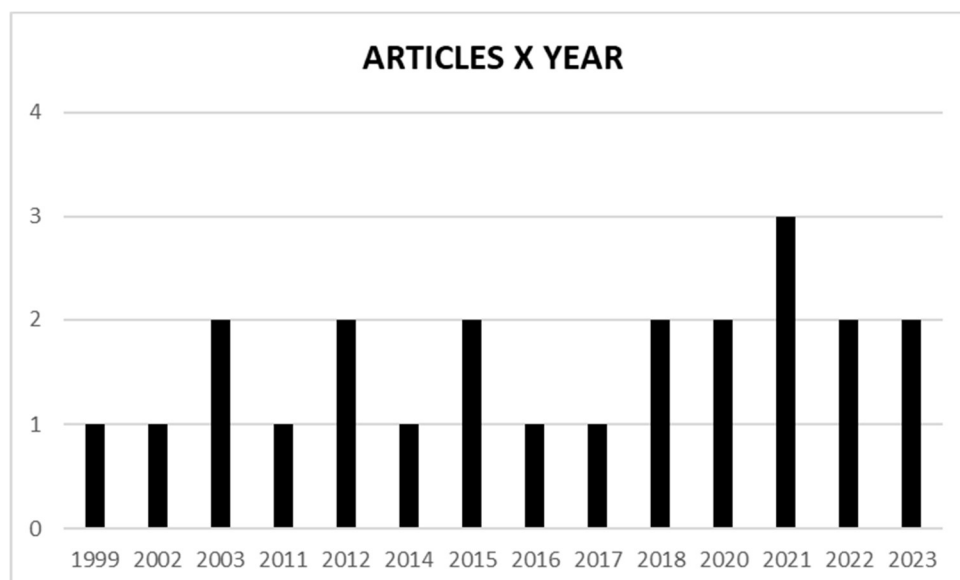
The 2022 article “Relationship Between Enterprise Talent Management and Performance Based on the Structural Equation Model Method” states that intellectual capital has a significant positive effect on the company’s innovation performance, as human capital plays a significant role in driving innovation performance only at the most mature stage of business development. The research also addresses the relationship between talent management and corporate performance, using the structural equation model to quantify the human resource management factors that affect logistical performance. The results highlight the positive impact of intellectual

capital on innovation performance and the economic benefits of staff training and good customer service. In short, the article focuses on the importance of human resources, especially intellectual capital and staff training, to boost performance and innovation in organizations (Liu et al., 2022).

“Connecting information literacy and social capital to better utilize knowledge resources in the workplace” is a 2023 study that discusses the relationship between intellectual capital and human resources within the context of knowledge processes at work. It explores the connection between information literacy and social capital, which represent the individual and social contexts that affect organizational knowledge processes. The results suggest that information literacy supports all three dimensions of social capital in the workplace, indicating that strong information handling skills allow better access to knowledge beyond the resources of an individual, which is social capital. The paper emphasizes that investing in information literacy is an investment in social capital, and managing employee information processing skills is a concrete step towards using organizational social capital and achieving positive results. It is also mentioned that knowledge management, which involves creating, sharing, using, and managing organizational knowledge and information, is closely related to information skills and the development of social capital (Widen et al., 2023).

Also published in 2023, “Investing in green intellectual capital to enhance green corporate image under the Influence of Green Innovation Climate: A Case of Chinese Entrepreneurial SMEs” also discusses green intellectual capital and green human resources. The study states that green intellectual capital is a corporate resource composed of the wisdom, skills, and capabilities of an individual to carry out environmental conservation efforts efficiently, which can be cultivated through training and development programs, organizational knowledge dissemination capacities, etc. The authors propose that green human resources are a component of green intellectual capital and refer to the knowledge, skills, and experiences of employees related to environmental conservation. Employees with simultaneous knowledge of the external environment tend to pay more attention to their contribution to a sustainable business environment, making their wisdom an additional skill in their green intellectual capital. The study concludes that green intellectual capital, measured through green human resources, relations capital, and structural capital, positively influences green central competence, which in turn positively impacts the green corporate image (environmental performance and green innovation practices). The study also found that green central competence mediates the relationship between green intellectual capital and green corporate image. The paper highlights that the innovative green climate moderates the relationship between green central competence and green corporate image. In doing so, the research provides empirical evidence for the multidimensional construction of green intellectual capital and its role in estimating green central competence and green corporate image. The findings suggest that investing in green intellectual capital can be a viable solution for small and medium-sized entrepreneurial enterprises to improve their green corporate image (Khan et al., 2023).

Thus, as a complementary analysis, we can verify that no articles were obtained for the years 2000, 2001, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2013, and 2019. The year 2021 had the most articles, having a total of 3 articles, as shown in **Figure 4**.



**Figure 4.** Chart of number of articles per year.

Throughout the years, we have seen the idea of dividing IC into dimensions being adopted and enriched by other studies. An interesting example of this is the relationship between IC dimensions in green HR. We also highlight green human management as a recent innovation, mentioned only after 2018. Another notable point is that elements related to training appear in the initial articles and are then revisited in the articles from the final years, indicating that it is an issue that was used and has returned to prominence in the current scenario; although it is a concept linked to general training, innovative elements emerge from new training practices, which are more current and can also be considered innovative.

#### 4. Conclusion

In the following topics, we organized some contributions to be highlighted through the analysis. We grouped these observations into three domains: (1) innovation; (2) future prospects; and (3) key conclusions.

Innovative content:

- The integration of technological, commercial, organizational, and cultural aspects in intellectual capital and human resources management is an innovative approach to creating value in organizations.
- Investing in long-term strategies and human capital, encompassing education and training, is regarded as an innovative method to enhance the workforce's flexibility and adaptability in response to market conditions.
- Exploring the link between green intellectual capital and green human resources management is an innovative area of research that focuses on the impact of environmental sustainability on human resource management practices.

The future of human resources and intellectual capital:

- The future path of human resources (HR) and intellectual capital involves the integration of technological, commercial, organizational, and cultural aspects to manage and effectively use intellectual capital in HR processes. This approach

recognizes the importance of harnessing highly qualified and experienced employees to create value in organizations.

- Human resources management needs to focus on adding knowledge-rich components to work processes, emphasizing the role of intellectual capital in organizational success. Integrated approaches that consider technological and commercial aspects, as well as organizational and cultural factors, are crucial for effective human resources management.

Key conclusions:

- Intellectual capital plays a crucial role in human resource management (HRM) and knowledge management, significantly contributing to organizational value. It is recognized as a valuable resource in the knowledge economy and can be a competitive advantage for organizations.
- Human resource management needs to consider the integration of technological, commercial, organizational, and cultural aspects to manage intellectual capital and human resources effectively. Integrated approaches that focus on adding knowledge-rich components to work processes are essential to creating value.
- Understanding the dynamics of recruitment, training, and knowledge management is vital for the development of efficient human resources management strategies. Dynamic systems modeling can help organizations formulate effective strategies for managing intellectual capital and human resources.
- Education and training are considered important for accumulating human capital and increasing the flexibility and adaptability of the labour force to market conditions. Investing in long-term strategies and people is crucial to the success and survival of organizations in the market.
- Green intellectual capital, including green human capital and green relational capital, has a significant influence on green human resource management (GRH). The dimensions of green intellectual capital impact green human resource management practices.

According to the analysis, intellectual capital and human resources management are crucial for organizations in the knowledge economy. The recognition of intellectual capital value and the need to use it effectively in HRM processes are emphasized in several sources. The integration of technological, commercial, organizational, and cultural aspects is seen as an innovative approach to creating value and ensuring organizational success. Long-term strategies, investments in education and training, and the development of a flexible and adaptable workforce are considered important for future human resource management. In addition, exploring the link between green intellectual capital and green human resources management is an emerging area of research that focuses on the impact of environmental sustainability on human resource management practices. Overall, the future path of HR and intellectual capital involves a holistic approach that integrates multiple aspects and recognizes the importance of leveraging human capital to drive innovation, competitiveness, and sustainable practices in organizations. As propositions for further research, we suggest investigating the role of artificial intelligence in intellectual capital and in human resource management. Artificial intelligence heralds a new era in the future of work, promising unparalleled efficiency and the

transformation of job landscapes across industries. Because of that, we understand that it is valuable to discuss the relationship between intellectual capital and human resources.

**Conflict of interest:** The authors declare no conflict of interest.

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