

A systematic literature review of current understanding and future scope on Green Intellectual Capital

Deepika Ahlawat , Dr. Priti Sharma , Dr. Sanjiv Kumar 

Maharshi Dayanand University, Rohtak (India)

grenaldeepika11@gmail.com, pritisrm04@gmail.com, sanjivkmdu@gmail.com

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Abstract

Purpose: This paper intends to scrutinize evolution and the growth of literature on green intellectual capital(GIC)over the period 2008 to 2022, consequences of green intellectual capital, its sectoral classification, current trends and future scope of research.

Design/methodology: For a better understanding of this concept, a systematically arranged review was performed following PRISMA framework. For this, data has been extracted from Scopus and Web of Science databases because they are the largest databases and provide international coverage. Collected data was confined on the basis of inclusion and exclusion criteria. The paper was sectioned into two types of analysis: bibliometric analysis and content analysis.

Findings: Results highlighted that green intellectual capital has important meanings in influencing organisational performance namely economic, social and financial performance. Studies were focused mainly on Asian countries using quantitative analysis and deduced that researchers were mainly focused on manufacturing sector. Findings depict that GIC translates into explicit results but when its components' effects are analysed, they individually show ambiguous results.

Research limitations/implications: This study will provide useful insights to researchers, practitioners, managers and policy makers. Findings suggest intangible resource- green intellectual capital should be managed efficaciously which will provide competitive benefits and also contribute to organisations' financial, social and environmental performance.

Originality/value: The existing literature needs to be comprehended and streamlined by interpreting the nuances in the existing research work for enabling synergy in deciphering the explicit outcomes of the extant literature. Also, there are only a few studies focusing on this construct and on its systematic literature review.

Keywords: Green Intellectual Capital, Green Human Capital, Bibliometric Analysis, Systematic Literature Review

Jel Codes: O34, Q56

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1. Introduction

Attainment of sustainable development and sustainability of production have become buzz words nowadays in the light of widespread environmental degradation impacting one and all. Every nation has been actively indulging in preserving the environment and environmental resources with the help of socially responsible investment so that future generations can have a safe future. Sustainability goals can only be attained through the communities and corporations' joint collaboration (Sidik, 2019). Nowadays, communities are also turning out to be more concerned and conscious about environment and environment protection guidelines persuade organisations to concentrate more on sustaining and managing environment (Chen, 2008). In this environmentally concerned era, to mitigate environmental problems like pollution, resource over exploitation, hazardous waste production, loss of biodiversity and gain competitive benefit, organisations started following eco-friendly practices and initiated producing environmentally sound goods and services like green products produced with clean energy and resource optimisation while employing principles like polluter pays, extended producer liabilities, etc.

Sheikh (2021) suggests that going green will foster sustainability if organisations exploit their available resources. As per Rastogi (2003) "Intellectual Capital may properly be viewed as the holistic or meta-level capability of an enterprise to co-ordinate, orchestrate, and deploy its knowledge resources toward creating value in pursuit of its future vision." This suggests that besides financial and material resources, it is Intellectual Capital (IC) which plays a considerable role in the smooth functioning of businesses as well as in enhancing firm value (Rexhepi, Ibraimi & Veseli, 2013). Intellectual Capital is the summation of learnings, proficient skills, acquaintance, know-how of processes, novelty in concepts which altogether synergise into producing productive assets for an organisation (Stewart, 1998; Wiig, 1997; Chu, Lin, Hsiung & Liu, 2006). Intellectual capital is "the intellectual resources that have been formalised, captured, and leveraged to create assets of higher value" (Kim, Yoo & Lee, 2011).

GIC of an organisation acts as the driving force when environmental aspects are concerned. Chen (2008) initiated this construct and contributed to research in this field. Chen delineated GIC as "total stocks of all kinds of intangible assets, knowledge, capabilities, and relationships, etc. about environmental protection or green innovation at the individual level and the organisational level within a company". As per Sidik (2019), GIC is a powerful, efficient apparatus for companies, a summation of personnel skills and talent to accelerate the environment savvy output of companies. Amplification of environmental consideration at global level triggered organisations to enhance sustainable practices which in turn led to relying more on Green Intellectual Capital. GIC is the driving force and an aid in achieving the organisation's sustainability and environmental goals and objectives, thereby propagating and enhancing both its bottom line and productivity. The considerations regarding GIC empower an organisation to be more environment conscious and mitigate as well as adapt to turmoil caused due to environment stipulations.

Consequently, for a better comprehension of the construct of Green Intellectual Capital, it is imperative to explore all researches performed from its inception and to figure out and understand the role of GIC in different aspects. Alongside, all aspects have been immensely discussed and outcomes analysed from these researches.

In order to clarify, this research investigated evolution and growth of GIC from years 2008 to 2022, consequences of green intellectual capital, its sectoral classification, current trends and future scope of research. To ascertain known facts or the ones yet to be explored, a systematically arranged literature review was performed, further divided into a two-part SLR namely descriptive and content analysis. Under descriptive analysis, bibliometric analysis was executed to uncover its evolution, to analyse authors and corresponding author countries, journals with highest publications and sectoral classification. Post this, content analysis was performed which comprehensively analysed the available studies. Although only a few researches are available on this construct, as this field is still in its developing stage, yet no research has been done with this perspective, making this work unique in its own aspect.

The study provides useful insights to researchers, practitioners, managers and policy makers on the role of green intellectual capital's on affecting different aspects such as competitive advantage, green human resource management, green supply chain, sustainability, etc. Outcomes of this study recommend that intangible resource-green intellectual capital should be managed efficaciously which will provide competitive benefit and also contribute to organisations financial, social and environmental performance. Organisations should deploy new strategies, tactics and guidelines to manage efficiently all the dimensions of GIC. Policymakers should organise environmental conservation training courses to further streamline their GIC potential.

This article is broadly classified into different sections where, first includes introduction, second describes methodology used in the study, third covers research developments/progress in two phases (through descriptive analysis and content analysis) and the last section is about discussion, conclusion, further research areas and implications.

2. Theoretical background

As per resource-based theory of Barney (1991), for strategically managing and gaining persistent benefit from competitors', organisations must have a good hold on resources that are "valuable, rare, inimitable and not substitutable". Organisations hold prominently tangible and intangible resources. In this information intensive generation, focus of organisations deviated from tangible (physical) resources to intangible resources (Mondal & Ghosh, 2012; Sharma, 2018). As per this paper's authors, intangible is like an idea construct and tangible is commensurate with the machinery used to foster this idea. Intellectual capital is one of the pertinent intangible resources. In 1960's, this construct initially was expressed by J. Galbraith. In 1991, Stewart outlined this construct in his publication – "Brainpower". In the views of Quinn (1992), "ideas and intellect, not physical assets, built great companies". According to Andriessen (2004), "Intellectual capital has encapsulated an organisation's non-monetary sources of wealth creation". Chu et al. (2006) elaborated "Intellectual capital is the group of knowledge assets that are attributed to the value creation of an organisation".

The concept Intellectual Capital evolved some decades ago. Till now, this concept has evolved through various phases. First phase was from the years 1991 to 2000, emphasised on critically analysing intangibles (Hall,1993), developed models for measuring and administering Intellectual Capital (Edvinsson & Sullivan, 1996; Bontis, 1998) associated it with knowledge (Wiig, 1997) and outlined it as 'nations' wealth' (Bradley, 1997). Second phase started from 2001 to 2010 and was immensely geared towards enlarging models to gauge, report and administer Intellectual Capital (Bontis, 2001; Guthrie, 2001; Brennan, 2001; Andriessen, 2004; Chen, Zhu & Xie, 2004; Striukova, Unerman & Guthrie, 2008; Dumay, 2009) in addition to assessing its role in organisations bottom line and worth (Chen, Cheng & Hwang, 2005; Tseng and Goo, 2005; Bharathi, 2008; Sharabat,i Jawad & Bontis, 2010). Third phase spanned the years 2011 to 2022 and was majorly oriented towards assessing the consequential effect of Intellectual Capital on performance (Joshi, Cahill, Sidhu & Kansal, 2013; Lu, Wang & Kweh, 2014; Xu and Wang, 2018; Asiaei, Jusoh & Bontis, 2018; Chatterjee, Chaudhuri, Thrassou & Sakka, 2021; Xu and Li, 2020; Campos, Dias, Teixeira & Correia, 2022; Prasojo, Yadiati, Fitrijanti & Sueb, 2022; Bataineh, Abbad, Alabood & Alkurdi, 2022), competitive strength (Jardon & Martos, 2012; Yaseen, Dajani & Hasan, 2016; Jain et al., 2017; Niwash, Cek & Eyupoglu, 2022), innovative strength (Han & Li, 2015), knowledge governing practices (Kianto, Ritala, Spender & Vanhala, 2014), corporate governance (Hidalgo, García-Meca & Martínez, 2011; Soriya & Kumar, 2022) and sustainability (López-Gamero, Zaragoza-Sáez, Claver-Cortés & Molina-Azorín, 2011; Massaro, Dumay, Garlatti & Dal Mas, 2018) on diverse sectors. Yet the study of IC so far has not been sufficient in analysing its ecological aspects and thus arose the need for the study of Green Intellectual Capital. Of late, the corporate performance has started to be influenced by its ecological footprints in many ways. To deal with this aspect and to strengthen existing IC prospects, environmental aspects were incorporated. Chen (2008) contributed by discussing the consequences of green intellectual capital on competitive strength. The view regarding sustainability, pioneered by the Brundtland Report of 1987: Our Common Future (Brundtland, 1987) necessitated the attention towards the ecological footprints of enterprises and various states. Sustainable development became the buzzword and the performance came to be synonymous with carbon emissions mitigations and sustainability target achievements. The zenith has been achieved in this scheme of things in the form of Sustainable Development Goals targeted for the 2030, adopted by the United Nations member states in

2015 in New York (Deren & Skonieczny, 2022). The European Green Deal of 2019, targeted for climate neutrality by 2050 is also aligned in a similar direction. All these have necessitated the study of GIC of enterprises as the sustainability of working of states is the net summation of sustainability of enterprises operating in their respective jurisdictions. GIC elaborates on the knowledge relevant for an enterprise's ability to adapt to greener practices. The changes in attitude, boosting of ecologically sensitive morale, recycling of materials, carbon neutral actions, resources use optimisations, efficient energy consumption and effective yet ecologically friendly managerial practices are what comprise the study area of GIC.

GIC is a vital asset enabling the organisation in proactively adapting to the ever-changing scenarios related to the environmental sustainability and enables the firms to acquire a competitive benefit over their peers.

The awareness and study of GIC enables enterprises in achieving environmental, social and eventually economical sustainability (Wasiluk, 2013). The customers envision the ecologically sensitive companies and their products in a totally different and positive light, accolading green reputation to firms thereby reinforcing their industry position and providing competitive advantage. The study of GIC also focusses on green technologies, enabling firm's green performance and giving the enterprises an innovative edge over its peers by reaping sustainable profits.

3. Methodology

Systematic literature review was conducted to divulge the known and unknown facts about GIC. As discussed by Massaro, Dumay and Guthrie (2016), SLRs employ a procedure with clear regulations employing explicit principles, procedure clarity, accountability in discharging functions and role play clarity along with no bias judgements. SLR has been applied to generate reproducible, analytical and transparent results and has been recently refurbished to multiple fields (Boaz, Ashby & Young, 2002). SLR is the better version of conventional literature review because it analyses critically and systematically, more transparently provides good quality and reduces subjectiveness (Massaro et al., 2016; Petticrew & Roberts, 2008). The PRISMA framework has been used in this paper. Notably the first stage involved determining the topics of interest. The second stage included screening procedure to limit the scope of the search. The penultimate stage entails establishing the suitability of the prominent articles shortlisted while the last stage involves deciding on the final incorporation of shortlisted papers (Escobar & Escobar, 2022) (see Figure 1). PRISMA enables the researchers to pursue systematic review in a broad framework and not in a detailed manner for which other processes need to be pursued (Liberati et al., 2009). PRISMA also does not handle quality assessment to judge the attributes and merit of other structured reviews.

According to Massaro et al (2016), the preliminary stage includes ascertaining research questions. The research questions for the purpose of this study are as follows:

RQ 1: How has the construct "green intellectual capital" evolved so far?

RQ 2: What are the current research areas and the future scope of green intellectual capital?

To answer these research questions, this paper was divided into two sections. In the first section, bibliometric analysis was done using Biblioshiny tool of RStudio which covered the evolution of publications over time, sectoral classification, relevant authors, source, dominant research countries and top cited documents which answers the first research question. Second part analysed the content of articles in which findings of studies were categorised to gain some meaningful understanding and future research areas were also discovered thereby answering the second research question. Lastly, critical analysis and discussion comprises of a two-step SLR with a bibliometric and content analysis as existing research suggests that it diminishes the inefficiencies in the results, decreases errors in findings, if any while enhancing the quality of the outcomes.

3.1. Search from database

To conduct systematic review, Scopus and Web of Science databases were utilised in the month of June 2022. The intention for choosing these two was that they are the largest databases and provide international coverage.

For extracting the data, search string was set to search on the basis of Abstract, Title and Keywords: “Green Intellectual Capital”. From this initial search, 60 articles from Scopus and 29 from Web of Science were found spanning years 2008 to 2022.

3.2. Inclusion and Exclusion criteria

Inclusion criteria:

- Availability on databases: Web of Science (ISI); Scopus
- Scripted in English language
- Focussed on subject areas: Business, Management, Finance and Social Science
- No limitation based on year
- Document type set to articles only

Exclusion criteria:

- Articles not addressing green intellectual construct.
- Articles in any language but English.
- Research papers for which the complete text was not accessible.
- Excluded on the basis of title and abstract suitability.
- Sources like books, edited chapters, editorials, conference papers and reports were rejected for this study.

Following the above, after retrieving the data from Scopus and Web of Science databases, relevant articles were spotted further through inclusion and exclusion criteria which was divided into three sections: first section included all pertinent articles, researches confined on the basis of language, document type and subject area where articles written in English language only were selected due to language barrier of the researchers; only articles were included and subsequently subject area was confined to: Business, Management, Finance and Social Science. No limitation was set to the year section to fully explore the evolution of the concept. This led the results to 53. In second section both the Web of Science and Scopus data was merged and 12 duplicates removed using RStudio tool. In third section researchers thoroughly studied the titles and abstracts of articles to exclude all irrelevant articles from the study. This constricted the number of papers to 35. Lastly, researchers excluded articles which were not publicly accessible, eventually leading to 31 studies being thoroughly reviewed by both the researchers for the purpose of this study.

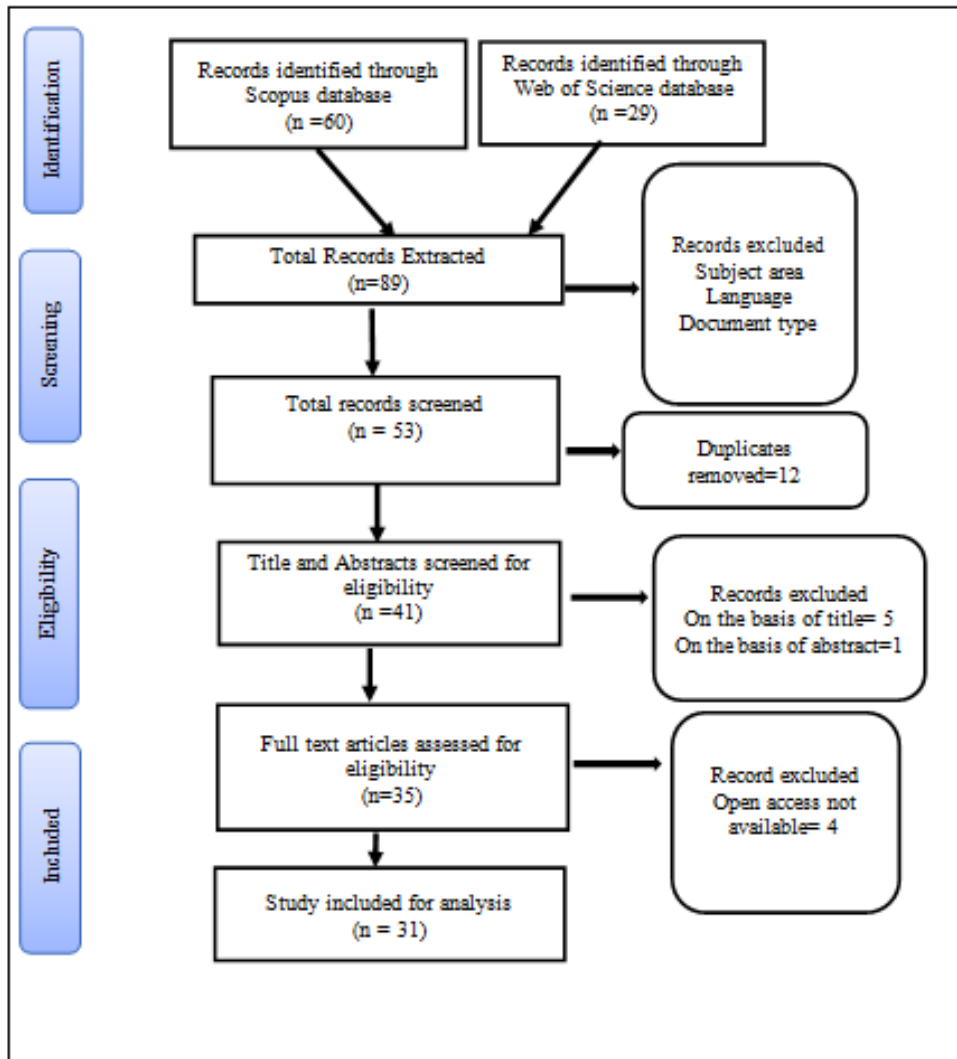


Figure 1. PRISMA

4. Results of bibliometric analysis

4.1. Evolution of Green Intellectual Capital

Figure 2 reveals annual publications related to this field, growing year on year with an annual growth rate of 36.87%. Only a meagre number of studies have been conducted on Green Intellectual Capital from the year 2008 till now, but the studies have been increasing nevertheless with a phenomenally high yearly growth rate. Chen (2008) is the pioneer who carried out research on Green Intellectual Capital in his study: “The Positive Effect of Green Intellectual Capital on Competitive Advantages of Firms.” From a chronological perspective, the number of studies have increased tremendously from year 2019 vis-à-vis the year 2008. This may be due to multiple reasons viz., emphasis by enterprises to mend their styles of functioning while incorporating green procedures in their working, renewed vigour due to shifting of focus on sustainable development as suggested in sustainable development goals adopted by the United Nations in 2015. (references) The withdrawal by United States of America from the Paris agreement also provided a fresh impetus to the reaffirmed essence of green components in the functioning of various stakeholders as important industrialised nation’s actions are closed watched and monitored worldwide. The studies concerning this subject have been actively pursuing the task of projecting and analysing the impacts and effects of green components on overall output of multiple stakeholders.

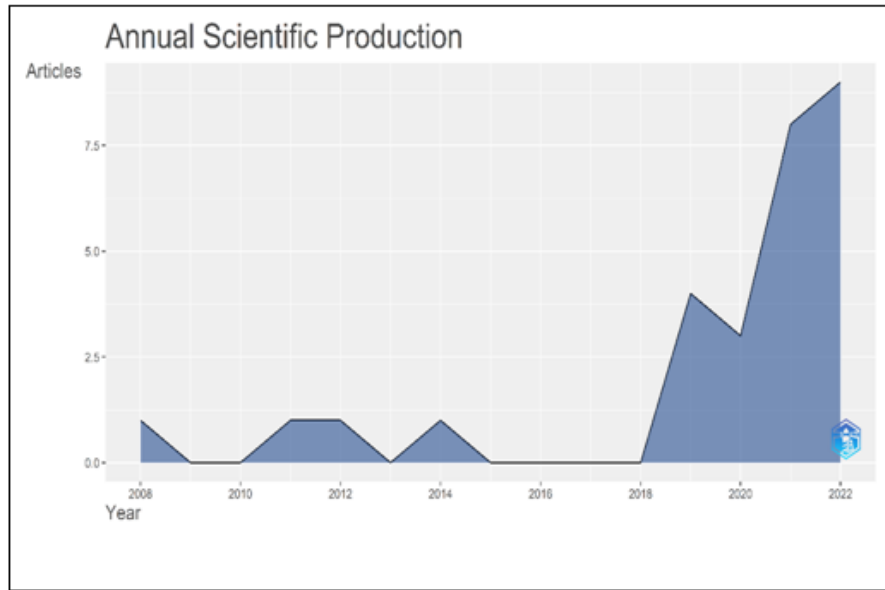


Figure 2. Annual Scientific Production

4.2. Classification of studies

4.2.1. Sectoral analysis

Figure 3 exhibits sectoral classification of various studies performed on the concept of Green Intellectual Capital from the year 2008 to 2022. Amongst the 31 studies, 20 were conducted on manufacturing sector which is almost 65% of the total. All other studies were performed on different kinds of organisations such as information and electronic companies, banks, hotels, courier services, public listed companies. Two among these are related to review of GIC.

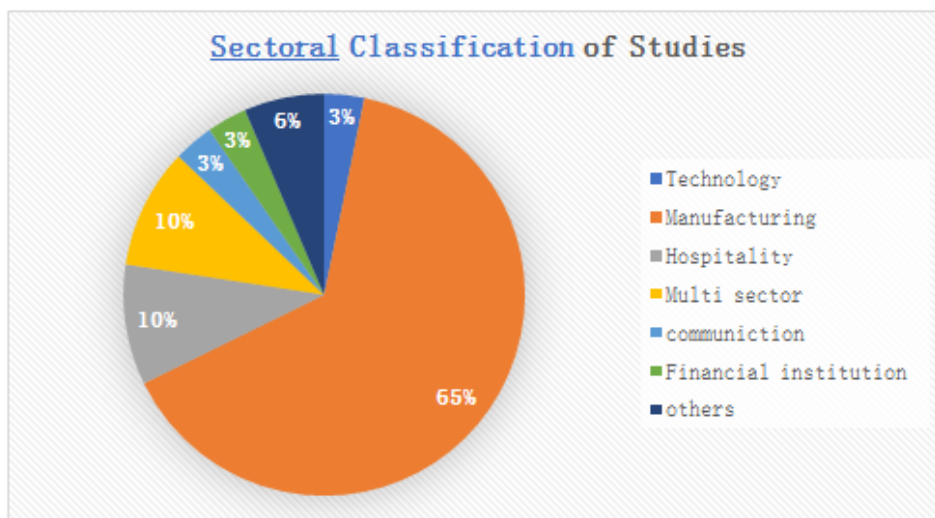


Figure 3. Sectoral Classification of Studies

Table 1 enumerates all the studies analysed in this paper with their sectoral divisions, year of publications and the authors details.

Researchers	Year	Data type	Study Country	Study Organisation
Chen	2008	Quantitative	Taiwan	Information and electronics companies
Huang & Kung	2011	Quantitative	Taiwan	Manufacturing companies
Chang & Chen	2012	Quantitative	Taiwan	Manufacturing companies
Delgado-Verde, Amores-Salvadó, Martín-de Castro and Navas-López	2014	Quantitative	Spain	Manufacturing companies
Sidik	2019	Quantitative	Indonesia	Manufacturing companies
Yadiati	2019	Quantitative	Indonesia	Manufacturing companies
Yong, Yusliza, Ramayah and Fawehinmi	2019	Quantitative	Malaysia	Manufacturing companies
Yusoff, Omar, Zaman and Samad	2019	Quantitative	Malaysia	Manufacturing companies
Sudibyo and Sutanto	2020	Quantitative	Indonesia	Manufacturing companies
Yusliza, Yong, Tanveer, Ramayah, Faezah and Muhammad	2020	Quantitative	Malaysia	Manufacturing companies
Malik, Cao, Mughal, Kundi, Mughal and Ramayah	2020	Quantitative	Pakistan	Manufacturing companies
Jirakraisiri, Badir and Frank	2021	Quantitative	Thailand	Manufacturing companies
Maaz, Ahmad and Abad	2021	Quantitative	India	Food processing industry
Ali, Puah, Ali, Raza and Ayob	2021	Quantitative	Pakistan	Banks
Mansoor, Jahan and Riaz	2021	Quantitative	Pakistan	Manufacturing companies
Ali, Wen, Hussain, Khan, Younas and Jamil	2021	Quantitative	Pakistan	Manufacturing companies
Rehman, Kraus, Shah, Khanin and Mahto	2021	Quantitative	Malaysia	Manufacturing companies
Shah, Ahmed, Ismail and Mozammel	2021	Quantitative	Baharain and United Arab Emirate	Services(hotels)
Nisar, Haider, Ali, Jamshed, Ryu and Gill	2021	Quantitative	Malaysia	Services(hotels)
Sheikh	2021	Quantitative	India	Manufacturing companies
Haldorai, Kim and Garcia	2022	Quantitative	Manila	Services(hotels)
Asiaei, O'Connor, Barani and Joshi	2022	Quantitative	Iran	Public listed companies
Asiaei, Bontis, Alizadeh and Yaghoubi	2022	Quantitative	Iran	Public listed companies
Xi, Fang and Feng	2022	Quantitative	China	Manufacturing companies
Muafi and Sulistio	2022	Quantitative	Indonesia	Courier service
Ullah, Mehmood and Ahmad	2022	Quantitative	Pakistan	Manufacturing companies
Mehmood and Hanaysha	2022	Qualitative		
Ghosh and Haque	2022	Quantitative	India	Energy sector

Researchers	Year	Data type	Study Country	Study Organisation
Asiaci, Jusoh, Barani and Asiaci	2022	Quantitative	Iran	Public listed companies
Wang, Zhang, Wang, Zhu and Morabbi Heravi	2022	Quantitative	China	Manufacturing companies
Farooq, Yusliza, Muhammad and Saputra	2022	Qualitative	Malaysia	

Table 1. Classification of studies

4.2.2. Geographical analysis

Figure 4 shows the analysis of geographical areas in which the research was performed. As per this analysis, barring Spain, all studies were conducted in Asian countries amongst which Malaysia is the leading contributor followed by Pakistan. Publications from both the countries enormously pay much attention to manufacturing sector.

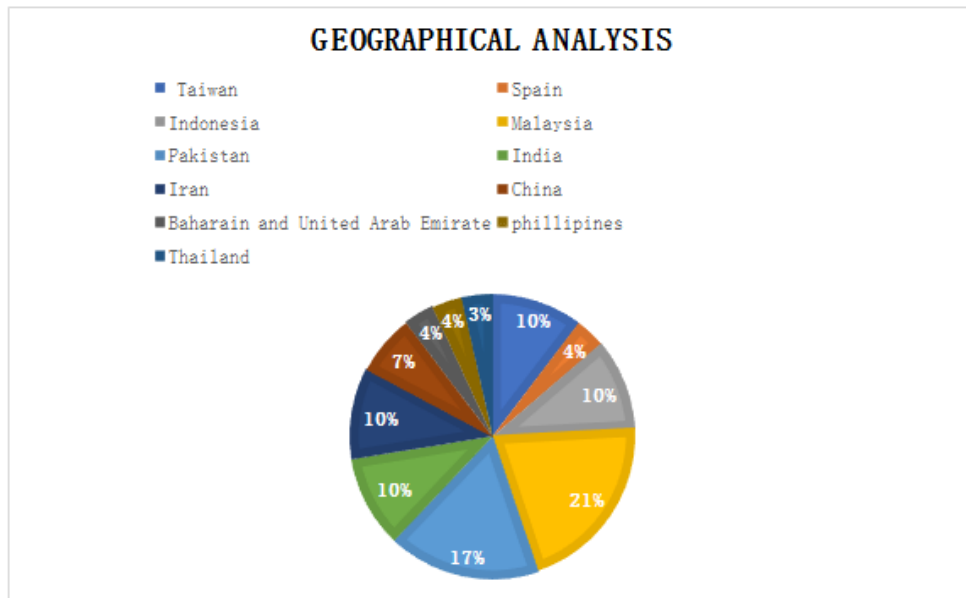


Figure 4. Geographical analysis (Prepared by author)

4.3. Authors with maximum publications

Figure 5 demonstrates the preeminent researchers who contributed in this field with their publications and total author citations. A total of 100 authors have made their contribution in this theme amongst which 91 have single publications which constitutes about 91% of the total. Asiaci K, Ramayah T and Yusliza M are the top authors with 3 published documents each.

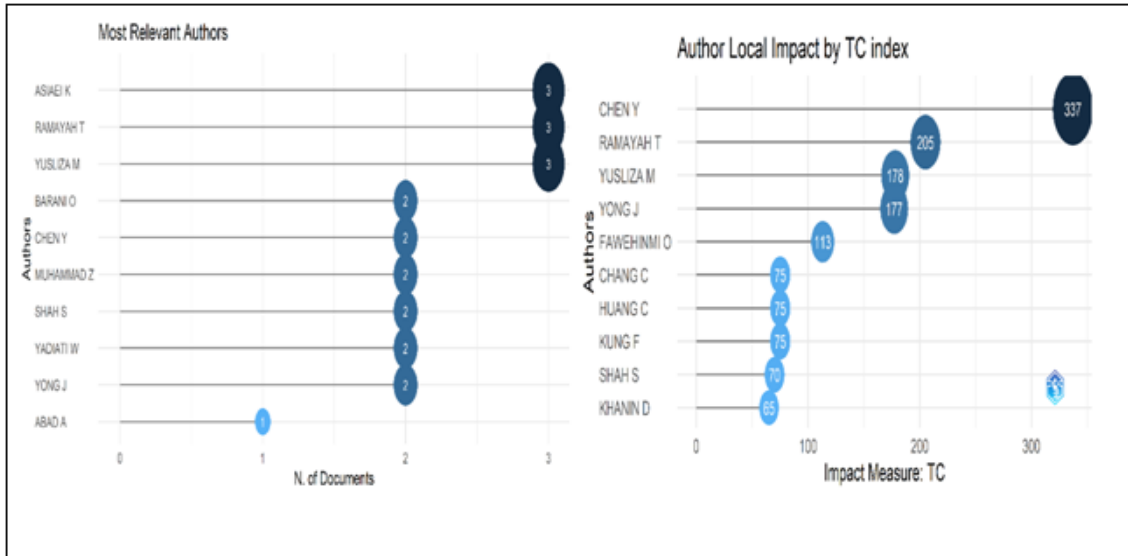


Figure 5. Prominent author

4.4. Authors' country analysis

Figure 6 enumerates the authors' country affiliations showing various nations making their contribution in the field of Green Intellectual Capital. A total of 12 countries' researchers analysed this concept among which 7 countries have only a single published paper. Barring the three countries namely Canada, Spain and USA, all are Asian indicating that this concept is mostly discussed in Asian regions. As per the bibliometric analysis, China leads with the highest number of researches done and also tops with a total of 449 citations.

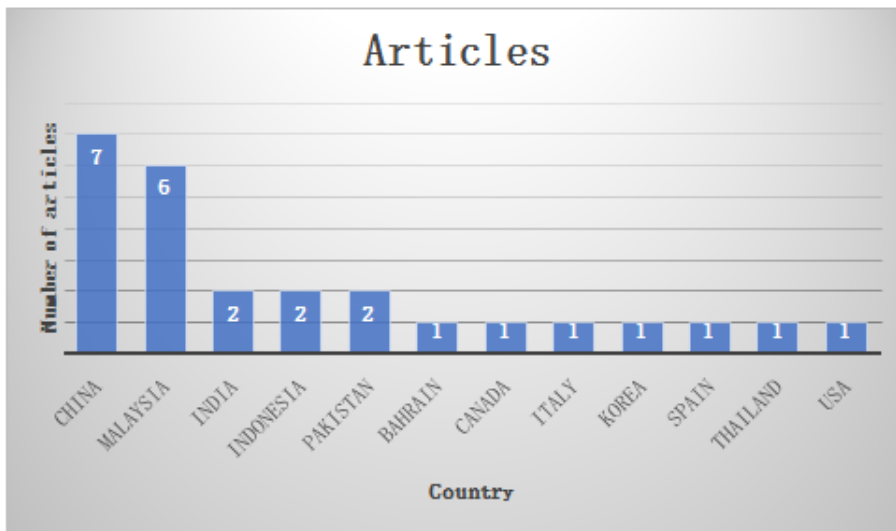


Figure 6. Authors' country analysis

4.5. Journal analysis

Figure 7 exhibits relevant sources on the basis of maximum published articles. Journal of Intellectual Capital is leading with the maximum number of published articles. Journal of Cleaner Production follows in second with four published articles, with highest total citations and h-index. Amongst all, top 6 journals contribute 72% of the total articles on this theme.

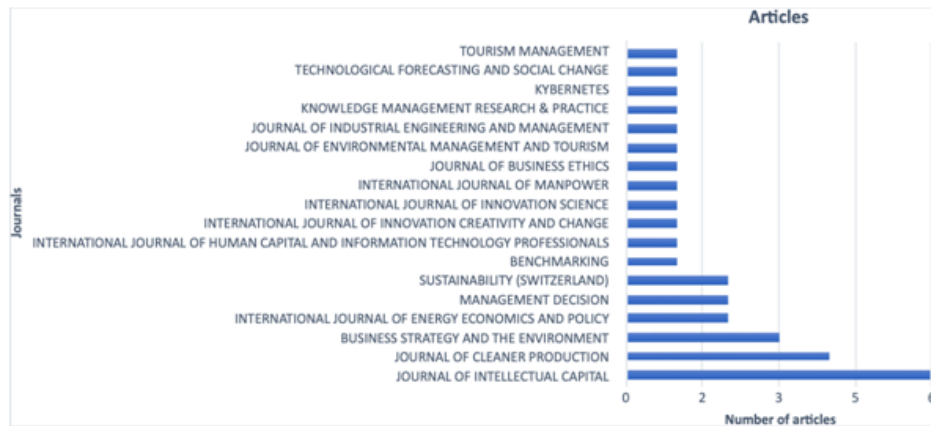


Figure 7. Journal analysis

4.6. Relevant articles

Table 2 shows five most influential articles as per citation count. Total citations per year are also depicted in the table. As depicted in the table, Chen who introduced this concept in his research in 2008 got the highest citations. He elaborated in his research that higher the green intellectual capital, higher will be competitive benefit to the organisations. Subsequently, research work by Yong and his colleagues (2019) on manufacturing firms of Malaysia follows in order.

Paper	Total Citations	TC per Year	Title
Chen (2008)	262	17.47	“The Positive Effect of Green Intellectual Capital on Competitive Advantages of Firms”.
Yong et al. (2019)	113	28.25	“Nexus Between Green Intellectual Capital and Green Human Resource Management”.
Huang and Kung (2011)	75	6.25	“Environmental consciousness and intellectual capital management evidence from taiwans manufacturing industry”.
Chang and Chen (2012)	75	6.82	“The determinants of green intellectual capital”.
Rehman et al. (2021)	65	32.50	“Analysing the relationship between green innovation and environmental performance in large manufacturing firms”.

Table 2. Top cited documents

4.7. Content analysis

4.7.1. Green Intellectual Capital and its constituents

Over the last decade, concept of Intellectual Capital has been discussed extensively, but the concept of Green Intellectual Capital has recently come in prevalence after organisations calibrated their focus towards environmentalism. Chen (2008) is the pioneer who researched primarily on GIC. He described it as “total stocks of all kinds of intangible assets, knowledge, capabilities, and relationships, etc. about environmental protection or green innovation in the individual level and the organisation level within a company”. He sectioned GIC into three parts: green human capital (GHC), green structural capital (GSC), and green relational capital (GRC). Chang and Chen (2012) mirrored the opinion of Chen (2008) about GIC and its constituents. According to Delgado-Verde et al. (2014) GIC is the non-physical resource and the comprehensive expertise ability inherent in a firm associated with its environmental supervision. GIC is counted as a vital refuge and a soft skill for companies to produce product in an environmentally sound manner. (Ali, Wen et al., 2021).

As per Sidik (2019), GIC is a potent instrument of organisations and is the assimilation of nonphysical resources and abilities that further expediate in generating and boosting the performance. GIC is vital in the cut-throat critical technological performance of companies as they are thoroughly dependent on human knowledge and skills (Wang & Juo, 2021). GIC is the summation of intangibles, skills and associations assisting in the economical achievement for companies (Ullah et al., 2022)

As per the literature, GIC, likewise Intellectual Capital, can also be predominantly sliced into three sections: green human capital, green structural capital and green relational capital. Green human capital (GHC) elucidated by Chen (2008) as “summation of employee’s knowledge, skills, capabilities, experience, attitude, wisdom, creativities, and commitments, etc. about environmental protection or green innovation, and was embedded in employees not in organisations”. To handle problems relating to environment, personnel should have adequate competence, skills, expertness, creative thinking and proficiency (Huang & Kung, 2011). Green human capital allows an industrial enterprise to acknowledge its nonphysical assets like soft assets, information, wisdom, proficiency and understanding (Yusliza et al., 2020). According to Farooq et al. (2022) GIC is the synergy caused by worker strengths like creativeness, originality, sagacity and environment savvy prudence.

Green structural capital (GSC) has been explained as “stocks of organisational capabilities, organisational commitments, knowledge management systems, reward systems, information technology systems, databases, managerial mechanisms, operation processes, managerial philosophies, organisational culture, company images, patents, copy rights, and trademarks, etc. about environmental protection or green innovation within a company” (Chen, 2008). Huang and Kung (2011) elaborated it as “specification, empowerment, and support infrastructure associated with environmental protection or the development of sustainability strategies”. Wang, Wang and Liang (2014) defined it as “institutionalised knowledge about the form of organisational processes, structures, technologies, policies and culture”. According to Asiaei, O’Connor et al. (2022) “Green structural capital can support managers to handle to what extent companies can reduce environmental pollution by redesigning their production processes and increasing their green productivity”. Green structural capital is deeply entrenched in an undertaking and always remains in its possession. It can be quantified from the company ethics, its values, personnel policies, IPRs, technological know-how, critical technologies, information databank, environmental policies and its know how (Salvado et al., 2021).

Green relational capital (GRC) “as the stocks of a company’s interactive relationships with customers, suppliers, network members, and partners about corporate environmental management and green innovation, which enables it to create fortunes and obtain competitive advantages” (Chen, 2008). Huang and Kung (2011) defined GRC as the relationship of vendors, end-users and commercial partners with environment protection. He further interprets that organisations should focus on gaining end users’ loyalty by spending more on environment friendly products and also make healthy relations with vendors.

Data demonstrates that various researchers majorly sectioned GIC as three dimensional: green human capital, green structural capital and green relational capital. A total of twenty-four studies out of thirty-one studies corroborate that GIC is predominantly composed of these three dimensions. But as exceptions always exist, Yadiati (2019) included green social capital instead of green structural capital.

But there are some other researchers who considered it as general construct, two dimensional and four dimensional. Amongst all, the two researchers who supported and performed research in two dimensions are Delgado-Verde et al. (2014) and Mansoor et al. (2021) where the former performed research in 2014 to evaluate the repercussions of GIC components, precisely green organisational capital and green social capital on ecological product innovation and lastly concluded that only green social capital has direct effects. Researchers also elucidate that these two types of capital enable us to comprehend in an improved manner while the latter investigated GHC and GRC dimensions to explore whether they have a role in influencing environmental performance and results deduce the same.

Further, in three researches, authors conceptualised GIC as four dimensional, where Ullah et al. (2022) and Rehman et al. (2021) embraced green social capital into three dimensions but other researchers Ghosh and Haque (2022) embraced green spiritual capital as the fourth dimension.

From 2008 till now, various researchers attempted to assess the crucial role of GIC and its components in different organisations, in different time periods and from different perspectives. Different perspectives such as GIC and its consequences on competitive advantage, corporate social responsibility (CSR), green human resource management (GHRM), sustainable performance and economic performance. All these have been elaborated under different heads.

4.7.2. Green Intellectual Capital, Environmental Consciousness and Competitive Advantage

Some researchers comprehend that GIC has prominent role in affecting the competitive advantage of organisations and conducted research on diverse contexts. In that manner, Chen (2008) attempted to explore the influence of components of Green Intellectual Capital on competitive advantage of information and electronics organisations in Taiwan and concludes a favourable relationship between them. Increased GIC will contribute respective competitive strength. According to him, organisations should not overemphasise their vulnerability vis-à-vis stringent environmental laws and growing environmental consciousness, as all these dynamic environment trends can become driving force for GIC that will further create competitive benefit. Another researcher Huang and Kung (2011) investigated the manufacturing organisations of Taiwan and concluded that GIC mediates the association between competitive strength and environmental concern. Sidik (2019) also aimed to explore role and association of GIC, Environmental Management Accounting, Energy Efficiency with Competitive Advantage and Environmental Performance in the manufacturing firms in Indonesia. PLS-SEM (Partial least square- structural equation modeling) was applied to conduct the study and it deduced that all three factors prominently influence the Competitive Advantage and Environmental Performance. Mehmood and Hanaysha (2022) put forward that organisations started focusing on green concepts and on enlarging their green intellectual capital which is further supposed to enhance green innovation providing them competitive benefit.

4.7.3. Green Intellectual Capital, GHRM and Environmental Performance

Organisations comprise diverse description of resources which performs a critical role. One of the preeminent resources is human resource, which has noteworthy contribution in the organisations' activities. Organisations assimilate many practices to manage this resource advantageously. To grapple with green issues contemporarily, they started adopting activities to efficiently manage the human resource. GIC exerts a beneficial impact on GHRM further augmenting environmental performance. Various researchers made an attempt to explore the correspondence between GIC and GHRM, GIC and Environmental Performance, and finally GIC, GHRM and environmental performance viz. Mansoor et al. (2021) attempted to examine the role of green human capital and green relational capital on the environmental performance of manufacturing organisations of Pakistan and concluded a positive dependence and suggested to concentrate on increasing and preserving green human capital and green relational capital. Like Sidik (2019), Yadiati (2019) conducted study in Indonesia in the multinational firms but with different variables. Researcher attempted to explore the relation and impact of GIC and organisations' reputation on the environmental performance and summarised that adding up to Green Intellectual Capital of an undertaking will further enhance environmental performance. Wang and Juo (2021) also researched on the connection between Green Intellectual Capital and its elements and the organisations' Performance precisely its Economic Performance and Green Performance. Results deduce interconnection between variables and also suggest that Green Intellectual Capital is the determinative factor in organisations' Economic and Green Performance. Shah et al. (2021) analysed the footprints of Green Intellectual Capital and environmental responsibility on the environmental performance of hotels in Bahrain and United Arab Emirates. Data was collected through questionnaires and analysed using Partial Least Square by utilising Smart PLS software. Results concluded that GIC had its footprint on the environmental performance of organisations. Asiaei, Bontis et al. (2022) performed research on Iran's public listed firms and summarised that GIC had its imprints in environmental performance. Yong et al. (2019) investigated the association between GIC and its segments (GHC, GSC, GRC) on GHRM in the manufacturing firms in Malaysia by conducting a survey and analysed the data by Partial Least Squares analysis. Results revealed that GHC and GRC have directly proportionate relation with GHRM but not with GSC. Liao, Hsu and Chiang (2021) conducted research in Islamic banks to identify the role of Green Intellectual Capital on green human resource management and green

social identity and found that GIC paid significant contribution to GHRM and green social identity. Nisar et al. (2021) explored contribution of GHRM on the environmental performance by taking Green Intellectual Capital and Pro-Environmental Behaviour as a mediator variable and results confirmed this contribution. Haldorai et al. (2022) made an attempt to explore the role Green Intellectual Capital and management's green commitment in influencing GHRM and Environmental Performance of hotels. PLS-SEM (Partial least square- structural equation modeling) was applied on the data and findings concluded direct consequences of GIC on GHRM and EP. Asiaei and his colleagues researched on public listed companies of Iran in 2022 on measuring the prominence ramifications of Green intellectual capital on environmental performance of organisations through green innovation and results inferred that GIC not straight away affected environmental performance but did the same through the mediating variable. Rehman et al. (2021) argued that organisations' concentration on managing green innovation efficiently would flourish green intellectual capital and their intersection would further lead to better environmental performance. Ullah et al. (2022) made an effort to examine association between Green Intellectual Capital and Green Human Resource Management on Environmental performance where green innovation acted as the mediator in Pakistan manufacturing industries and concluded that they don't have direct association with environmental performance and proposed that organisations should focus on strengthening their environmental strategies so that they can get competitive benefit in Environmental Performance.

4.7.4. Green Intellectual Capital and Corporate Social Responsibility (CSR)

Organisations pursue activities in the environmental space as part of their mandatory CSR quota. The GIC of companies focuses on adaptation and mitigation measures concerning the environment viz plantation, energy budgeting, reducing ecological footprint, modifying energy mix, maximising power efficiency, collaborating, cooperating and devising eco-friendly techniques. Studies examining this above-mentioned relationship are as follows: Chang and Chen (2012) examined associations between Corporate Social Responsibility and Green Intellectual Capital components by taking environmental consciousness as a mediator in the manufacturing industries of Taiwan and the results deduced a favourable association. Sudibyoy and Sutanto (2020) deliberated ramifications of CSR and Environmental consciousness on GIC and finally indicated that CSR had conducive effect on all GIC elements but EC had effect on two elements except green relational capital and claimed that it didn't assist in creating relations. Ali, Puah et al. (2021) stated that impression of CSR was an intermediary amongst GIC and GRC and environmental consciousness of the personnel. But the results could not ascertain the same in the case of GSC. The findings provided empirical support for the fact that analysing corporate GIC might actively impact CSR activities initiating pro-ecological activities.

4.7.5. Green Intellectual Capital, Sustainability and Green & Social Innovation

With enhancing ecological consciousness, and environmentally sound laws being implemented, companies need to constantly improvise and innovate their strategies and procedures to become relevant and remain sustainable. Different researches performed in this segment are Delgado-Verde et al. (2014) investigated the effect of GIC segments especially: green organisational capital and green social capital on environmental product innovations in production and transformation metals organisations. For this, a questionnaire was prepared and post examination, the results concluded that green social capital had a favourable correspondence with environmental product innovation but green organisational capital didn't have any kind of direct correspondence. Malik et al. (2020) disclosed that sustainable performance was affected by adopting Green Human Resource Management and Green Intellectual Capital practices that would help organisations cut their cost, allure skilled personnel, open up new prospects, and expand consciousness for environment related issues. Yusoff et al. (2019) also conducted research on Malaysian manufacturing organisations by using partial least square analysis for examining GIC segments and business sustainability connections. Results concluded that green structural capital and green relational capital had positive connection but green human capital didn't have this kind of connection. Ali, Wen et al. (2021) examined consequences of Green Intellectual Capital on the Green Innovation Adoption in the SMEs of manufacturing firms of Pakistan precisely in textile, chemical, pharmaceutical and steel firms. Data was collected through questionnaire and then analysed by applying multiple regression in SPSS software. Results deduced Green Human Capital and Green Structural Capital had favourable and consequential effect on Green

Innovation Adoption. On the other hand, third component Green Relational Capital had favourable impact but at the same time had inconsequential effect and suggested to adopt those practices that help in increasing personnel's green attitude. Yusliza et al. (2020) found that Green Intellectual Capital and Sustainable Performance were connected. The findings indicate GIC enlightenment in an organisation's personnel translated into better financial performance as the skill, innovativeness, know-how enable compelling edge over others. Sheikh (2021) conducted his research in the manufacturing sector in Jammu & Kashmir for determining the repercussions of GIC on Social Innovation (product and service innovation) and asserted that Green Intellectual Capital paid a significant contribution in Social Innovation of organisations and among its elements, green human capital and green structural capital paid a notably higher contribution. Also, organisations should provide due diligence on arising and effectively managing them. Jirakraisiri et al. (2021) found that green intellectual capital and its parts had favourable correspondence with green innovation. Ghosh and Haque (2022) made an attempt to explore the association of GIC elements (green human capital, green relational capital, green structural capital and green spiritual capital) with employee green behaviour on the organisations in energy sector in India. For this, a questionnaire was prepared and results deduced favourable affect, majorly of spiritual capital.

4.7.6. Green Intellectual capital and Green Supply Chain

With environmental degradation, there arises a need for organisations to properly and efficaciously manage their supply chains. A supply chain comprises of all factions involved in the processes required from origination of business, receipt of orders and supply of the same to clients viz., procurement, production, packaging, transportation, marketing, storage, logistics, financing and even formulating and conceiving new products Chopra and Meindl (2007). According to Al-Khatib and Shuhaiber (2022) companies harnessing their intellectual capital and its components in tandem with the ecologically sound aspect often end up improving the efficiency of their supply chain by providing new and innovative inputs to prevalent skills and expertise. Various researchers made an attempt to explore the correspondence between GIC, its segments and green supply chain viz., Xi et al. (2022) pursued research on determining the consequential effect of elements of GIC on green supply chain integration which covered green supplier, internal and customer integration in the manufacturing organisations of China. Results concluded that two elements of GIC precisely GSC and GRC affirmatively had consequential effect on all green supply chain variables but green human capital affected only two of them. Muafi and Sulistio (2022) also performed research on GIC and supply chain integration and deduced favourable link between the two. They emphasised that GIC's potential which includes green human, green structural and green relational capital has the power to carry out intrinsic company consolidation, seller integration, and client assimilation. Maaz et al. (2021) asserted that green supply management methodologies can improve the performance of food processing industries of India. They suggest that the organisations wary of green practices focus on carrying out green supply chain management (GSCM), by initiating with green policies in personnel training (green human capital), production management, procedures (green structural capital) being followed and in the rapport with external stakeholders (green relational capital). According to Ullah et al. (2022) green structural capital can help in improving supply chain efficiency by facilitating ecologically and environmentally sound knowledge exchange amongst personnel, enterprises and external stakeholders. Yong et al. (2019) and Yusoff et al. (2019) analysed the significance of green personnel capital vis-à-vis vital elements success for green supply chain.

5. Discussion

Comprehensively from the literature, it can be understood that GIC construct is a pre-eminent part of an organisation that creates value and furnishes sustainability. As shown above, the publication trend on this construct is increasing expeditiously with a fast annual growth rate. Yet now not many studies have been performed on this construct which make this field further explorable. The intention of this article was to delve into the evolution and development of GIC throughout the period from 2008 to 2022, consequences of GIC, current and future trends. For this, a systematic review was performed, on the data collected from Scopus and Web of Science databases, to provide exhaustive and pragmatic aspects on the substantial contribution of GIC on attaining sustainability.

As per sectoral classification, 65% of the studies were performed on manufacturing industries. Different researchers reasoned this, such as (Yong et al., 2019), that due to the commitment to government regulations and enhanced consumer awareness, these industries are more focussed and conscious about green issues. In the same way various researchers reasoned that this type of industry was the major cause of contamination of environment by way of emission of carbon and water contamination (Rehman et al., 2021; Mansoor et al., 2021; Malik et al., 2020). As per the reviews, majorly manufacturing sector is focussed till now but it's not that only this sector contributes to the Green intellectual construct. Other industries or areas such as Transportation, Agriculture, Residential, Commercial and Institutional Sectors also contribute to contamination of environment and can also be taken into account for further exploration. All types of organisations should be given equal importance whether public or private.

As per the geographical analysis, all studies except one were performed in Asian countries. Studies have predominantly been focussed on southern Asia, eastern Asia, south-eastern Asia while no study has been done in central Asia. Western Asia also has only a single study and all the above mentioned have a scope for future study. Western countries can also work on the aspects of GIC management. The authors' country affiliations are also concentrated in the Asian continent. Both the above points suggest that there is ample scope for further studies in other territories.

Further as per analysis amongst thirty-one studies, all but two, focus on quantitative analysis with primary data and concentrated in the Asian continent, whereas secondary sources can also be utilised for the same.

Regarding the consequences of GIC, researchers were mainly focused on the aspects of Environmental Performance (Mansoor et al., 2021; Yadiati, 2019; Wang & Juo, 2021; Shah et al., 2021; Asiaei, Bontis et al., 2022), further on GHRM (Yong et al., 2019; Liao et al., 2021; Nisar et al., 2021), Competitive Advantage (Chen, 2008; Rezaei, 2016; Sidik, 2019; Mehmood & Hanaysha, 2022), CSR (Chang & Chen, 2012; Sudibyo & Sutanto, 2020; Ali, Puah et al., 2021), Sustainability (Malik et al., 2020; Yusoff et al., 2019; Yusliza et al., 2020), Green and Social Innovation (Ali, Wen et al., 2021; Sheikh, 2021).

As per a thorough examination of articles, ten out of thirty articles contemplate Green Intellectual Capital as entirety meaning that it is not further divided into segments. Results from these researches shows affirmative and significant correspondence of GIC with competitive advantage, environmental performance, green human resource management, green supply chain management and green innovation. Moreover, the remaining researchers broke up GIC into different dimensions (one, two, three or four dimensions). But most of the studies segmented their researches into three dimensions which included green human capital, green structural capital and green relational capital. Generally, GIC translates into unambiguous results but when its components' effects are analysed, they individually show ambiguous results. Such as in some researches results of green human capital have significant correspondence but in some other researches, the results show insignificant correspondence.

Study of Muhammad Shah et al. (2021) discovered that two dimensions of GIC precisely green human capital and green relational capital had a considerable role in affecting environmental performance but the role of green structural capital was unfavourable. Whereas, Asiaei, Bontis et al. (2022) in his study revealed that all the dimensions had a positive contribution in environmental performance. In another study of Asiaei and his colleagues, it was concluded that two dimensions GHC and GSC had direct correspondence with environmental performance but GRC didn't have any correspondence. It was noted that Iranian companies had been unable to properly exploit relational capital with back and front-end supply chain companies and suppliers, and this had resulted into inefficient working for all in the scenario. In continuation of the above, one more study of Asiaei, O'Connor et al. (2022) acknowledged that three dimensions of study were not directly associated.

Study of Yong et al. (2019) inferred that green structural capital didn't have any contribution in green human resource management but the study of Ali, Puah et al. (2021) depicted different results and concluded that all three elements had contributing role in management of green human resource. Studies related to environmental consciousness also showed ambiguous results as in the study of Chang and Chen (2012) all three constituents of GIC favourably linked with environmental consciousness but the results of Sudibyo and Sutanto (2020)

emphasised contrary opinion and found that green relational capital didn't have any link with the environmental consciousness. As per the study of Chen (2008) all three were associated with competitive advantage. In the same manner, GIC dimensions had an association with green strategic intent (Jirakraisiri et al., 2021) and sustainable performance (Malik et al., 2020).

Even post diverse findings, it is clear that better GIC shall enhance the output and financial performance of companies and produce beneficial outcomes. Also, if all the dimensions of GIC are administered properly and efficaciously, this shall further improve organisations' performance. The results motivate the researchers to focus on this construct further.

6. Conclusion

Environmental management has become the present need in environmentally progressive economies and organisations too are concentrated on placing more emphasis on developing green environment. This has led organisations to replace their conventional practices by adopting green practices. Green intellectual capital is one of the practices that has been adopted by organisations and is the crucial factor in enhancing environmental performance and providing competitive benefit. Researches are also now focused to contribute to this green generation. Chen was the one who initiated research related to this construct. From his seminal work, other researchers also started getting indulged in research in this field. This study also contributes to this field by providing insights about its evolution and development over the periods and by also discussing about the gaps in literature and further future research areas.

To sum up the findings of this systematic review, overall, green intellectual capital has influential positive role in organisations but when it is portioned into further parts, their results have been ambiguous. Reason of ambiguous results could be that different researches were performed in different contexts, in different countries, for different time periods and importantly in different organisations by choosing different respondents, so any generalisation could not be built. Another important finding was that most of the researches were performed in Asian countries in manufacturing sectors by undertaking quantitative approach. The study provides useful insights to researchers, practitioners, managers and policy makers on the role of green intellectual capital's on affecting different aspects such as competitive advantage, green human resource management, green supply chain, sustainability, etc. Outcomes of this study recommend that intangible resource- green intellectual capital should be managed efficaciously which will provide competitive benefit and also contribute to organisations financial, social and environmental performance. Organisations should deploy new strategies, tactics and guidelines to manage efficiently all the dimensions of GIC. Policymakers should organise environmental conservation training courses to further streamline their GIC potential.

6.1. Implications

This article puts forward various theoretical and managerial implications. Firstly, this article made an addition to the available knowledge by shedding light on green intellectual capital construct. This review article highlighted that all studies were focussed on measuring the role of Green Intellectual Capital on affecting different aspects. Amongst all, large number of studies were focussed on assessing the role of GIC on performance, GHRM and competitive advantage aspects whereas less number of studies were present focussing on green and social innovation and green product innovation aspects. Moreover, vast majority of studies were performed on manufacturing firms and followed quantitative approach. Secondly, this article highlights the crucial role of green intellectual capital in organisations which is enormously noteworthy in contemporary environmentally concerned economy.

Findings of this study will provide useful insights to researchers, practitioners, managers and policy makers. Outcomes of this study provide input that intangible resource- green intellectual capital should be managed efficaciously which will provide competitive benefit and also contribute to organisations financial, social and environmental performance. Organisations should deploy new strategies, tactics and guidelines to manage efficiently all the dimensions of GIC (green human capital, green structural capital and green relational capital). GHC having noteworthy contribution in organisations, is possessed by personnel of organisations and leave it

behind when they depart. Organisations should train and educate their personnel to be environment savvy. By developing environmentally concerned conception and motivating them, organisations can boost their lucrativeness. Secondly, green relational capital according to past researches depict that bondings enabling better knowledge flows among companies shall better enhance the opportunities for an organisation's profitability and sustainability. Lastly, organisations should focus on improving their capabilities, methods, procedures which focuses on efficiently managing green structural capital.

Companies must employ training their personnel, expanding their CSR activities and enhancing their exposure to environmental concepts for gaining an advantage over its competitors and peers, which shall indirectly decrease their environmental footprint as well.

To strengthen organisations, policymakers should organise environmental conservation training courses. The relevant government authorities must employ mitigation and adaptation facilities to decrease the environmental damage caused by industrial areas and co-operate with relevant operators to sustainable use the scarce resources.

6.2. Limitations and further research areas

As there are always some limitations, this article also has some limitations. Firstly, this study only included data from Scopus and Web of Science databases and search was made with limited keywords. Thus, it is possible that some of the important articles were not included in this research, although the authors attempted to include all relevant articles because Scopus and Web of Science are the two largest databases which also have a broad coverage. Secondly, this article was limited to include articles published in English language only. There could be some relevant articles which have been published in other languages. Thirdly, this study only covers systematic review. Meta-analysis can further provide deeper insights on this concept. Limitations of this study open up new door for further researchers. Some suggestions for further research areas are:

- Further researches can be performed on other types of organisations such as: transportation, agriculture, food retail, sanitary services, communication services, real estate services, education and courier services.
- Research can also be performed by comparing results of two different types of organisations.
- Green intellectual capital contribution in value creation.
- Role of green intellectual capital and its dimensions in untangling green or social issues.
- Longitudinal studies can also be performed to know various stages of GIC.
- Consequences of GIC on firm value and profitability.
- Impact of training and education of environmental protection on green human capital. Its existing scope and after affects can be measured.
- Further researches can be done by utilising other databases such as google scholar.
- Impact of single dimension can be analysed in different contexts.
- Role of knowledge and innovation in sustaining the environment.

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