Review

A Mixed Review of Research on Competencies of Built Environment Professionals in Infrastructure Delivery within Emerging Economies

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A Mixed Review of Research on Competencies of Built Environment Professionals in Infrastructure Delivery within Emerging Economies

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Abstract: This study presents a mixed review of research on the competencies of built environment professionals in infrastructure delivery within emerging economies. By integrating bibliometric analysis with a systematic review, the research offers a comprehensive understanding of key themes, trends, and debates in the field. The review process culminated in the selection of 59 publications, which were analyzed to identify critical topics including embedding emerging skills in built environment competencies, competency-based curriculum, technology infrastructure and assessment, municipal competency training, and the role of the Fourth Industrial Revolution (4IR). The findings underscore the importance of evolving educational frameworks to meet the demands of globalization, integrating advanced technologies, and fostering industry-academic collaborations to enhance the skills of professionals in the built environment sector. This approach ensures a robust examination of the competencies necessary for effective infrastructure delivery in emerging economies.

Keywords: built environment competencies; infrastructure delivery; emerging economies; bibliometric analysis; systematic literature review; competency-based curriculum; construction management skills

1. Introduction

The infrastructure sector plays a critical role in the socio-economic development of emerging economies, acting as a catalyst for growth, modernization, and overall improvement in quality of life [1,2]. However, the effective delivery of infrastructure projects within these contexts often encounters a myriad of challenges. Among these, the competencies of built environment professionals emerge as a pivotal factor influencing project outcomes. The competencies required for successful infrastructure delivery are multi-faceted, involving technical expertise, project management skills, and a deep understanding of local socio-economic and regulatory environments [3,4]. In emerging economies, these requirements are further complicated by factors such as resource constraints, rapid urbanization, and evolving governance structures [5]. Consequently, professionals in the built environment must possess not only core technical skills but also adaptive and integrative competencies to navigate these complex and dynamic settings [6]. The deployment of appropriate skills and competencies is essential for the growth and sustained relevance of any profession. In the built environment, selecting the right skills and competencies for quantity surveyors and understanding their interdependencies remains a critical area of research [7,8]. When assessing the training needs of construction site managers, there is a widespread belief that they are currently facing skill shortages. How these managers are adapting to the evolving landscape of construction technology, material innovations, management techniques, knowledge expansion, and client demands continues to be a topic of ongoing investigation [9,10].

This issue mirrors the performance expectations of professionals in the built environment. Skills are defined as proficiency or ability gained through training or experience, while competence refers to actions, behaviors, or outcomes that a person should be able to demonstrate, including the ability

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to apply skills and knowledge in new situations within a specific occupational area [11,12]. Semantically, "competence" is often used to describe specific knowledge or observable characteristics, whereas skills represent a combination of human expertise and resources, integrated by an organization's processes, systems, and culture [13,14]. Competence can be seen as a cluster of related knowledge, attitudes, skills, and personal characteristics that significantly impact job performance, correlate with work outcomes, can be measured against accepted standards, improved through training, and broken down into various dimensions [1,15].

Formal assessment of skills and competencies requires clear definitions and classifications in terms of type and extent. However, a comprehensive review of these classifications reveals significant inconsistencies, with overlapping definitions and redundant categorizations, making it challenging to compare skill and competence frameworks precisely. For construction professionals, there are foundational skills and knowledge that are expected, typically acquired in academic settings, particularly at tertiary institutions. These must be integrated into an appropriate educational framework to ensure their ongoing relevance.

However, with recent advancements in the industry and the surge in information technology, academic institutions are struggling to impart all the necessary information and skills required for these professions. Recent reports indicate that current industry demands for skills are not being sufficiently met, as the capabilities of recent graduates often fall short of industry expectations. For higher education institutions (HEIs) to address both present and future challenges effectively, a comprehensive and well-developed understanding of the education-industry skills landscape is essential. This deeper conceptual grasp will enable HEIs to formulate meaningful recommendations and implement effective interventions.

To meet the evolving needs of the industry, professionals in the built environment must be equipped with the training necessary to engage with key issues such as informality, urban poverty, infrastructure and service provision, land management, and local governance. These areas are critical for the sustainable development and management of urban spaces, and addressing them requires a workforce that is not only technically skilled but also socially aware and adaptable to complex urban challenges. As Alshawi et al. (2007) noted, traditional training and education models are often criticized for their lack of alignment with industry needs, a gap often referred to as the 'skills and competence gap.' Education and training, along with the continuous enhancement of skills and knowledge, have been recognized as crucial factors in the advancement of professions within the built environment. Having computer literacy and information technology skills is increasingly seen as an added advantage in performing fundamental technical tasks like measurement and quantification. Currently, there is a significant shift towards automation across various areas [13]. Many services are either being automated or have already seen a reduction in manual involvement due to technological advancements [16]. The reality is that anything that can be done manually has the potential to be automated. The benefits of automation, such as time savings, increased accuracy, and enhanced productivity, cannot be overstated. In emerging economies, the delivery of infrastructure projects is critical to supporting economic growth, urbanization, and improved quality of life. However, built environment professionals in these regions often face significant challenges due to gaps in competencies that are essential for effective project delivery. Rapid advancements in technology, the demands of globalization, and the shift towards sustainable practices have heightened the need for professionals who possess a diverse set of skills, knowledge, and attitudes. Despite the growing recognition of the importance of competency development, there is a lack of comprehensive understanding of the specific competencies required for built environment professionals in emerging economies [17]. This gap hinders the ability of educational institutions, industry stakeholders, and policymakers to design and implement effective training and development programs that align with industry needs.

This study addresses this problem by conducting a mixed review of existing research on the competencies of built environment professionals in infrastructure delivery within emerging economies. Through a combination of bibliometric analysis and systematic literature review, the study aims to identify key themes, trends, and debates surrounding competency development in this

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context. The findings will provide valuable insights into the critical skills needed to meet the demands of the Architecture, Engineering, Construction, and Operation (AECO) industry, and inform the development of competency-based curricula, technology infrastructure, and industry collaborations essential for advancing the capacity of built environment professionals in emerging economies.

2. Research Method

A mixed review approach is considered highly effective for addressing the core objectives of this study on the competencies of built environment professionals in infrastructure delivery within emerging economies [18–20]. By combining bibliometric analysis to track research trends and key themes with a systematic review to explore critical discussions and central debates, this approach provides a comprehensive understanding of the subject matter [21,22]. Mixed reviews have been successfully applied across various fields, and in this study, a four-stage method was adopted to answer the research objectives based on the research questions [23–26].

The first stage involved searching for relevant publications, followed by the application of exclusion criteria in the second stage [27,28]. The third stage consisted of a scientometric analysis, and the final stage was a systematic literature review [27,29–31]. This four-stage approach leverages the strengths of both scientometric and systematic methods to conduct an in-depth examination of the research objectives [32–34]. The mixed review approach is well-supported and widely used in built environment studies.

Stage One: Search for Publications

Following guidelines for systematic literature reviews, as illustrated by [18,35], the study adopted inclusion criteria covering academic databases, keywords, and publication types. The Scopus database was chosen for its extensive coverage and high-quality articles [19–21]. Publications were retrieved from Scopus using the query terms "Competencies," "Skills," "Education," "Learning," "Teaching," and "Built Environment" without any year restrictions, with the search conducted in May 2024.

Stage Two: Exclusion Criteria

Exclusion criteria, a standard protocol in both systematic and scientometric reviews, were applied to ensure reliable and reproducible results, reducing the inclusion of irrelevant studies [36–38]. The criteria were applied in three stages, limiting the documents to English-language papers related to construction management. Non-journal publications were excluded to maintain credibility and scientific rigour, ensuring that only relevant research outputs were considered [39–41]. This process resulted in a final selection of 59 publications.

Stage Three: Scientometric Analysis

In this stage, metric data from the reviewed articles were analyzed to track the evolution of publications in the construction/built environment field over time [42–43]. Bibliometric analysis was also performed to generate networks of document co-citation and co-occurring keywords, which highlighted the relationship between emerging research themes and methodologies. The document co-citation network identified key authors who received significant peer recognition and how their research quality was enhanced by the methods they employed.

Stage Four: Systematic Literature Review

The systematic literature review focused on identifying and categorizing key information topics. These categories included: Embedding Emerging Critical Skills in Built Environment Competencies, Competency-Based Curriculum, Technology Infrastructure & Assessment of Competency Development, Municipal Competency Training for Built Environment Professionals, Innovative Skills and Competencies Required of Construction Management Graduates, Driving the Fourth Industrial Revolution Initiative Through University and Industry Collaborations, and Effective Use of Learning Management Systems and Pedagogical Innovations in Competency Development.

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3. Results

3.1. Yearly Document Distribution

In understanding the competencies of built environment professionals to deliver sustainable infrastructure, especially in developing countries, an analysis of documents published towards this area reveals that from 2001 to 2008, the number of documents published annually was very low, generally at zero or one. This indicates minimal research activity or publications in this area during this period. However, this increased slightly from 2009 to 2012, This suggests a growing interest or emerging recognition of the importance of competencies in built environment professionals for infrastructure delivery. A more noticeable increase was observed from 2013 to 2015 which marked the beginning of a more focused research effort or possibly the influence of key events or developments in the field [44]. Going forward, continued interest with notable peaks and troughs occurs from 2017-2018. The peak in 2017 with six documents signifies a heightened research activity, followed by a sharp decline in 2018. Meanwhile, from 2019 to 202, the trend continued with fluctuations, but the overall number of documents was higher compared to the earlier years. This period shows a sustained interest in the topic, with annual publications ranging from two to six documents. Finally, recent publications indicate that a significant increase is observed, especially in 2023, where the number of documents spikes to twelve. This sharp rise indicates a surge in research activity, possibly driven by recent developments, increased funding, or a heightened awareness of the critical role of competencies in the built environment sector [45].

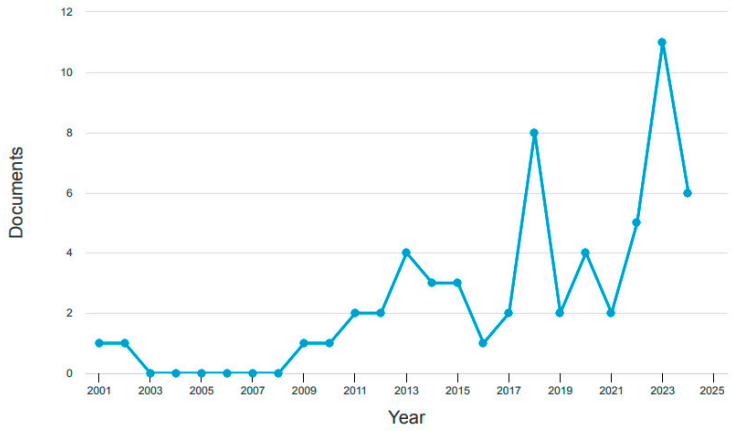

Figure 1. Yearly document distribution.

3.2. Key Contributors and Collaborative Networks within the Research Area of Competencies of Built Environment Professionals for Infrastructure Delivery

This co-authorship analysis visualizes the collaborative relationships between authors who have contributed to research on the competencies of built environment professionals for infrastructure delivery in developing countries. The analysis uses full counting, meaning each co-authorship occurrence is counted fully for each author involved. Each node in the figure below represents an author who has published at least two documents and has received a minimum of three citations. The size of the node also indicates the number of documents authored by that individual. Additionally, the colour of the nodes represents the average publication year, ranging from dark blue (earlier years, around 2021.5) to yellow (recent years, around 2023.5). To showcase the collaborations, each link represents a co-authorship relationship between two authors and the thickness of the link indicates the strength of the collaboration, with thicker lines representing more frequent collaborations [46]. The proximity of nodes also suggests the frequency of collaboration; closer nodes have collaborated more frequently. It is observed from the study that Clinton Ohis Aigbavboa and Andrew Ebekozien are central figures with numerous connections, indicating they are key researchers in competencies of built environment professionals for infrastructure delivery research

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area with multiple co-authorships. Other prominent authors include Wellington Didibhuku Thwala, John Aliu, Samuel Adeniyi Adekunle, and Ayodeji Emmanuel Oke. There are several visible clusters where groups of authors frequently collaborate[34]. For example, a strong collaboration is observed between Clinton Ohis Aigbavboa and Wellington Didibhuku Thwala, as well as between Clinton Ohis Aigbavboa and Andrew Ebekozien. Another network involves John Aliu, Samuel Adeniyi Adekunle, and Ayodeji Emmanuel Oke, who also collaborate frequently.

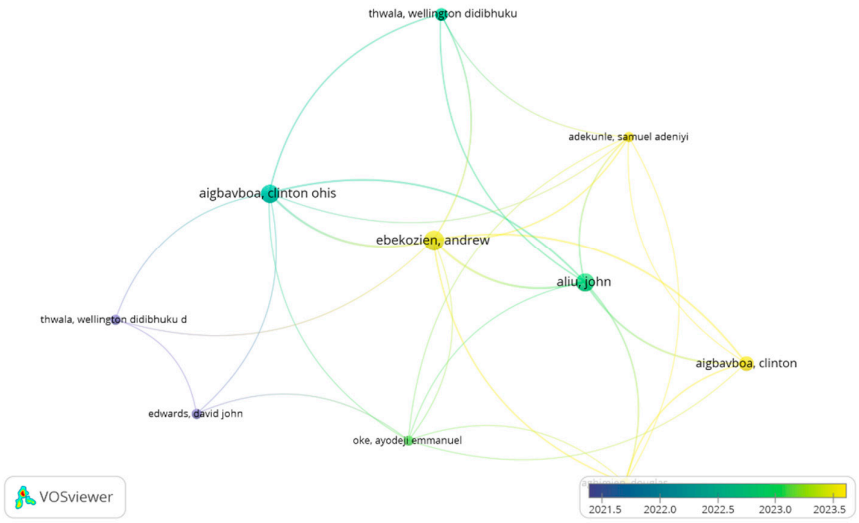

Figure 2. Key contributors and collaborative network.

3.3. Relationships and Frequency of Thematic Areas in Competencies of Built Environment Professionals for Infrastructure Delivery in Developing Countries

This co-occurrence analysis visualizes the relationships and frequency of keywords used in research related to competencies of built environment professionals for infrastructure delivery in developing countries. The analysis uses all keywords with a full counting method, meaning each co-occurrence of keywords is fully counted [47]. Each node represents a keyword that has appeared at least three times in the research documents with the size of the node indicating the frequency of the keyword's occurrence. The colour of the nodes represents the average year of the publications in which the keyword appeared, ranging from dark blue (earlier years, around 2016) to yellow (recent years, around 2022). Early research in this area focused on thematic topics in education and training, inequality in gender in education, curriculum development to fit required competencies etc. Keywords like pedagogy, employability skills, and construction education are more recent (closer to yellow), indicating newer areas of focus or emerging research interests. Another cluster around project management and competencies suggests research focused on professional skills and project management within the built environment sector.

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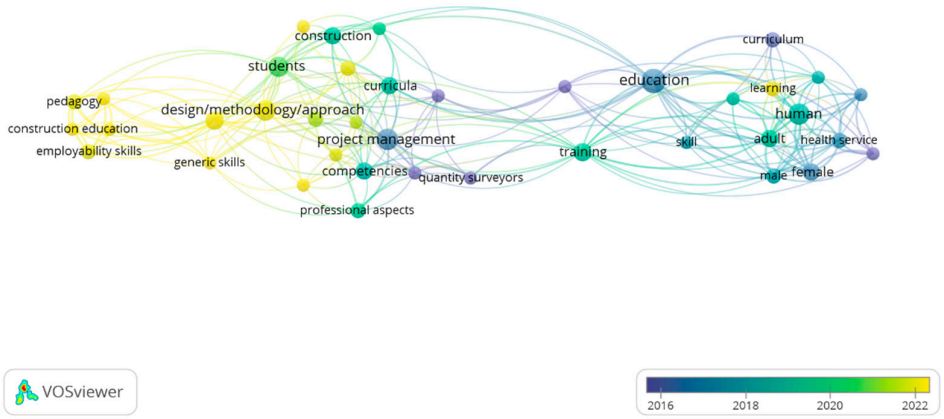

Figure 3. Relationships and frequency of Thematic areas.

3.4. Interconnections in Influential Research Output in Competencies of Built Environment Professionals for Infrastructure Delivery in Developing Countries

This analysis examines the frequency and pattern of citations among documents. It helps identify the most influential papers and the interconnections between them. Each node in the visualization represents a document with a minimum number of citations a document must have to be included in analysis 2 and Out of 59 documents, 47 met this threshold. Roberts (2002) appears to be the most highly cited document with "aliu (2023b)", "dada (2012)", and "slusher (2018)" also showing significant citation activity.

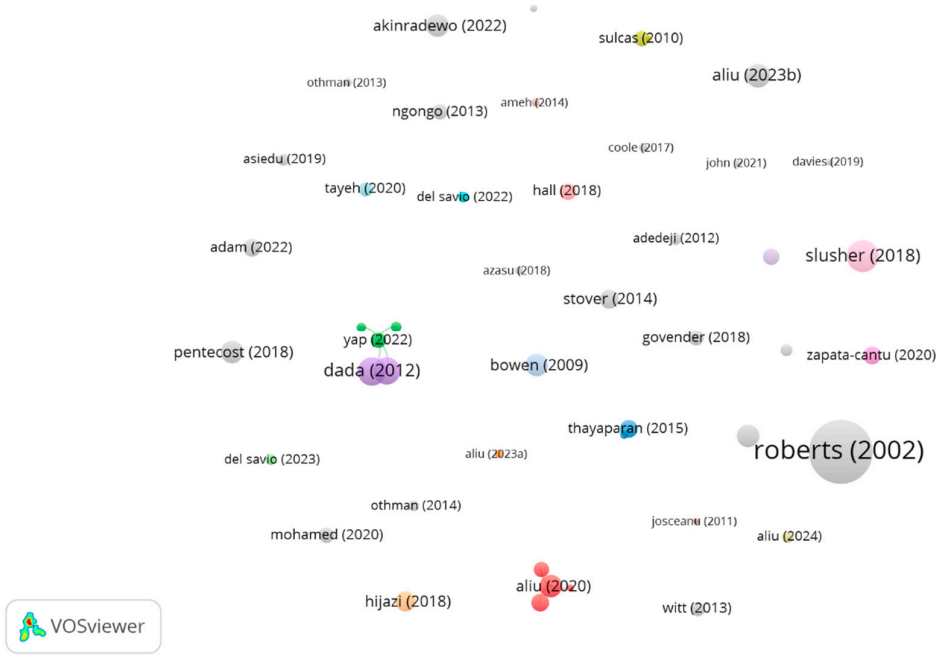

Figure 4. Interconnections in Influential research output in competencies of built environment professionals for infrastructure delivery in developing countries.

3.5. Co-Citation Analysis

This analysis examines how often two authors are cited together in other documents. It helps identify influential authors and the structure of research fields. The minimum number of citations an author must have to be included in the analysis is 3, Out of 4665 cited authors, 228 met this threshold.

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Each labelled node represents a cited author. The label typically includes the author's surname and initials, The size of a node indicates the number of co-citations the author has received. Larger nodes represent more frequently co-cited authors. Authors are grouped into clusters based on their co-citation relationships. Nodes that are close together are more frequently co-cited together or have stronger co-citation links. Different colours represent different clusters, indicating thematic or topical groupings of co-cited authors. Lines between nodes represent co-citation links. Thicker lines indicate stronger co-citation relationships or more frequent co-citations between authors. Some nodes are significantly larger, indicating that these authors are highly influential in the field. For example, "ebekozien a." appears to be a highly co-cited author. Authors like "kelly j.", "amaratunga d.", and "cilliers s." also show significant co-citation activity. The central cluster likely represents a core set of authors whose work is foundational in the study of competencies in infrastructure delivery [48]. These authors cover essential theories, methodologies, or key findings that many other papers cite. This co-citation analysis highlights the influential authors and thematic clusters in the study of competencies of built environment professionals in infrastructure delivery in developing countries.

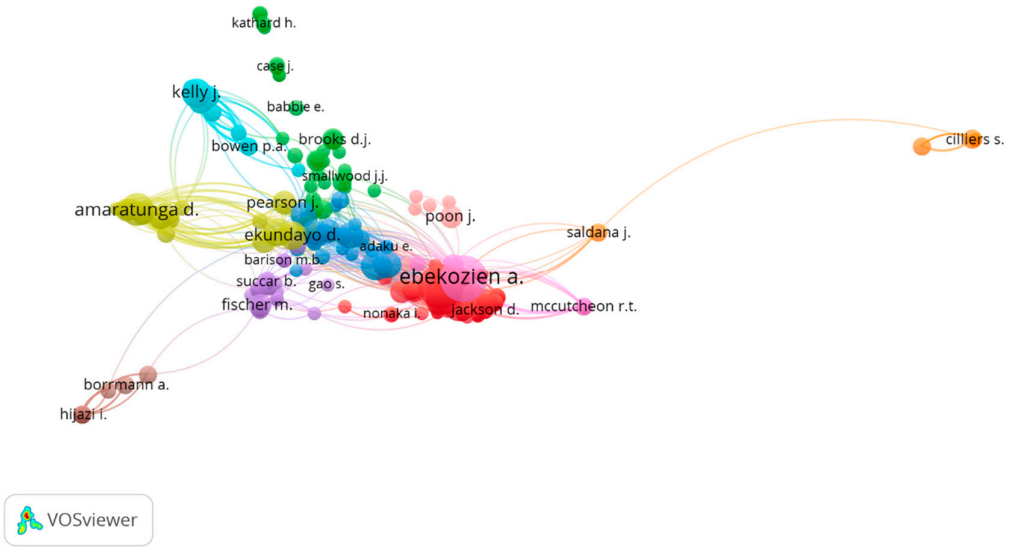

Figure 5. Co-citation Analysis.

4. Discussion

The study revealed that despite the importance of competencies in the delivery infrastructure critically required in developing countries, there has been a paucity of studies in this area over the years. The study attempts to understand why this is the case and how to improve on this. Limited awareness or recognition of the importance of competencies in infrastructure delivery in developing countries is noticed in the distribution of documents and points to a much larger general issue of funding and research focus shifting more towards studies on digitalisation in construction. Recent conversations on how to drive investment in infrastructure development in developing countries reveal the need to have increased funding and research grants focusing on infrastructure in developing countries and the required skills and competencies.

The capacity of local practitioners has also brought to the fore growing recognition of the critical role of competencies due to lessons learned from past projects. In providing solutions, it is essential to have global initiatives or partnerships emphasizing the importance of capacity building in developing countries. More importantly, of benefit would be intra-Africa collaborations in driving capacity development of local practitioners in participating in infrastructure delivery in their countries towards sustainable infrastructure.

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4.1. Embedding Emerging Critical Skills in Built Environment Competencies

Undergraduate programs are continually challenged to evolve and maintain a curriculum that is up-to-date with the demands of globalization and internationalization. For civil engineers, professional education must align with the needs of the Architecture, Engineering, Construction, and Operation (AECO) industry [5][17]. Higher education programs must integrate competency-based curricula, as competencies equip students to thrive in diverse circumstances by fostering knowledge and adaptability in both professional and personal settings. Therefore, such curricula should address contemporary societal demands by producing skilled and competitive professionals in their respective fields, while also driving progress by proposing solutions to emerging challenges [49]. Competency-based curricula emphasize comprehensive skill development, incorporating learning strategies like self-regulation, autonomy, leadership, teamwork, problem-solving, and critical thinking[16]. Consequently, these curricula must be regularly reviewed and updated to reflect the evolving nature of each profession, a standard that recognized accreditation boards worldwide aim to certify.

4.2. Competency-Based Curriculum

Competencies are multifaceted, integrated, and dynamic abilities that combine knowledge, skills, attitudes, and values, all of which individuals apply in specific contexts [4]. These competencies contribute to holistic human development and are supported by four key attributes: knowing, doing, being, and coexisting. As competencies need to be cultivated and strengthened, they are linked to different proficiency levels or stages, each with distinct characteristics [50]. This allows for gradual and continuous progression in the training process, where higher proficiency levels build upon the traits of the preceding ones. In the socio-formative approach, there are five proficiency levels: pre-formal (P), receptive (R), basic (B), autonomous (A), and strategic (S) [51,52]. The pre-formal level involves a general understanding of the competency, while the receptive level is tied to a specific understanding, operational actions, and partial motivation. The basic level focuses on simple problem-solving, integrating technical elements and monitoring processes [9]. The autonomous level deals with complex problem-solving, initiative, managing and directing processes, and scientific reasoning. The strategic level is characterized by the application of strategies for change, driven by context, innovation, flexibility, and commitment [53]. Competencies are categorized into three types: primary, generic, and specific. Primary competencies are developed during primary and secondary education; generic competencies are common across all disciplines in higher education, and applicable to all degree programs and professionals; and specific competencies are unique to particular fields, and tailored to meet the demands of each profession [54]. Additionally, competencies consist of five components: capacities, purposes, scopes, requirements, and quality conditions. Curricula represent the practical application of pedagogical theories and training plans, designed to ensure effective learning through teaching. They are shaped by the culture, era, and specific community in which they are implemented. Curricula serve as the foundation for the educational process, outlining the goals to be achieved, the steps to reach them, and the underlying rationale: the practical execution of a pedagogical theory in the classroom. Curricula must align with the educational model of each institution [55,56]. To develop a relevant curriculum, it is crucial to analyze the situational, professional, and labour-related challenges and requirements. In competency-based training, the curricular process involves three distinct stages: contextualization profile, training plan, and implementation [57]. The contextualization profile stage includes studying the context and constructing the graduation profile. The training plan stage involves the actual curricular design, which includes establishing a sequence of learning activities [58]. Finally, the implementation stage is the execution of the study plan with the students.

4.3. Technology Infrastructure & Assessment of Competencies Development

In today's rapidly evolving educational landscape, technology infrastructure plays a crucial role in the effective development and assessment of competencies [12,59]. As educational institutions

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increasingly adopt competency-based learning models, robust and adaptable technology infrastructure becomes essential to support these processes, ensuring that students acquire and demonstrate the necessary skills, knowledge, and attitudes required for their fields [60,61].

In the teaching and learning processes, active methods are favoured, as they promote student engagement in actively constructing their learning. Regarding assessment methods, the techniques and tools used to make learning outcomes visible, based on competencies and expected results, should be carefully planned to align with specific objectives within the training process [62]. It is advisable to employ a variety of techniques and tools to appropriately assess each student according to their learning style (active, reflective, theoretical, or pragmatic) [63,64]. This approach ensures the evaluation of comprehensive development across the four attributes of competencies. Suggested techniques include observation, questioning, class exercises, portfolios, tests, written exams, projects, and presentations. Additionally, recommended tools include checklists, rating scales, rubrics, and structured evaluation guides. The specific selection of teaching, learning, and assessment methods will depend on microplanning and the design of classroom sessions by the professor.

4.4. Municipal Competencies Training for Built Environment Professionals

Africa, including South Africa, has one of the highest unemployment rates in the world. Providing quality vocational training is essential to ensure that built environment professionals are employable and recognized as vital contributors to infrastructure projects. Competency-based skills training is essential for ensuring that professionals in the built environment can contribute effectively to the industry's growth and sustainability. Skilled trainers and supervisors with the necessary educational knowledge and industry-specific skills are crucial for this purpose. Municipal courses must be built around the educational principles of learner-centeredness and adult learning theory. Over the days of training, topics such as the roles and responsibilities of trainers and learners, creating an effective learning environment, curriculum alignment, and assessment strategies could be covered. Recently, online assessment tools, e-portfolios, and the use of competency-based evaluation have been suggested to be added to the course content.

4.5. Innovative Skills and Competencies Required of Construction Management Graduates

The construction industry is undergoing a significant transformation globally due to the innovative demands of the 4th Industrial Revolution, which extends to this sector as well. Traditional design and build principles are being replaced by advanced technologies that require specialized skills and competencies. However, the industry is currently facing a shortage of professionals with the necessary innovative skills to manage the building lifecycle process, a challenge that is particularly pressing in developing countries [65]. Construction industry employers are now seeking construction management graduates (CMG) who are not only academically qualified but also possess strong innovative skills and competencies in relevant technological software and tools [66]. Competency, in this context, refers to the combination of behavioural qualities, skills, abilities, and knowledge necessary to achieve effective job performance. It encompasses the abilities, skills, and capabilities that an individual possesses in a specific domain and is a key factor in enhancing professional performance across various occupational sectors[9,67]. Competence can be understood as the ability to apply specific knowledge, skills, talents, or personal qualities to complete critical tasks or activities. Previous studies have highlighted essential skills such as interpersonal skills, core technical knowledge, sustainability and life cycle analysis, environmental waste management systems knowledge, effective communication, commitment to personal development, emotional intelligence, resilience, persistence, and dedication to professional growth. CMGs must also possess the unique ability to address complex constructability challenges and visualize the final product in a virtual reality setting [68,61].

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4.6. Driving the Fourth Industrial Revolution Initiative Through University and Industry Collaborations

The Fourth Industrial Revolution (4IR) marks a significant transition from the traditional industrial paradigm, driven by digital technology, automation, artificial intelligence (AI), and the Internet of Things (IoT). This transformative wave is reshaping industries worldwide, including the built environment sector, which encompasses architecture, construction, urban planning, and related disciplines. For South Africa, embracing 4IR is not merely an option but a necessity to stay competitive on the global stage. The country must harness the potential of 4IR by fostering collaborations between universities and the construction industry to advance the competencies of built environment professionals. As the world embraces the excitement of the Fourth Industrial Revolution (4IR), Africa, with South Africa as a leading force, is preparing to enter this innovative era. One way to capitalize on the opportunities offered by 4IR is to strengthen collaborations between universities and the construction industry to enhance the capacity of built environment professionals. Globally, universities are seen as hubs for developing human capital, which in turn contributes to national development. Their role in generating knowledge positions them as key drivers of innovation and significant agents of economic growth [69].

One effective way for universities to revitalize and enhance their academic frameworks is by deepening collaborations with the construction industry, which has numerous positive impacts on built environment students. These symbiotic relationships between universities and the construction industry facilitate knowledge diffusion, enhance research and development (R&D), and create opportunities for patents, thereby contributing to the economic development of society [70]. Such collaborations can also strengthen R&D efforts in universities, as they are exposed to industry activities and professionals who are continuously seeking ways to improve their processes. Additionally, these partnerships provide students with valuable opportunities for field trips, where they engage in industry-based activities under the guidance of their supervisors, gaining practical learning experiences. The Fourth Industrial Revolution introduces unprecedented opportunities for innovation, efficiency, and economic growth. In the built environment sector, 4IR technologies enable more sophisticated design processes, improved project management, and the automation of construction tasks. For instance, Building Information Modeling (BIM), 3D printing, AI-driven project management tools, and smart city technologies are revolutionizing the way infrastructure is planned, built, and maintained. However, these advancements also present significant challenges, particularly in terms of the skills gap. Many professionals in the built environment sector, both globally and in South Africa, are not adequately equipped to leverage these new technologies. The traditional education and training systems have not yet fully adapted to the rapidly changing demands of the industry. Universities play a crucial role in the 4IR by acting as centres of knowledge production, innovation, and human capital development. They are uniquely positioned to drive the 4IR initiative by equipping students with the skills and knowledge required in this new era. For built environment professionals, this includes competencies in digital design tools, data analytics, smart construction techniques, and sustainable development practices. Moreover, universities can contribute to the 4IR by engaging in research and development (R&D) that pushes the boundaries of current technologies and explores new applications for the built environment sector [71].

In South Africa, universities are vital in addressing the skills gap in the built environment sector. By updating curricula, integrating 4IR technologies into teaching, and fostering a culture of continuous learning, universities can ensure that graduates are not only academically qualified but also industry-ready. However, to achieve this, universities must go beyond traditional academic boundaries and actively collaborate with industry stakeholders. Industry collaboration is essential for bridging the gap between academic knowledge and practical skills [72]. The construction industry in South Africa is transforming, driven by the adoption of 4IR technologies. To keep pace with these changes, universities must establish strong partnerships with industry players. Such collaborations can take various forms, including joint research projects, internships, co-developed curricula, and industry-sponsored workshops and seminars.

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4.7. Effective Use of Learning Management Systems and Pedagogical Innovations in Competencies Development

People's actions have far-reaching effects on others, shaped by shared beliefs and attitudes. Marzano's concept underscores the importance of learning and intellectual development, allowing individuals to grow while appreciating the value of intellectual work. In today's educational landscape, managing learning processes increasingly necessitates the integration of digital technologies, as they play a crucial role in enhancing students' abilities and skills, ultimately leading to meaningful learning outcomes.

Education should encompass a wide spectrum of learning approaches, from memorization to self-directed study strategies. These strategies are the processes that individuals initiate to solve problems, perform actions, and engage in activities. To achieve effective learning, these methods must integrate being, knowing, and acting, all while fostering independent thought. The theoretical model serves as the foundation for developing these skills, guiding the learning process and providing data for informed decision-making on how to proceed.

A critical step in this direction is for educators to assess the skills and interests of their students. To foster growth in students' abilities, it is essential to revisit and refine both concepts and established methods continually. This requires ongoing follow-up, planning activities that nurture creativity, and adapting teaching practices to the unique contexts of students. Quality education is characterized by innovative methodologies and techniques in teaching-learning processes, which in turn lead to better educational practices. Innovation in education involves reflecting on what works, generating new ideas, shaping those ideas into viable plans, implementing them, and continually improving educators' skills to achieve successful outcomes [73].

Competencies are the various processes that individuals initiate to meet challenges and complete tasks, balancing between "being," "knowing," and "doing," while maintaining the necessary mental independence. The theoretical model not only serves as the starting point for developing these skills but also provides a framework for making decisions that enhance learning. However, it is the teacher who facilitates learning, creating scenarios and acting as a mediator to help students work in groups, infer, reflect, and reason about various situations. It is crucial to recognize that no instructional design is perfect; instead, the goal is to create learning contexts that encourage meaningful engagement with the material.

In this dynamic and open learning system, teaching and learning are in constant dialogue with one another, facilitated by communication and a systematic input-output model. Learning is not limited to rational and analytical processes; it also encompasses affective and social dimensions. Teachers must motivate and encourage students, fostering a positive emotional and learning climate in the classroom. This is especially important for young people, whose development can be hampered by an inadequate educational environment. For teachers to have a positive impact on students' attitudes and create an enjoyable learning experience, they must feel welcomed and comfortable in the learning environment. To achieve this, both teachers and students must appreciate the importance of the task at hand and have a clear, direct path to its completion.

Achieving these educational goals requires a combination of "declarative knowledge"—the understanding of facts or phenomena through manifest qualities, information, data, and constructs—and "procedural knowledge," which involves the acquisition of skills and methods. Procedural learning emphasizes "learning to do" by integrating new information with practical application in real-life contexts provided by the teacher. Students benefit from evaluating new information and applying it to real-world scenarios, enhancing their understanding through processes of categorization, abstraction, induction, and analysis.

Through active participation in the classroom, students have the opportunity to broaden their perspectives, examine diverse viewpoints, and deepen their understanding of various topics. The guidance provided by educators plays a crucial role in paving the way for in-depth information acquisition. By applying what they have learned to real-world problems, students develop essential skills such as systems analysis, problem-solving, creative thinking, and decision-making. These skills

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are critical for students as they make connections between new material and their existing knowledge, ultimately progressing in their education[74,75].

All learners, whether critical or creative thinkers, develop mental patterns that shape their behaviour. These patterns, along with one's attitude and perspective, form the foundation for habits that facilitate learning. These habits enable students to complete tasks and acquire new skills, equipping them to handle any challenging situation that arises in school or life. The continuous development of these competencies is essential for lifelong learning and personal growth [23].

5. Conclusions, Recommendations and Limitations of Study

The study provides a comprehensive examination of the competencies required for built environment professionals in infrastructure delivery within emerging economies. By combining bibliometric analysis and systematic literature review, the research has identified critical areas where competencies must evolve to meet the demands of globalization, technological advancements, and the Fourth Industrial Revolution (4IR). The identified themes—ranging from embedding emerging critical skills to driving industry-university collaborations—highlight the multifaceted and dynamic nature of competencies in the built environment sector. The findings underscore the importance of competency-based curricula, robust technology infrastructure, and continuous collaboration between academia and industry to ensure that professionals are well-equipped to contribute to sustainable infrastructure development in emerging economies. This study revealed an overall positive trend in research activity on the competencies of built environment professionals for infrastructure delivery in developing countries. This trend likely reflects a growing recognition of the importance of this area, driven by various factors such as global initiatives, policy changes, and increased funding for research. Key contributors and collaborative networks within the research area of competencies of built environment professionals for infrastructure delivery in developing countries revealed to be; Clinton Ohis Aigbavboa and Andrew Ebekozien, Wellington Didibhuku Thwala, John Aliu, Samuel Adeniyi Adekunle, and Ayodeji Emmanuel Oke. The key themes and evolving focus areas in research on competencies of built environment professionals for infrastructure delivery in developing countries reveal core topics like education, project management, competencies, and construction, as well as emerging interests such as pedagogy and employability skills. The Fourth Industrial Revolution presents both challenges and opportunities for the built environment sector in South Africa. To thrive in this new era, it is essential to advance the competencies of built environment professionals through effective university-industry collaborations. By leveraging the strengths of both academia and industry, South Africa can equip its workforce with the skills and knowledge needed to drive innovation, improve productivity, and contribute to sustainable economic growth. Overcoming the challenges to collaboration and implementing the recommendations outlined in this essay will be critical to realizing the full potential of 4IR in the built environment sector. Through these efforts, Emerging economies can position themselves as a leader in the global built environment landscape, ready to meet the demands of the future.

It is recommended that there is a need to integrate competency-based curricula across higher education institutions, particularly in fields related to the built environment. These curricula should focus on both technical and soft skills, ensuring that graduates are versatile and adaptable to industry changes. Furthermore, Institutions should prioritize the development of technology infrastructure that supports competency-based learning and assessment. This includes the use of Learning Management Systems (LMS) and other digital tools to facilitate innovative teaching and learning practices. Also, Strengthening partnerships between universities and the construction industry can enhance the relevance of academic programs. Joint research, co-developed curricula, and internships can bridge the gap between theoretical knowledge and practical skills.

What this implies is that the study emphasizes the need for competency-based training programs that align with industry needs and the importance of continuous professional development to keep pace with technological advancements. However, The study's reliance on existing literature may have excluded emerging themes and competencies not yet widely discussed in academic

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publications. Additionally, the focus on bibliometric and systematic reviews means that the study may not fully capture the practical challenges faced by built environment professionals in different contexts within emerging economies. Despite these limitations, future studies can examine the barriers and facilitators of technology adoption in competency-based training within the built environment sector could provide deeper insights into how to effectively integrate digital tools in education and professional development. Also, Conducting longitudinal studies to track the evolution of competencies over time, particularly in response to industry changes and technological advancements, would provide valuable insights into the long-term impact of competency-based education and training.

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