**Attaining ambidexterity in construction organisations through digitalisation**

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**SUMMARY**

*In an ever-changing construction environment shaped by pervasive digital technologies, the role of digitalisation in ensuring effective exploitation and exploration (ambidexterity) of available opportunities cannot be overlooked. Leveraging digital technologies is crucial to attaining ambidextrous construction organisations and their continuous success. However, while studies have emanated on the ways of attaining ambidexterity within organisations in diverse sectors, construction has received little attention. Therefore, through a review of existing literature, this study unearths the role of digitalisation in improving the ambidexterity of construction organisations. A bibliometric and narrative review of existing works on digitalisation and organisational ambidexterity was conducted using bibliographic data gathered from the Scopus database. The findings revealed that while not much exists on the digital technologies needed in improving organisations' ambidexterity, organisations that strive for digital transformation stand a better chance to explore future opportunities while exploiting the currently available resources to make maximum profit. The study contributes theoretically to the existing discourse on the development of construction organisations and provides guidance for attaining ambidextrous construction organisations through digitalisation. In addition, the study suggests possible directions for future research on construction organisations' ambidexterity – an area that has gained little attention within the construction domain.*

**Introduction**

The construction industry has been described as an important contributor to economic growth through infrastructure delivery, contributing to countries' gross domestic products and providing employment (Ofori, 2012). Organisations within this industry are crucial to successfully delivering this important role in the industry in countries worldwide. However, it has been noted that construction organisations operate in a highly competitive environment, which places a high demand on organisations to be competitive in order to survive (Abidin *et al*., 2014). The survival strategies adopted by organisations within the construction industry have cut across the use of diverse management approaches (Ogbu, 2017), diversification (Abidin *et al*., 2014), and collaborative partnerships (Odediran *et al*., 2013), among others. Dimick (2014) noted that organisations that will be competitive in a dynamic environment like construction must be ready to adopt the concept of working smarter, not harder, with a keen emphasis on innovation. The fourth industrial revolution, driven by innovative technologies, has ushered in the digitalisation paradigm, which has become a strategic priority for most organisations due to its unparalleled benefits (Cenamor *et al.*, 2019). Digitalisation, which entails the use of digital technologies to transform business operations, offers organisations the innovativeness required to improve their service delivery and stay competitive within the industry. According to Gastaldi *et al.* (2022), most organisations push for digitalisation, as it provides better productivity, efficient control of their production processes and supply chain, as well as attaining competitive advantage. However, the embrace of emerging digital technologies and the digitalisation of construction organisations has been slow (Aghimien *et al*., 2022; Pärn and Edwards, 2019), with little innovativeness evident in the construction industry of many countries around the world (Agarwal *et al*., 2016).

Over time, studies have ascertained that there are several ways to attain competitive advantage, including organisational ambidexterity (OA) (Stelzl *et al.*, 2020; Turner *et al.*, 2013). This OA is an organisation's ability to exploit and explore opportunities in its immediate environment. Eriksson and Szentes (2014) described OA as an organisation's ability to exploit current knowledge to make profits while exploring new knowledge in preparation for future challenges. Ubeda-Garcia *et al.* (2020) described OA as an organisation's ability to pursue exploitation and exploration as two separate learning approaches. It has also been described as the ability of companies to apply two different business models (exploitation and exploration) simultaneously (Nieto-Rodriguez, 2014). The concept of OA has become popular as it can help organisations survive turbulent environments and harsh market conditions (O'Reilly and Tushman, 2008; Stelzl *et al.*, 2020). Moreover, ambidextrous organisations are, in most cases, high-performing (Nieto-Rodriguez, 2014), and according to Turner *et al.* (2013), organisations can gain competitive advantage by exploiting existing products and processes and exploring opportunities required for developing innovative products and processes.

Albeit its importance, the concept of OA has not gained traction within the construction industry. This is in spite of the strict and competitive nature of the construction environment and the need for competitiveness among organisations operating within this industry. A review of the few available construction studies shows that ambidexterity is assessed from an organisational or a project perspective. Eriksson (2011) assessed the ambidexterity of construction organisations and submitted that organisations stand the risk of concentrating too much on exploiting current knowledge, assets and position with less emphasis on exploring inherent opportunities. Liu *et al.* (2012) assessed ambidexterity from the project level by examining the possibility of attaining ambidexterity in complex engineering projects. The study concluded that at a project level, ambidexterity could be achieved by first separating the exploration and exploitation components through the different project phases and later integrating them. Also, it was noted that policies and financial support for promoting ambidexterity are essential. These studies give pointers to the importance of OA within the construction domain. However, while these studies assessed ambidexterity from different perspectives, the role of digital technologies to assist construction organisations in becoming ambidextrous is silent. Ashton and Morton (2005) noted earlier that technological advancement had created a turbulent, challenging and dynamic environment for most businesses. Construction is no exception, as clients' requirements have continued to change due to pervasive digital technologies that offer easy access to information and better possible construction outputs (Aghimien *et al.*, 2022). As a result, Mahmood and Mubarik (2020) submitted that organisations that will survive this turbulent business environment must be able to balance their ambidexterity with their ability to absorb technological knowledge through the use of digital tools.

It is essential to note that the construction industry is no stranger to emerging digital technologies. Evidence of the adoption of digital tools abounds in literature. For instance, building information modelling (BIM), which offers cost and time effectiveness on projects through clash detection and elimination of possible rework on construction projects, has gained prominence within the industry (Aboushady and Elbarkouky 2015). Moreso, the use of Internet of Things (IoT), cloud computing, and big data analytics (BDA), which allows better communication, improved information storage and processing, better prediction and easier decision making have all been noted within the construction industry (Ammar *et al*., 2018; Jin *et al*., 2015). Also, three-dimensional (3D) printing, robotics, and automation, which offer safer and better project delivery, are gradually gaining traction in the construction industry (Fonseca, 2018; Sakin and Kiroglu, 2017). However, the use of these technologies is low when compared to other industries. More so, these technologies are used mostly to improve project delivery, with less emphasis on the impact of these technologies on the ambidextrousness of these organisations. To improve the competitiveness of construction organisations and ensure their continuous survival to impact positively on economic growth, exploring how emerging technologies can help these organisations become ambidextrous is important. Based on this knowledge, this study, through a review, explored digitalisation in attaining ambidextrous construction organisations. The study identified the various forms of ambidexterity and the digital technologies that can improve the ambidexterity of construction organisations. Additionally, the study identified the areas of research focus in ambidexterity and digitalisation studies and proposed areas for future research within the construction domain.

**Research methodology**

The study adopted an interpretivist philosophical stance using a bibliometric and narrative review of existing studies, with the unit of analysis being each publication. This approach which is inductive in nature, was adopted due to the scarcity of studies on the ambidexterity of construction organisations. Drawing from the knowledge within similar industries becomes paramount in proposing the digitalisation concept to attain ambidexterity within construction organisations. The bibliometric review has been described as a computer-assisted approach of reviewing the available body of knowledge to unravel core research or authors and their relationship within a given research field (De Bellis, 2009). This method of review gives a visual perspective of the structural and dynamic aspects of existing scientific research contained within a body of knowledge (Cobo *et al*., 2011). While the bibliometric review assisted in unearthing key publications, countries, areas of focus and trends in ambidexterity research, a narrative review was further considered necessary to pinpoint the forms of OA and the digital technologies required. The narrative review entails summarising different primary studies and drawing conclusions from a holistic viewpoint. These conclusions drawn are mostly shaped by the experience of the researcher and the existing theories Dinther *et al.* (2011).

The review was done in stages. The first stage entails the identification of the database from whence bibliographic data will be extracted and the ideal keywords for data search. In terms of databases, Scopus was selected since it has garnered significant attention among researchers in the field of science. Moreover, the database has a significant overlap with other databases like the Web of Science (Guz and Rushchitsky, 2009). Also, selecting the right keywords is crucial to the reliability of the outcomes of bibliometric reviews (Chen and Xiao, 2016). Since the study was aimed at exploring digitalisation as a way of attaining OA, a preliminary investigation of the major forms of presenting the term ambidexterity and digitalisation in past studies was conducted. These terms were then adopted as keywords and were searched within the title, abstract and keywords section using two major Boolean operators ("OR", "AND"). The search protocol used includes Title-Abstract-Keywords: ambidexterity OR ambidextrous OR ambidextrousness AND digitalisation OR "digital technologies" OR "digital transformation", published from 2012 to 2022. Studies from 2012 were targeted on the premise that the concept of digitalisation, which is a product of industry 4.0, only became popular after the 2011 Hannover fair in Germany (Crnjac *et al.*, 2017). A total of 122 documents were initially extracted and were carefully scrutinised and narrowed to 98 using the language (English), document type (journal articles and conference papers) and area of study (engineering, business administration, computer science, and social sciences). The selection of these refining criteria was based on the fact that most articles are published in the English language, while journal and conference articles have, over time become reliable sources of information due to their rigorous review process (Vuksic *et al*., 2018; Zheng *et al*., 2016). Engineering, business administration and social sciences were selected because many construction-related papers are published within these subject areas. Also, the concept of OA is mostly business related. Computer science was also included in the subject area due to its relation to the digitalisation concept.

The analysis of the extracted bibliographic data for review was done by frequency (*f*) of publication year, sources, country, citations, area of research focus, trends and direction for future studies. In understanding the area of focus of these extracted documents and the trends in these researches, a map visualisation of the keywords in the documents was produced using the visualisation of similarities viewer (VOSviewer) software**.** This software has been favoured in recent bibliometric studies due to its ease of use and ready availability (Aghimien *et al.*, 2022). Furthermore, in conducting the narrative review, the extracted documents were carefully assessed to uncover the forms of OA and the digital technologies required. These results were then used to propose directions for construction organisations.

**Findings and discussions**

**Bibliometric review**

*Documents per year and sources*

To understand the attraction garnered by this area of research as well as the key sources of documents published in this area, the document per year and sources were evaluated. The result in the figure 1 shows the number of publications per year and the average total citation per article (av.TC/art) for each year. The figure revealed a rise in the number of publications around ambidexterity and digitalisation from 2015 to 2019. A substantial increase was noticed in 2020 (*f* = 26) and 2022 (*f* = 30). This is a pointer to the importance and the continuous recognition that this area of research is gathering among scholars. Also, the year 2015 has witnessed the highest av.TC/art of 105, while 2022 has the lowest of 3. It is expected that as more forthcoming publications leverage on the documents published in this area and cite them, these low av.TC/art in the graph will increase.

In terms of the sources from whence these documents were drawn, it was observed that the majority (*f* = 55) were published in the form of journal articles, while 43 were published as part of conference proceedings. Prominent among the journal outlets based on the attainment of over 50 total citations( TC) are Technological Forecasting and Social Change (*f* = 3; TC = 103), Business Horizons (*f* = 2; TC = 73), Industrial Marketing Management (*f* = 2; TC = 79), Journal of Business Research (*f* = 2; TC = 190) (all published by Elsevier), as well as Business Process Management journal (*f* = 2; TC = 55) (published by Emerald Insight), and Journal of Product Innovation Management (*f* = 2; TC = 72) (published by Wiley-Blackwell). The 2016 international conference on information systems, held in Dublin also attracted 3 related documents with 103 TC.

<insert Figure 1 right about here>

*Documents per country*

In understanding countries wherein, the findings of this research can be most useful, the contributions per country was assessed. It was observed that the extracted documents emanated from 31 countries. However, some documents were affiliated with more than one country, while some countries have just one document. To avoid overlap, only countries with at least two documents were considered significant in figure 2. The figure revealed 15 countries within this threshold. Most of the extracted documents were produced from parts of Europe, with Germany having the highest number (*f* = 30; TC = 357). It has been noted that more attention has been given to issues relating to digitalisation in European countries (Aghimien *et al.*, 2020). China has also published significantly in this research area, with 13 publications and 149 TC. Again, China has been observed to be contributing significantly to the digitalisation discourse (Aghimien *et al.*, 2020). Interestingly, South America and Africa recorded no output in this area, thus indicating the possibility of a research gap within these two regions. As such, researchers in countries within these two regions can explore this area of research to improve the competitiveness of their construction organisations.

<insert Figure 2 right about here>

*Most cited documents*

The citation count of a document has been described as the bibliometric performance of such document and their impact on the research area (Hirsch, 2005; Wang *et al*., 2019). As such, Table 1 shows the top most cited documents extracted. Table 1 shows that most of the top cited papers are from the manufacturing sector. This further affirms past submissions that digital transformation has gained prominence within manufacturing than construction (Aghimien *et al.*, 2021). The work of Cenamor *et al.* (2019), which explores how small and medium enterprises (SMEs) within the manufacturing sector compete using digital platforms, has garnered 174 citations. This study noted that digital platforms could positively influence organisations' performance through their network capability. Also, organisations' ambidexterity orientations can moderate this influence of digital platforms. The work of Piccinini *et al.* (2015) has also gained attention, as it has been cited 105 times. The study, which explored the impact of digitalisation on automotive organisations, identified specific challenges associated with digitalisation. It was noted that ambidexterity plays a critical role in dealing with the identified challenges. Haffke *et al.* (2016) also assessed the role of Chief Digital Officer in organisation's digital transformation and this document has garnered 88 citations.

Table 1: Most cited documents

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Authors | Title | Method | Industry/Sector | Focus | Citations |
| Cenamor *et al.* (2019) | How entrepreneurial SMEs compete through digital platforms: The roles of digital platform capability, network capability and ambidexterity | Quantitative / Questionnaire | Manufacturing / SMEs | Effect of a digital platform on SMEs' financial performance | 174 |
| Piccinini *et al.* (2015) | Transforming industrial business: The impact of digital transformation on automotive organisations | Qualitative / Delphi | Automotive industry | Managerial challenges associated with the impact of digital transformation | 105 |
| Haffke *et al.* (2016) | The role of the CIO and the CDO in an Organization's Digital Transformation | Qualitative / Interviews | Mixed | Role of Chief Digital Officer in organisation's digital transformation | 88 |
| Mahmood and Mubarik (2020) | Balancing innovation and exploitation in the fourth industrial revolution: Role of intellectual capital and technology absorptive capacity | Quantitative / Questionnaire | Manufacturing / SMEs | Role of intellectual capital in balancing innovation and exploitation activities | 66 |
| Jackson (2019) | Managing for competency with innovation change in higher education: Examining the pitfalls and pivots of digital transformation | Quantitative / Review | Higher education | Ambidexterity and employing innovation | 62 |
| Coreynen *et al.* (2020) | Unravelling the internal and external drivers of digital servitisation: A dynamic capabilities and contingency perspective on firm strategy | Quantitative / Questionnaire | Mixed | Ambidexterity and firms' orientation towards digitalisation, servitisation and digital servitisation. | 61 |

*Research focus, trends and areas for future studies*

The document extracted had 669 major terms. VOSviewer grouped these terms into more coherent clusters using a set co-occurrence threshold. Since there is no rule regarding the threshold to be used, a minimum co-occurrence threshold of three was set, as this gives the optimum visualisation map. Based on the set threshold, 54 terms co-occurred three times, and these were grouped into five clusters (see Table 2) with a total link strength (TLS) of 706.

The first cluster has 13 items that are strongly related to the term 'ambidexterity'. Prominent among these are digitalisation, artificial intelligence, innovation management, technological innovation, business model innovation, exploitation and exploration, service innovation, competition, manufacturing and supply chain. These terms relate to *ambidexterity for the innovativeness of businesses*. The second cluster has 12 items that are strongly related to the term 'digital transformation'. These include information systems, information use, agile manufacturing systems, IT governance, bimodal IT, systems science, and IT ambidexterity, among others. These terms relate to *digital transformation using information technology*. The third cluster has 11 items, including organisational ambidexterity, digital innovations, the internet of things, enterprise resource management, business process management, and dynamic capabilities. These terms point towards *OA in the management of business processes*. The fourth cluster has ten items that are strongly related to the term' digital 'technologies'. These terms include personnel, ambidextrous learning, e-learning, engineering education, digitisation, innovation, transformation, organisational, and sustainability. These terms point to *improving personnel ambidexterity through digitalisation.* The last cluster has eight items: industry 4.0, metadata, organisational learning, small and medium-sized enterprise, exploration, exploitation, and knowledge management. These terms point towards *organisational learning by exploiting and exploring industry 4.0 technologies*.

Table 2: Cluster of keywords indicating areas of research focus

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Keyword | Nos. | TLS | Keyword | Nos. | TLS |
| **Cluster 1**  | **Cluster 3**  |
| Ambidexterity | 36 | 99 | Business process management | 5 | 15 |
| Artificial intelligence | 3 | 13 | Covid-19 | 5 | 23 |
| Business model innovation | 4 | 12 | Digital innovation | 7 | 36 |
| Competition | 4 | 19 | Digital innovations | 11 | 50 |
| Digitalisation | 5 | 6 | Dynamic capabilities | 6 | 15 |
| Economic and social effects | 3 | 19 | Efficiency | 5 | 16 |
| Exploitation and explorations | 3 | 11 | Enterprise resource management | 5 | 19 |
| Manufacture | 3 | 13 | Internet of things | 3 | 18 |
| Manufacturing | 5 | 24 | Life cycle | 4 | 16 |
| Service innovation | 3 | 9 | Organisational ambidexterity | 13 | 45 |
| Supply chain management | 3 | 11 | SMES | 4 | 6 |
| Technological innovation | 3 | 9 | **Cluster 4**  |
| Innovation management | 7 | 19 | Ambidextrous learning | 3 | 13 |
| **Cluster 2** | Digital technologies | 17 | 79 |
| Agile manufacturing systems | 4 | 23 | Digitization | 4 | 15 |
| Bimodal IT | 3 | 10 | E-learning | 5 | 28 |
| Case study | 3 | 14 | Engineering education | 4 | 21 |
| Case-studies | 3 | 19 | Innovation | 11 | 41 |
| Digital transformation | 41 | 117 | Organisational | 4 | 19 |
| Information systems | 22 | 92 | Personnel | 6 | 23 |
| Information use | 17 | 80 | Sustainability | 5 | 15 |
| IT ambidexterity | 5 | 24 | Transformation | 3 | 11 |
| IT governance | 5 | 17 |  |  |  |
| Maturity model | 3 | 8 |  |  |  |
| Organisational levels | 3 | 13 |  |  |  |
| Systems science | 3 | 5 |  |  |  |
| **Cluster 5** |  |  |  |
| Exploitation | 6 | 31 |  |  |  |
| Exploration | 7 | 28 |  |  |  |
| Exploration and exploitation | 6 | 22 |  |  |  |
| Industry 4.0 | 12 | 51 |  |  |  |
| Knowledge management | 4 | 18 |  |  |  |
| Metadata | 4 | 22 |  |  |  |
| Organisational learning | 3 | 14 |  |  |  |
| Small and medium-sized enterprise | 3 | 16 |  |  |  |

Further assessment of the overlay visualisation map which gives the trend in the research focus was conducted. It was observed that studies from 2019 to early 2020 have explored areas such as IT governance, IT ambidexterity, information systems and uses, and digital innovation, agile manufacturing systems, among others. These terms are shown in purple and green. From the middle of 2020, the research focused on digital transformation, organisational ambidexterity, innovation management, knowledge management, exploration and exploitation. However, from 2021 more emphasis has been placed on innovation, e-learning, ambidextrous learning, engineering education, organisation, artificial intelligence, SMEs, sustainability, among others as seen in the yellow nodes. This shows that studies are beginning to place focus on individuals' ambidexterity development through technology.

Interestingly, artificial intelligence (AI) and IoT were the only digital technologies that emerged based on the set threshold of three co-occurrences. While there are other digital tools mentioned in these extracted studies, they have not gained significant attention. Future studies in construction can seize this opportunity to explore the different technologies that can assist construction organisations to be ambidextrous. Besides, it has been noted that the closer keywords are to each other, the higher their co-occurrence (Van Eck and Waltman, 2014). As such, a look at the occurrence and TLS of the keywords in the recent area of focus can show which areas are receiving adequate attention and which can be further researched. Therefore, keywords such as ambidextrous learning (*f* = 3, TLS = 13), engineering education (*f* = 4, TLS = 21), economic and social effects (*f* = 3, TLS = 19), sustainability (*f* = 5, TLS = 15), supply chain management (*f* = 3, TLS = 11), and small and medium-sized enterprise (*f* = 3, TLS = 16) are all current areas but with less attention. Future works within the construction domain can explore these areas to ensure construction organisations are ambidextrous in this digital era.

**Narrative review**

The forms of OA and the digital technologies that can help attain this phenomenon within construction organisations were assessed through the narrative review. For the narrative review, the bibliographic data earlier extracted were assessed to see documents which focused on the different forms of OA and the digital tools organisations can embrace to achieve OA. These documents were then downloaded and summarised along with other ambidexterity-related studies gathered through preliminary review, as suggested by Dinther *et al.* (2011).

*Forms of organisational ambidexterity*

The assessment of the documents extracted revealed that OA could be seen in diverse forms. An earlier study by Birkinshaw and Gibson (2004) observed ambidexterity in structural and contextual forms. However, studies have noted a third form (temporal) which has to do with the time component (Jackson, 2019; Wang *et al.*, 2019).

1. Structural ambidexterity

Structural ambidexterity stems from the contention that exploitation and exploration are different in their learning approaches and should be treated separately (Jackson, 2019). Birkinshaw and Gibson (2004) noted that it is ideal for organisations to create separate structures for different types of activities. Jackson (2019, p.765) describes the relationship between exploitation and exploration as ""sibling rivalry"", indicating the need for a clear separation in structures. As such, both Birkinshaw and Gibson (2004) submitted that while the core business units align existing products and markets, the research and development (R&D) or innovation unit should be responsible for exploring emerging markets, technologies and industry trends. In application to construction, operation management units or other core units within construction organisations should be responsible for getting construction clients and using existing market strategies to ensure client satisfaction which is a core approach of marketing construction businesses. However, a separate unit need to be created to focus on R&D, particularly in the area of emerging technologies and trends within the construction environment. Unfortunately, construction organisations have continually lagged in the investment in R&D that could help the industry as a whole (Aghimien *et al.*, 2021). As such, studies have continued to propose the need for better investment and promotion of R&D within construction organisations and collaboration with higher education institutes to provide solutions to real-life problems and opportunities for the construction industry (Aghimien *et al.*, 2021; Aliu and Aigbavboa, 2020).

1. Contextual ambidexterity

Contextual ambidexterity follows the notion that separating exploitation from exploration in some environments is impractical. As such, the pursuit of exploitation and exploration must occur simultaneously for organisations to succeed (Gibson and Birkinshaw, 2004). This is essential for organisations that need to exploit existing competencies to gain short-term benefits and, at the same time, explore emerging competencies for long-term success (Balboni *et al.*, 2019). This contextual ambidexterity employs behavioural, cognitive and social approaches in integrating divergent activities within an organisation (Eisenhardt *et al.*, 2010; Gastaldi *et al.*, 2022). According to Jackson (2019), this type of ambidexterity is most favourable to small organisations that may need to scale up or down quickly to adapt actively to external changes. Considering the construction industry, where a significant number of SMEs exist (Aigbavboa *et al.*, 2018), improving contextual ambidexterity through digital technologies can be crucial to the short- and long-term success of these organisations.

1. Temporal ambidexterity

Wang *et al.* (2019) noted that the increasingly dynamic nature of business environments has called for a temporal perspective in understanding the capabilities of businesses and their success. As such, temporal ambidexterity emphasises the need to consider the time factor for when an organisation needs to exploit or explore (Jackson, 2019). Wang *et al.* (2019) described this temporal ambidexterity as a firm's ability to exhibit simultaneous and strong commitments to activities with short- and long-term outcomes. This approach can assist organisations in attaining continuous change (Brown and Eisenhardt, 1997). In the context of digital innovation, Holotiuk and Beimborn (2019) noted that ambidexterity can be attained through a dedicated digital innovation unit for exploration and the temporal transfer of people between these units and operational parts of organisations. It was noted that temporal ambidexterity is better suited for the digitalisation of organisations. The construction industry has, over time, been described as a dynamic industry with ever-changing client needs and expectations (Navon, 2005). This dynamic nature of the industry, coupled with the continuous development of technologies, can make exploitation and exploration difficult in construction organisations. As such, employing digital tools to help achieve short-term goals and simultaneously employing innovative ideas for future growth is important.

*Digital technologies for organisational ambidexterity*

The extracted documents show that significant work has been done on ambidexterity and digitalisation in diverse sectors. However, not many of these studies specifically indicated the digital technologies organisations need to employ to be ambidextrous. Saratchandra *et al.* (2022) explored knowledge ambidexterity in SMEs through the use of cloud computing. The study mentioned that while organisations are focusing on knowledge exploitation, their ability to be innovative can be truncated due to a lack of emphasis on knowledge exploration, which can be attained through cloud computing. Cloud computing has been described as a digital tool that allows data to be stored and accessed over the internet (Raza and Khan, 2021). This information can help improve the speed of decision-making and the overall performance of a business (Ganesan *et al.*, 2020). As such, cloud computing can help promote the exploration of knowledge by extracting vital information from structured and unstructured sources. In the same vein, new knowledge gained via exploration can be stored to be used later to improve existing knowledge and ensure exploitation is achieved effectively (Saratchandra *et al.*, 2022).

De Luca *et al.* (2020), in understanding how and when big data investments pay off for organisations, suggested that investing in big data analytics can impact an organisation's market ambidexterity. BDA can allow organisations to leverage current market information and use this information to explore future market opportunities (Erevelles *et al.* 2016). The construction industry generates numerous data daily (Aghimien *et al.*, 2021), and can exploit this data through BDA to make informed decisions now and, at the same time, create future projections to improve the ambidexterity of construction organisations. Also, Kar *et al.* (2021) explored how the industrial internet of things influences professionals learning behaviour. These industrial internets of things include IoT, BDA, augmented and virtual realities, AI, blockchain, among others (Hasnan and Yusoff, 2018). Kar *et al.* (2021) concluded that for professionals to survive the fast pace development of emerging technologies, they must be willing to employ ambidextrous learning behaviour. In a study on AI ambidexterity, Van de Wetering *et al.* (2022) found that the ambidextrous use of AI (i.e., advanced analytics, applications, combined with logic-based techniques that imitate human behaviour) can positively improve the adaptive transformation capability of organisations. The study noted that the ambidextrous use of this technology could be routine or innovative. The routine use of AI (i.e., the day-to-day adoption of AI) and its innovative use (deep and comprehensive use of AI) significantly impact organisations' adaptive transformation.

Belhadi *et al.* (2022) explored the possibility of building the resilience and efficiency of the supply chain through additive manufacturing. The study found that additive manufacturing technology offers the possibility of developing ambidextrous dynamic capabilities that will significantly impact the resilience and efficiency of the supply chain. Additive manufacturing, also known as three-dimensional (3D) printing, involves using a 3D digital model to create physical objects using a layer-by-layer process (Lim *et al.*, 2012). This technology has continued to gain prominence in most industries, including construction, due to its ability to produce rapid prototypes, increased productivity, better quality and faster project delivery (Sakin and Kirogly, 2017; Wu *et al.*, 2016). Therefore, the continuous use of this digital technology within the construction industry can help improve the exploitation of its inherent potential and create the way for innovations within the construction industry.

**Implication of findings for construction organisations**

Drawing from the narrative review of related articles from the bibliographic data, the digital technologies that can assist construction organisations in attaining digital transformation and also the different features that could help attain OA is presented in Figure3. Based on these findings, directions for construction organisations seeking to be ambidextrous are provided. The existing literature has shown that the diffusion of digital technology into construction activities will improve the ambidexterity of construction organisations (Del Giudice *et al.*, 2021). However, the use of digital tools has been slow, and the benefits thereof have not been fully actualised in the construction industry (Aghimien *et al.*, 2021; Agarwal *et al*., 2016). Therefore, to attain OA and gain a competitive advantage, top management and construction business owners must leverage emerging technologies' potential by intensifying their usage. They must be willing to invest in the identified emerging technologies such as cloud computing, BDA, AI, machine learning, IoT, robotics, blockchain, and augmented and virtual realities (De Luca *et al.*, 2021; Hasnan and Yusoff, 2018; Kar *et al.*, 2021). By adopting these technologies, construction organisations can further boost their intellectual capital, which is important in attaining OA (Mahmood and Mubarik, 2020).

The findings on the different digital technologies that can assist in attaining OA show that these technologies can help construction organisations exploit their dynamic business environment by meeting the ever-changing desires of construction clients. Much more, these technologies can help construction organisations make informed decisions for the future and forecast construction changes that may impact their business process. Through this exploration of the future, construction organisations can be innovative and attain long-term success. Mahmood and Mubarik (2020) also noted the need to improve the organisation's intellectual capital to be ambidextrous. Hence, construction organisations must strive to improve their human, structural and relational resources. In the past construction organisations have been berated for their lack of investment in technologies, training and development of human capital required to use these technologies as well as forward-looking R&D (Agarwal *et al*., 2016; Oke *et al*., 2018; Pärn *et al*., 2019). Therefore, for better competitive advantage achieved through OA, there is the need for these organisations to prioritise and invest in training and development of the existing construction workforce to use adopted technologies, create well-structured systems that will promote digital tools and encourage R&D, ensure strategic alliances with partners that can help improve their digitalisation process, and understanding construction clients' needs.

 Also, the review revealed that organisations can attain structural, contextual or temporal ambidexterity. Based on these different types of OA, top management and owners of construction organisations can create a clear structure within their organisations. Having dedicated units for exploiting available digital technologies to improve the organisation's day-to-day business is important for structural ambidexterity to be attained. Also, a unit dedicated to exploring emerging technologies and markets to give the needed innovativeness to construction organisations is critical to achieving contextual ambidexterity. However, ensuring a balance between structural and contextual ambidexterity is crucial in allowing these different dedicated units to succeed in the short- and long-term. Similarly, the temporal movement of people within units to maintain recency and a continuous flow of ideas is essential (Holotiuk and Beimborn, 2019).

<insert Figure 3 right about here>

**Conclusion**

This study set out to explore the attainment of ambidexterity through digitalisation in construction organisations. Following the review of extant literature, the study has been able to unearth the different forms of OA, the digital technologies and organisation features that can help construction organisations attain ambidexterity. The review shows that while the concept of OA in relation to technology has continued to gain traction within other sectors, studies focusing on construction organisations specifically are not many. Moreso, the review shows the possibility for meaningful research contributions on OA and digitalisation in construction organisations within countries in South America and Africa. Based on the area of focus and research trends, the study proposes future research direction in areas such as ambidextrous learning in construction, engineering education reinforced by digital technologies, economic and social effects of the use of digital technologies, sustainability of digital technologies in improving ambidexterity of construction organisations, ambidextrous use of digital technologies to improve supply chain management, and construction digitalisation for improving the ambidexterity of SMEs within the construction industry.

The study noted that available digital tools such as AI, 3D printing, IoT, blockchain, and BDA, among others, will not only improve how projects are delivered but can also lead to the digitalisation of construction organisations and, by extension their attainment of OA. However, in implementing these technologies, care must also be given to the intellectual capital of the organisations. This entails having structured systems, training and development, forward-looking R&D, strategic alliance with other organisations and knowledge of construction clients' needs and expectations. It is believed that the findings of the study can be beneficial to top management and owners of construction organisations as it provides directions for organisations who wish to attain OA and improve their competitiveness. Furthermore, the findings of the study serve s an excellent platform for future works on digitalisation and the attainment of ambidexterity in construction organisations. Albeit these contributions, it is important to note that the findings are limited by the database used in the search protocol. The literature reviewed emanated from a single database, and as a result, further studies can be conducted to include other databases. Also, empirical evidence on the impact of digitalisation on the ambidextrousness of construction organisations is needed to encourage the use of these digital technologies.

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Figure 1: Publication per year

Figure 2: Document per country



Figure 3: Summary of digitalisations for ambidextrous construction organisations