

A scientometric analysis of quantity surveying research: trends and future direction

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ABSTRACT

The development of people, organisations and professions is driven by several factors including research. As such, evaluating research trends within a given field of study is necessary to understand current issues and identify gaps to make meaningful contributions to the body of knowledge. The scientometric analysis offers the opportunity to understand these research trends while identifying leading contributors (authors, countries, institutions), impactful contributions and areas of focus in existing studies. Using the scientometric analysis, this paper presents a visualisation of quantity surveying (QS) research published from 2003 to 2023 and indexed in the Scopus database. Using an interpretivist philosophical stance, the study found that QS studies have emanated from diverse countries, including the United Kingdom, Malaysia, Nigeria, South Africa and Australia. Journal outlets are the major sources of disseminating QS research findings, while the lack of proper indexing of many QS conference proceedings is responsible for fewer conference publications. Past QS studies have focused on six major areas, which are (1) QS professional service and management, (2) QS and BIM in design and cost estimating, (3) QS competencies, (4) QS education and training, (5) QS in the construction industry, (6) QS and project planning. These identified areas create room for future studies to research less explored areas such as human resource management, higher education, information theory, QS and climate change adaptation, green/circular/bio-economy, digitalisation, and innovative construction.

Keywords: Bibliometric, Network visualisation, Quantity surveying, Scientometric analysis, Science mapping

1. INTRODUCTION

The construction industry has been adjudged to be a crucial contributor to the socio-economic development of countries worldwide. To make this significant contribution to nation development, the industry relies on diverse stakeholders drawn from different professions within the built environment. One such profession is quantity surveying (QS), which, according to Murdoch and Hughes (2008), involves a high level of professional competence rooted in genuine ethical conduct. The QS profession is noted to have originated in England and has become prominent in the construction industry of many countries worldwide (Maritz and Sigle, 2010). The provision of regulations rooted in professionalism and ethical conduct has made this profession popular within the construction industry. Moreover, the important role of quantity surveyors in overseeing the financial aspect of construction projects has necessitated the need for a high level of professionalism rooted in sincere ethical conduct (Olatunji et al., 2016; Paul et al., 2021).

The Royal Institute of Chartered Surveyors (RICS, 2023) described a quantity surveyor as an individual with a strong QS knowledge. Such individuals are responsible for estimating construction costs, quantifying construction materials and determining project timelines. According to Dada and Jagboro (2012), they have expert knowledge of construction costs and contracts and can be involved in managing contractual and financial aspects of construction works. The QS profession has been described as one that combines several other professions, such as law, accounting, management, and economics, among others, in a dynamic manner to deliver successful construction works and ensure clients get value for money (Ashworth et al., 2013; Fanous, 2012). Ashworth et al. (2013) noted that quantity surveyors, among other functions, carry out cost planning and estimating, measurement, procurement guidance, preparation of contract documents, valuations, contractual claims, payments, and final accounts for construction projects. Oyediran and Akintola (2011) also noted that the QS profession is a service-based organisation that provides consultancy, financial, and management services to construction clients. More so, the profession is rooted in knowledge as quantity surveyors offer information rather than physical items. These professionals use their knowledge to administer a wide range of activities which they offer to their clients as services.

Like other built environment professions, the QS profession has members practising within the construction industry and in academics. Many professionals within the academic system conduct research designed to improve the delivery of QS services. To this end, the QS profession has received significant research attention in the past, and research findings relating to core issues in the profession have been well documented. However, there is an absence of studies exploring the different research areas undertaken within the QS profession to provide a clear direction for future research within the profession. Moreover, as the world continues to evolve and innovations continue to revolutionise the way diverse professions operate, research within the QS profession is also worth exploring to unearth the trends and new areas of focus. By exploring research trends within the profession, researchers seeking to undertake research activities in the profession can have clear areas to focus their searchlight on to make meaningful contributions to the body of knowledge from the QS perspective. Moreover, critical evaluation of research trends is necessary for understanding current issues and identifying research gaps to make meaningful contributions to the body of knowledge within a given field of study. The scientometric analysis offers the opportunity to understand these research trends while identifying leading contributors (authors, countries, institutions), impactful contributions and areas of focus in existing studies (Blazun et al., 2015; Olawumi and Chan, 2018). To this end, this paper explored the trend in QS-related research to map out the areas of focus of past studies and suggest directions for future research within the profession using scientometric analysis. The subsequent parts of the paper highlight the methodology adopted, the findings and conclusions drawn from the findings.

2. METHODOLOGY

The study adopted an interpretivist philosophical stance using a scientometric review of existing studies where each publication represented a unit of analysis for the review. The scientometric approach was adopted based on the study's objectives, which were to unearth areas of the research focus of QS research and proffer directions for future studies. This approach has gained attention in recent built environment studies in determining popular authors, countries, funding bodies, sources and types of collaborations within a subject area (Adah et al., 2023; Aghimien et al., 2022; Olawumi and Chan, 2018; Saka and Chan, 2019). Figure 1 shows the research method framework adopted. The Scopus database was used in the scientometric review to gather bibliographic data of QS-related articles published in the last 20 years (2003 to 2023).

Scopus was used because it is a well-recognised database among researchers in the field of science and has some overlaps of articles with other databases (Aghimien et al., 2020; Chadegani et al., 2013; Guz and Rushchitsky, 2009). The search protocol adopted was **Title-Abstract-Keywords**: "Quantity surveying". While the QS profession has been given different names in different countries (Aibinu and Venkatesh, 2014), the term "quantity surveying" is widely recognised and used to describe the profession in many parts of the world. Also, this study is centred on QS-related research, hence the use of the term for bibliographic search. The twenty-year range was adopted to ensure the trend in research in this area is clearly understood. The initial search gave 395 documents within the selected timeframe. This search was refined based on the language and source type. The language was set at English, while the source type was journals and conference proceedings. These refinement criteria reduced the number of documents to 318. These documents were extracted in Comma-separated values (CSV) and Bibtext format for further analysis using Excel, Biblioshiny in R-studio and VOSviewer software. The use of a combination of software for the analysis of the extracted bibliographic data was premised on the need for a robust outcome that clearly delineates the trend of research in the QS profession. The results are presented based on the performance analysis (year, sources, country, authors), science mapping (top cited documents) and network analysis (network visualisation).

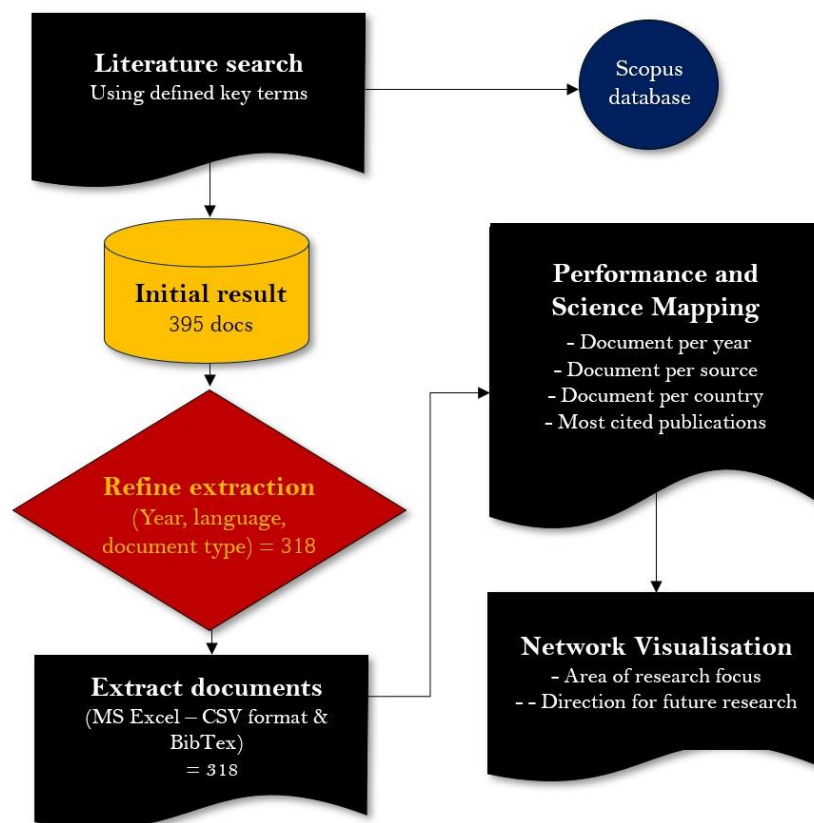


Figure 1: Research method framework

3. FINDINGS AND DISCUSSION

3.1 Performance analysis of quantity surveying research

3.1.1 Publication per year

Figure 2 shows a continuous rise and fall in the number of quantity surveying documents published and indexed in Scopus from 2003 to 2023. Significant output was noticed from 2018 to 2022. 2023 has witnessed 19 documents, with the possibility of increasing by the end of the year as this search was conducted in September. The figure also gives the mean total citations (TC) per article in each year (MeanTCperArt). The line graph shows that 2003 and 2014 recorded the highest MeanTCperArt of 55.5 and 45.1, respectively. It can be noticed that the MeanTCperArt dropped from 2015. It is believed that when forthcoming publications leverage these documents and cite them, the MeanTCperArt in these years will increase.

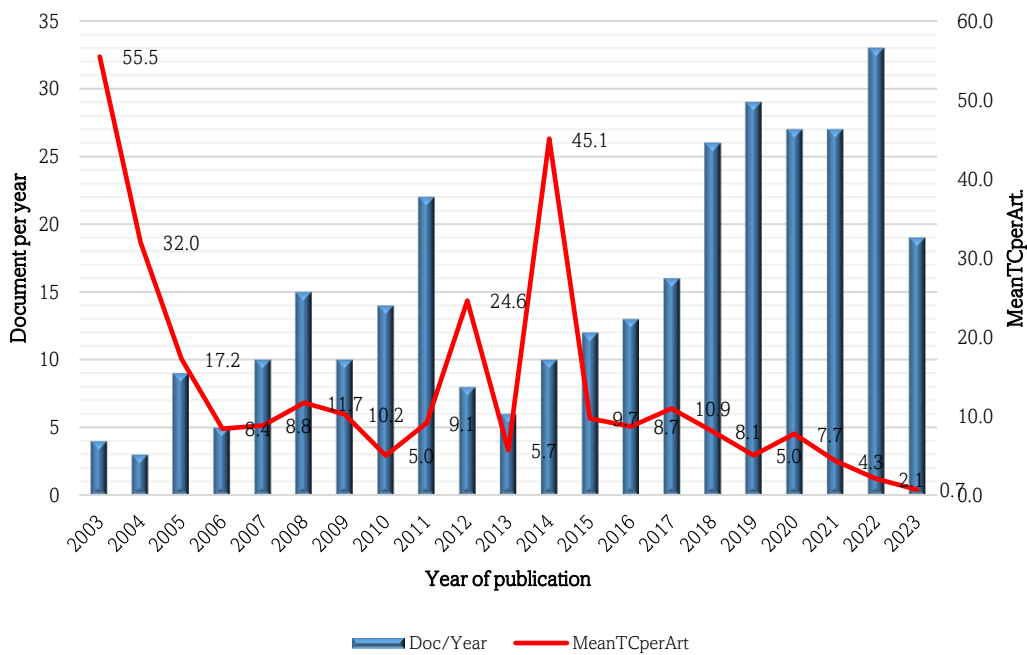


Figure 2: Publication per year

3.1.2 Documents per country

Figure 3 shows the countries of publication of the extracted documents. The figure shows the Single Country publications (SCP) and Multiple Country Publications (MCP). The United Kingdom has the highest number of publications, most of which emanate from the country alone. Only 12 documents were done in collaboration with authors from other countries. The documents emanating from the United Kingdom have garnered 459 TC with an average citation of 10.4 per article. Malaysia ($f = 34$, TC = 160), Nigeria ($f = 30$, TC = 397), South Africa ($f = 27$, TC = 102) and Australia ($f = 15$, 205) have also witnessed significant publications and reasonable collaborations with other countries. It is imperative to note that some countries with a scant number of publications can be as a result of the keyword used in searching. Since some countries do not use the nomenclature "quantity surveying", it is expected that their publications might not have this name in their title, abstract or keywords.

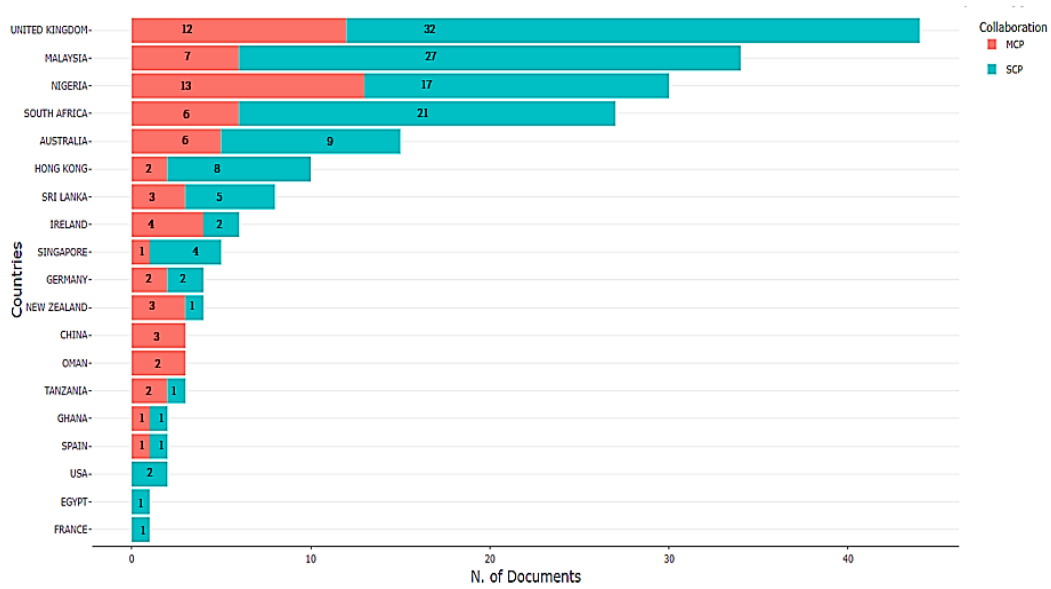


Figure 3: Countries of publication

3.1.3 Contribution of authors

Figure 4 shows a three-field plot of the countries, authors and key terms. Top on the list of most published authors is Ekundayo D ($f = 12$, h -index = 9, TC = 195), Babatunde SO ($f = 13$, h -index = 9, TC = 2), Perera S ($f = 8$, h -index = 6, TC = 110), and Ismail NAA ($f = 6$, h -index = 3, TC = 42). Viewing these authors' contributions from the perspective of citations gathered over time, it was observed that Holt GD, Akintoye A, Endut IR and Shehu Z have all garnered over 160 citations each.

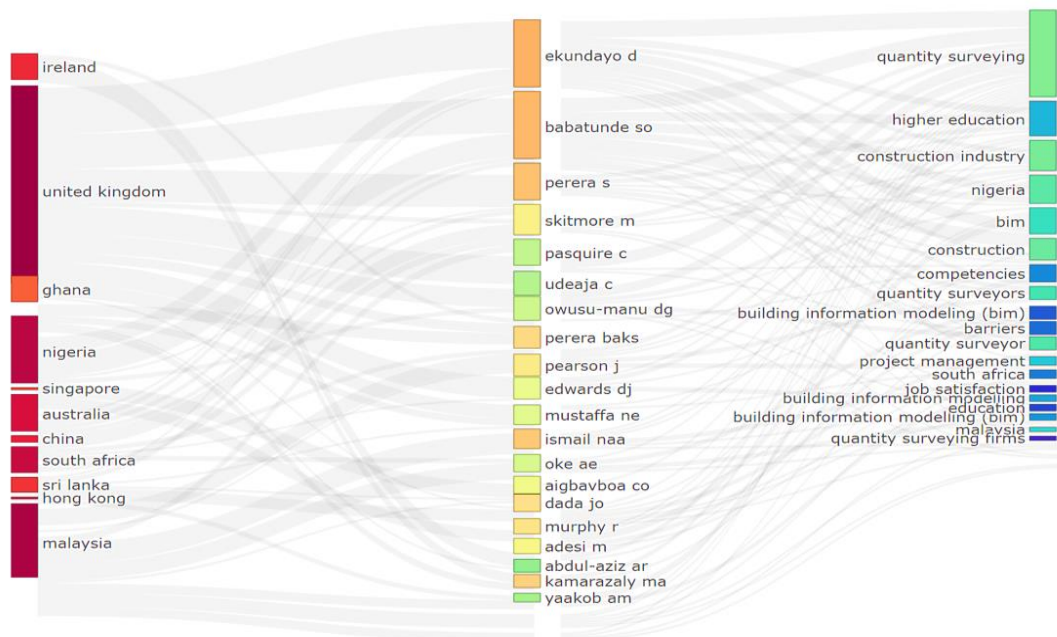


Figure 4: Three-field plot

3.1.4 Publication per source

The extracted documents came from 140 sources. The top ten sources, which comprise nine journal outlets and one conference, are shown in Table 1. Engineering, Construction, Architectural and Management, published by Emerald, has the highest number of publications ($f = 16$) with a TC of 243. The QS-related papers published in this journal have an h -index of 8, which implies that at least eight of these papers have been cited eight times in other publications. This is followed by the Journal of Engineering Management ($f = 15$, h -index = 7; TC = 187) published by Emerald, Construction Management and Economics ($f = 11$, h -index = 8; TC = 313) as well as the International Journal of Construction Management ($f = 11$, h -index = 4; TC = 54), both published by Taylor and Francis. The Association of Researchers in Construction Management (ARCOM) 2010 - Proceedings of the 26th Annual Conference also saw five publications cited 27 times with an h -index of 3. It is important to note that while more QS-related conferences have occurred over the years, the non-indexing of the proceeding of most of these conferences is responsible for the low outcome of conference sources on the list provided in the table.

Table 1: Top sources of publication

Element	f	TC	h -index	m -index
Engineering, construction and architectural management	16	243	8	0.42
Journal of engineering, design and technology	15	187	7	0.41
Construction management and economics	11	313	8	0.38
International journal of construction management	11	54	4	0.33
Journal of financial management of property and construction	8	74	5	0.29
ARCOM 2010 - proceedings of the 26th annual conference	5	37	3	0.21
Australasian journal of construction economics and building	4	134	4	0.31
Journal of professional issues in engineering education and practice	4	157	4	0.31
Built environment project and asset management	4	30	3	0.33
Benchmarking	3	27	3	0.14

3.2 Science mapping of quantity surveying research

3.2.1 Publications with the highest citations

Past studies have noted that citation counts are effective in determining the scientometric performance of scholarly publications and the impact of academics within their respective field (Hirsch, 2005; Wang et al., 2019; Zhang, 2013). As such, to understand the impactful articles published within the selected timeframe, a scientific mapping of documents by citations was conducted. It was noticed that 242 documents have been cited at least once. Table 2 reports the top-cited documents with at least 60 citations. Shehu et al. (2014) explored the cost overrun of projects in Malaysia and found that public projects are more susceptible to overrun than private projects, which have received 149 TC. Similarly, Aibinu and Venkatesh (2014) explored BIM adoption and its experience among cost consultants in Australia using a questionnaire survey approach. They found that QS firms in the country rarely use BIM features. This lack of adoption was attributed to several factors, including design uncertainties, inadequate information in models, lack of knowledge, and lack of client demands, among others. This research has been cited 118 times since it was published. Earlier, Yong and Mustafa (2012) explored the critical success factors for construction projects in Malaysia using a questionnaire survey and found that human-related factors are crucial to the success of construction projects in the country. This study has garnered 107 citations. An exciting insight from these top-cited articles is that most were conducted using

a questionnaire survey. This is a pointer to the need for future works conducted through other research methods such as case studies, participatory approach, etc.

Table 2: Top cited publications

Document	Title	Source	TC	TC/ Year	Normalised TC
Shehu et al. (2014)	Cost overrun in the Malaysian construction industry projects: A deeper insight	International Journal of Project Management	149	14.9	3.303
Aibinu and Venkatesh (2014)	Status of BIM adoption and the BIM experience of cost consultants in Australia	Journal of Professional Issues in Engineering Education and Practice	118	11.8	2.616
Yong and Mustafa (2012)	Analysis of factors critical to construction project success in Malaysia	Engineering, Construction and Architectural Management	107	8.9	4.345
Odusami et al. (2003)	The relationship between project leadership, team composition and construction project performance in Nigeria	International Journal of Project Management	90	4.3	1.622
Stanley and Thurnell D. (2014)	The benefits of, and barriers to, implementation of 5D BIM for quantity surveying in New Zealand	Australasian Journal of Construction Economics and Building	87	8.7	1.929
Kohler and Moffatt (2003)	Lifecycle analysis of the built environment	Industry and Environment	80	3.8	1.441
Fong and Choi (2009)	The processes of knowledge management in professional services firms in the construction industry: A critical assessment of both theory and practice	Journal of Knowledge Management	76	5.1	7.451
Wong et al. (2011)	Building information modelling for tertiary construction education in Hong Kong	Electronic Journal of Information Technology in Construction	68	5.2	7.442
Aibinu and Pasco (2008)	The accuracy of pre-tender building cost estimates in Australia	Construction Management and Economics	64	4.0	5.485
Barnes et al. (2004)	Exploring the linkage between internal marketing, relationship marketing and service quality: A case study of a consulting organisation	Total Quality Management and Business Excellence	61	3.1	1.906
Ellis et al. (2005)	Value management practices of leading UK cost consultants	Construction Management and Economics	61	3.2	3.541

it was observed that these firms do not have staff assigned to knowledge acquisition from external sources.

Cluster 2 – named "*QS and BIM in design and cost estimating*", has ten items and is evident in the green nodes. These items include building information modelling, architectural design, cost estimating, information theory and structural design. Aibinu and Venkatesh (2014) explored BIM adoption in QS firms in Australia. They found that BIM features are rarely used due to design uncertainties, inadequate information in models, lack of knowledge, and lack of client demands, among others. Sepasgozar et al. (2022), in a bid to proffer solutions to cost overruns, explored the use of BIM in reducing overruns in agreed construction costs. It was observed that BIM can be applied to critical QS functions like estimating, preparing bills of quantities, risk identifications, cost control and value management. In New Zealand, Stanley and Thurnell (2014) assessed the benefits and challenges of using 5D BIM in QS profession. The study discovered that 5D BIM offers efficiency, better visualisation and risk identification over the conventional construction method. It was further noticed that several factors, including compatibility issues, high initial cost, and lack of BIM standards, among others, challenge this innovation. From the students' perspective, Babatunde et al. (2018) explored the drivers and benefits of BIM in the QS profession in Nigeria. The study provided empirical evidence on the perceptions of the drivers and benefits of BIM to the QS profession. Adekunle et al. (2022) explored the BIM consciousness of young quantity surveyors and found that Revit, Naviswork, Tekla structure, CostX and Buildsoft cubit are among the most common software among these sets of quantity surveyors. A systematic introduction of BIM into the QS curriculum in institutes of higher learning was further proposed to improve the use of BIM in the QS profession.

Cluster 3 – named "*QS competencies*", has eight items in the blue node. These include quantity surveyors, construction, competencies, construction professionals, cost benefits and sustainable development. Victar et al. (2023) investigated the role and competencies of quantity surveyors in the attainment of circular built environments using a qualitative approach. It was discovered that cost planning and control, feasibility studies, measurement, risk and value management, and innovations are vital roles of quantity surveyors in the quest for a circular built environment. In terms of required competencies, it was observed that basic interpersonal skills, economic analysis, BIM management, and cost and risk management are needed. In Sri Lanka, Yogeshwa et al. (2018) explored the competencies required by quantity surveyors. They found cost planning, strategic planning, risk management, value management, life cycle cost analysis, sustainability, surveying and levelling, research and development, building surveying and business management as crucial competencies needed. Also, in Zimbabwe, Moyo et al. (2023) explored the competencies expected from quantity surveyors. It was observed that quantity surveyors in the country are expected to exhibit competencies in project finance control and reporting, sustainability conflict avoidance and dispute resolution procedures.

Cluster 4 – named "*QS education and training*", has eight items in the yellow node. This includes education, construction education, engineering education, curricula, students, project management, and construction management. The QS profession cuts across several built environment fields and is taught in relation to these fields in higher institutions. Hence, it is reasonable to see studies exploring QS education and training in relation to project and construction management as well as engineering. In Malaysia, Wong et al. (2022) explored sustainability diffusion in QS education through a mixed-method approach. The study found that the concept of sustainability is not adopted holistically as a standalone module but rather embedded within a course as a subtopic. In the same vein, Yap et al. (2022) examined the factors influencing the learning experience of quantity surveying students and noted factors relating to the lecturers' competence and professionalism, quality of services, the structure of the curriculum, the environment and interpersonal connections and external consideration. From the perspective of entrepreneurship, Sampath et al. (2020) explored gaps

in entrepreneurial skills, traits and knowledge in quantity surveying education in Sri Lanka. The study concluded that seven major skills and three knowledge areas are underdeveloped in QS education at the undergraduate level. The studies show the need for sustainable education within the QS field and the proper development of younger generations for a sustained QS profession.

Cluster 5 – named "*QS in the construction industry*", has six items in the purple nodes. These are the construction industry, built environment, quantity surveying firms, construction projects, information technology, and innovation. The studies within this cluster have explored the role of QS in the construction industry and diverse measures for QS firms to stay relevant in the industry. For instance, Shen et al. (2003) explored information technology usage in QS firms in Hong Kong and provided an updated view of how these firms incorporated information systems into their service delivery. In South Africa, Cruywagen (2006) explored the implementation of quality management systems with QS firms and concluded that these firms can adhere to the requirements of ISO 9001:2000 quality principles. To ensure the continuous operation of QS firms, Otasowie and Oke (2022) explored the drivers of mentoring practices within QS firms in Nigeria. It concluded that there is a high awareness of mentoring but poor adoption of its practices within these firms.

Cluster 6 – named "*QS and project planning*"- has five items in the torques nodes: planning, lifecycle, budget control, costs and contractors. Several studies have explored the importance of planning for the success of a project. The traditional role of QS in ensuring cost-effective projects are delivered has also been noted. To this end, studies have continued to explore issues around cost overruns and how to combat this menace that has bedevilled the construction industry for a long period (Aibinu and Pasco, 2008; Shehu et al., 2014; Yong and Mustafa, 2012). From the perspective of QS and lifecycle, Kohler and Moffat (2003) argued that conducting Lifecycle assessment (LCA) is germane to attaining sustainable construction; however, a comprehensive LCA can prove expensive unless used along with other practices such as QS.

3.4 Direction for future studies

An assessment of the overlay visualisation derived from VOSviewer revealed that earlier studies from 2012 to 2014 majorly explored areas such as surveying, project management, cost, planning, education, and professional services, among others. However, from 2015 to 2017, the focus shifted towards curricula, students, budget control, cost estimating, contractors, lifecycle, and structural design, among others. Since 2018, more current focus has been on quantity surveyors and their relationship with architectural design ($f = 39$, $TLS = 226$), building information modelling ($f = 25$, $TLS = 130$), human resource management ($f = 7$, $TLS = 17$), higher education ($f = 14$, $TLS = 40$), information theory ($f = 12$, $TLS = 88$), and competencies ($f = 7$, $TLS = 27$). Looking at the derived frequency of occurrence (f) and TLS of these keywords in the recent area of focus can show which areas are receiving adequate attention and which can be further researched. As such, it is evident that more research can be conducted in the area of the QS profession and the management of human resources as this gave the lowest TLS. Considering the current digital era where technology is changing how professions operate, it is essential to explore how these emerging technologies are influencing the management of quantity surveyors and workers in QS firms. Moreover, exploring the management of workers in QS firms is quintessential considering that skill shortage is recorded as one of the major challenges facing the construction industry in recent times (Okoronkwo, 2023). Also, QS profession in relation to higher education in the current digital era, information theory as it applies to QS firms, as well as competencies of quantity surveyors in the current technology-driven industry, can also be given further attention as they all have the least occurrences in recent studies.

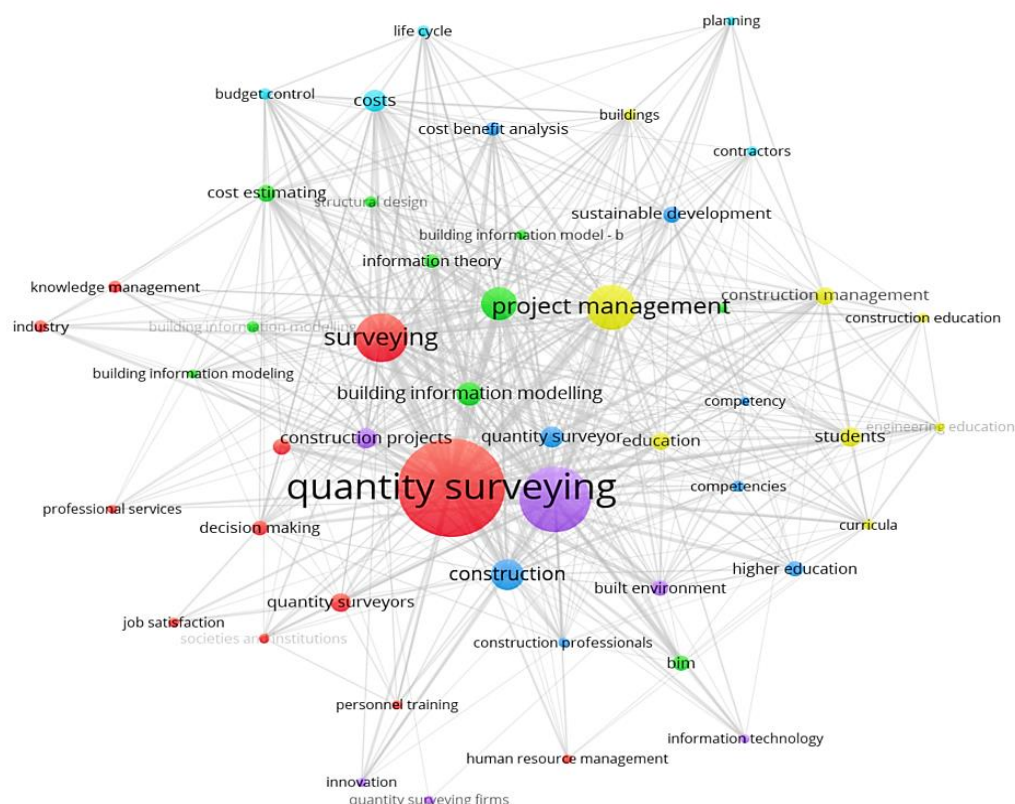


Figure 6: Network visualisation of co-occurring keywords in past QS studies

An important takeaway from these recent focus areas is the lack of attention to the role of QS in current global events. It was observed that the role of QS in current global issues is lacking, and this indicates an area for future studies to explore. For instance, none of the extracted documents focused on the role of QS in the current climate change discourse. Zikhathile et al. (2023) noted earlier that the effect of climate change on the earth's sustainability is devastating, and this has become a growing concern for countries worldwide. There is no gainsaying that the QS profession has a critical role to play in climate change adaptation as well as energy efficiency and conversation in the built environment. Similarly, none of the extracted studies emphasise the importance of QS in areas such as green/circular/bio-economy, digitalisation and innovative construction such as additive manufacturing and modular construction; these are all worthy of exploration in future research. For instance, Richer (2023) submitted that, among other issues, the slow adoption of emerging digital tools is a crucial problem facing the construction industry. Many of these technologies have brought about the digitalisation of businesses, and adopting these technologies promises enormous solutions to construction problems (Ikuabe et al., 2020; Oke et al., 2018). Based on these observations, coupled with the earlier noted recent areas of research focus, it is suggested that future research in QS beam their searchlights in areas such as competency of QS in the current technology-driven industry, human resource management in QS firms in the current digital era, revamping/reanalysing the QS curriculum in higher education, information theory in QS firms, the role of QS in climate change adaption, green/circular/bio-economy, digitalisation of QS services and innovative construction methods (e.g., 3D printing and modular construction) as seen in figure 7.

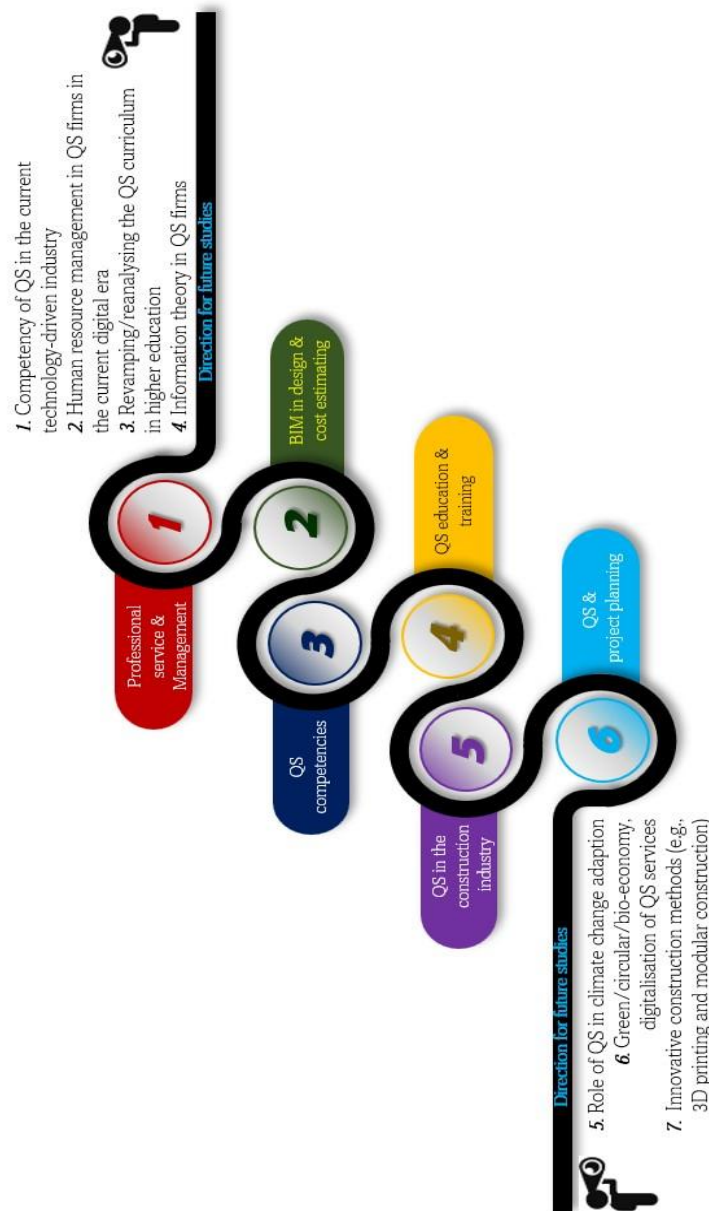


Figure 7: Summary of the area of research focus and direct for future studies

4. CONCLUSION

This study visualised QS-related research published from 2003 to 2023 and indexed in the Scopus database. Using a scientometric analysis wherein performance analysis, science mapping and network analysis were conducted, the study concludes that QS studies have emanated from diverse countries around the world. The United Kingdom, Malaysia, Nigeria, South Africa and Australia topped the list of countries with the highest publications. Journal outlets are the major source of disseminating the QS research findings, with fewer studies coming from conferences. The non-indexing of many conference proceedings from the diverse QS conferences worldwide led to this smaller number of conference publications. If QS researches is to make an increased impact and garner more recognition and citations,

organisers of core QS conferences where research outputs are disseminated must endeavour to either index their proceedings in reputable index platforms or publish the proceedings emanating from their programmes in reputable outlets with good indexing. This is necessary as while several QS conferences are held worldwide yearly, the medium of publishing their proceedings is not given adequate attention and, as such, lacks the needed visibility.

The study also concludes through science mapping that the use of questionnaire survey is common in past QS studies. This observation allows future QS researchers to contribute methodologically through other research approaches. Also, the network analysis conducted showed that past QS studies have focused on six major areas which are, (1) QS professional service and management, (2) QS and BIM in design and cost estimating, (3) QS competencies, (4) QS education and training, (5) QS in the construction industry, and (6) QS and project planning. Additionally, the trend in these extracted publications showed that while several aspects of QS have received adequate attention in the past, there is still room for further studies on competency of QS in the current technology-driven industry, human resource management in QS firms in the current digital era, revamping/reanalysing the QS curriculum in higher education, information theory in QS firms, role of QS in climate change adaptation, green/circular/bio-economy, digitalisation of QS services and innovative construction methods.

Based on the finding of this study, it is believed that the outcome offers a theoretical platform and signposting for future research in QS. The direction for future research offers a good base for future studies to contribute significantly to the QS body of knowledge. It is imperative to note that the findings of this paper are limited by the database used (Scopus only). Although a significant overlap between Scopus and other databases has been noted, there is still the possibility of getting more articles if other databases were explored. Also, the keyword used in searching the database was restricted to quantity surveying, and this limit the number of extracted documents published from countries where the QS profession is called a different name. Future studies can, therefore, include other nomenclatures.

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