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Mapping the conceptual structure of intellectual capital research: A co-word analysis

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ABSTRACT

This bibliometric study aims to map the conceptual structure of intellectual capital (IC) research between 1975 and 2020 using co-word analysis and social network analysis drawing upon the Web of Science database. The results show that 12,310 documents have been published from 1975 to 2020. From a total of 6,516 keywords used in documents, the five most frequent keywords have been identified as: “performance”, “innovation”, “knowledge”, “impact”, and “management”. The United States is the top-producing country with 3,303 documents. In addition, the findings indicate that the *Journal of Intellectual Capital* is the most prolific journal with 208 articles, and the *Academy of Management Journal* is the most frequently cited journal with 11,914 citations. The National Bureau of Economic Research (NBER) is the world's most prolific research institute with 84 documents. The most frequently used keywords in different geographical regions show that except for South America, where the most frequently used keyword is "innovation", "performance" is the most common keyword in Asia, Europe, North America, Oceania, and Africa. This study provides a comprehensive picture of the current state of IC research, thereby paving the way for future studies by shedding light on the gaps in the literature and presenting suggestions for future research.

Introduction

Intellectual capital (IC) has become a vibrant topic in management research in general and accounting and strategic management in particular (Martin-de-Castro et al., 2019; Serenko & Bontis, 2022). The rationale behind labeling it as “capital” can be traced back to its economic roots since it was described in 1969 by the economist Galbraith simultaneously as a process of value creation and a bundle of assets. Nonetheless, the term "capital" has been the subject of intense debate within the academic field as a highly controversial concept (Dean & Kretschmer, 2007; Martín-de-Castro et al., 2011). Stewart (1991) described IC as the "brainpower" of an organization. Afterward, Stewart & Losee (1994) underscored the importance of IC in the 21st century and beyond by defining IC as follows:

“the sum of everything everybody in a company knows that gives it a competitive edge [...] Intellectual Capital is intellectual material, knowledge, experience, intellectual property, information [...] that can be put to use to create wealth.” (Stewart, 1997, p.x)

Intellectual capital is indisputably an interdisciplinary topic given the fact that it is not purely concerned with accounting for intangibles on a balance sheet (Bontis, 1998, Dumay & Guthrie, 2019). Instead, it carries broader implications for accounting that embrace management, law, corporate governance, business sustainability, human resources and the political economy (Garanina et al., 2021). IC research, which is constantly changing, has evolved over five different stages, and yet not always consecutively applied (Dumay et al., 2020). The first stage raised awareness, whereas the second stage shaped theories and frameworks (Petty & Guthrie, 2000). The third stage was concerned with examinations of IC in practice from a performative and critical standpoint (Guthrie et al., 2012). The fourth stage was related to an ecosystem perspective, as initially highlighted by Dumay & Garanina (2013). In the fifth stage of IC research, the boundaries were removed, and the questions asked ranged from: "What is IC worth to investors, customers, society, and the environment?" to "Is managing IC a worthwhile endeavor?" (Dumay et al., 2020). The aforementioned phases are the cornerstone of the IC

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research pathway. They are essential for understanding how IC has emerged from a curious idea into a far-reaching and changing contemporary field of research and practice (Dumay & Guthrie, 2019).

This study aims to map the conceptual structure of IC research between 1975 and 2020 using co-word analysis and social network analysis. Its purpose is to identify the main topics that make up the IC research structure; the dominant, saturated, fading, and emerging topics in the IC setting. Further, it highlights the most frequently cited articles published by permanent authors in high-quality journals at top universities in different countries, and presents the future direction of IC research. In order to achieve the objectives of the research, this study uses data from 12,310 documents published on the Web of Science (WOS) database.

This study contributes to the IC literature in several ways. First, bibliometric research has focused primarily on publishing patterns based on authorship (Andrikopoulos & Kostaris, 2017; Chan et al., 2009; Faraji et al., 2020; Kılıç et al., 2019) journals (Bamel et al., 2022; Bellucci et al., 2021; Carmona et al., 1999; Chung et al., 1992; Gaviria-Marin et al., 2018), universities (Heck & Bremser, 1986), countries (Brown & Gardner, 1985) and different geographical regions (Shiffrin & Börner, 2004). Although these studies provide valuable insights, they fail to map the conceptual structure of the discipline (Ding et al., 2001). Therefore, the present study seeks to fill this gap in the literature and enhance the understanding of the conceptual structure of IC research through co-word analysis and social network analysis. Second, this study informs quantitative evaluations of IC research by adopting a qualitative approach to evaluate the literature in this field. Third, previous studies on IC have mainly focused on the Scopus database (Mohammad et al., 2021; Quintero-Quintero et al., 2021). The present research focuses on WOS as a more comprehensive database, and the results could reveal previously unknown evidence. Fourth, this study outlines the conceptual structure of IC research based on different geographical regions, which can be useful in identifying regional trends. Fifth, this study will provide a comprehensive picture of the current state of IC research. In addition, it will pave the way for future studies by identifying research gaps. Therefore, the results of this study can help IC researchers better understand emerging trends in this field and conduct their future research approaches accordingly. Moreover, the results may get other researchers interested in studying IC.

Although considerable academic literature has been conducted around the theme of IC in the last few decades, research on IC is still scattered and inconclusive. It is necessary to shed light on the IC dominant factors and the paradigmatic evolution of this important research topic over time. This, therefore, motivates the current study to examine the conceptual structure of IC research as an interdisciplinary field that has absorbed various theories and knowledge from other disciplines. This study is an effort to extend this area by generating fresh insights into the current state of IC paradigms and future research horizons. To this end, this paper aims to answer the following questions:

RQ1: What are the main topics that make up the IC research structure?
RQ2: What are the dominant, saturated, fading, and emerging issues in the field of IC?
RQ3: Have there been any changes in IC topics between 1975 and 2020?
RQ4: Are there any differences in the patterns and trends of IC research across geographical regions?
RQ5: What are the most frequently cited articles, top authors, top countries, top journals, and top universities in IC research?
RQ6: What are the future directions of IC research?

The remainder of this paper is structured as follows. Section 2 describes the research methodology. Section 3 presents the findings using social network analysis and visualization maps. Finally, the paper ends with a discussion of the study's implications.

Research methods

This study aimed to systematically review IC academic research from the period 1975 to 2020. Following prior research (Bamel et al., 2022; Bellucci et al., 2021; Gaviria-Marin et al., 2018; Uyar et al., 2020), co-word analysis and social network analysis (in VOSviewer software) were used to map the conceptual structure of IC research. These methods are described in detail below.

Co-word analysis

The co-word analysis technique was first proposed by Callon et al. (1986). Since then, academic researchers have used co-word analysis to map the bibliometric structure of different fields, including creativity (Zhang, et al., 2015), environmental responsibility (Dai & Zhang, 2020; Yang et al., 2021), auditing (Uyar et al., 2020), and IC (Bamel et al., 2022; Quintero-Quintero et al., 2021).

Co-word analysis has been considered an effective method for content analysis and text mining (Feng et al., 2017; Zupic & Čater, 2015). One of its key advantages was that it revealed the conceptual structure of a discipline without the need to consult the full text (Romo-Fernández et al., 2013). Co-word analysis was based on the assumption that the co-occurrence of two or more keywords in a document indicated the correlation between them, and the higher the co-occurrence frequency, the stronger their relationship (An & Wu, 2011; Callon et al., 1986; Hu & Zhang, 2015; Ravikumar et al., 2015; Whittaker, 1989). Another assumption was that keywords were carefully selected by the authors and accurately represented the document's content (Feng et al., 2017). Co-word analysis can be used to quantify the links between research themes in a scientific discipline (Ding et al., 2001; Khasseh et al., 2017; Ravikumar et al., 2015; Sedighi, 2016), identify domains, subdomains, and hot topics (Dai & Zhang, 2020; et al., 2012; Zhang et al., 2015), and predict future trends (Uyar et al., 2020).

Social network analysis

Social network analysis (SNA) was used for exploring the latent content of scientific texts. It was introduced in the 1960s by the renowned sociologist Harrison White. Social networks were defined as a network of relationships or interactions, where the nodes were people or actors, and the edges represented the relationships or interactions between them (Abbasi et al., 2011). The main element in a social network was the actor or keyword (Köseoglu et al., 2019). The relationship between these actors (or keywords) constituted ties or links (Yang et al., 2012), the sum of which formed the graphical networks in SNA or the conceptual map and the knowledge network that reflected the current state of a specific subject area (Uyar et al., 2020).

SNA has been increasingly employed by researchers in various fields such as information science (Otte & Rousseau, 2002), economic geography (Ter Wal & Boschma, 2009), communities of practice, and natural resource management (Cross et al., 2006; Prell et al., 2009), water pollution management (Cantner & Graf, 2006; Ruzol et al., 2017), creativity (Zhang et al., 2015), environmental responsibility (Dai & Zhang, 2020; Yang et al., 2021), medicine (Xie et al., 2020), auditing (Uyar et al., 2020), knowledge transfer (Marchiori & Franco, 2020) and IC (Bamel et al., 2022), among others.

VOSviewer

VOSviewer has been used as a software tool for constructing and visualizing bibliometric networks, including networks of journals,

Table 1
Sample selection process.

Sample	1975–2020	1975–2000	2001–2020
Total	22,613	2222	20,391
Excluded	10,303	994	9309
Final	12,310	1228	11,082

researchers, or articles based on citation, bibliographic coupling, co-citation, or co-authorship relationships. VOSviewer also has text mining functionality that can be used to construct and visualize co-occurrence networks of keywords extracted from a body of scientific literature.

Data

This study used the Clarivate Analytics WOS database to retrieve data and VOSviewer software to construct social networks. WOS has been widely used as a reliable source for the systematic review of texts (Benavides-Velasco et al., 2013; Khan & Wood, 2015; Köseoglu et al., 2019; Kumar & Jan, 2013; Uyar et al., 2020; Yan et al., 2015; Zupic & Čater, 2015). The period between 1975 and 2020 was covered since prior to 1975, scientific journals seldom required keywords, and the content was mostly unavailable online.

After an in-depth review of the texts, 19 keywords[1] were selected as the most extensive representatives of IC research which were used with the WOS database on November 22, 2021. This application resulted in 22,613 documents, of which 10,303 belonged to unrelated disciplines (e.g., philosophy, nursing, history) and were removed. The final statistical population, covered the disciplines of economics, management, business, finance, social science, interdisciplinary, information science, library science, operations research, management science, and public administration, and consisted of 12,310 documents. Of these, 8,413 were articles[2], 824 were books[3], and 3,073 were proceedings papers. For a more detailed analysis, the population was divided into two periods, i.e., 1975 to 2000 and 2001 to 2020, the latter of which represented over 90% of the documents. Sample statistics are reported in Table 1. Fig. 1 also demonstrates the data collection framework.

Findings

The overall trend of published documents between 1975 and 2020 was entirely upward, and, in the last two decades, IC has received increased attention from researchers. As shown in Fig. 2, out of a total of 12,310 documents, the highest number of publications belongs to 2019 with 895 documents.

Keyword frequency and trends

Co-occurrence refers to the presence, frequency, and proximity of similar keywords across articles and can reveal hot research topics. It includes thematically identical keywords, but not exactly the same. A total of 6,516 keywords were used in the documents between 1975 and 2020. Following prior research (Dai & Zhang, 2020; Zhang et al., 2015), a threshold was set for keyword frequency. The research period was divided into three parts: a threshold of 50 for the entire period (1975–2020); a threshold of 5 for the period 1975–2000; and a threshold of 50 for the period 2001–2020. Consequently, 159 keywords in the total time period, 55 in the period 1975–2000, and 156 in the period 2001–2020 met the specified thresholds. Table 2 shows the top 50 frequent keywords in these time periods.

Fig. 3 illustrates the co-occurrence network. The most frequent keywords were divided into 6 clusters with six different colors. Keywords that were similar in content were grouped in a cluster. For example, the keywords "Performance" and "Networks" were in the blue cluster and the keywords "Knowledge" and "Strategy" were in the green cluster. The size of the circles indicated keyword frequency, and the thickness of the lines indicated the strength of co-occurrence within and between clusters. As the figure shows, all the clusters were interconnected, and there were strong relationships between the 6 clusters. This indicated the high interdependence of different areas of IC research.

Overall, there were 159 keywords, 6 clusters, and 7,671 links in this network, with a total link strength of 44,502. Cluster 1 (red) with 56 keywords was the largest cluster and was represented by "Growth", Cluster 2 (green) had 34 keywords and was represented by "Knowledge", cluster 3 (blue) had 27 keywords and was represented by "Performance", cluster 4 (yellow) had 20 keywords and was represented by "Innovation", cluster 5 (purple) had 17 keywords and was represented by "Impact", and cluster 6 (turquoise) had five keywords and was represented by "Success".

Mapping keywords in terms of density can also be informative. In a density map, the closer a keyword is to the red areas, the higher is the keyword frequency. As shown in Fig. 4, keywords such as "Innovation", "Knowledge", "Networks", "Governance", "Business", "Company", "Performance", "Trust", "Market", "Model", "Management", "Effect", "Information", "Success", "Growth", and "Education" received a great deal of attention from researchers in recent years and were practically saturated. In contrast, keywords such as "Mediating Role", "Efficiency", "Gender", and "Firm Market Value" received relatively little attention. This finding could inform researchers about the most effective areas to focus on.

Figs. 5 and 6 show the keyword density map for the period 1975–2000 (with a co-occurrence threshold of 5) and 2001–2020 (with a co-occurrence threshold of 50), respectively. According to these figures, keywords such as "Growth", "Economic Growth", "Model" and "Earnings" that featured prominently between 1975 and 2000 (keywords in the red and orange sections) faded between 2001 and 2020. Moreover, keywords such as "Performance" and "Management" that were not prominent between 1975 and 2000 became very common in the period 2001 to 2020 and were in the red areas of the map. In addition, new areas such as "Mediating Role", "Entrepreneurial Orientation", "Competitive Advantage", and "Knowledge Management" became more prominent between 2001 and 2020.

The word clouds for the four dimensions of IC (human capital, structural capital, relational capital, and social capital) are illustrated in Fig. 7 using VOYANT software. Word clouds are a weighted list for visualizing text or language data and have become increasingly popular in recent years (Jin, 2017). It must be noted that a larger font size indicates higher keyword frequency.

Most frequently cited articles

The top ten most frequently cited articles are listed in Table 3. The results show that the article titled "*The Benefits of Facebook Friends: Social Capital and College Students' Use of Online Social Network Sites*" was the most frequently cited article in the field of IC with 3,519 citations. This information can help researchers and readers identify the most relevant research studies.

Co-citations between documents were also analyzed. A co-citation network can visualize the evolution of a scientific field. Co-citation refers to the frequency with which two documents are cited together in a third document (Small, 1973). The results indicated

[1] Intellectual Capital, Human Capital, Structural Capital, Organizational Capital, Relational Capital, Social Capital, Intellectual Assets, Intangible Capital, Intangibles, Intangible Assets, Knowledge Assets, Intangible Resources, Knowledge Resource, Intellectual Property, Knowledge Capital, IP Assets, Intellectual Asset Management, Intangible Property, and Knowledge-Based Assets

[2] Article; Early Access Article

[3] Book; Book Review; Book Chapter; Reprint

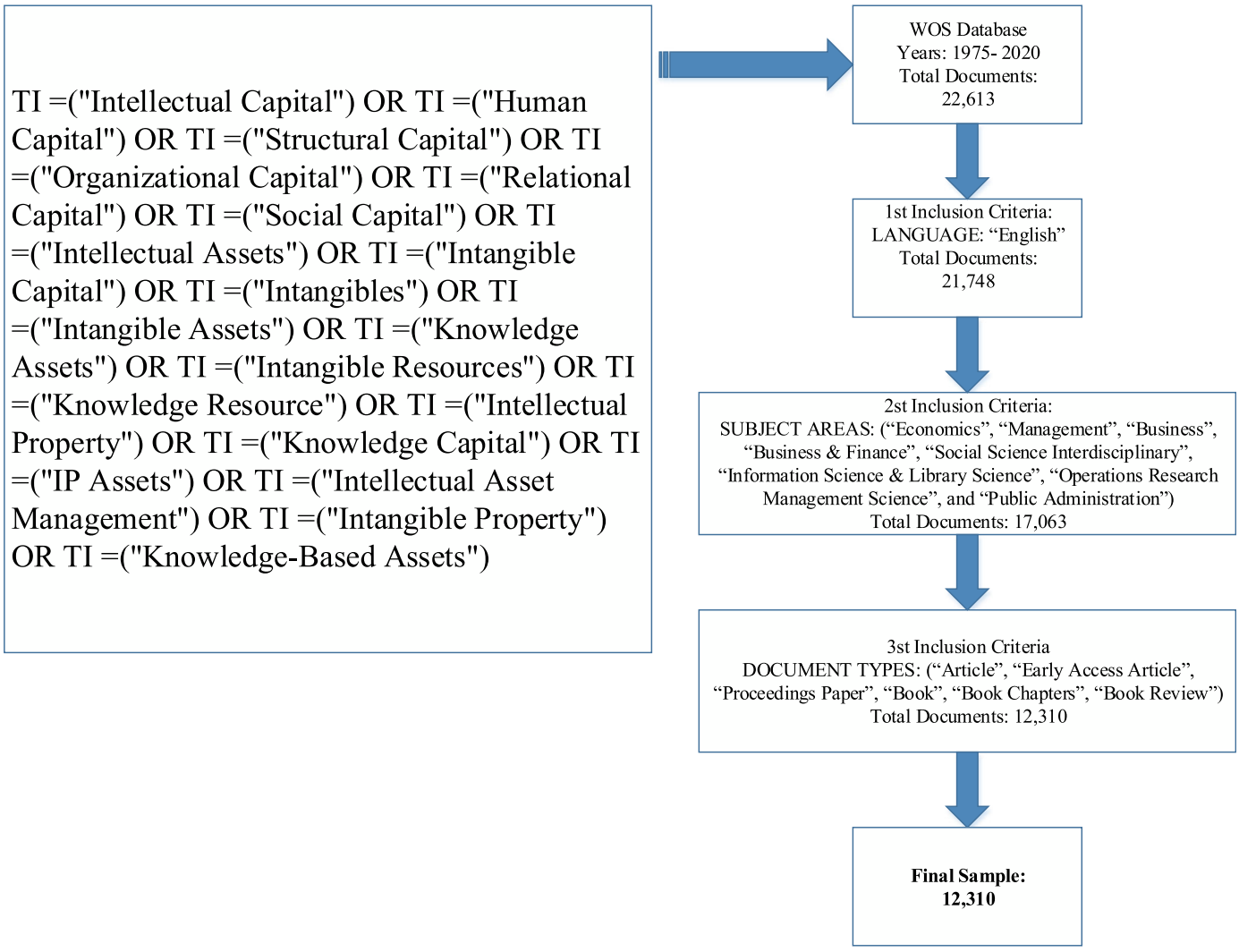


Fig. 1. Data Collection Framework.

268,369 co-citations across the documents. Fig. 8 shows the co-citation network of documents with at least 80 co-citations. It must be noted that 246 documents met this threshold. Overall, 246 documents, 4 clusters, and 19,455 links are shown in Fig. 8. In addition, the total link strength is 223,107. Cluster 1 (red) was the largest cluster with 73 documents. It was based on the article by Nahapiet & Ghoshal (1998), with 1,445 citations, 228 links, and a total link strength of 15,012. The second largest cluster in green had 65 documents. It was based on the article by Barney (1991) with 700 citations, 228 links, and a total link strength of 7,375. The third largest cluster was blue with 63 items. It was based on the article by Edvinsson (1997) with 897 citations, 217 links, and a total link strength of 8123. The fourth and last cluster was yellow with 45 items. It was based on the article by Lucas (1988) with 586 citations, 168 links, and a total link strength of 2,398.

Top authors

Table 4 lists the top ten authors in terms of the number of documents published. According to these statistics, "Jeffrey Chen" is the top author in the field of IC with 32 documents. This list can help readers identify the most prominent researchers in this field.

The co-authorship network is also illustrated in Fig. 9. Co-authorship networks have been used in various studies to understand the structure of a research field (Andrikopoulos & Kostaris, 2017; Chan et al., 2009; Faraji et al., 2020; Kılıç et al., 2019). There were a total of 20,226 authors in the field of IC, but only those who had written at least eight documents and received ten citations were illustrated in Fig. 9. 65 authors met this threshold. Overall, there were 65 authors, 45 clusters, and 31 links. In addition, the total link strength was 120. Authors in a network have research collaborators. For example, "Nick Bontis" has collaborated with "Muhammad Khalique" and "Francesca Sgrò" on a number of research projects. Of course, "Nick Bontis" has also collaborated with "John Dumay", but these collaborations have not been extensive enough to form a co-authorship network.

Top countries

Table 5 shows the ten most prolific countries. Most articles on IC have been published in the United States (about 27% of articles). China (about 12% of articles) and the United Kingdom (about 8% of articles) were in second and third place, respectively. It must be noted that in terms of publications, there was a big gap between the United States and the next ranked countries.

The co-authorship network of countries was also illustrated in Fig. 10. A total of 139 countries were involved in writing and publishing works, as suggested by the organizational affiliation of the

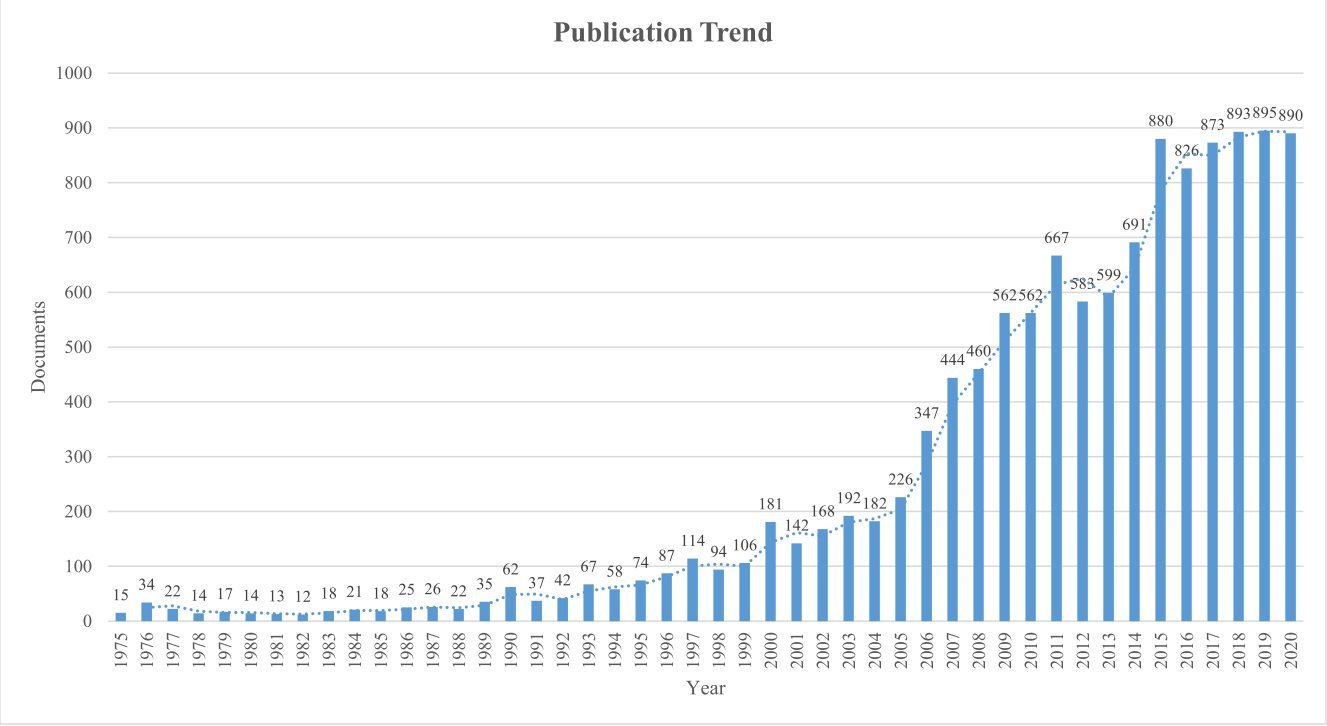


Fig. 2. Publication trend.

Table 2
Top 50 keywords in 3 periods.

Keywords (1975 - 2000)	Frequency	Keywords (2001 - 2020)	Frequency	Keywords (All Periods)	Frequency
Growth	37	Performance	1191	Performance	1207
Economic Growth	28	Innovation	808	Innovation	830
Earnings	26	Knowledge	686	Knowledge	691
Model	24	Impact	683	Impact	687
Innovation	22	Management	649	Management	656
Technology	22	Networks	643	Networks	646
Policy	22	Growth	581	Growth	618
Performance	16	Trust	478	Trust	481
Models	15	Model	450	Model	474
Endogenous Growth	14	Education	428	Education	440
Trade	14	Research and Development	377	Investment	382
Lung-run Growth	13	Investment	374	Research and Development	379
Market	13	Determinants	355	Determinants	366
Productivity	12	Firm	341	Firm	353
Firm	12	Technology	317	Technology	339
Education	12	Firms	306	Firms	313
Determinants	11	Competitive Advantage	290	Economic Growth	310
Economic Development	11	Productivity	285	Productivity	297
Taxation	10	Economic Growth	282	Competitive Advantage	294
Information	10	Firm Performance	265	Information	273
Returns	9	Information	263	Firm Performance	266
United States	9	Capabilities	235	Capabilities	236
Turnover	9	Strategy	232	Strategy	236
Mobility	8	Creation	226	Creation	228
International Trade	8	Absorptive Capacity	211	Perspective	215
Investment	8	Perspective	211	Absorptive Capacity	211
Increasing Returns	8	Returns	185	Returns	194
Patents	8	Inequality	182	Inequality	189
Firms	7	Health	182	Quality	186
Income	7	Quality	180	Models	183
Power	7	Resource	174	Health	183
Inequality	7	Models	168	Earnings	181
Industry	7	Human Resource Management	167	Policy	180
Management	7	Market	166	Resource	179
Wages	7	Industry	164	Market	179
Income Distribution	7	Organizations	162	Industry	171
Protection	7	Policy	158	Organizations	167

(*continued*)

Table 2 (*Continued*)

Keywords (1975 - 2000)	Frequency	Keywords (2001 - 2020)	Frequency	Keywords (All Periods)	Frequency
Rights	7	Behavior	155	Human Resource Management	167
Limitation	6	Earnings	155	Behavior	158
R&D	6	Governance	154	Governance	154
Quality	6	Embeddedness	149	Embeddedness	152
Equilibrium	6	Resource-based View	145	Protection	151
Choice	6	Entrepreneurship	145	Trade	149
Contracts	6	Protection	144	Entrepreneurship	148
Technology Transfer	5	Antecedents	142	Resource-based View	147
Organizations	5	Trade	135	Antecedents	142
Countries	5	Framework	128	Framework	131
Demand	5	Business	126	Income	131
Knowledge	5	Income	124	Business	128
Labor	5	Economics	119	Economics	122

authors, with only 68 countries meeting the threshold of at least 12 documents and 100 citations.

Overall, there were 68 countries, 6 clusters, and 736 links in the network, with a total link strength of 3,574. The size of the circles indicated the number of documents published by each country through international collaboration. The larger the circle, the more active the country was in international research. The lines between the two countries indicated the frequency of collaboration, and the thicker the line, the more extensive the collaboration and the closer the relationship. For example, the United States had extensive collaboration with many countries, including China, Canada, South Korea, Australia, Taiwan, Singapore, and the United Kingdom.

Top journals

Table 6 lists the top ten publications by the number of articles (Panel A) and the number of citations (Panel B). This list can help researchers identify the most prominent journals involved with IC research to publish their findings. A total of 3,188 journals were active in this field. The "*Journal of Intellectual Capital*" was the top journal in terms of the number of articles with 208 documents, and the "*Academy of Management Journal*" was the most frequently cited journal with 11,914 citations. In Panel A, three of the top ten journals were conference journals.

In addition, Fig. 11 illustrates the co-citation network of journals, which can help identify the most important journals in the field of IC. The results indicate 102,326 co-citations among journals. This network included journals with at least 290 citations. It must be noted that 199 journals met this threshold. Fig. 11 had 4 clusters, 199 journals, and 18,975 links with a total link strength of 4,301,902. Cluster 1 (red) with 87 journals was the largest cluster. It was based on the "*American Economic Review*" with 8,232 citations, 198 links, and a total link strength of 231,316. The second-largest cluster was cluster number 2 (green), with 50 journals. This cluster was based on the "*Strategic Management Journal*" with 9,491 citations, 198 links, and a total link strength of 487,632. The third-largest cluster was cluster

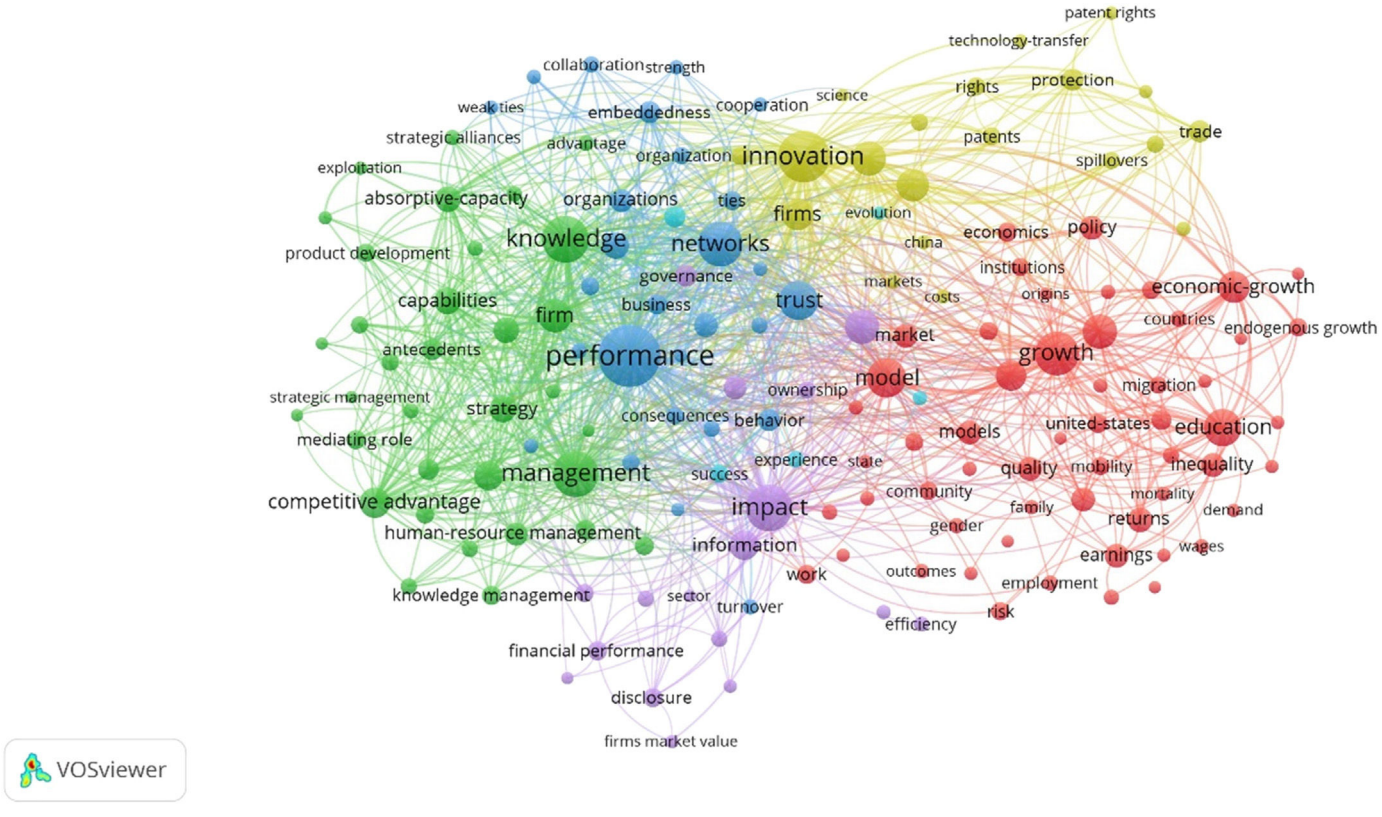


Fig. 3. Co-occurrence network of keywords (1975–2020).

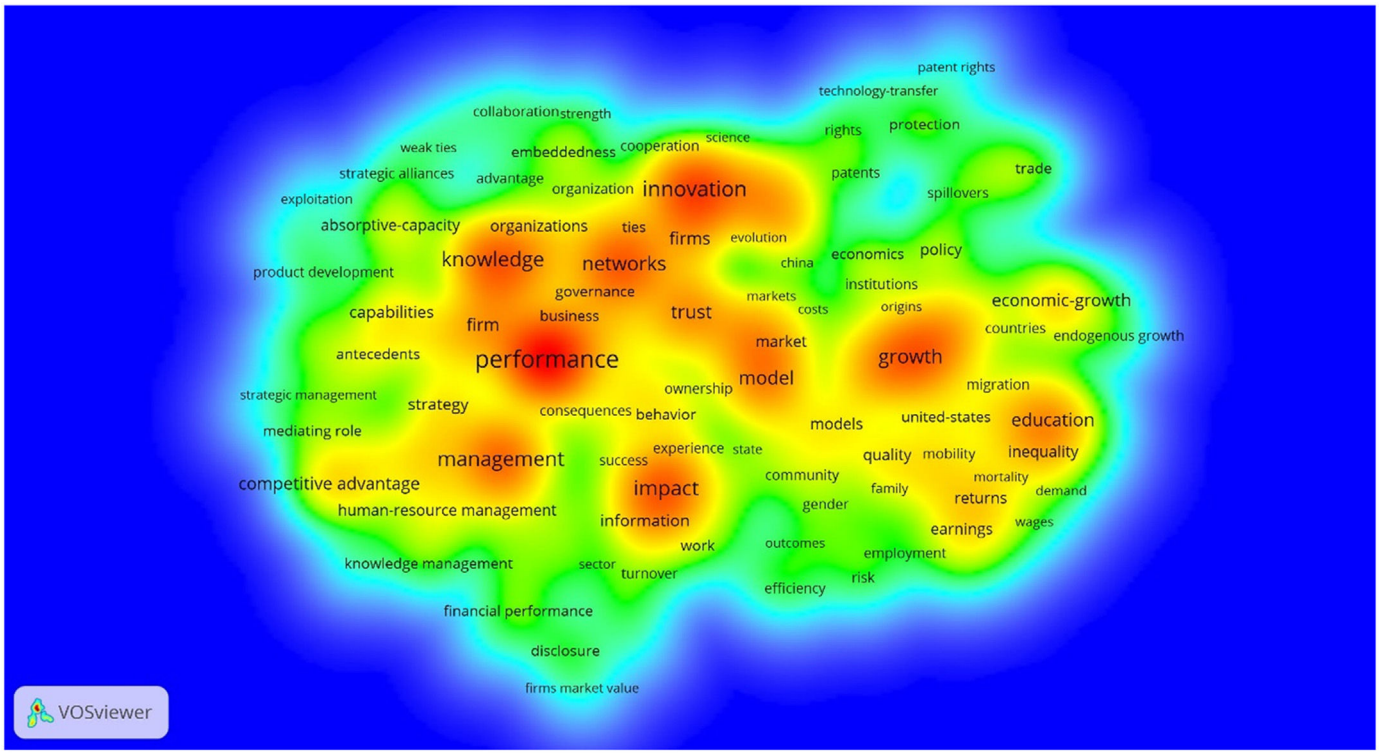


Fig. 4. Keyword density map (1975–2020).

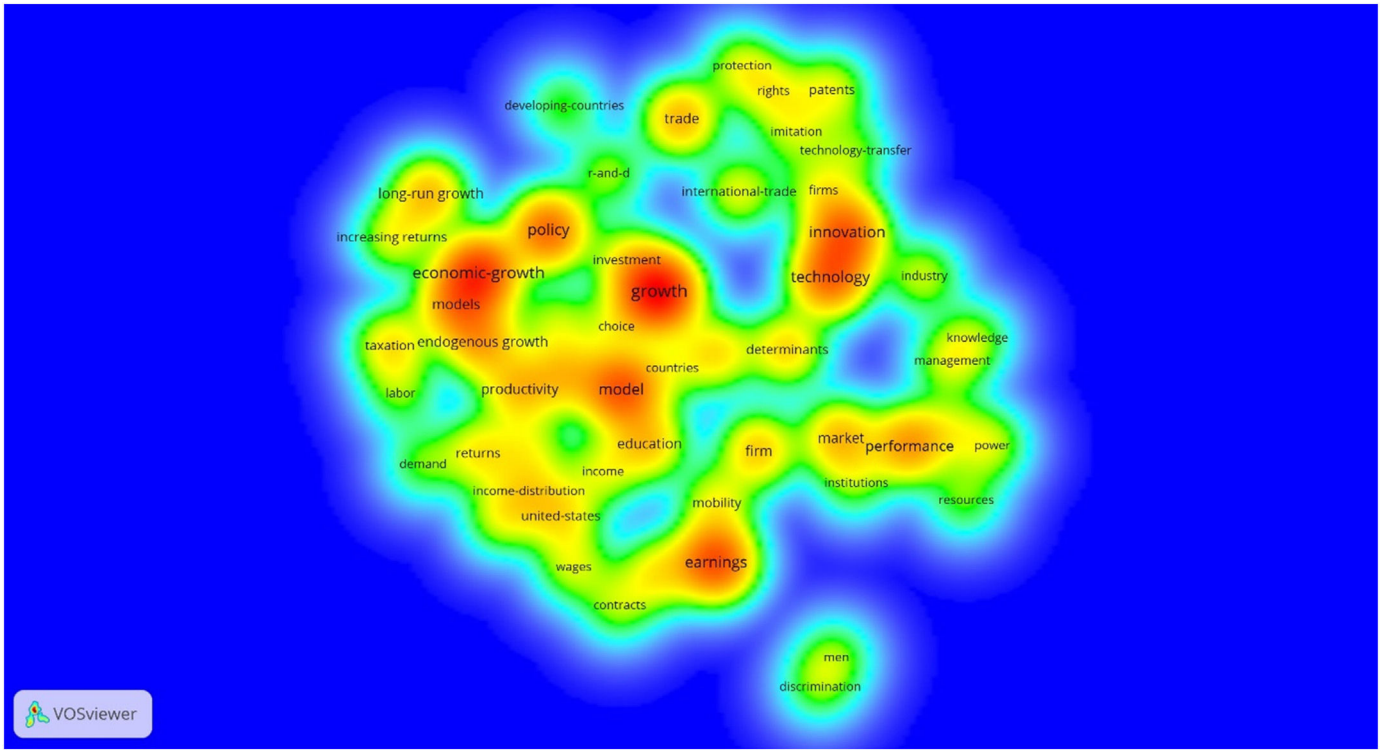


Fig. 5. Keyword density map (1975–2000).

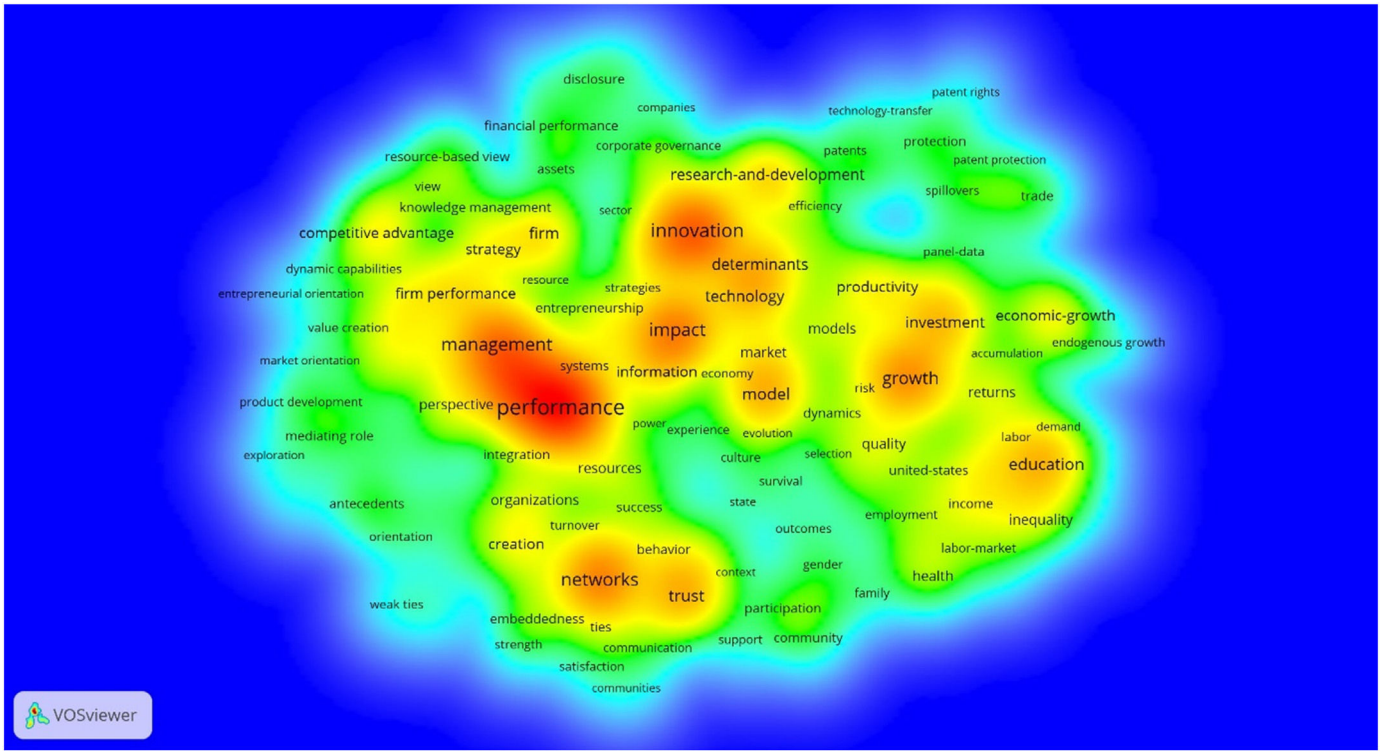
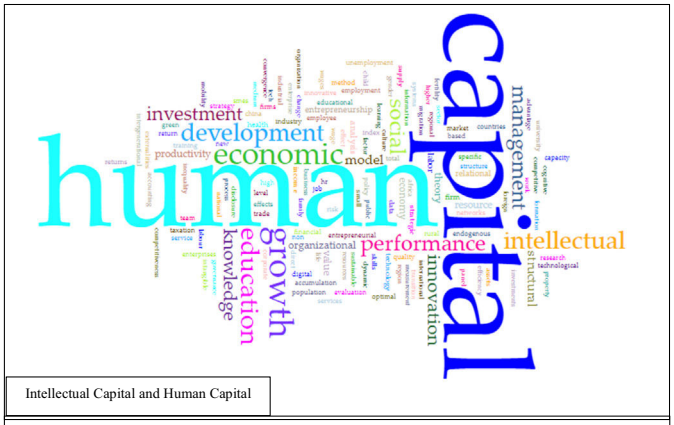
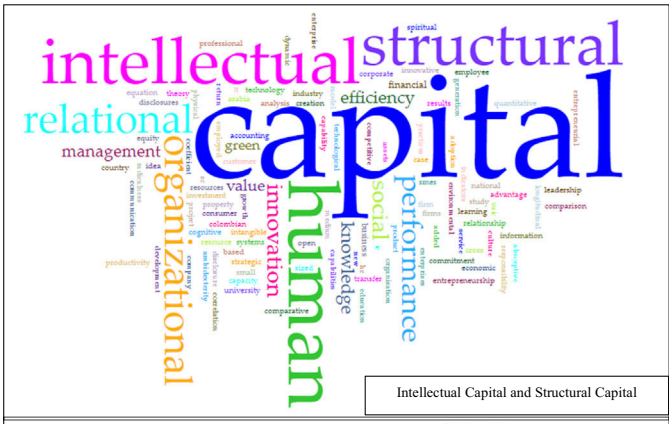
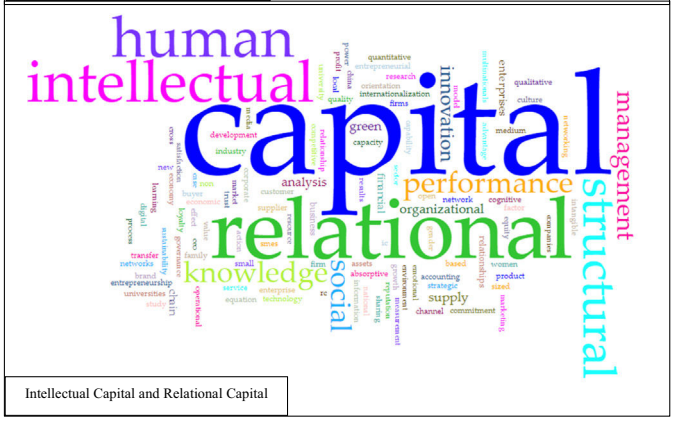


Fig. 6. Keyword density map (2001–2020).







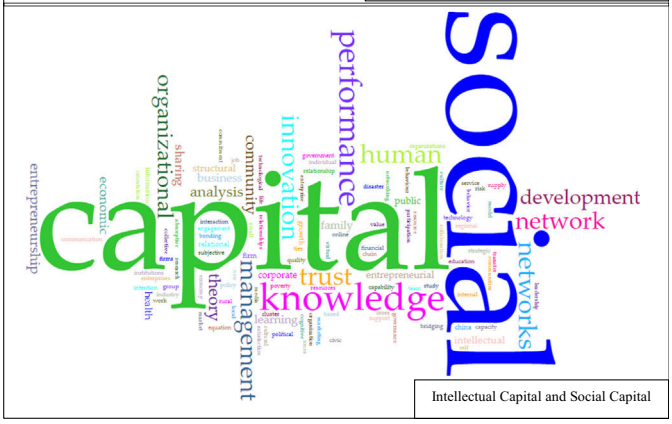


Fig. 7. Word clouds for the four dimensions of intellectual capital.

Table 3
Ten most frequently cited documents.

Title	Author(s)/ Publication Year	Journal	Total Citations	Average Citations per Year
The Benefits of Facebook "Friends:" Social Capital and College Students' Use of Online Social Network Sites	Ellison et al., (2007)	Journal of computer–mediated communication	3519	270.692
Social capital and value creation: The role of intrafirm networks	Tsai & Ghoshal (1998)	Academy of management Journal	2975	135.227
Does Social Capital Have an Economic Payoff? A Cross-Country Investigation	Knack & Keefer (1997)	The Quarterly Journal of Economics	2877	125.086
Why Should I Share? Examining Social Capital and Knowledge Contribution in Electronic Networks of Practice	Wasko & Faraj (2005)	MIS Quarterly	2307	153.8
The role of social and human capital among nascent entrepreneurs	Davidsson & Honig (2003)	Journal of Business Venturing	2007	154.384
The Network Structure Of Social Capital	Burt (2000)	Research in Organizational Behavior	1701	85.05
The Influence of Intellectual Capital on the Types of Innovative Capabilities	Subramaniam & Youndt (2005)	Academy of Management Journal	1662	110.8
The Contingent Value of Social Capital	Burt (1997)	Administrative Science Quarterly	1660	72.173
Understanding knowledge sharing in virtual communities: An integration of social capital and social cognitive theories	Chiu et al. (2006)	Decision support systems	1578	112.714
Learning and protection of proprietary assets in strategic alliances: building relational capital	Kale et al. (2000)	Strategic management journal	1511	75.55

number 3 (blue), with 43 journals. It was based on the "*Journal of Intellectual Capital*" with 11,542 citations, 197 links, and a total link strength of 294,930. The fourth and last cluster was cluster number 4 (yellow), with 19 journals. It was based on the "*Research Policy*" journal with 4,691 citations, 198 links, and a total link strength of 184,437.

Top universities

Table 7 lists the top ten universities by the number of articles. This list can help interested readers identify universities active in IC research for potential research collaborations. The results showed that a total of 5,920 universities and research institutes were involved in publishing research papers in the field of IC, and the "National Bureau of Economic Research (NBER)" was the world's leading research institute with 84 research papers. It must be noted that 7 of the top 10 universities were located in the United States. This suggests the substantial investment in IC research and the commitment of US universities to this important research area.

The co-authorship network between universities is illustrated in Fig. 12. A total of 5,920 universities and research institutes were involved in conducting and publishing IC research, as suggested by the organizational affiliation of the authors, with 97 universities meeting a threshold of at least 25 documents and 100 citations.

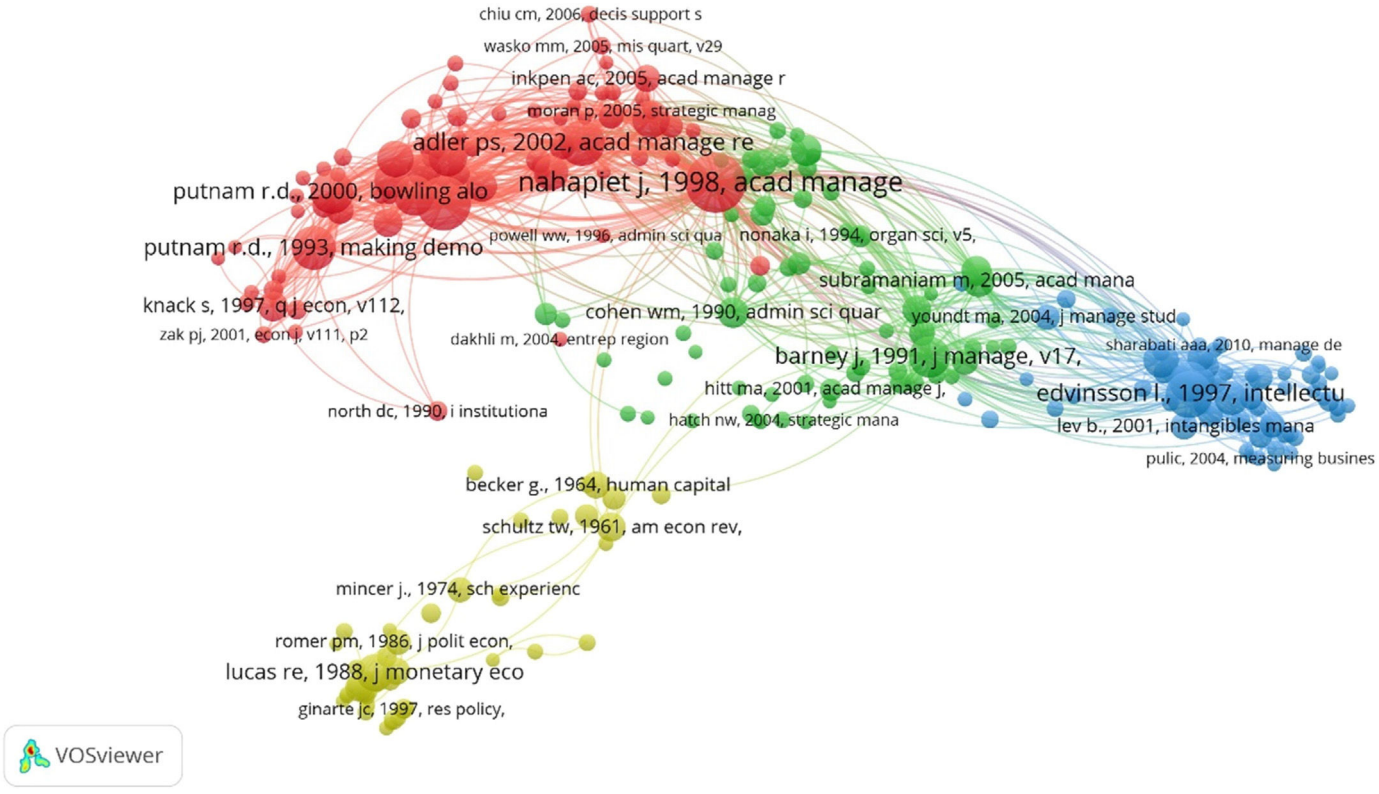


Fig. 8. Co-citation network (1975–2020).

Table 4
Top authors.

Author	University/ Workplace	Number of Documents	Share of Total Documents (Percent)
Jeffrey Chen	Accenture Chicago (USA)	32	0.26
Leif Edvinsson	University of Lund (Sweden)	31	0.252
Carol Yeh-Yun Lin	National Chengchi University (Taiwan)	31	0.252
Keith E. Maskus	University of Colorado Boulder (USA)	30	0.244
Tord Beding	TC-Growth AB Gothenburg (Sweden)	27	0.219
John Dumay	Macquarie University (Australia)	26	0.211
Markku Markkula	Aalto University (Finland)	23	0.187
Lindon Robison	Michigan State University (USA)	23	0.187
Nick Bontis	McMaster University (Canada)	22	0.179
Florinda Matos	University of Lisbon (Portugal)	22	0.179

Overall, there were 97 universities, 8 clusters, and 580 links, with a total link strength of 845. The size of the circles indicated the number of documents published through inter-university collaborations within and between countries. The larger the circle, the more active the university was in inter-university collaborations. The lines between the two universities indicated the frequency of collaboration, and the thicker the line, the more extensive the collaboration and the closer the relationship. For example, Harvard University had extensive collaborations with the University of Columbia, University of Pennsylvania, UC Berkeley, University of Melbourne, University of Manchester, and University of Massachusetts among others.

Co-word analysis by geographical regions

In order to examine regional (continental) differences in IC research, the co-occurrence of keywords in Asia, Europe, North America, South America, Oceania, and Africa are highlighted in Table 8. The results showed that except for South America, where the most frequently used keyword was "Innovation", "Performance" was the most frequently used keyword in all the other continents. Moreover, to clarify the co-occurrence networks, the co-occurrence of the keywords was visualized for each geographical region (Figs. 13–18).

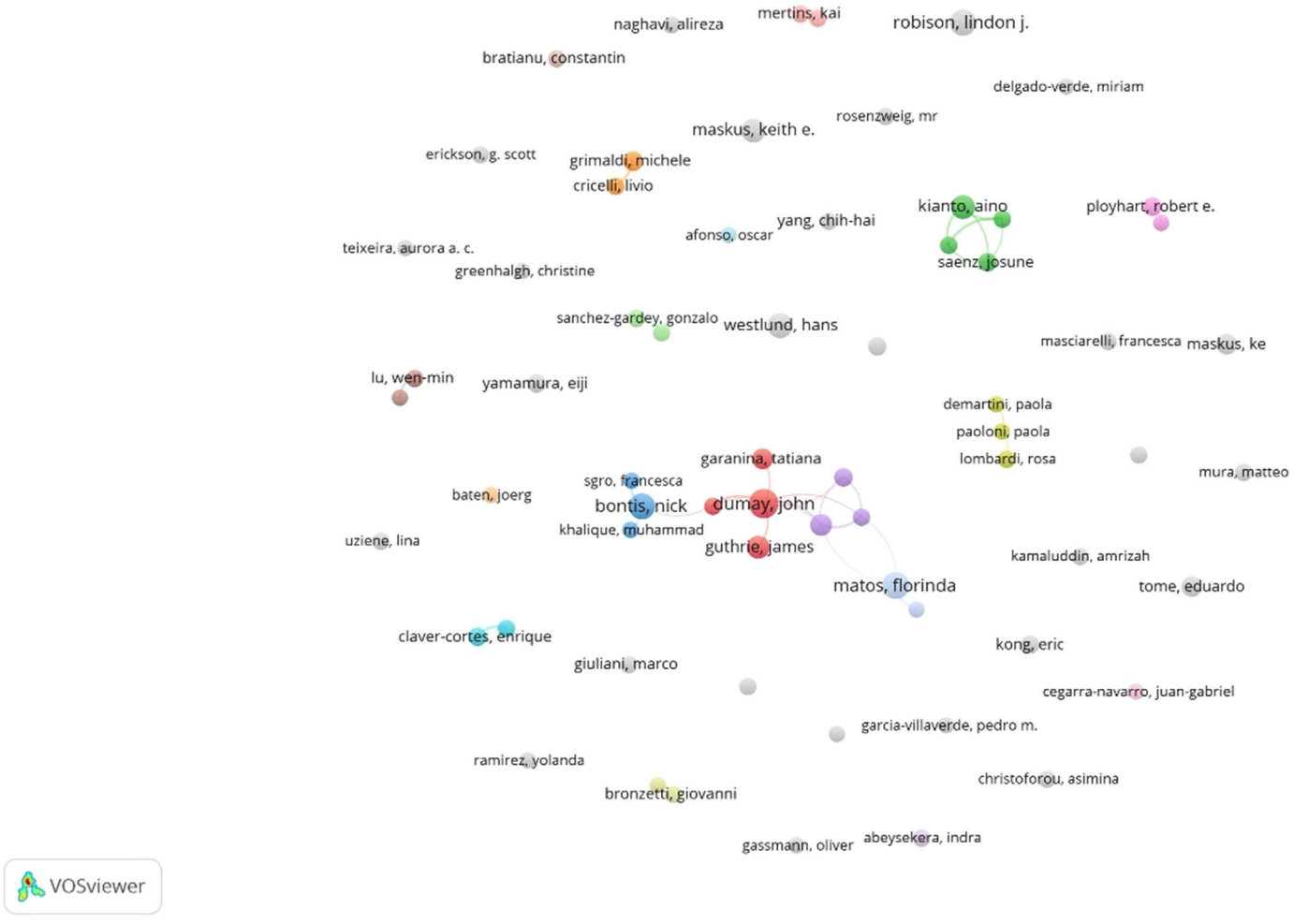


Fig. 9. Co-authorship network (1975–2020).

Table 5
Top countries.

Country	Documents	Share Of Total Documents (Percent)
USA	3303	26.832
China	1500	12.185
England	1022	8.302
Italy	649	5.272
Spain	566	4.598
Australia	492	3.997
Germany	471	3.826
Canada	444	3.607
Taiwan	336	2.729
France	290	2.356

The interpretation of these regional co-occurrence networks was similar to Fig. 3. Each network was made up of several clusters, and keywords that were similar in content were grouped together. The size of the circles indicated keyword frequency, and the thickness of the lines indicated the strength of co-occurrence within and between clusters. For example, Fig. 13 consisted of 99 keywords, 5 clusters, and 2,791 links with a total link strength of 10,841. The red cluster with 30 keywords was the largest cluster represented by "Innovation", the green cluster with 24 keywords was the second largest cluster represented by "Management", the blue cluster with 17 keywords was the third-largest cluster represented by "Performance", and the yellow and purple clusters with 14 keywords each were the fourth and fifth clusters represented by "Impact" and "Trust", respectively. Moreover, the high interconnectedness of different clusters indicated strong relationships between different keywords. The interpretation of other regional co-occurrence networks (Figs. 14–18) was the same.

Discussion and conclusion

This study aims to provide a comprehensive overview of published papers in the field of IC between 1975 and 2020 using co-word analysis and social network analysis. The results show that the number of articles in this field has increased significantly in recent years. This study presents the state of research in IC, thereby enhancing the existing understanding of the conceptual structure of IC research and highlighting research gaps and possible avenues for future research.

The first research question deals with the main topics that make up the IC research domain. We performed the co-word analysis for three time periods (1975–2000, 2001–2020, and 1975–2020). The results show that between 1975 and 2000, "Growth", "Economic Growth", "Earnings", "Model", and "Innovation" are the most frequently used keywords; between 2001 and 2020, "Performance", "Innovation", "Knowledge", "Impact", and "Management" are the most frequently used keywords; and between 1975 and 2020, "Performance", "Innovation", "Knowledge", "Impact", and "Management" were the most frequently used keywords. This finding suggests a shift in researchers' focus and interest over the past three decades. In addition, more than 90% of IC articles have been conducted in the last 20 years, and as a result, the associated keywords also featured prominently in our analysis of the entire time period.

The second question addresses the dominant, saturated, fading, and emerging topics in the field of IC. We used keyword density maps for the three periods to answer this question. The dominant topics in the period 1975–2000 are "Growth", "Economic Growth", "Model", and "Earnings", which are frequently used during this period (keywords in the red and orange sections of Fig. 5). However, these recurring keywords received much less attention from researchers between 2001 and 2020. On the other hand, keywords such as "Performance" and "Management", which did not feature prominently in the period 1975–2000, became much more common in the period 2001–2020 and are located in the red part of the map (Fig. 6). This finding could inform researchers about the areas that are most effective for academia and industry with the potential to provide policy, practice, and research implications.

The third research question is concerned with changes in IC research topics between 1975 and 2020. The results show that there have been significant changes in the dominant research topics between those three time periods. In the last 20 years (2001-2020), researchers have focused on new topics, none of which existed between 1975 and 2000. New topics like "Mediating Role", "Entrepreneurial Orientation", "Competitive Advantage", and "Knowledge Management" have attracted the attention of researchers in the period 2001–2020 (compare Figs. 6 to 5).

The fourth question is about the differences in patterns and trends of IC research in different geographical regions. The results show that except for South America, where the most frequently used keyword is "Innovation", "Performance" is the most frequently used keyword in all the other continents. This finding helps researchers discover

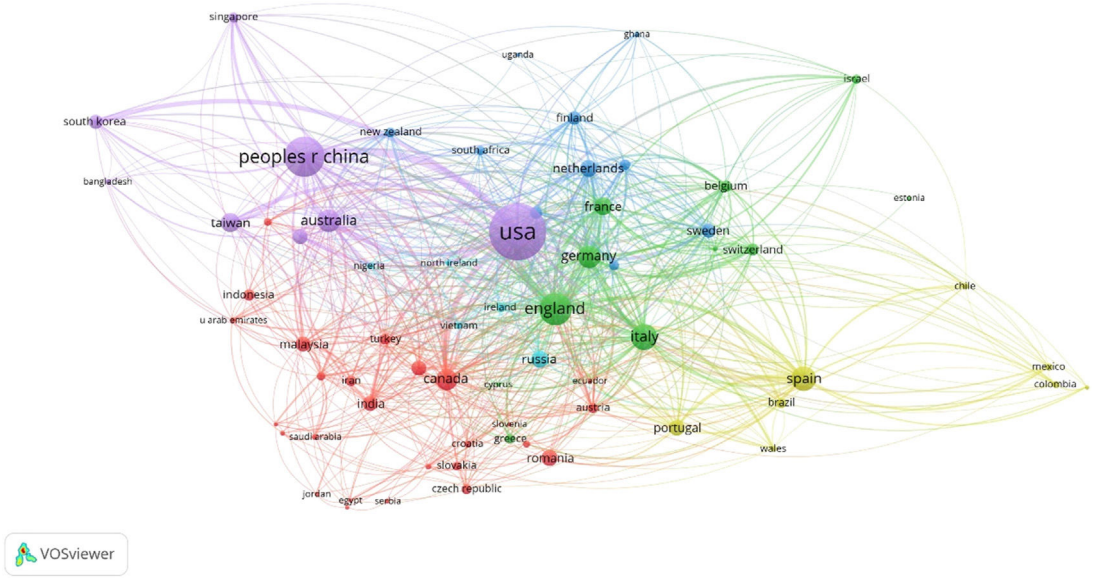


Fig. 10. Co-authorship network of countries (1975–2020).

Table 6
Top journals.

Panel A: TOP 10 Journals by the Number of Documents

Journal	Scope	Country	Publisher	H-Index (2021)	Impact Factor (2021)	Documents	Share of Total Documents (Percent)
Journal of Intellectual Capital	Business, Management and Accounting	United Kingdom	Emerald	89	7.198	208	1.690
Proceedings of the European Conference on Intellectual Capital	Business, Management and Accounting	United Kingdom	Web of Science Group	-	-	193	1.568
Social Indicators Research	Arts and Humanities	Netherlands	Springer	107	2.614	100	0.812
Advances in Social Science Education and Humanities Research	Social Science, Education and Humanities	Netherlands	Atlantis Press	-	-	83	0.674
Proceedings of the European Conference on Knowledge Management, ECKM	Decision Sciences	United Kingdom	Web of Science Group	10	-	80	0.650
American Economic Review	Economics, Econometrics and Finance	United States	American Economic Association	297	9.170	79	0.642
World Development	Economics, Econometrics and Finance	United Kingdom	Elsevier	175	5.278	75	0.609
Proceedings of the International Conference on Intellectual Capital, Knowledge Management and Organisational Learning, ICICKM	Business, Management and Accounting	United Kingdom	Web of Science Group	4	-	73	0.593
Procedia Social and Behavioral Sciences	Psychology	United Kingdom	Elsevier	53	-	71	0.577
Applied Economics	Economics, Econometrics and Finance	United Kingdom	Taylor and Francis	85	1.835	66	0.536

Panel B: TOP 10 Journals by the Number of Citations

Journal	Scope	Country	Publisher	H-Index (2021)	Impact Factor (2021)	Citations	Documents
Academy of Management Journal	Business, Management and Accounting	United States	Academy of Management	318	10.194	11914	27
Strategic Management Journal	Business, Management and Accounting	United Kingdom	John Wiley and Sons Ltd	286	8.641	9223	47
American Economic Review	Economics, Econometrics and Finance	United States	American Economic Association	297	9.170	8558	79
Journal of Computer-Mediated Communication	Computer Science	United States	Wiley-Blackwell	119	5.410	6654	13
Quarterly Journal of Economics	Economics, Econometrics and Finance	United Kingdom	Oxford University Press	259	15.563	6038	21
Journal of Business Venturing	Business, Management and Accounting	United States	Elsevier	182	12.065	5898	24
Research Policy	Business, Management and Accounting	Netherlands	Elsevier	238	8.110	4898	60
Journal of Labor Economics	Business, Management and Accounting	United States	University of Chicago	109	4.119	4640	46
World Development	Economics, Econometrics and Finance	United Kingdom	Elsevier	175	5.278	4602	75
Organization Science	Business, Management and Accounting	United States	INFORMS Institute for Operations Research and the Management Sciences	238	5.000	4276	29

relevant research topics as well as neglected topics in their geographic region and adjust their research accordingly.

The fifth research question deals with the most frequently cited articles, top authors, top countries, top journals, and top universities in the field of IC. The results show that the article titled "*The Benefits of Facebook Friends: Social Capital and College Students' Use of Online Social Network Sites*" published in 2007 is the most frequently cited article with 3,519 citations and an average of 271 citations per year, and "Jeffrey Chen" is the top author with 32 documents. The United States is the top country with 3,303 documents out of 12,310 documents. The results also indicated that the "*Journal of Intellectual Capital*" is the top journal in terms of the number of articles with 208 documents, and the "*Academy of Management Journal*" is the most frequently cited journal with 11,914 citations. The "National Bureau of Economic Research (NBER)" is the most prolific research institution with 84 documents. These findings inform researchers about the most prominent articles, researchers, countries, journals, and universities in the field of IC.

The sixth question addresses the future direction of IC research. According to Fig. 6, authors have recently focused on new areas such as "Mediating Role", "Entrepreneurial Orientation", "Competitive Advantage", and "Knowledge Management", and topics such as "Growth", "Economic Growth", "Model" and "Earnings" are practically saturated and are no longer areas of focus for researchers. These

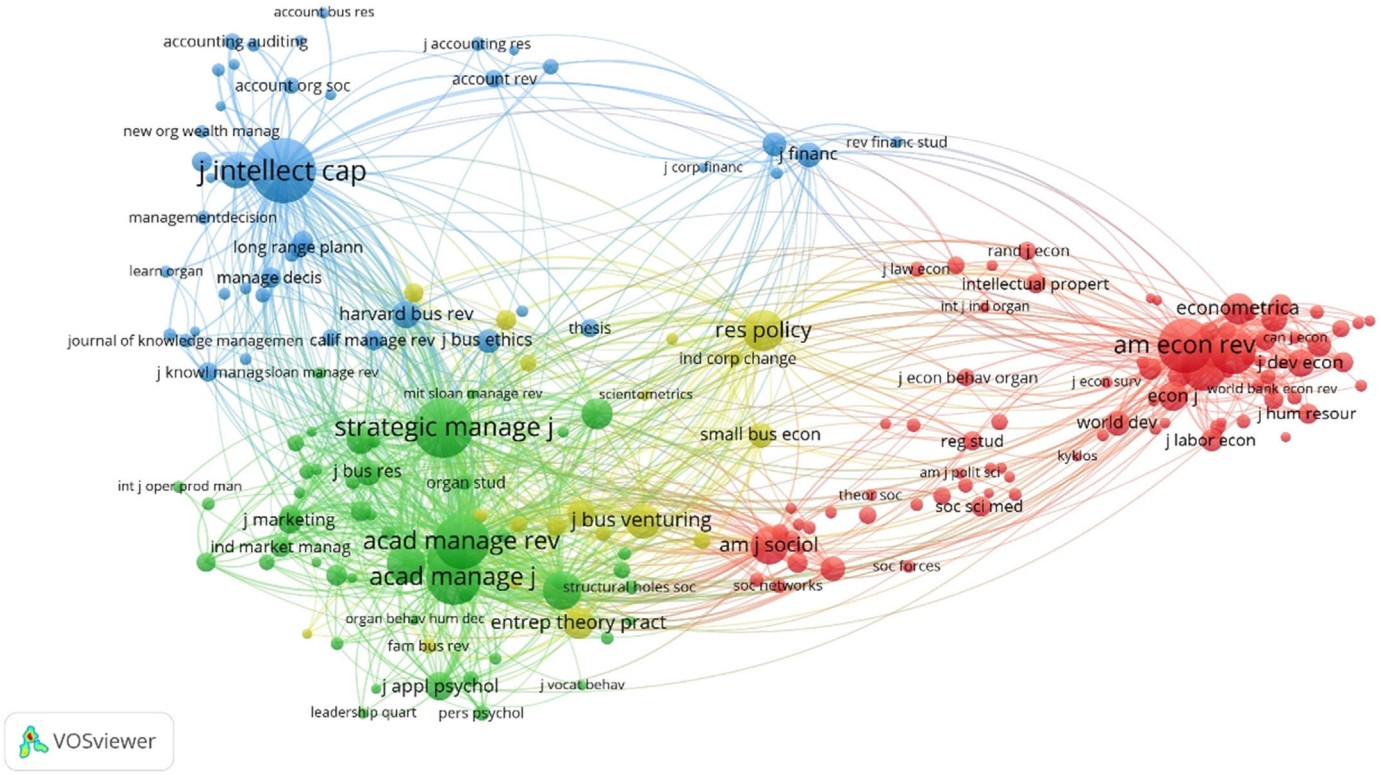


Fig. 11. Co-citation network of journals (1975–2020).

Table 7
Top universities.

University/ Organization	Country	Documents	Share of Total Documents (Percent)
National Bureau of Economic Research (NBER)	USA	84	0.682
The University of Chicago	USA	74	0.601
Harvard University	USA	73	0.593
World Bank	International	73	0.593
University of California, Berkeley	USA	70	0.569
University of Pennsylvania	USA	70	0.569
University of Illinois at	USA	69	0.561
Wuhan University of Technology	China	69	0.561
Michigan State University	USA	64	0.52
University of Oxford	United Kingdom	64	0.52

findings suggest that the role of strategy in IC research has become more prominent in recent years, and it is expected that the future direction of IC research will be toward interdisciplinary fields and efforts to solve problems on a larger scale (Capatina et al., 2017). For example, more research has been done on entrepreneurial orientation in recent years (Monteiro et al., 2019). Furthermore, more investigations of the mediating mechanisms in IC research are becoming more prevalent (Asiaei et al., 2020). This corroborates the notion that knowledge assets seldom are able to influence performance directly and immediately (Asiaei & Jusoh, 2017). Instead, they often affect these organizational outcomes through chains of cause-and-effect relationships involving two or three intermediate stages (Kaplan & Norton, 2001). Last but not least, in order to develop IC research in its next stage, it is crucial to follow the proponents of the recent trend in the field (Garanina et al., 2021; Dumay & Guthrie, 2019) that advocates going beyond just being interdisciplinary approaches. According to Jacobs & Cuganesan (2014, p. 1254), multidisciplinary teams must be formed that come from "*government agencies, corporatized government entities, not-for-profit organization [s] and private sector businesses*", not to mention IC and socially-minded researchers. Hence, IC scholars need to consider transforming from being interdisciplinary to multidisciplinary since "*interdisciplinary research involves researchers are crossing boundaries between disciplines as part of their analysis, whereas multidisciplinary research involves researchers going out in the world and interacting with people and organizations as part of the solution*" (Dumay & Guthrie, 2019, p. 2299).

This paper provides several policies, practices, and research implications for the further development of the IC field. First and foremost, this study contributes to the IC literature by offering fresh insights into the conceptual structure of IC research through an overarching co-word and social network analyses based on WOS as a comprehensive database. Furthermore, while this study provides a comprehensive picture of the current state of IC research, the results can pave the way for future studies by shedding light on the gaps in the field and providing direction for future research. Organizations of all types and sizes can use these findings to make changes to their communications, reporting, and control systems, using the results presented in this study. Policymakers and standard-setters can use the IC topics identified to assist with future regulations and law-setting deliberations.

Finally, it must be noted that the present study is not without limitations. The most important limitation is related to the constraints of the WOS database. Although WOS is a comprehensive database, it does not cover all IC research and only includes documents in SCIE, SSCI, AHCI, ESCI, CPCI, BKCI, and CCR indexes. Therefore, readers should be careful in generalizing the results. Additionally, in bibliometric studies, WOS only analyzes the words in the title, abstract, and keywords of articles and does not analyze full texts. Therefore, future research can investigate IC research in more depth. For example, researchers can examine the industries in which these studies have been conducted or how they differ in terms of methodology (quantitatively, qualitatively, or mixed), data collection, and the key

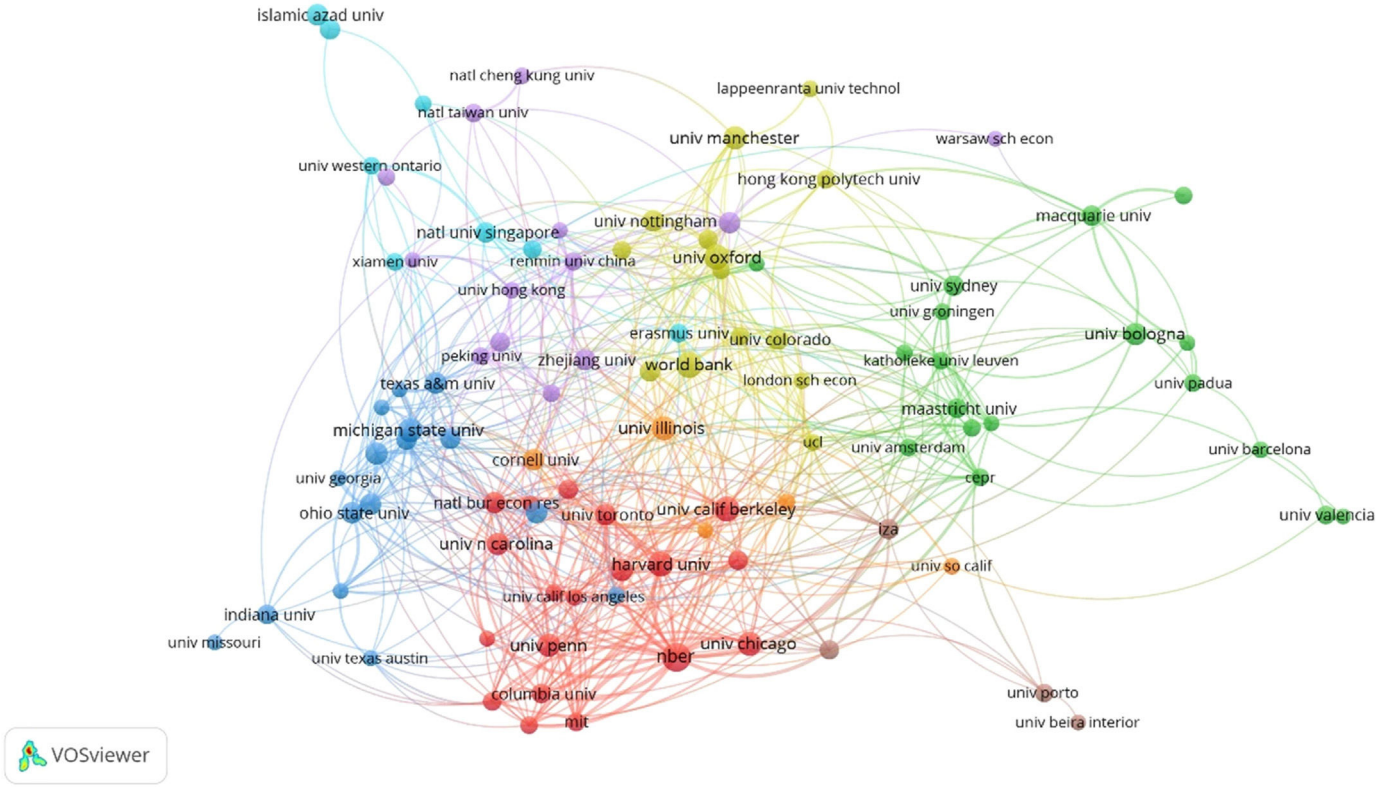


Fig. 12. Co-authorship network between universities (1975–2020).

Table 8
Top 20 keywords by regions.

Asia	Frequency	Europe	Frequency	North America	Frequency	South America	Frequency	Oceania	Frequency	Africa	Frequency
Performance	368	Performance	482	Performance	50	Innovation	26	Performance	66	Performance	29
Innovation	250	Innovation	343	Innovation	47	Performance	21	Innovation	50	Impact	24
Impact	236	Knowledge	309	Impact	40	Impact	20	Management	44	Management	23
Management	206	Growth	281	Knowledge	34	Growth	15	Impact	43	Determinants	18
Networks	204	Networks	261	Management	30	Networks	15	Networks	41	Innovation	16
Knowledge	190	Impact	252	Networks	30	Management	15	Knowledge	36	Growth	15
Trust	168	Management	252	Growth	30	Knowledge	13	Growth	32	Education	15
Growth	156	Trust	194	Education	30	Education	12	Model	27	Knowledge	14
Model	140	Research & Development	183	Model	28	Determinants	9	Information	25	Investment	14
Investment	120	Model	179	Firms	22	Model	9	Trust	24	Economic-Growth	14
Firm Performance	119	Education	176	Investment	21	Productivity	8	Determinants	23	Technology	13
Determinants	115	Determinants	145	Trust	19	Research & Development	8	Creation	23	Firm Performance	10
Education	113	Investment	143	Earnings	19	Creation	8	Research & Development	22	Information	10
Research & Development	105	Firm	134	Perspective	18	Economic-Development	7	Firms	21	Models	9
Firms	104	Technology	132	Productivity	17	Inequality	7	Firm	21	Competitive Advantage	8
Technology	98	Firms	127	Information	16	Protection	7	Technology	21	Industry	8
Firm	92	Economic-Growth	126	Technology	15	Market	7	Education	21	Model	8
Economic-Growth	91	Competitive Advantage	120	Firm	14	Quality	6	Firm Performance	19	Firm	8
Competitive Advantage	83	Productivity	111	Determinants	14	Firm Performance	6	Economic-Growth	19	Trust	8
Productivity	92	Capabilities	106	Embeddedness	14	Industry	6	Perspective	18	Creation	8

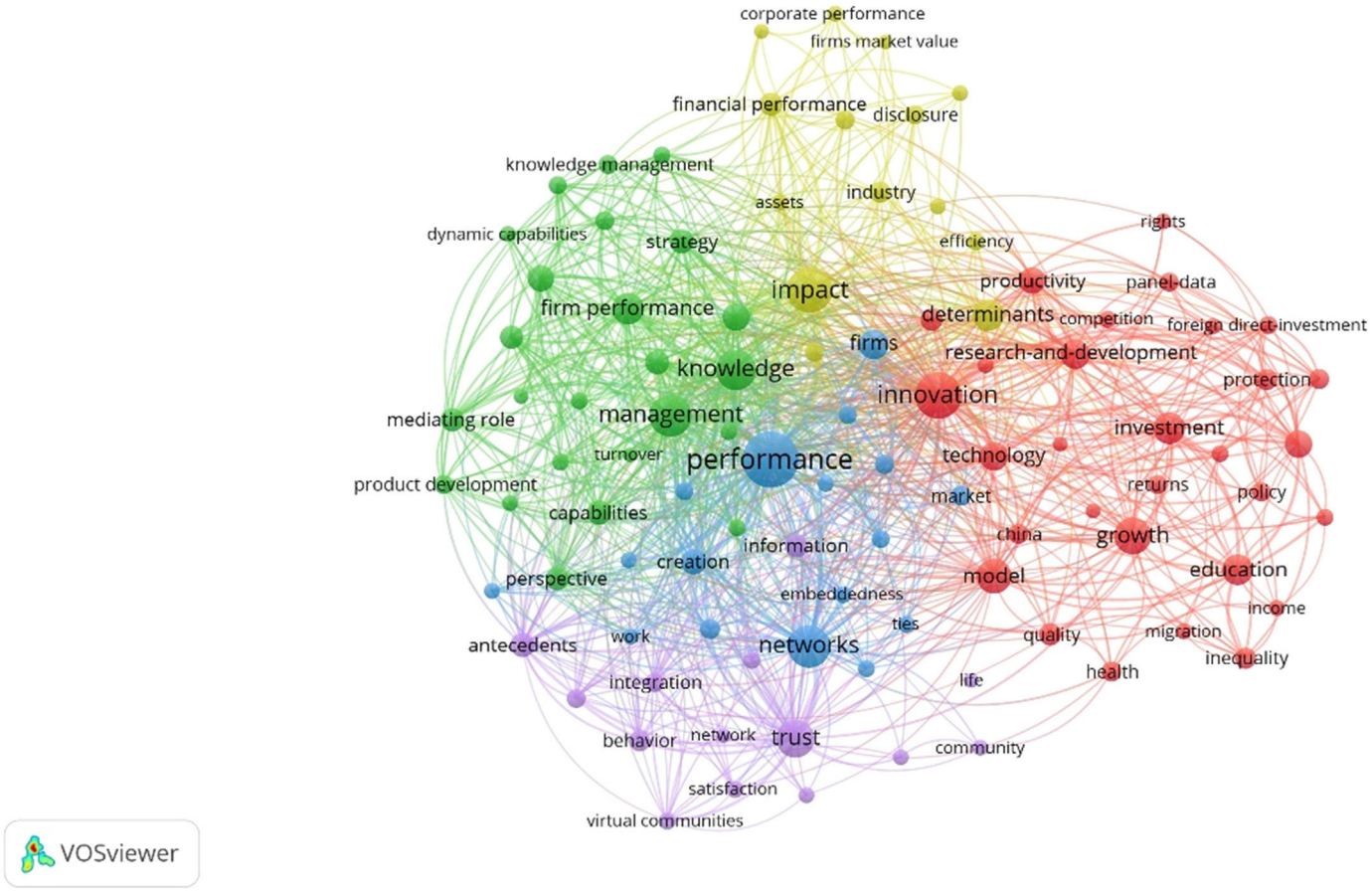


Fig. 13. Co-occurrence network in Asia (1975–2020).

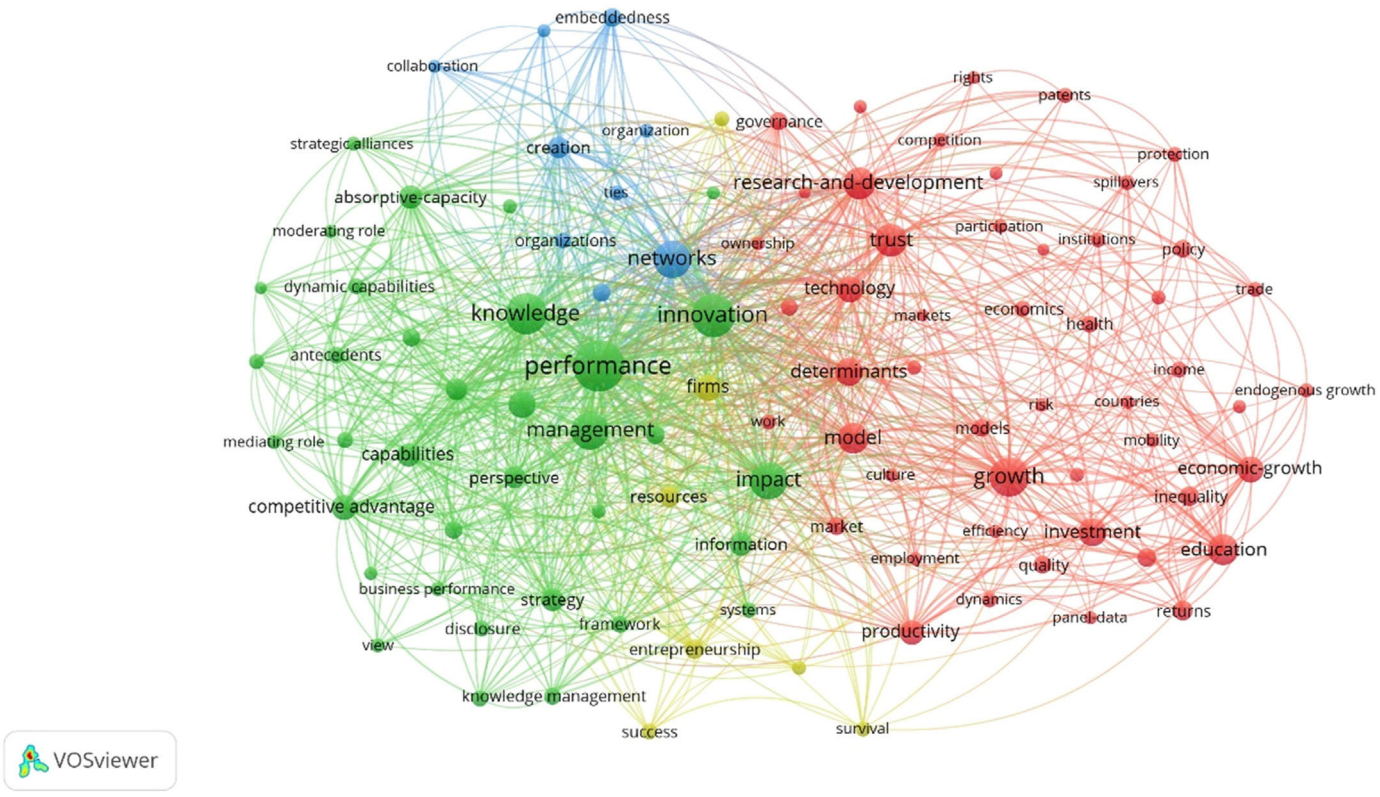


Fig. 14. Co-occurrence network in Europe (1975–2020).

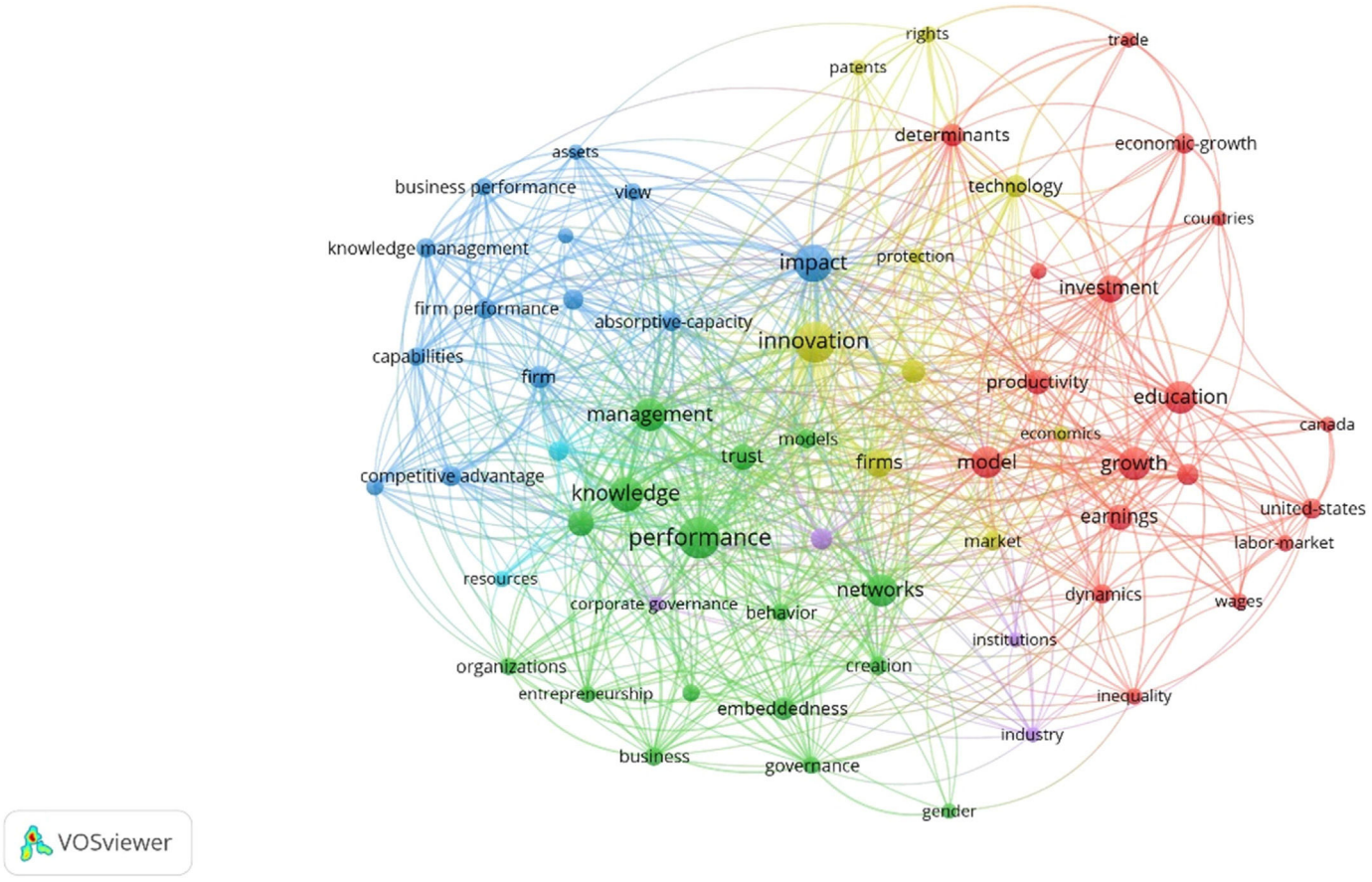


Fig. 15. Co-occurrence network in North America (1975–2020).

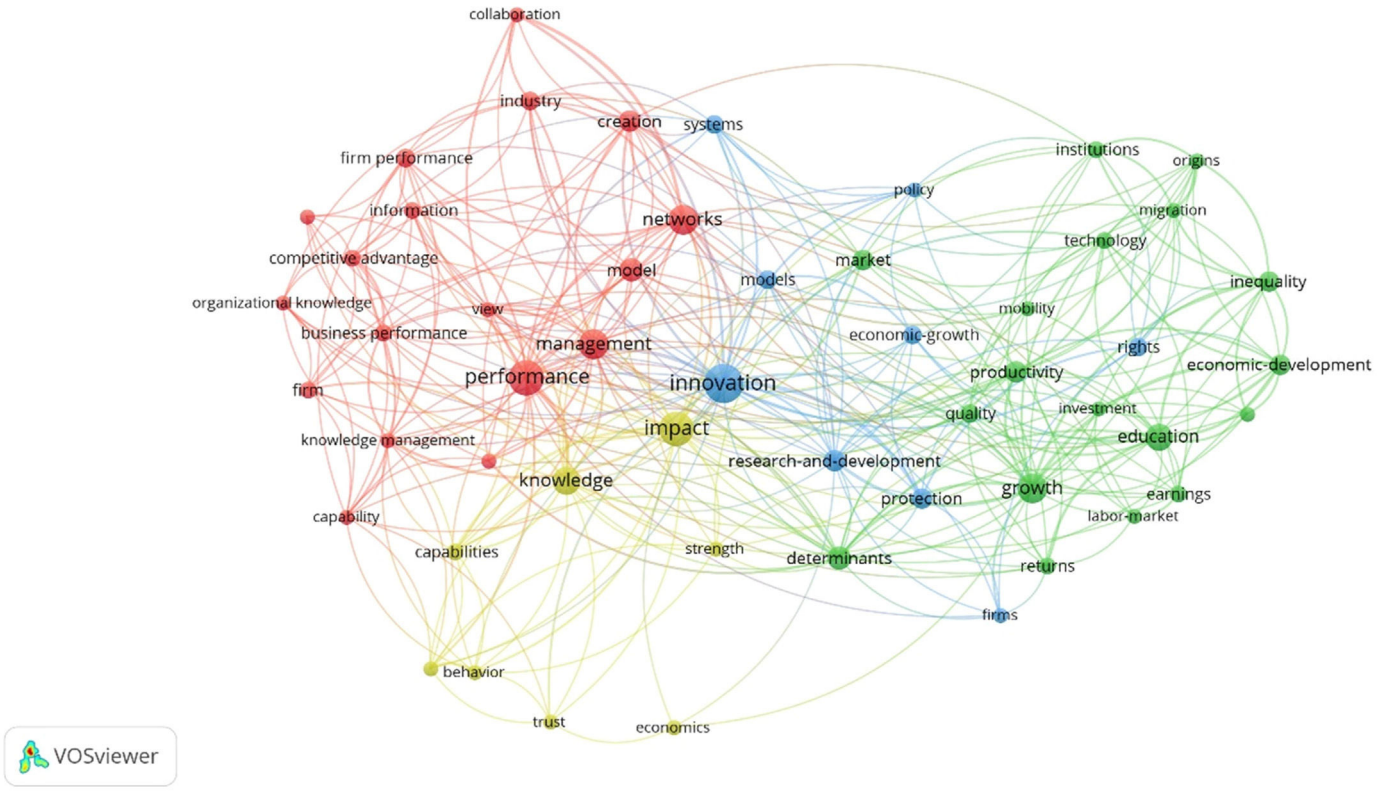


Fig. 16. Co-occurrence network in South America (1975–2020).

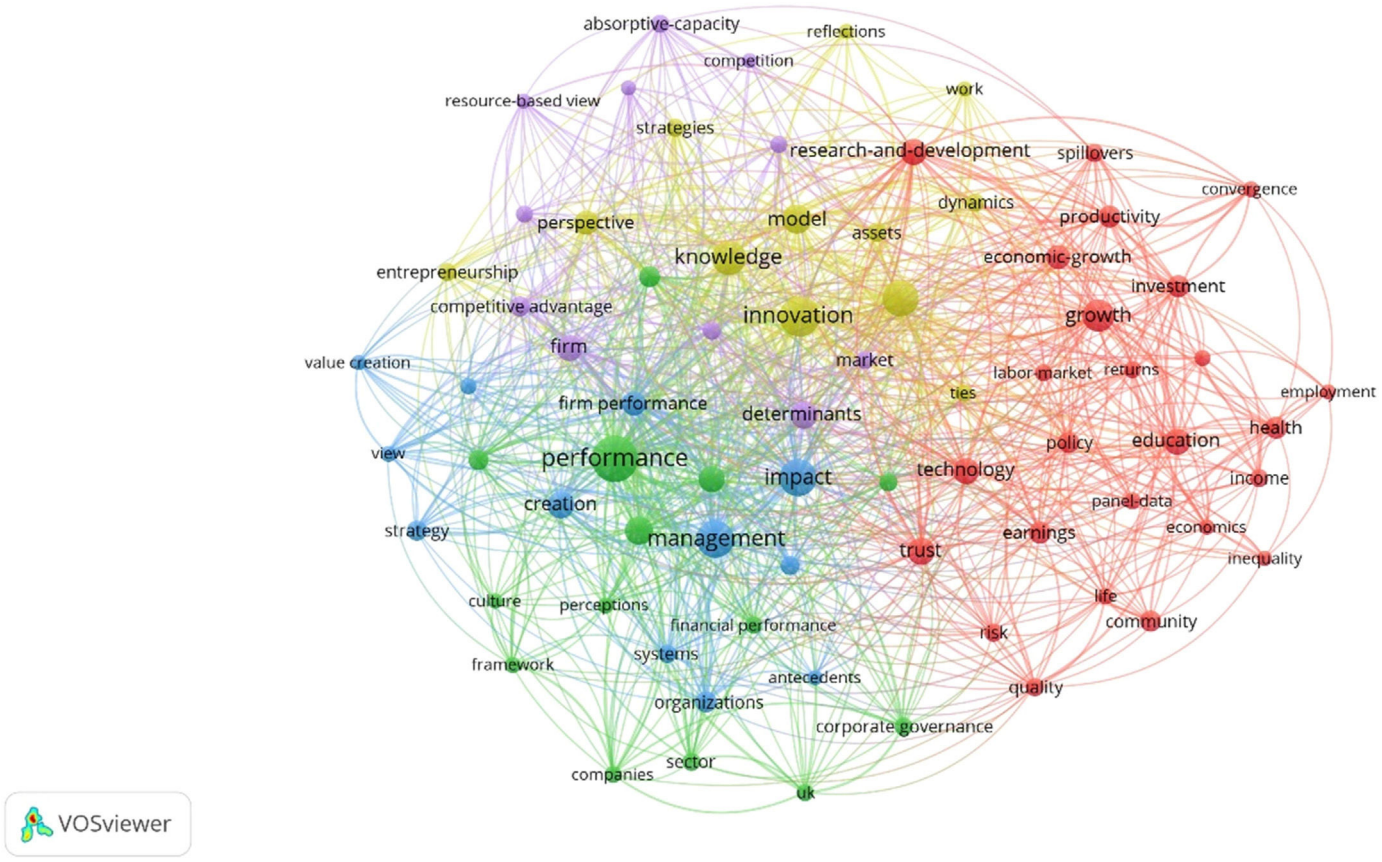


Fig. 17. Co-occurrence network in Oceania (1975–2020).

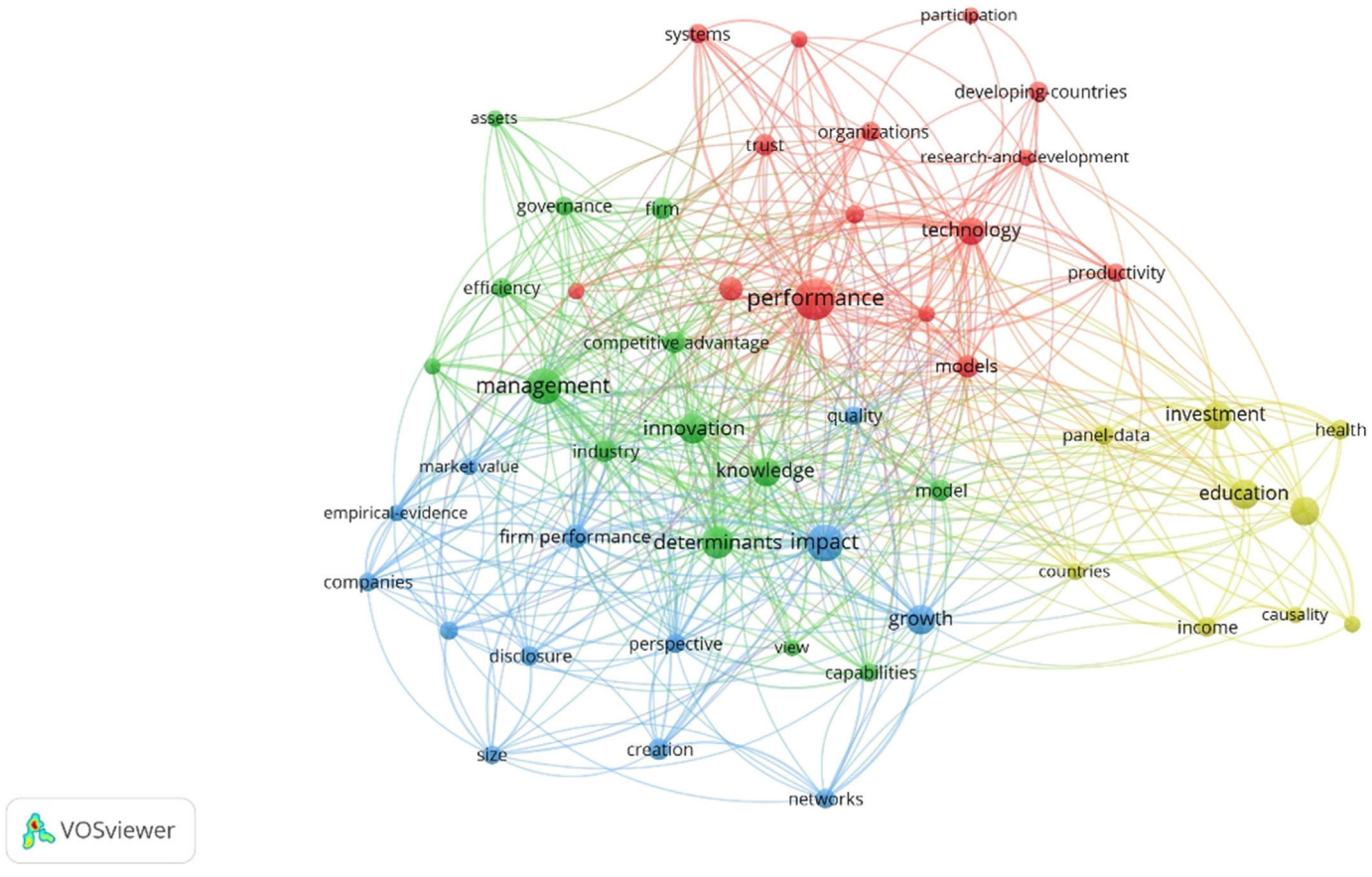


Fig. 18. Co-occurrence network in Africa (1975–2020).

variables used. Lastly, future studies may examine what theories are involved in IC studies, thereby demonstrating the most dominant theoretical perspectives in the IC setting.

Data availability

The data used in the present research are available on the Web of Science database.

Declaration of Competing Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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