

Enhancing stakeholder management in construction: The role of digital leadership skills

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Abstract

The construction industry has been slow to adopt innovative technologies, particularly in digitalisation. This study examines the impact of digital leadership on stakeholder management in the UK construction industry, focusing on communication, leadership theories, and organisational factors. Through a literature review and a survey of 112 construction professionals, this research investigates the efficiency of digital leadership capabilities in stakeholder management and identifies factors enhancing or hindering its performance. The results demonstrate that digital leadership significantly enhances stakeholder management processes, though challenges like ineffective collaboration platforms and authoritarian leadership approaches can impede its efficiency. The study reveals that informed and innovative leaders are crucial for leveraging digital leadership to improve productivity. A conceptual framework is proposed to help organisations optimise digital leadership processes and address current challenges in stakeholder management by combining skills such as adaptability, feedback loops, innovative leadership, and effective use of digital tools. This research contributes to understanding how digital leadership can transform stakeholder management in construction. The insights provided offer industry practitioners, policymakers, researchers, and the construction industry with a framework to promote resilience by integrating adaptable digital leadership skills and strategies, enhancing stakeholder management, and overcoming organisational challenges to boost productivity and project success.

1. Introduction

The adoption of digitalisation is perceived to be slow in the construction industry [1]. In recent years, with the emergence of Building Information Modelling (BIM) and additional software-based tools, the industry is on the path to changing the narrative [2]. Studies suggest the UK construction industry saw a growth of about 18% in the adoption of digital tools in 2010, which increased to 73% by 2020 [3, 4].

Digital leadership in the construction industry cuts across the different sectors of construction and includes stakeholder management and its practices [5]. Advances in digital systems across various construction-related fields highlight the growing role of intelligent technologies in improving decision-making and operational performance [6]. Although Digital Leadership (DL) has had extensive interpretations, the definition of digital leadership is not closed-ended, as the diverse descriptions have a common focal point [7]. Digital leadership has been defined as the ability of an organisation

or an individual to leverage digital technologies to increase performance, achieve results, and foster a culture of continuous improvement and creativity [8].

Stakeholder management was revised by scholars to include the effective production of results such as cost adherence, schedule adherence, and stakeholder satisfaction, as well as to promote stakeholder communication, collaboration, and relationship-building. However, the question surrounding the efficiency of digital leadership to guarantee these results in real-world settings remains largely untested [1, 9]. Consequently, the possibilities and limitations of digital leadership in stakeholder management to effectively produce results are yet to be identified.

Digital Leadership Skills (DLS) can significantly improve the results of construction projects [10]. Conversely, digitalisation does not always meet previous expectations [9]. It has been suggested that the specific skills required to be combined with digitalisation for project success across different sectors of construction, particularly in the aspect of

stakeholder management, have not been sufficiently identified [1, 97]. Thus the gap between promise and practice persists. Proposed theoretical concepts generated from research studies concerning DLS have proven useful, but a gap exists in a feedback loop that should highlight how effective these concepts are in real-life scenarios [11]. Furthermore, the effect that the adoption of digital transformation could have on stakeholder management could have on the construction industry is yet to be explored [9].

This study is focused on the United Kingdom (UK), although the global construction industry is faced with these challenges. Therefore, the processes and findings from the study may have international relevance. The scope of this research includes examining the role of DLS in the construction industry in the UK, its necessity, and the considerations involved in supporting and enhancing stakeholder management and project performance. Therefore, the goal of this study will be realised by identifying DLS functionality levels, assessing digital leadership theories, and finding the organisational impact of DLS functionalities. Consequently, this study aims to (1) understand how effective functional digital leadership skills contribute to stakeholder management, (2) assess the extent of their capability to fulfil real-world stakeholder management scenarios, and (3) evaluate the impact of digital leadership skills on organisations, particularly within construction projects.

The significance of this research lies in its potential to enhance the understanding and current knowledge of digital leadership skills (DLS) in improving stakeholder management and organisational outcomes in the construction industry. By exploring the specific practical digital skills essential for project success and stakeholder management, the study may highlight an effective approach to the adoption of digital tools and leadership strategies for better performance and innovation within the industry.

This research is organised to explore the study's key areas, beginning with setting the background and outlining the objectives and focus of the study. The literature review identifies gaps and aligns existing theories with the research aims, while the methodology section explains and justifies the research design and methods used. The study concludes by presenting the results, discussing their implications, and offering recommendations and reflections on the research.

2. Theoretical Basis and Review

This section discusses the impact of digital leadership skills on stakeholder management in detail, with three of its subsections highlighting the current knowledge of digital leadership in relation to communication, collaboration, and relationships (DLC), leadership theories (DLT), and organisational impact (DLO). It also highlights the gaps in the literature through a theoretical gap link.

2.1. Effective DL and stakeholder coordination

Effective digital leadership depends on three factors: leadership with a strategic focus, entrepreneurial capabilities, and proficiency in digital technology [12]. Studies argue that fostering an environment of innovation would enhance functionality [13]. According to an examination carried out, digital leadership is the capacity to showcase and nurture skills and talents important for sufficient employee engagement in an organisation for the process of digitalisation [14].

Understanding effective digital leadership comprehensively is suggested by scholars who argue that the current knowledge of digital leadership is more modest than extensive [15]. Researchers have proposed that effective digital leadership is a high function of emotional intelligence and adaptability in leading digital initiatives [16]. However, the knowledge of self-awareness, social skills, and empathy possessed by digital leaders is crucial in the dynamic environment as it enables navigation around resistance, mitigating conflicts, and adaptability to foster a culture of innovation and resilience. This positions effective functional digital leadership as a social blend of technical expertise, strategic vision, emotional intelligence, and adaptability [17].

Communication in digital leadership is crucial to facilitating and enhancing stakeholder management by maximising the tools and technologies while mitigating risks [18]. However, an analysis shows communication remains a concern in implementing digital tools in the UK, due to the requirement of institutions to use a shared local server to collaborate [9]. An analysis suggests digitalisation was previously perceived to be the change industries needed, with emphasis on improved communication, innovation, and dissemination of knowledge among stakeholders [19]. Studies argue the transformative evolution of digital tools for stakeholder communication in construction from Total Information Transfer System at the turn of the millennium to digital tools such as Building Information Modelling (BIM), Virtual Reality (VR) platforms, Augmented Reality (AR) and project management software today, have attempted to restructure the process of interaction and communication between stakeholders to keep all involved parties satisfied [9].

VR facilitates stakeholder engagement as early as the design phase of a construction project, with its distinct immersive experience, spatial presence, human scale representation, interaction, and navigation, positioning it as an effective transmitter of a wealth of knowledge and qualitative experience [20]. This, therefore, enhances communication among stakeholders, facilitating collaboration and ensuring satisfaction. Studies have shown that VR/AR are widely applied with positive feedback on effective communication in building inspection, managing facilities, education, and safety training [20]. However, studies argue that VR only simulates exemplary hazard scenarios and lacks the potential to identify hazards in real time [21]. Potential hazards could still be avoided by a critical

evaluation of the scenarios by the collaboration of designers and builders. Digital leadership comes into play in fostering an environment of learning, innovation, and mitigating risks in counteracting these setbacks [22].

Effective stakeholder collaboration in construction is essential to project success. Digital leadership has a significant impact on facilitating and enhancing collaboration through collaborative platforms and technologies [23]. In 2011, the UK Cabinet, in a bid to enhance productivity, passed a 5-year mandate for the adoption of BIM in construction projects to position the UK as a leading nation in digitalisation and efficiency in the industry by 2016, though by 2016, the adoption rate was less than 50% [24]. By 2020, the UK construction industry had achieved an adoption rate of about 73% with efforts ongoing to sustain this growth steadily [4]. Besides the adoption of BIM, other collaborative platforms and tools such as Aconex and SharePoint have also seen tremendous growth in use in the UK [25]. This growth in turn has massively impacted collaboration among stakeholders, providing a centralised body of information for construction professionals' real-time coordination [26]. However, cultural differences are a barrier to leveraging these platforms and technologies, and further studies on enhancing digital leadership may be required to foster a culture of information exchange, open communication, and teamwork to dissolve these barriers [27].

Building and nurturing stakeholder relationships has been established as crucial to the success of projects and ongoing business opportunities in construction [28]. The continuous progression of digital transformation within the construction industry has had an impact on the strategies and methods for managing stakeholders while building relationships [29]. The authors further suggest that the role of digital leadership moves beyond effective communication and collaboration to understanding and leveraging digital tools and platforms to enhance the relationships among stakeholders. Studies show the readiness and capacity of organisational leaders to become digital leaders equips them with the skills to use social media, project websites and other virtual communication tools to build trust, contentment, and endorsement in today's day and age [18]. Furthermore, these skills are effective methods of building a reputation and projecting its values to the public [18].

Interpersonal interactions cannot be substituted by digital tools, although these tools may facilitate relationship building, communication, and collaboration [30]. Similarly, reflexes and reactions may be lost in digital communication, hence not painting an ideal image of the current situation and circumstances [31]. The evolution of digital media has given rise to the introduction of emojis, and avatars and teams have been seen to build better bonds and work more effectively [32]. In contrast, studies highlighted certain shortcomings in the avatars and emojis portraying verbal and non-verbal cues alike, therefore altering the authenticity of virtual communications and relationships [33]. Despite these

setbacks, digital leadership has proven to significantly enhance stakeholder relationships in the UK and globally [34].

This section cross-examines digital leadership's effectiveness for stakeholder management in terms of communication, collaboration, and relationships within construction projects. Digital tools such as BIM, VR, and AR have widely enhanced the capabilities of digital leadership, fostering a sense of cohesiveness within a team and real-time coordination among stakeholders regardless of challenges such as technological limitations and cultural barriers [18, 3, 27]. Digital leadership has tremendously transformed the industry, although some areas seem to be in deficit highlighting the gap in the extent to which digital leadership contributes to communication, collaboration, and relationships with stakeholders. There is inadequate information dissemination to team members including urgency, information significance, and interpretation of silence [18]. Likewise, full integration of interpersonal interactions with digital mediums needs to be further explored [30, 33]. This research intends to investigate to what extent digital leadership contributes to enhanced productivity with stakeholders in the construction industry.

2.2. Theoretical concepts of DL and practical stakeholder management

Theories on leadership have evolved and been explored across various fields such as management, psychology, and organisational behaviour. Traditional leadership theories like the trait theory, behavioural theory, and situational theory are essential for management [35]. This lays the groundwork for understanding the effectiveness of leadership in various contexts and for further research [36]. Table 1 displays the theories extracted from the new leadership era based on an examination of leadership theories which have facilitated the dynamic and turbulent technological advancements and growing influence of globalisation [37].

Transformational and transactional leadership may be similar as they both possess the desire to motivate employees [38]. The difference lies in transformational leadership providing subordinates with a reason to be motivated while transactional projects authority for stimulation. These theories gave rise to shared, collaborative, and collective leadership, which were centred around coordination and an even weight of responsibilities distributed across hierarchies and individuals in an establishment, as opposed to members of leadership only [39]. Servant and inclusive leadership were further proposals for supporting each member of a team and incorporating the needs and well-being of individuals. Complexity leadership was born out of a desire to navigate the complexity of the world today, considering that interplays within a social system take place within a broader context. These theoretical frameworks of leadership are a guide to understanding the theoretical frameworks of digital leadership and their capabilities [37].

Table 1. Digital leadership theories for stakeholder management

DL Theories	Skills	Implementation
Transformational	Inspirational, motivational and people – centred.	Defines management roles according to project vision, understands stakeholder needs.
Trait	Drive, business knowledge, motivation	Effective communication, digital proficiency, manages expectations, builds trust
Situational	Adaptative	Uses different styles of leadership as required, promoting agile practices,
Transactional	Task-driven, task-and-reward, Defined roles Vision oriented, Authoritative	Goal alignment, structured roles, regular progress tracking and reporting, empowerment, and accountability.
Shared	Even distribution of labour across hierarchies	Inclusive decision-making, transparent, skill-based task assignment.
Collaboration	Partnership, teamwork	Sets shared goals and objectives, coordination, promotes knowledge sharing, empowerment, consistent communication

Leadership theories are consequential to digital leadership as they provide a basis for developing effective practices for management [19]. A study suggests that transformational is the only useful theory of leadership pertinent to digital leadership as it promotes productivity and innovation [40]. Other theories, such as servant, collaborative, shared, and inclusive, are equally important to digital leadership as they promote growth, change, and innovation [41]. An analysis proposes that transactional leadership does not correspond with digital leadership, as digital leadership is more flexible and does not tally with the principles of transactional leadership, characterised by contingent reward [42].

In contrast, transformational leadership is an expansion of transactional leadership as an affirmative and constructive response that fosters motivation and trust, automatically making it transformational [43]. Likewise, situational leadership theory suggests that adaptability is a significant constituent of effective leadership [37]. Transformational leadership is the intersection of leadership theories and digitalisation [41]. The transformational digital leadership in practice is more a blend of bits of the other socio-technological theories and transformational than merely transformational leadership [44]. An examination shows that the current information around the theories of leadership is not sufficient, and further research would be required to understand the functionality of these theoretical concepts [18].

An analysis suggests that the most important critical factors for success in construction projects within the UK include consistent and recurrent stakeholder communication and engagement and building a good relationship [45]. However, [46] in recent times, teams do not go through the group stages of development: forming, storming, norming, performing, and adjourning sequentially [47]. Hence, this presents some loopholes in achieving the desired project success. The leadership within construction has moved towards collaboration [48]. Many more theories were observed to be in play than just mere collaboration within the UK construction industry [49]. Trait theories are still important in digital teams because they can be adapted to

traits such as drive, business knowledge, and motivation [46]. Therefore, the propositions in the literature influenced many theories as listed in Table 1 [37, 46]. The authors in this study have put these theories in perspective and developed Table 1, illustrating the behaviour of the theories in digital settings and applications for stakeholder management. It has been suggested that perspectives have changed, and currently employees look out for their own interests than in the past, therefore rendering the theories somewhat ineffective [50]. Similarly, it has been pointed out that effective digital leadership has been associated with domination and authoritative leadership rather than a people-centred function, which opposes previous schools of thought [46].

This section has discussed the various theories of digital leadership and their capacity in stakeholder management. Transformation and transactional have been central to the discussion. However, it has been suggested that digital leadership is a blend of all theories, adapting as situational theory proposes [41]. While the theories have promised success, studies suggest that a change in employee perspectives and behaviour in this era calls for a re-evaluation of the theories [50]. Additionally, there is a divergence in views as to whether effective digital leadership leans more toward controlling leadership theories or people-centred approaches [46]. This gives rise to the gap in the extent to which digital leadership theories can fulfil real-world stakeholder management scenarios and needs to be further explored [18]. This research investigates which digital leadership theories can contribute to stakeholder satisfaction in the construction industry.

2.3. Organisational impact of DL skills on stakeholder management

Understanding the organisational impact of digital leadership skills on stakeholder management is important to every project [51]. In the literature, organisational culture meets transformation and innovation with resistance regardless of its proposed impact [52]. Digital leadership, without a doubt, has reshaped organisational procedures, structure, performance, and culture, although these changes have not gone without challenges or been seamless [53]. Construction

companies in the UK face challenges such as overall laxity in managing the organisational transition and unsettled, as well as a lack of positive cost-benefit analysis with the infusion of digital leadership [53]. Similarly, existing construction practices at the organisational level are not exactly compatible with digital leadership, and a significant shortage of essential long-term planning poses challenges for the organisation [54, 98]. It has been suggested that keeping up with digital trends can place significant stress on the workforce and on organisation culture and processes, which in turn leads to diminished productivity [55]. Although studies affirm that productivity is greatly enhanced with digital leadership among stakeholders, provided it is headed by informed and innovative leaders [56].

The development of costs, schedules, and plans easily fits the theories of digital leadership, and stakeholders such as quantity surveyors tend to feel more of the impact of digital leadership [53]. In contrast, all stakeholders alike experience the pressure of digital leadership in their own capacity [2]. Construction companies have produced results in the past without said digital leadership skills and so struggle with the necessity of digital leadership within their projects [53]. Conversely, digital leadership improves productivity and performance through team knowledge sharing [57, 96]. The construction industry does not practice what it preaches; hence, employees/stakeholders do not have a good work-life balance and are stressed [53]. They also highlight the need for relationship management skills by professionals such as project managers, who require soft skills to get the most out of every stakeholder on the project [53]. Digital leadership eases organisational managerial responsibilities by automating the process [58]. Digital leadership has a positive impact on organisational capabilities, including drive, collaboration, and innovation [59]. In addition to that, studies infer that digital leadership also increases competitiveness in the industry [56].

This section discusses the current knowledge on the organisational impact of digital leadership in the capacity of stakeholder management. Digital leadership has proven to

have a positive impact on productivity, performance, innovation, collaboration, and competitiveness [53, 54, 59]. Furthermore, studies have shown that digital leadership relieves managerial burdens and is highly effective at the inception phase of any construction project [58, 53]. Scholars contend that there is an existing work-life imbalance and diminished productivity in staying abreast of digital advancements [54, 55]. Similarly, relationship management among different professionals is lacking, as well as laxity among employees in digital transitioning for maximum productivity [53]. This gives rise to the gap in the impact of digital leadership in managing stakeholders at an organisational level. This research seeks to identify areas of best practice and needed improvement in stakeholder management with digital leadership.

2.4. Gaps in the literature

There is existing research on DLS and stakeholder management, particularly in terms of communication, collaboration, and relationships. Similarly, there is extensive knowledge on the theories of leadership and the proposed impact of DLS on organisations. While this knowledge exists, there is insufficient information on the efficiency and effectiveness of DLS in meeting stakeholder management, practical leadership, and the actual impact they have on organisations. Table 2 presents the theoretical gap highlighted from the analysed literature on digital leadership. This research seeks to investigate which digital leadership skills are efficient for stakeholder management in construction.

3. Methodology and Approach

This section discusses the methods and steps employed in approaching and investigating the role of digital leadership skills in stakeholder management in construction projects. This study is grounded in clearly defined ontological and epistemological foundations, which underpin the research design and methodology. Research philosophy, as discussed by scholars, guides the strategy for sourcing, analysing, and interpreting data [60].

Table 2. Theoretical gap highlighted from the analysed literature of digital leadership

Focus Area	Identified Gap	Corresponding Objective
DL role in Communication, Collaboration and Relationships	A gap exists in digital leadership's ability to fully integrate interpersonal communication and effectively convey crucial information, therefore, limiting effective and maximum stakeholder collaboration in construction projects.	Understand how effective functional digital leadership skills contribute to stakeholder management
DL Theories' practicality	A gap exists in the extent to which current digital leadership theories align with real-world stakeholder management needs, particularly in balancing control-oriented and people-centred approaches within the construction industry.	Assess the extent of their capability to fulfil real-world stakeholder management scenarios
DL Organisational impact	A gap exists in the organisational impact of digital leadership on stakeholder management, particularly in addressing work-life balance, productivity, and the effectiveness of relationship management during digital transitions in construction projects.	Evaluate the impact of digital leadership skills on organisations, particularly within construction projects.

Epistemology and ontology form the core of these philosophical positions [61]. This research adopts a positivist epistemology, which assumes that knowledge is best gained through observable and measurable facts, allowing for empirical investigation into the relationships between digital leadership skills and stakeholder management. Positivism supports a scientific and objective approach, aligning with the study’s focus on measurable outcomes in construction project environments [62, 63]. Complementing this, the objectivist ontology assumes that reality exists independently of human perception, reinforcing the empirical and factual nature of the investigation [64, 65]. Together, these philosophical positions justify the use of a deductive approach, enabling the formulation and testing of hypotheses based on existing theories. This philosophical alignment ensures that the methods used are coherent with the study’s aim of uncovering objective truths about how digital leadership skills impact stakeholder management in construction projects. Additionally, the research employed a mixed-method approach, suggesting the approach of research by gathering qualitative data and employing quantitative analysis to authenticate these qualitative claims. Fig. 1 explains the research methodology diagram steps [66].

The data collection steps, as seen in Fig. 1, include a combination of literature selection focusing on relevant literature connected to the study and a questionnaire survey. To achieve the survey, a snowball sampling technique has been employed. Sampling refers to the process of selecting a subset of individuals from a larger population for study or analysis [67]. Sampling methods can be divided into probability and non-probability approaches, and snowball

sampling falls under the non-probability methods [68]. Snowball sampling was adopted to access construction professionals with relevant experience in digital leadership and stakeholder management. According to [92] this sort of expertise is embedded within professional networks rather than through publicly available sampling frames. Therefore, a referral-based approach enabled the recruitment of participants with practical exposure to digital leadership practices. Snowball sampling is recognised as an appropriate strategy when studying specialised or networked populations [93]. As this study adopts an exploratory approach aimed at understanding informed professional perspectives rather than achieving statistical generalisability, this technique was considered methodologically suitable.

The inclusion and exclusion criteria for the sample used were extracted from Memon et al. [69]. They suggest survey participants should be conversant with the sought-after knowledge. In this light, participants in this survey were only within the construction industry, had a minimum of a high school diploma, and over one year of experience and knowledge of digital leadership. Memon et al. [69] posit that Roscoe’s guidelines are widely used for behavioural studies requiring a minimum of 30 participants, while a priori power analysis is required for studies that work to reveal an effect [69]. It is also utilised in research where a non-probability technique has been used [69]. A sample size ranging from 100 to 150 will be employed in this study.

3.1 Research methods

The methodology steps for DL communication and the outcome were outlined and illustrated in Fig. 1.

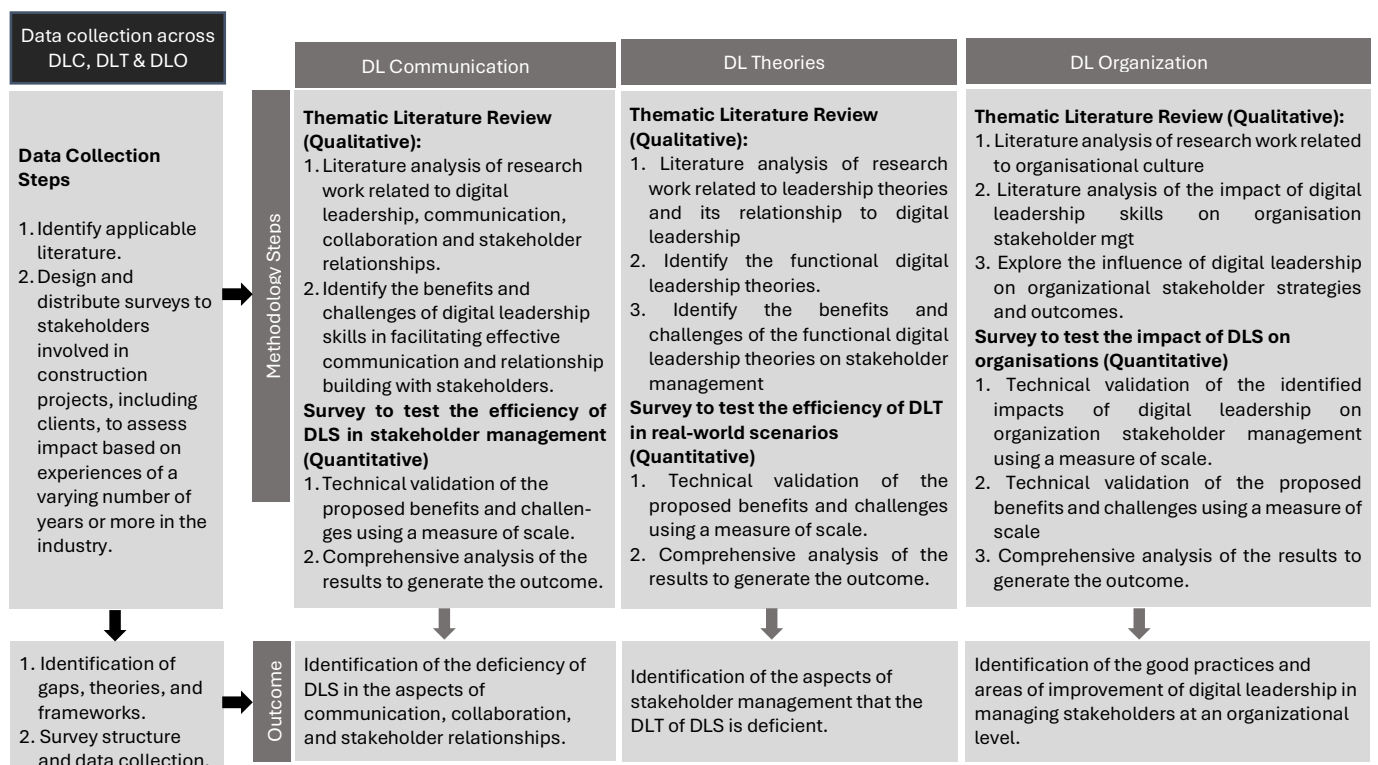


Fig. 1. Research methodology steps across DLC, DLT & DLO

A thematic literature review can be utilised to synthesise knowledge, thereby informing the research design [70]. This would help highlight the gap in the extent to which digital leadership contributes to stakeholder communication, collaboration, and relationships. Identification of variables can be used to establish relationships between parameters in research, which can help to determine areas of positive or negative effects [71].

The literature analysis of research connected to digital leadership, collaboration, communication, and stakeholder relationships was conducted to understand these variables and identify the relationships that have been established in existing research. Following the identified relationship, an identification of the benefits of digital leadership on these variables was necessary to determine the proposed and promised positive impact functional digital leadership has on the variables, and identifying the challenges was to determine if the proposed impact was effective or had potential areas of lapses that may be rectified at the end of the research. There was a discovery of gaps in the capacity of digital leadership for the variables, and this led to the design of the survey.

Although there may be a wide range of theories on a concept, only a few of them are functional in everyday life, hence the identification of functional digital leadership theories [72]. As illustrated in Fig. 1 under DL Theories, identifying the benefits of these theories was in a bid to determine the proposed capacity of digital leadership theories in managing stakeholders and the challenges were identified to determine what is lacking or preventing the theories from being optimised in managing stakeholders.

Identifying variables in research serves as a foundational step for establishing connections between parameters, shedding light on both positive and negative impacts within the study [73]. The literature analysis of research related to organisational culture and digital leadership, as seen in Fig. 1 under DL Organisation, was examined to understand these parameters and identify the relationships that have been established in existing research. Following the relationship, an identification of the benefits of digital leadership on these parameters was necessary to determine the proposed positive impact digital leadership has on the parameters. Identifying the challenges was to determine if the proposed impact had negative effects on organisational culture in the capacity of stakeholder management that could be rectified at the end of the research.

3.2 Survey development

Surveys are an effective means of data collection, which would aid in verifying the impact of digital leadership on the variables and highlight the areas that have not been optimised by digital leadership [74]. A measure of scale can be beneficial in verifying the benefits and challenges of digital leadership [75]. The theme for the questions is "Digital tools and stakeholder dynamics in construction project management". The study utilises a five-point Likert scale that

ranges from strongly disagree to strongly agree to collect data with questions derived from the literature review, as illustrated in Table 3. These results will highlight the areas in which digital leadership can be improved to optimise communication, collaboration, and relationships among stakeholders.

Surveys are suitable for capturing stakeholder perspectives on organisational practices, particularly in exploratory research [76]. This method aligns with the study's aim to explore the role of digital leadership in construction stakeholder management. By enabling broad data collection to inform practical outcomes, the study aims to understand the capacity of the theoretical concepts of digital leadership in fulfilling practical stakeholder management scenarios. The theme for the questions is "Exploring digital leadership theories in stakeholder management", which is illustrated in Table 3. These results will highlight the areas in which the theoretical concepts of digital leadership can be improved to optimise stakeholder management.

Surveys are an efficient and accessible means of research that would aid in collecting data [77]. This would enable the researcher to verify the impact of digital leadership on the variables, highlighting the areas of stakeholder management and organisational culture that have not been optimised by digital leadership. The theme for the questions is "Digital leadership's organisational impact on stakeholder dynamics" as illustrated in Table 3. These results will highlight the areas in which digital leadership can be improved to optimise stakeholder management in organisational culture.

3.3 Data analytics

A series of tests were carried out on the results from the study to ensure that the interpretation of the results and the outcomes are valid. This was dependent on the reliability, validity, agreement, and correlation of the data collected, hence Table 4 below. Skewness and kurtosis are employed in research to measure the asymmetric distribution of data, defining the degree to which the data deviates from the line of symmetry and the level of peakedness or flatness of the data collected, as illustrated in Table 4 [78]. Data distribution may be considered normal if the skewness lies between a range of -2 to +2 and the kurtosis between -7 to +7 [79]. Pearson's correlation is used to establish the strength and direction of the relationship between two variables, which can be analysed linearly, thereby gauging the outliers of the study [80]. Cronbach alpha is recognized as a genuine statistical metric in terms of internal consistency and reliability for data determined to produce a concept [81]. As illustrated in Table 4 below, it is essential to determine that the survey effectively gathers relevant data and inferred values range between 0 to 1 [82]. Kaiser-Meyer-Olkin's (KMO) measure of sampling adequacy is widely used to indicate that the correlation among variables is significant to support factor analysis [83]. This test, as shown in Table 4, was taken to ensure the study was useful for further analysis.

Table 3. Survey development

Digital leadership for stakeholder communication, collaboration, and relationship. (DLC)			Theoretical concepts of Digital Leadership and its application to stakeholder management scenarios. (DLT)		Digital leadership impact on Organisations stakeholder management. (DLO)	
S/N	Survey questions	References	Survey questions	References	Survey questions	References
1	Digital tools such as BIM, Virtual reality and Augmented reality foster a sense of cohesiveness within a team. (DLC1)	[18, 3]	Leadership styles which rely on contingent rewards does not correspond to digital leadership in stakeholder management. (DLT1)	[42, 19]	Understanding the organisational impact of digital leadership skills on stakeholder management is crucial to projects. (DLO1)	[51]
2	Communication and collaboration in teams using digital tools is affected by cultural barriers. (DLC2)	[3, 18, 27])	In a ‘task-then-reward’ leadership system, affirmative feedback to stakeholders from managers fosters motivation and trust. (DLT2)	[43, 41]	Organisational culture is resistant to transformation. (DLO2)	[52, 53]
3	Digital modes of communication in a project consistently convey adequate information. (DLC3)	[18, 3]	In a ‘task-then-reward’ leadership system, constructive feedback to stakeholders from managers fosters motivation and trust. (DLT3)	[43, 41]	Organisational culture is resistant to innovation. (DLO3)	[52, 53]
4	Digital modes of communication and collaboration in a project effectively convey urgency in completing tasks. (DLC4)	[18, 3]	Adaptability in stakeholder management is a significant constituent of effective digital leadership. (DLT4)	[37, 16]	Construction practices at the organisational level are not fully compatible with digital leadership in stakeholder management. (DLO4)	[53, 54]
5	A shared collaboration server affects communication and collaboration in terms of dependency on server reliability. (DLC5)	[18, 9]	Digital leadership for stakeholder management is a perfect blend of social and technological philosophies. (DLT5)	[44, 41]	Keeping up with digital trends causes stress on organisational workforce which leads to lower. (DLO5)	[55, 53]
6	Virtual reality is not able to identify real time hazards in projects. (DLC6)	[21, 22]	Consistent recurrent stakeholder communication and engagement are critical factors to success in managing projects. (DLT6)	[45, 46]	Productivity in managing stakeholders is enhanced by digital leadership if the leaders are informed and innovative. (DLO6)	[56, 55, 57]
7	Potential hazards can be avoided by critical analysis of scenarios from Virtual reality by stakeholders. (DLC7)	[22, 21]	Due to digitalisation, teams do not go through Tuckmans group stages of development sequentially and this affects project success. (DLT7)	[46, 45]	Initial phases of planning in construction are better suited for digital leadership than other phases. (DLO7)	[53, 2]
8	Silence in digital communication and collaboration on a project is always adequately interpreted by stakeholders. (DLC8)	[18, 3]	The current era of stakeholders look out for their own interests more than the interest of their collective project. (DLT8)	[50, 46]	Stakeholders such as quantity surveyors are the most impacted by digital leadership in the initial stages of planning in construction. (DLO8)	[53, 2]

Table 3. Cont'd

9	Avatars and Emojis in digital communication help to build better bonds among stakeholders. (DLC9)	[32, 33, 31]	Digital leadership is effective with an authoritative leadership than a people-centred approach. (DLT9)	[50, 46]	All stakeholders in organisations are impacted by digital leadership. (DLO9)	[2, 53]
10	Avatars and Emojis in digital communication and collaboration of stakeholders sufficiently portray verbal and non-verbal cues. (DLC10)	[33, 31]	Individuals with natural born leadership characteristics are better digital leaders in stakeholder management. (DLT10)	[37, 46]	Digital leadership stakeholders in construction do not have a good work-life balance. (DLO10)	[53, 58]
11	The lack of reflexes and reactions of stakeholders in digital communication channels alter the understanding and interpretation of current circumstances. (DLC11)	[31, 33]	Digital leadership styles centred around coordination is useful for stakeholder management. (DLT11)	[37, 39]	Relationship management skills is required by project managers practicing digital leadership to get the most out of the stakeholders on projects. (DLO11)	[29, 53]
12	Leaders who use social media communication tools build trust and endorsement with stakeholders. (DLC12)	[18, 29]	Digital leadership styles centred around even distribution of responsibilities across hierarchy is useful for stakeholder management. (DLT12)	[37, 39]	Digital leadership eases organisational responsibilities by automating processes. (DLO12)	[53, 58]
13	/	/	Individuals with vast digital proficiency are better leaders in stakeholder management. (DLT13)	[46, 12]	/	/

Table 4. Data analytics tests

Test	Purpose	Reference
Skewness	This test was necessary to establish the degree of deviation of survey responses from a consensus.	[79]
Kurtosis	This test was necessary to establish the concentration of a consensus in the responses.	[79]
Pearsons's correlation	This test is important to establish the negative or positive linear relationship between the variables.	[85]
Cronbach's Alpha	This was important to determine the reliability of the survey and the internal consistency amongst the data.	[81]
Kaiser-Meyer-Olkin	This test was necessary to determine the survey questions consistently defined the variables and the outcome can be useful for research.	[83]
Kendall's Coefficient of Concordance	This was useful to establish a level of agreement and correlation within the factors.	[86]

Kendall's coefficient of concordance is widely used to statistically establish a level of agreement and correlation between markers ranking a set of items [84].

4. Results and Discussion

This section discusses the outcome of the methodological steps and provides an interpretation and analysis of the results achieved.

It comprises descriptive analysis and inferential statistics. It begins with a comprehensive representation of the demographic data and explains the reliability and validity of its results, followed by a conceptual framework.

This study focused on individuals belonging to the construction industry within the United Kingdom. To this effect, the target population was as such. The questionnaire survey resulted in a total of 112 respondents from an initial pool of 187 invitations, 112 valid responses were received (60% response rate) who belong to the construction industry in the professions of contractors, architects, site managers, quantity surveyors, project managers, engineers, and clients. Significantly high responses from professionals indicate expertise and stronger familiarity with the topic, while low responses from experts suggest a difference in focus between the professions and the topic. In this study, high responses were from architects, project managers, engineers, and site managers, while lower responses were from quantity surveyors, clients, and contractors [87].

The sample consists of 47 respondents who hold a bachelor's degree, 61 hold a master's, 3 hold a Ph.D. and 1 holds a high school diploma. Furthermore, 14 respondents hold 11 years and above of experience, 43 respondents with 5 to 10 years, and 55 respondents with experience under 5 years. This demography of respondents is well-informed and possesses a high level of understanding, rendering them suitable to provide answers to the survey [88].

Data statistics that undergo internal consistency tests, reliability tests, correlation and agreement produce results that are useful for replication, further analysis and are considered valid [84, 80, 81]. In this light, Table 5 displays the tests that were carried out on the collected data, the

obtained values, and are compared to the standard values. The data sets were all proven reliable, consistent, and correlated as illustrated in Table 5.

4.1. Analysis of effective DL and stakeholder coordination

In Table 6 below, the summary of responses indicates that DLC1, DLC5, and DLC3 have the highest mean scores of 4.30, 3.96, and 3.91, respectively, while DLC8 has the lowest mean score of 2.88. This indicates that the most significant role of digital leadership in communication and collaboration with stakeholders in the UK is that digital tools and modes of communication foster a sense of cohesiveness and consistently convey accurate information within a team on a project (DLC1 & DLC3).

However, a shared local collaboration server, cultural barriers, and silence in digital platforms affect communication and collaboration in terms of dependency on server reliability and inadequate interpretation of the quietness. (DLC2, DLC5 & DLC8). This validates the claims of Cortellazo and Zampieri [18] that there is inadequate information dissemination to team members through digital modes and tools and Prebanic et al. [9] assertion that communication remains a concern in implementing digital tools in the UK, due to the requirement of institutions to use a shared server to collaborate.

The results also show some minor indications that while virtual reality is not able to identify real-time hazards in projects, potential hazards can be avoided by critical analysis of scenarios from VR by stakeholders to improve collaboration (DLC6 and DLC7). Similarly, while avatars and emojis in digital communication and collaboration help to build better bonds among stakeholders (DLC9), the lack of reflexes and reactions alters the understanding and interpretation of current circumstances (DLC10 and DLC11). This reaffirms the analysis of Li et al. [22] that VR can assist in avoiding hazards and the study of Giovanni et al. [33] claiming that avatars and emojis' lack of reflexes and reactions alters the authenticity of virtual communications and relationships, but do not rank as the most significant roles of digital leadership in this context.

Table 5. Inferential statistics

Test name	Factor	Obtained Value			Standard Value	Comments
Skewness	DLC	-0.449			-2 to +2 [79]	The values suggest an even distribution around the mean except DLO which may suggest close situation around the mean.
	DLT	-0.676				
	DLO	-0.116				
Kurtosis	DLC	1.254			-7 to +7 [79]	The values of DLT suggest a peakedness which may indicate a consensus in the responses.
	DLT	2.233				
	DLO	0.790				
Pearson's Correlation	DLC	1	0.655	0.698	R values range from -1 to +1 [85]	The values indicate strength and a positive relationship between the variables. Variables closer to 1 indicate a stronger relationship.
	DLT	0.655	1	0.604		
	DLO	0.698	0.604	1		
Cronbach Reliability & Validity	DLC	0.742			0 to 1 [89]	Values equal to or higher than 0.7 affirms the reliability indicating the survey questions were highly relevant to the study.
	DLT	0.787				
	DLO	0.815				
Kaiser-Meyer-Olkin Reliability & Validity	DLS	0.722			0 to 1 [90]	The study is suitable for further analysis based on its values.
Kendall's coefficient of concordance. (W) agreement	DLS	0.033			0 to 1 [86]	Correlation between the variables is significant.

All correlations significant at $p < 0.01$

Table 6. Digital leadership mean figures

CODE	MEAN	CODE	MEAN	CODE	MEAN
DLC1	4.30	DLT11	4.08	DLO12	4.13
DLC5	3.96	DLT6	4.07	DLO1	4.10
DLC3	3.91	DLT5	4.03	DLO6	4.08
DLC4	3.87	DLT4	4.00	DLO11	4.00
DLC7	3.83	DLT3	3.96	DLO9	3.94
DLC12	3.83	DLT2	3.91	DLO7	3.55
DLC11	3.76	DLT12	3.84	DLO8	3.36
DLC2	3.48	DLT13	3.56	DLO3	3.09
DLC9	3.46	DLT7	3.37	DLO2	3.09
DLC10	3.30	DLT8	3.33	DLO4	3.02
DLC6	3.24	DLT10	3.22	DLO10	2.91
DLC8	2.88	DLT1	3.03	DLO5	2.89
		DLT9	2.97		

Additionally, leaders who use social media communication tools build trust and endorsement with stakeholders (DLC12). These results hold significance; however, they do not appear to be the most relevant to industry professionals. The additional factors, demonstrating mean values ranging from 3.24 to 3.87, imply a consensus among respondents, indicating a state of agreement towards the statements.

4.2. Analysis of theoretical concepts of DL and practical stakeholder management

The responses illustrated in Table 6 above indicate DLT11, DLT6, and DLT5 hold the highest mean scores of 4.08, 4.07, and 4.03, respectively, while DLC9 has the lowest mean score of 2.97. These results suggest that the most significant digital leadership theory in the UK is coordination, followed closely by transformational, as analysis shows digital leadership styles centred around coordination are useful in stakeholder management (DLT11). Similarly, a blend of social and technological philosophies (DLT5) and a people-centred

approach (DLT9) is suitable for stakeholder management for successful projects (DLT6). Situational digital leadership style proves useful, as leveraging different styles to suit the unique situation is beneficial in stakeholder management. (DLT4) This affirms these studies [37, 44, 39, 45].

On the middle part of the mean spectrum, it shows transactional digital leadership is accepted in the UK if it is adapted to include affirmative (DLT2) and constructive feedback (DLT3). This supports the claims Antonopoulou et al. [43] that transformational leadership is an expansion of transactional leadership [46]. Shared digital leadership style centred around even distribution of responsibilities (DLC12) and trait theory concerning individuals with vast digital proficiency being better leaders for stakeholder management (DLC13). This reaffirms the claims of Lee and Mukundi [46, 39] but is not recognised by the construction industry as the most significant theory.

On the lower part of the spectrum, teams do not go through Tuckman's group stages of development sequentially (DLT7), and the current era of stakeholders looks out for their own interests more than the interests of their collective project (DLT8) [50].

Similarly, individuals with natural-born leadership characteristics are better digital leaders (DLT10), and leadership styles that rely on contingent rewards do not correspond with digital leadership in stakeholder management (Transactional) (DLT1). This agrees; it proves to be the least significant to professionals in the industry. At the bottom of the spectrum, stakeholders do not agree that authoritative leadership (Transactional) is more effective than a people-centred approach (Transformational) (DLT9) [50, 42, 46].

4.3. Analysis of organisational impact of DL skills on stakeholder management

The responses described in Table 6 above demonstrate that DLO12, DLO1, and DLO6 hold the highest mean scores of 4.13, 4.10, and 4.08, respectively, while DLO5 and DLO10 have the lowest mean scores of 2.89 and 2.91, respectively. This indicates that respondents believe the most significant role of digital leadership in organisations is that it eases organisational responsibilities by automating processes (DLO12) and enhances productivity, provided the digital leader is informed and innovative (DLO6). Additionally, stakeholders agree that understanding the organisational impact of digital leadership skills on stakeholder management is crucial to projects (DLO1). This affirms the study of Chatterjee, Araujo, and Nadzri [58, 56, 51].

In the middle part of the spectrum, it shows that relationship management skills are required by project managers practising digital leadership to get the most out of stakeholders on projects (DLO11) as all stakeholders in organisations are impacted by digital leadership (DLO9). Additionally, the initial phases of planning in construction are better suited for digital leadership than other phases (DLO7). This reaffirms the studies of Li, and Newman [2, 53], but they are not regarded as the most significant organisational impacts.

On the bottom part of the mean spectrum, it shows organisational culture is resistant to innovation (DLO3) and transformation (DLO2). Additionally, construction practices at the organisational level are not fully compatible with digital leadership in stakeholder management (DLO4). These agree with [52-54] but are also not as significant. However, the results show that the proposals of digital trends causing stress on the organisational workforce (DLO5) and construction stakeholders not having a good work-life balance were rejected (DLO10).

Table 7 below summarises the findings of this study and provides direct responses to the research questions outlined in Table 2.

Following the analysis of the results, the authors developed a conceptual framework for organisations to adopt in a bid to address the major and prominent digital leadership concerns in the industry related to communication, collaboration, relationships (DL Communication), leadership (DL Theories), and organisational impact (DL Organisation) of stakeholder management. The framework, as illustrated in Fig. 2, was developed through a combination of thematic analysis, descriptive data interpretation, and alignment with existing literature on digital leadership. This pattern explains reflexive thematic analysis as the researcher's interpretive engagement with the data, shaped by the interaction between the dataset itself, the theoretical framework guiding the analysis, and the researcher's own analytical skills and resources [91]. In this light, the relationships between the sub-elements/variables are not derived from inferential statistics but are conceptually mapped based on observed patterns in mean scores and supported by theoretical insights. Primary solutions from the study were identified by observing patterns in the descriptive data, specifically selecting those variables with higher mean scores indicating stronger agreement or perceived importance. Secondary solutions were identified through thematic connections across the three groups of variables, drawing on related concepts to address challenges comprehensively, rather than solely based on mean scores.

As highlighted in the previous section, the most significant challenges include server reliability (DLC5), silence in digital communication and collaboration (DLC8), authoritative leadership (DLT9), low productivity (DLO6), and organisational responsibilities (DLO12). In Table 5, the Pearson and Kendall correlation analyses between the variables obtained values above the minimum threshold for correlation acceptance, all significant at the 0.01 level, indicating a very high significance of the relationship between the main concepts [85, 86]. Server reliability (DLC5) can be rectified by the effective use of digital tools (DLC1), adaptability (DLT4), emails (DLC3), and consistent recurrent engagement and communication (DLT6). Silence in digital communication and collaboration (DLC8) can be resolved by a feedback loop (DLO6) and coordination (DLT11). Authoritative leadership (DLT9) can be addressed through transformational leadership approaches (DLT5) and revisiting leadership training (DLT4), fostering a more inclusive and innovative leadership style. Low productivity (DLO6) can be solved by adaptability (DLT4), automating processes (DLO12), and by placing informed and innovative leaders (DLO6) within organisations. Finally, organisational responsibilities (DLO12) can be managed through automating processes, coordination (DLT11), adaptability (DLT4), and understanding the organisational impact of digital leadership (DLO1). These measures will create a more resilient and efficient framework for managing stakeholders, ultimately leading to more successful and dynamic construction projects.

Table 7. Digital leadership outcomes

Focus Area	Identified Gap	Corresponding Objective	Key Finding	Overall Interpretation
DL role in Communication, Collaboration and Relationships	A gap exists in digital leaderships ability to fully integrate interpersonal communication and effectively convey crucial information, therefore, limiting effective and maximum stakeholder collaboration in construction projects	Understand how effective functional digital leadership skills contribute to stakeholder management	Highest support for cohesiveness (4.30), information clarity (3.91), and collaborative server use (3.96); weakest in interpreting silence (2.88)	Digital tools enhance communication and collaboration, but cultural barriers, server dependence, and limited non-verbal cues reduce communicative richness.
DL Theories' practicality	A gap exists in the extent to which current digital leadership theories align with real-world stakeholder management needs, particularly in balancing control-oriented and people-centred approaches within the construction industry.	Assess the extent of their capability to fulfil real-world stakeholder management scenarios	Highest means for coordination, communication, and socio technical approaches (4.08–4.03); lowest for authoritative, contingent reward, and trait-based theories (3.03–2.97)	Digital leadership theories that are people-centred, and a socio-technical blend received the strongest support. Mid-range scores show an unusual acceptance of adapted transactional (control-oriented) elements, such as affirmative and constructive feedback styles and shared responsibility. This indicates that hybrid leadership approaches are moderately valued. The lowest-scoring items reflect limited confidence in authoritative, contingent-reward, trait-based, and non-sequential development models.
DL Organisational impact	A gap exists in the organisational impact of digital leadership on stakeholder management, particularly in addressing work-life balance, productivity, and the effectiveness of relationship management during digital transitions in construction projects.	Evaluate the impact of digital leadership skills on organisations, particularly within construction projects.	Highest means for automation enabled efficiency, organisational awareness, and productivity gains (4.13–4.08); lowest means for digital trend stress, work life balance concerns, and cultural resistance (2.89–3.09)	Digital leadership is perceived to strengthen organisational performance primarily through automation, informed leadership, and effective relationship management, while organisational resistance, incompatibility concerns, and workforce stress are viewed as less influential challenges.

4.4. The study findings

Based on the discussion above, the findings of this study in connection to the stated aims are as follows:

Effective functional digital leadership significantly enhances communication, collaboration, and relationships with stakeholders by leveraging digital tools to foster cohesiveness and ensure the consistent conveyance of accurate information within teams. However, challenges such as reliance on shared local servers, cultural barriers, and the interpretation of silence on digital platforms can impede communication and collaboration. Additionally, while virtual reality aids in hazard analysis, and avatars and emojis improve bonding, they may lack the necessary reflexes and authenticity for real-time interaction. Therefore, while digital leadership facilitates stronger stakeholder engagement through social media and other tools, addressing these challenges is crucial for optimising its impact. The author's framework, as seen in Fig. 2, attempts to resolve local server reliability using skills such as adaptability, timely and

effective use of emails and other digital tools. Additionally, it highlights the effective use of a feedback loop, consistent recurrent engagement, communication, and coordination to resolve the limitation of silence that leads to misinterpretation.

This analysis shows that the theoretical concepts of digital leadership skills have varying degrees of application in real-world scenarios of construction practices, with coordination, transformational, and situational being the most useful in the UK's industry. Conversely, other theories, such as transactional, trait, and shared, are favoured in certain areas while being disregarded in others. This suggests that while the theories are, at large, effective in managing real-life stakeholder scenarios, a review of the bottom spectrum theories would be beneficial for maximum results. The study uncovers that previous studies have shown that transactional leadership is not functional in today's digital era. However, further analysis reveals that authoritative leadership is, in fact, the major downside to transactional leadership.

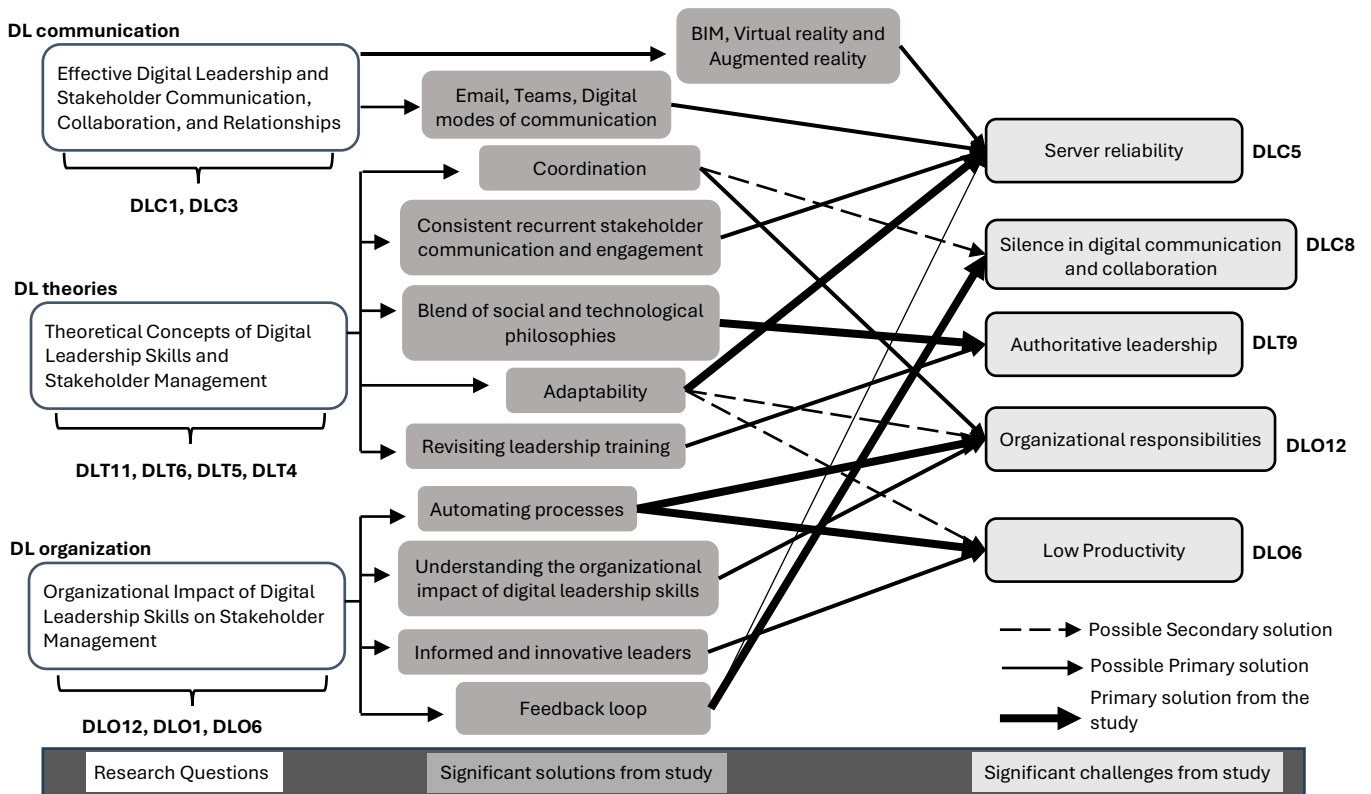


Fig. 2. A conceptual framework and solutions for improved impact of DL skills for stakeholder management in construction projects

The author’s framework attempts to address this by suggesting the use of a blend of transformational leadership and transactional leadership skills with refresher leadership training to produce innovative and inclusive leadership. The authors’ Table 1 also defines the functionality of digital leadership theories and the skills required to exhibit them actively.

Digital leadership skills significantly enhance stakeholder management within construction projects by automating processes, boosting productivity, and improving stakeholder understanding and relationship management. Although it is beneficial in the early planning phases, its efficiency is altered by organisational resistance to innovation and existing practice incompatibilities. However, concerns about increased stress and poor work-life balance due to digital trends are unfounded, suggesting that digital leadership can be integrated without detrimental effects on workforce well-being. The authors’ framework introduces the insertion of informed and innovative leaders who possess skills such as adaptability to manage cases of low productivity among stakeholders.

5. Conclusions

The research was undertaken to examine the role of digital leadership skills (DLS) in the UK construction industry, their necessity, and the considerations involved in supporting and enhancing stakeholder management and project performance. DLS significantly improves construction project outcomes; however, previous expectations around digitalisation have not been fully met [10]. Furthermore, essential complementary

skills for successful stakeholder management in construction remain unidentified, and there is a gap in assessing the real-life effectiveness of the proposed digital leadership theories [11, 9, 1].

This study addressed these gaps through a literature review and a survey of 112 UK-based construction professionals. The literature review identified three key thematic categories: communication factors (DL Communication), leadership factors (DL Theories), and organisational factors (DL Organisation). Survey results highlighted that digital tools and digital communication modes are the most significant communication enablers; however, issues such as a lack of shared collaboration servers, silence, and cultural barriers hinder effective communication and collaboration.

A survey involving 112 participants from the UK was carried out to assess the variables of the research identified in the literature review. The results identified the most significant communication factors as digital tools and digital modes of communication; however, a shared local collaboration server, silence, and cultural barriers affect the efficiency of communication and collaboration on these platforms. Additionally, coordination, transformational, and situational theories were highlighted as the most effective digital leadership theories, while transactional, trait, and shared theories have favoured aspects and areas that need to be reviewed. Furthermore, the most significant organisational factors were automating processes, a complementary informed and innovative digital leader, and understanding the impact of digital leadership on organisational processes. By

integrating skills such as adaptability, transformational leadership, and consistent feedback mechanisms, these obstacles can be effectively addressed. The survey responses were tested using a combination of descriptive and inferential analyses.

This study contributes to academic knowledge by enriching the existing literature on digital leadership and stakeholder management, bridging the gap between theoretical knowledge and the real-life capabilities of the topic. It also introduces and expands on digital leadership theories, an aspect that appears to be insufficiently addressed in previous studies [94, 95]. Additionally, a conceptual framework utilising the variables was developed for adoption by organisations to tackle the shortcomings the study identified, enlightening construction leaders on how to leverage these skills and theories to maximise the effectiveness of digital leadership on stakeholder management and achieve project success.

In terms of leadership theory, coordination, transformational, and situational leadership emerged as the most effective approaches in digital contexts. Transactional, trait-based, and shared leadership approaches demonstrated selective advantages but also presented limitations. Organisationally, the most significant factors were the automation of processes, the presence of informed and innovative digital leaders, and an understanding of how DLS influence organisational systems and performance. The findings were supported by descriptive and inferential analyses.

This research contributes to academic knowledge by bridging the gap between theoretical understanding and real-world application of digital leadership in stakeholder management. A conceptual framework was developed to help

organisations address the shortcomings identified and to guide the effective use of DLS in improving stakeholder outcomes.

The findings confirm that DLS has significantly reshaped construction processes in the UK and enhanced productivity. However, areas such as platform reliability and the issue of silence in digital collaboration still require further exploration. The study also reveals that certain aspects of transactional leadership theory yield productive outcomes, although the approach remains underutilised in the industry. It recommends that situational leadership be adapted to guide leaders in applying context-specific approaches, supported by leadership training and refresher programmes. Furthermore, innovation and a creative mindset should be actively cultivated within leadership teams to maximise the value of digital strategies.

Despite addressing the research questions comprehensively, the study faced certain limitations. These include its restriction to the UK, which may limit generalisability, and potential biases in survey responses due to self-reporting. Snowball sampling may limit generalisability beyond UK construction professionals, though findings align with global digitalisation trends. The research also employed thematic analysis to identify secondary solutions, which offer valuable insights and can inform future empirical validation. Future research should explore other geographic contexts for comparative insights and investigate ways to refine digital leadership theories and training models that better reflect current realities in construction. This will further strengthen the industry's ability to use digital leadership as a driver for effective stakeholder management and project success.

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Author Contributions

T. Dogun: Investigation, Data Curation, Formal Analysis, Conceptualization, Visualization, Writing of Original Draft.
A. Suliman: Conceptualization, Methodology, Supervision, Writing - Review & Editing.

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Data Availability Statement

The data presented in this study are available on request from the corresponding author.

Ethics Committee Permission

The authors acquired ethics committee permission for surveys implemented in this paper from the Northumbria University Ethics Committee, Date: [08/05/2024]

Conflict of Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

- [1] Zulu SL, Khosrowshahi F (2021) A taxonomy of digital leadership in the construction industry. *Construction Management & Economics* 39:565–578. <https://doi.org/10.1080/01446193.2021.1930080>.
- [2] Li Y, Sun H, Li D, Song J, Ding R (2022) Effects of digital technology adoption on sustainability performance in construction projects: The mediating role of stakeholder

- collaboration. *J Manage Eng* 38:04022016. [https://doi.org/10.1061/\(ASCE\)ME.1943-5479.0001040](https://doi.org/10.1061/(ASCE)ME.1943-5479.0001040).
- [3] Charalambous G, Demian P, Yeomans S, Thorpe T, Peters C, Doughty N (2012) BIM and online collaboration platforms – an investigation into emerging requirements. In: *Proceedings of the 3rd International Conference on Engineering, Project, and Production Management*. Loughborough, UK, pp 31–40. <https://doi.org/10.32738/CEPPM.201209.0004>.
- [4] Adeniyi O, Thurairajah N, Leo-Olagbaye F (2024) Rethinking digital construction: A study of BIM uptake capability in BIM infant construction industries. *Constr Innov* 24:584–605. <https://doi.org/10.1108/CI-09-2021-0161>.
- [5] Dolla T, Jain K, Kumar Delhi VS (2023) Strategies for digital transformation in construction projects: Stakeholders' perceptions and actor dynamics for Industry 4.0. *ITcon* 28:151–175. <https://doi.org/10.36680/j.itcon.2023.008>.
- [6] Omokaro H, Wu H, Gao D (2024) Advanced global maximum power point tracking (GMPPT) in PV systems using a triangular four-subset fuzzy logic and P&O hybrid approach. In: *Proceedings of the 4th International Symposium on Electrical, Electronics and Information Engineering (ISEEIE)*. Leicester, UK, pp 513–520. <https://doi.org/10.1109/ISEEIE62461.2024.00099>.
- [7] Uribe DF, Ortiz-Marcos I, Uruburu Á (2018) What is going on with stakeholder theory in project management literature? A symbiotic relationship for sustainability. *Sustainability* 10:1300. <https://doi.org/10.3390/su10041300>.
- [8] Damström M (2020) Digitalization and construction project management: What consequences the use of ICT tools has had on the project manager role in the construction industry. MSc Dissertation.
- [9] Prebanic KR, Vukomanovic M (2021) Realizing the need for digital transformation of stakeholder management: A systematic review in the construction industry. *Sustainability* 13:12690. <https://doi.org/10.3390/su132212690>.
- [10] Aghimien DO, Aigbavboa CO, Oke AE (2020) Critical success factors for digital partnering of construction organisations – A Delphi study. *Eng Constr Archit Manag* 27:3171–3188. <https://doi.org/10.1108/ECAM-11-2019-0602>.
- [11] Ebekoziem A, Aigbavboa CO, Ramotshela M (2023) A qualitative approach to investigate stakeholders' engagement in construction projects. *Benchmarking* 31:866–883. <https://doi.org/10.1108/BIJ-11-2021-0663>.
- [12] Sagbas M, Erdogan FA (2022) Digital leadership: A systematic conceptual literature review. *Istanbul Kent Univ J Human Soc Sci* 3:17–35.
- [13] Sulistiyorini D, Zahra GA (2023) The effects of leadership style and work environment on digital leadership: A literature review. *KnE Soc Sci*. <https://doi.org/10.18502/kss.v8i19.14385>.
- [14] Makedon V, Krasnikova N, Krupskyi OP, Stasiuk Y (2022) Arrangement of digital leadership strategy by corporate structures: A review. *Econ Stud* 31(8).
- [15] Eberl JK, Drews P (2021) Digital leadership – Mountain or molehill? A literature review. *Lect Notes Inf Syst Organ*:223–237. https://doi.org/10.1007/978-3-030-86800-0_17.
- [16] Kupiek M (2021) Digital Leadership, Agile Change And The Emotional Organization: Emotion As A Success Factor For Digital Transformation Projects. Springer Fachmedien, Wiesbaden.
- [17] Şisu JA (2023) Digital leadership competencies: A systematic literature review. *Rev Manag Comparat Int* 24:69–77.
- [18] Cortellazzo L, Bruni E, Zampieri R (2019) The role of leadership in a digitalized world: A review. *Front Psychol* 10:1938. <https://doi.org/10.3389/fpsyg.2019.01938>.
- [19] Jakubik M, Berazhny I (2017) Rethinking leadership and its practices in the digital era. In: *Proceedings of the Management International Conference*. Monastier di Treviso, Italy.
- [20] Castronovo F, Nikolic D, Liu Y, Messner J (2013) An evaluation of immersive virtual reality systems for design reviews. In: *Proceedings of the 13th International Conference on Construction Applications of Virtual Reality (CONVR)*. London, UK.
- [21] Wen J, Gheisari M (2020) Using virtual reality to facilitate communication in the AEC domain: A systematic review. *Constr Innov* 20:509–542. <https://doi.org/10.1108/CI-11-2019-0122>.
- [22] Li X, Yi W, Chi HL, Wang X, Chan APC (2018) A critical review of virtual and augmented reality (VR/AR) applications in construction safety. *Autom Constr* 86:150–162. <https://doi.org/10.1016/j.autcon.2017.11.003>.
- [23] Al A'ali E, Alazali RM, Al-Manna'ei M (2023) The impact of digital transformation on relationships between leadership and stakeholders. In: *Leadership and Workplace Culture in the Digital Era*. IGI Global.
- [24] Park K, Kim K (2017) BIM application and adoption in the UK housing sector. In: *Integrated Building Information Modelling*, pp. 46–81.
- [25] Bello SA, Oyedele LO, Akinade OO, Bilal M, Davila Delgado JM, Akanbi LA, Ajayi AO, Owolabi HA (2021) Cloud computing in construction industry: Use cases, benefits and challenges. *Autom Constr* 122:103441. <https://doi.org/10.1016/j.autcon.2020.103441>.
- [26] Cheng J, Huang L, Jiang L, Chen J, Chen W, He Y (2023) Fostering knowledge collaboration in construction projects: The role of BIM application. *Buildings* 13:812. <https://doi.org/10.3390/buildings13030812>.
- [27] Manukyan N, Papadonikolaki E (2019) Digitalisation in construction: Mixed blessing for collaboration in projects. In: *Proceedings of Project Management Congress*. Project Management Institute (PMI).
- [28] Johari S, Hendra S (2023) An overview of digital leadership dimensions in construction industry. *Int J Bus Technol Manag* 5:49–66. <https://doi.org/10.55057/ijbtm.2023.5.2.5>.
- [29] Barrane FZ, Ndubisi NO, Kamble S, Karuranga GE, Poulin D (2021) Building trust in multi-stakeholder collaborations for new product development in the digital transformation era. *Benchmarking* 28:205–228.
- [30] Gupta S, Pathak GS (2018) Virtual team experiences in an emerging economy: A qualitative study. *J Organ Change Manag* 31:778–794. <https://doi.org/10.1108/JOCM-04-2017-0108>.
- [31] Jawadi N, Daassi M, Favier M, Kalika M (2013) Relationship building in virtual teams: A leadership behavioral complexity perspective. *Hum Syst Manag* 32:199–211. <https://doi.org/10.3233/HSM-130791>.
- [32] Adolphe L, van de Zande GD, Wallace D, Olechowski A (2020) Analysis of virtual communication within engineering design teams and its impact on team effectiveness. In: *Proceedings of the ASME International Design Engineering*

- Technical Conferences. <https://doi.org/10.1115/DETC2020-22736>.
- [33] Giovannelli A, Thomas J, Lane L, Rodrigues F, Bowman DA (2023) Gestures vs. emojis: Comparing non-verbal reaction visualizations for immersive collaboration. *IEEE Trans Vis Comput Graph* 29:4772–4781. <https://doi.org/10.1109/TVCG.2023.3320254>.
- [34] Li W, Liu K, Belitski M, Ghobadian A, O'Regan N (2016) E-leadership through strategic alignment: An empirical study of SMEs in the digital age. *J Inf Technol* 31:185–206. <https://doi.org/10.1057/jit.2016.10>.
- [35] Fiedler FE (2006) The contingency model: A theory of leadership effectiveness. In: *Small Groups: Key Readings*.
- [36] Zaccaro SJ (2007) Trait-based perspectives of leadership. *Am Psychol* 62:6–16. <https://doi.org/10.1037/0003-066X.62.1.6>.
- [37] Benmira S, Agboola M (2021) Evolution of leadership theory. *BMJ Leader* 5:3–5. <https://doi.org/10.1136/leader-2020-000296>.
- [38] Bass BM, Avolio BJ, Jung DI, Berson Y (2003) Predicting unit performance by assessing transformational and transactional leadership. *J Appl Psychol* 88:207–218. <https://doi.org/10.1037/0021-9010.88.2.207>.
- [39] Mukundi Gichuhi J (2021) Shared leadership and organisational resilience: A systematic literature review. *Int J Organ Leadersh* 10:67–88.
- [40] Weber E, Krehl E, Büttgen M (2022) The digital transformation leadership framework: Conceptual and empirical insights. *J Leadersh Stud* 16:6–22. <https://doi.org/10.1002/jls.21810>.
- [41] McCarthy P, Sammon D, Alhassan I (2022) Digital transformation leadership characteristics: A literature analysis. *J Decis Syst* 32:79–109.
- [42] Bach C, Sulikova R (2021) Leadership in the context of a new world: Digital leadership and Industry 4.0. *Manag Glob Transit* 19:209–226. <https://doi.org/10.26493/1854-6935.19.209-226>.
- [43] Antonopoulou H, Halkiopoulos C, Barlou O, Beligiannis GN (2020) Leadership types and digital leadership in higher education. *Int J Learn Teach Educ Res* 19:110–129. <https://doi.org/10.26803/ijlter.19.4.8>.
- [44] Gledson B, Zulu SL, Saad AM, Ponton H (2024) Digital leadership framework to support firm-level digital transformations for Construction 4.0. *Constr Innov* 24:341–364. <https://doi.org/10.1108/CI-12-2022-0328>.
- [45] Nwachukwu CV, Udeaja C, Chileshe N, Okere CE (2017) Critical success factors for stakeholder management in restoration of built heritage assets. *Int J Build Pathol Adapt* 35:304–331. <https://doi.org/10.1108/IJBPA-07-2017-0030>.
- [46] Lee MR (2021) Leading virtual project teams: Adapting leadership theories and communication techniques. Auerbach Publications. <https://doi.org/10.1201/9781003119869>.
- [47] Tuckman BW, Jensen MAC (2010) Stages of small-group development revisited. *Group Facilitation*.
- [48] Chinyio E, Singh S, Suresh S (2022) A review of stakeholder management in construction. In: *Research Companion to Construction Economics*, pp. 422.
- [49] Zhang S, Fjermestad J (2006) Bridging traditional leadership theories and virtual team leadership. *Int J Technol Policy Manag* 6:274. <https://doi.org/10.1504/IJTPM.2006.011253>.
- [50] Anderson HJ, Baur JE, Griffith JA, Buckley MR (2017) What works for you may not work for (Gen)Me. *Leadersh Q* 28:245–260. <https://doi.org/10.1016/j.leaqua.2016.08.001>.
- [51] Nadzri E, Kannan R, Malarvizhi CAN (2022) Stakeholder satisfaction in IT project management: A two-decade review. *J Mod Proj Manag* 10:258–269.
- [52] Alvesson M (2012) *Understanding Organisational Culture*. Sage.
- [53] Newman C, Edwards D, Martek I, Lai J, Thwala WD, Rillie I (2021) Industry 4.0 deployment in construction industry: A bibliometric review. *Smart Sustain Built Environ* 10:557–580.
- [54] Sony M, Naik SS (2019) Ten lessons for managers while implementing Industry 4.0. *IEEE Eng Manag Rev* 47:45–52. <https://doi.org/10.1109/EMR.2019.2913930>.
- [55] Neugebauer R, Hippmann S, Leis M, Landherr M (2016) Industrie 4.0 from the perspective of applied research. *Procedia CIRP* 57:2–7. <https://doi.org/10.1016/j.procir.2016.11.002>.
- [56] Araujo LMD, Priadana S, Paramarta V, Sunarsi D (2021) Digital leadership in business organizations: An overview. *Int J Eng Appl Manag Lett*. <https://doi.org/10.51629/ijeamal.v2i1.18>.
- [57] Lyu J (2023) How does digital leadership improve organisational sustainability: Theory and evidence. *J Clean Prod*:140148.
- [58] Chatterjee S, Chaudhuri R, Vrontis D, Giovando G (2023) Digital workplace and organisation performance. *J Innov Knowl* 8:100334. <https://doi.org/10.1016/j.jik.2023.100334>.
- [59] Salamzadeh Y, Farzad FS, Salamzadeh A, Palalic R (2021) Digital leadership and organizational capabilities in manufacturing industry. *Period Eng Nat Sci* 10:195. <https://doi.org/10.21533/pen.v10i1.2237>.
- [60] Saunders M, Lewis P, Thornhill A (2009) *Research Methods For Business Students*, 5th Edition. Financial Times Prentice Hall, Harlow.
- [61] Žukauskas P, Vveinhardt J, Andriukaitienė R (2018) Philosophy and paradigm of scientific research. In: *Management Culture and Corporate Social Responsibility*, pp. 121–506.
- [62] Al-Ababneh M (2020) Linking ontology, epistemology and research methodology. *Sci Philos* 8:75–91.
- [63] St Pierre EA (2012) Another postmodern report on knowledge: Positivism and its others. *Int J Leadersh Educ* 15:483–503. <https://doi.org/10.1080/13603124.2012.696710>.
- [64] Heidegger M (2008) *Ontology—The hermeneutics of facticity*.
- [65] Muun K, Blackman D (2014) A guide to understanding social science research for natural scientists. *Conserv Biol* 28:1167–1177. <https://doi.org/10.1111/cobi.12326>.
- [66] Knight A, Ruddock L (2009) *Advanced Research Methods in The Built Environment*. Wiley, Oxford.
- [67] Singh AS, Masuku MB (2014) Sampling techniques and determination of sample size in applied statistics research: An overview. *Int J Econ Commer Manag* 2:1–22.
- [68] Bryman A (2016) *Social Research Methods*, 5th Edition. Oxford University Press, Oxford.
- [69] Memon MA, Ting H, Cheah JH, Thurasamy R, Chuah F, Cham TH (2020) Sample size for survey research: Review and recommendations. *J Appl Struct Equ Model* 4:i–xx. [https://doi.org/10.47263/JASEM.4\(2\)01](https://doi.org/10.47263/JASEM.4(2)01).

- [70] Ward V, House A, Hamer S (2009) Developing a framework for transferring knowledge into action: A thematic analysis of the literature. *J Health Serv Res Policy* 14:156–164. <https://doi.org/10.1258/jhsrp.2009.008120>.
- [71] Mohamed OA, Masood SH, Bhowmik JL (2015) Optimization of fused deposition modeling process parameters: A review. *Adv Manuf* 3:42–53. <https://doi.org/10.1007/s40436-014-0097-7>.
- [72] Ullrich CA (2011) Time-dependent density-functional theory: Concepts and applications.
- [73] Ellis T, Levy Y (2009) Towards A Guide For Novice Researchers On Research Methodology. <https://doi.org/10.28945/3325>.
- [74] Aithal A, Aithal P (2020) Development and validation of survey questionnaire and experimental data: A systematic review-based statistical approach. *Int J Manag Technol Soc Sci* 5:2581–6012. <https://doi.org/10.5281/zenodo.4179499>.
- [75] Maqbool R, Akubo SA (2022) Solar energy for sustainability in Africa: The challenges of socio-economic factors and technical complexities. *Int J Energy Res* 46. <https://doi.org/10.1002/er.8425>.
- [76] Szabelska A, Pollet TV, Dujols O, Klein RA, IJzerman H (2021) A tutorial for exploratory research: An eight-step approach. <https://doi.org/10.31234/osf.io/cy9mz>.
- [77] Story DA, Tait AR (2019) Survey research. *Anesthesiology* 130:192–202.
- [78] Facon B, Magis D, Belmont JM (2011) Beyond matching on the mean in developmental disabilities research. *Res Dev Disabil* 32:2134–2147. <https://doi.org/10.1016/j.ridd.2011.07.029>.
- [79] Hair JF (2009) *Multivariate Data Analysis*.
- [80] Schober P, Boer C, Schwarte LA (2018) Correlation coefficients: Appropriate use and interpretation. *Anesth Analg* 126:1763–1768. <https://doi.org/10.1213/ANE.0000000000002864>.
- [81] Vaske JJ, Beaman J, Sponarski CC (2017) Rethinking internal consistency in Cronbach’s alpha. *Leis Sci* 39:163–173. <https://doi.org/10.1080/01490400.2015.1127189>.
- [82] Bujang MA, Omar ED, Baharum NA (2018) A review on sample size determination for Cronbach’s alpha test: A simple guide for researchers. *Malays J Med Sci* 25:85.
- [83] Field A (2013) *Discovering Statistics Using IBM SPSS Statistics*. Sage.
- [84] Liu J, Tang W, Chen G, Lu Y, Feng C, Tu XM (2016) Correlation and agreement: Overview and clarification of competing concepts and measures. *Shanghai Arch Psychiatry* 28:115–120. <https://doi.org/10.11919/j.issn.1002-0829.216045>.
- [85] Sedgwick P (2012) Pearson’s correlation coefficient. *BMJ* 345:e4483. <https://doi.org/10.1136/bmj.e4483>.
- [86] Couso I, Strauss O, Saulnier H (2018) Kendall’s rank correlation on quantized data: An interval-valued approach. *Fuzzy Sets Syst* 343:50–64. <https://doi.org/10.1016/j.fss.2017.09.003>.
- [87] Weber EU (2010) What shapes perceptions of climate change? *Wiley Interdiscip Rev Clim Change* 1:332–342. <https://doi.org/10.1002/wcc.41>.
- [88] Stocklmayer SM, Bryant C (2012) Science and the public—What should people know? *Int J Sci Educ B* 2:81–101. <https://doi.org/10.1080/09500693.2010.543186>.
- [89] Bujang MA, Omar ED, Baharum NA (2018) A review on sample size determination for Cronbach’s alpha test: A simple guide for researchers. *Malays J Med Sci* 25:85.
- [90] Napitupulu D, Abdel Kadar J, Kartika Jati R (2017) Validity testing of technology acceptance model based on factor analysis approach. *Indones J Electr Eng Comput Sci* 5:697–704. <https://doi.org/10.11591/ijeecs.v5.i3.pp697-704>.
- [91] Byrne D (2022) A worked example of Braun and Clarke’s approach to reflexive thematic analysis. *Qual Quant* 56:1391–1412. <https://doi.org/10.1007/s11135-021-01182-y>.
- [92] Spann MN, Hua M, Shimbo D, Begg M, Gartrell R, Momen-Heravi F, Accordino M, Connolly E, Einstein A, Dimitropoulou K, Chang B (2025) Keeping the network alive: The importance of professional social networks for long-term research career development. *J Clin Transl Sci* 9:e170.
- [93] Ting H, Memon MA, Thuramy R, Cheah JH (2025) Snowball sampling: A review and guidelines for survey research. *Asian J Bus Res* 15(1).
- [94] Nguyen PMB, Vo XV, Truong GNT, Truong GLN (2025) Digital leadership: A systematic literature review and research direction. *Serv Ind J*, pp. 1–45.
- [95] López-Figueroa JC, Ochoa-Jiménez S, Palafox-Soto MO, Hernandez Munoz DS (2025) Digital leadership: A systematic literature review. *Adm Sci* 15:129.
- [96] Oz B (2025) A novel consensus-based Likert evaluation of public building dissatisfaction levels and quality recommendations. *J Constr Eng Manag Innov* 8(1):01-18. <https://doi.org/10.31462/jcemi.2025.01001018>
- [97] Gürbüz M, Çetinyokuş T (2025) Competency and collaboration based project team selection: A systematic and methodological literature review. *J Constr Eng Manag Innov* 8(3):209-235. <https://doi.org/10.31462/jcemi.2025.03209235>
- [98] Shooshtarian S, Maqsood T, Wong PS, Khalfan M, Yang RJ (2020) Market development for construction and demolition waste stream in Australia. *J Constr Eng Manag Innov* 3(3):220–231. <https://doi.org/10.31462/jcemi.2020.03220231>