Article

Individual Characteristics as Enablers of Construction Employees' Digital Literacy: An Exploration of Leaders' Opinions

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Abstract: The shift towards digitalisation has been empowering growth in the construction industry, especially in the past decade. Construction stakeholders are offered myriad benefits by embracing digital advancements to achieve efficiency. However, the exploitation of digital opportunities is bounded by the need for a practitioner skillset that aligns with the digital era, a requirement that has been described as difficult to meet and justified by the low degree of digital literacy among construction employees. This paper reports findings from interviews with 19 leaders and decision makers in the construction sector to reveal the indicators that can predict construction employees' digital literacy. Such an approach offers a comprehensive exploration of the likelihood of employees' digital literacy through socially oriented characteristics. Overall, 19 individual characteristics emerged from the thematic analysis and highlight the critical connection between social behaviour and digital literacy. The findings of this paper are timely and important for those businesses assessing their employees' willingness and maturity with regard to technological change through social and behavioural information. The qualitative approach led to the development of a conceptual framework that can explain the dynamics needed to assess employees' digital literacy in construction organisations. This study, therefore, reveals the effectiveness of predicting employees' readiness to shine in the digital era by shedding light on their digital literacy through examinations of individual characteristics in a construction workplace. This paper is among the first to encourage research efforts that take into account the importance of studying social and psychological complexities, which are subject areas that are limited in recent construction literature. As such, it is of value to employers wishing to embed greater digitalisation in their firms, as well as researchers in this domain and policymakers looking to encourage greater digital transformations.

Keywords: digitalisation; individual characteristics; innovation; construction employees; diffusion

1. Introduction

The construction industry is regularly criticised for delays [1], cost overruns [2], and unsafe work environments [3]. Both researchers and practitioners are devoting efforts to identifying solutions that would enable the industry to address such challenges. One of the solutions is increased use of digital innovations, which include building information modelling (BIM) [4], virtual reality (VR) [5], blockchains [6], artificial intelligence (AI) [7], digital twins (DTs) [8], and a spectrum of other innovations that have emerged in the digital era. The belief that such innovations are effective is supported by data that suggest critical time savings [9], cost reductions [10], and significant safety values [11]. Scholars, however, have recorded low uptake of these solutions in construction organisations [12–15]. The argument presented in this paper is that digital technologies are rapidly evolving

in the construction sector regardless of their contingency in relation to the existing social system, making it difficult for stakeholders to cope with digitalisation.

The lag in embracing digital innovations can be explained by the longstanding adverse relationship between the construction sector and the adoption of innovations [16,17]. This relationship is associated with reluctance towards new ideas, resistance to change, and unfavourable decisions regarding non-traditional practices [18], which have led to a plethora of contemporary issues and challenges that contribute to the industry's bad reputation [14]. Despite this, only a few studies have theorised the reasoning behind the lag in digital innovation adoption in the construction context [19–23]. Overall, less attention has been given to the non-technical attributes that are argued to be of equal importance [12], as the adoption of digital innovations is influenced by social attributes, such as culture, talent, and structure [24].

The skills that are needed to be digitally competent have been contended to change as digital innovations change and develop over time [25]. However, there is a consensus that digital literacy is a fixed and non-changing foundation for digital competency [26]. The first definition of the term "digital literacy" described it as the ability to utilise basic skills to survive in a digital society [27]. The term was later adapted to fit with the accelerated use of digital innovations since the 1990s, emerging as a philosophy that measures an individual's effective comprehension and use of digital technologies [28]. Such skills have been described as operational, social, and creative [29], extending an individual's ability to make sense of information [30]. These skills may seem basic and to exist by default in today's advanced digital era; however, evidence suggests that digital literacy has significantly impacted the workforce by changing work conditions and threatening the dynamics of traditional work environments [31].

Recently, the longstanding use of individual characteristics to explain social behaviour has been widely employed in different research areas, such as sports [32], education [33], and health [34]. However, similar uses in construction management research are limited [35], apart from the early seminal work by Carr [36], who related personality traits of construction employees to their performance in the workplace. This was then expanded by Xiong [37], who conceptualised the direct relationship between individual characteristics and job performance. This paper, therefore, relates digital literacy to the construction context through an empirical qualitative investigation. The key focus, as detailed in depth in the following sections, is on the individual characteristics that would help indicate the degree of digital literacy among employees in the construction sector. The ethnographic interviews applied in this study identified the views of digital leaders and decision makers from the industry, providing a cluster of variables believed to indicate the digital literacy of construction practitioners. The theoretical underpinnings of this study are related, in the first instance, to digital literacy in general and then to the digital literacy gap within past construction management research, leading to empirical signification of these observations.

Digitalisation currently dominates other construction innovations, and it has been argued to be the most important change foreseen in the modern era [38]. Such a change, nevertheless, is dependent on a variety of conditions that can ensure an effective transformation. These dependencies include organisations' financial capability [39], awareness [40], and maturity [41]. However, research exploring the individual digital competencies of construction professionals is limited [42]. In the construction context, a link has been established between digital competency and digital literacy [43], a matter of high significance that may exclude individuals from modern society [44] and impact their prospects with regard to job opportunities [45]. Digital literacy, therefore, is emerging as a significant study area and research gap in the quest to explore digitalisation in construction [46].

Harmony exists in the literature with regard to the fundamental need for digital literacy in order to survive in a changing environment [47]. However, predicting digital literacy in construction is a matter of debate among scholars. For instance, Olugboyega et al. [48] suggest that digitally literate individuals tend to solely seek new information

instead of depending on others' support and training, whereas Fitriani and Ajayi [49] argue that such literacy is gained through education at universities. In a different context, Mukti et al. [50] indicate that digital literacy is linked to an individual's willingness and motives, Vere [51] relates it to generational differences and age, and Kuek and Hakkennes [52] indicate that it is related to the ability of an individual to communicate and manage information. Overall, studies focusing on digital literacy are limited, and there seems to be a lack of a consensus across the literature as to what could determine digital literacy in construction organisations, informing the authors of a critical research gap.

The authors undoubtedly agree with the reasoning that highlights the need for a high level of digital literacy among construction stakeholders. Nonetheless, the argument presented in this study is that there is a need to explore the predictors that would indicate digital literacy in an arguably complex social system given the increasing use of digitalisation among construction firms. Bhatt and MacKenzie [53] shed light on digital literacy from a theoretical social lens, indicating the need for scholars to extract meanings that would predict digital literacy from social acts. Similarly, Meyers et al. [54] suggested that the level of digital literacy could be determined by making sense of the interaction and engagement between humans in a workplace. To approach this, an exploration of the traits of those achieving higher digital literacy has been deemed necessary to better understand its determinants [53]. In the seminal work of Helsper and Eynon [55], the interaction between social and digital exclusions has been described as a "vicious cycle".

The construction literature shows less focus on and criticism of the social aspects that may predict stakeholders' digital literacy. An emphasis on sociocultural tendencies encouraging the use of digitalisation, therefore, would involve exploring the individual traits that may reveal the level of digital literacy at an individual level [56]. Knowledge of the degree of digital literacy would allow decision makers to better incorporate educational strategies to enhance the same [57] and equip employees with the competency required to be included among the roles of modern society [31]. Previous studies, irrespective of the construction context, have assessed digital literacy against multiple individual characteristics, such as agreeableness [58], openness to experience [59], and emotional stability [60]. The lack of means to indicate digital literacy among construction professionals may, consequently, inhibit the diffusion of digitalisation and limit social mobility in the construction sector. The purpose of this study, therefore, was to explore the individual characteristics that can act as predictors of an individual's digital literacy in construction organisations.

The aim of this study was to hypothesise a latent relationship that could be important in assessing employees' readiness for technological change through social indicators, contributing to previous research efforts accelerating digitalisation in construction. In light of studies linking digitalisation to the characteristics of an innovation [17] and leadership characteristics [12], a review of the literature suggests a direct link between individual characteristics and social behaviour that could help researchers and practitioners better assess employees' digital literacy in the construction context.

2. Materials and Methods

Though studies concerned with exploring digitalisation in construction organisations are increasing [61], qualitative studies focusing on employees' competency are limited [62]. Informed by a research philosophy of interpretivism, this work employed a qualitative methodology that has been described as important in exploring views and opinions [63], allowing participants to unrestrictedly share their perceptions [64], and aiding authors' efforts in explaining social phenomena [65]. The use of the qualitative approach to explore construction leaders' perceptions, therefore, suited the direction of this study.

Data collection was tailored to focus on construction leaders' holding key managerial positions in their construction firms in order to explore their opinions on this topic. Such a choice of sampling offered an actor–observer informative paradigm, which is key to determining a person's competence by linking behaviour to traits [66]. Moreover, collecting

data through the lens of leaders describing their employees' activities was hoped to achieve a less biased perspective [67]. In terms of validation, a qualitative approach's validity does not rely on particular tests [68] but rather on the level of data saturation achieved from the sample [69]. Empirically, the number of interviews needed to reach saturation varies; it is, to some extent, subjective and differs based on context. For instance, recent qualitative studies required 32 interviews [70], 43 interviews [71], and 47 interviews [72] to reach saturation, whereas others were satisfied with 5 [73], 8 [74], and 10 interviews [75]. Such saturation has been argued to be achieved after interviewing over 12 participants [76]. Here, 19 leaders contributed to the study, and the number, coupled with the rich data and insights yielded, was deemed sufficient to reach saturation (see Table 1).

Table 1. Roles and organisational types of the interviewed sample.

Number	Role	Organisation Type	Years of Experience
1	BIM manager	Consulting	>20 years
2	CDM co-ordinator	Contractor	10–15 years
3	Associate director	Consulting	10–15 years
4	Senior quantity surveyor	Consulting	15–20 years
5	Director	Consulting	10–15 years
6	Equity partner	Consulting	>20 years
7	Director	Contractor	>20 years
8	Quality manager	Contractor	15–20 years
9	Managing director	Contractor	>20 years
10	Change agent	Contractor	15–20 years
11	Director	Consulting	15–20 years
12	Director	Consulting	>20 years
13	Director	Contractor	10–15 years
14	Lead advisor	Client	>20 years
15	Innovation manager	Contractor	5–10 years
16	Cost management lead	Consulting	>20 years
17	Manager–digital projects	Consulting	10–15 years
18	Chief financial officer	Contractor	>20 years
19	Head of IT operations	Contractor	10–15 years

Interviewees were purposively selected from a knowledge-exchange network comprising leaders from the industry. This provided a communication channel and an opportunity that enabled the authors to connect with the designated participants. The questions asked varied due to the semi-structured nature of the interviews, in which the leaders amplified the meaning behind each question to a context they judged to best fit it [77]. This study did not collect data relevant to age and gender. Overall, the questions asked varied to comprise an unstructured set of questions where interviewees were given the flexibility to freely express their opinions in relation to the level of digital literacy among their employees. Such an approach allows researchers to gather meaning from information derived during conversations, where the interviewees are not restricted from further expanding and exemplify their opinions and views, thereby leading to rich and diverse reporting [78].

The length of each interview spanned from thirty minutes to an hour, offering a rich set of qualitative empirical data considered adequate for analysis. The interviews led to a large amount of qualitative data comprising over ten hours of recordings. The study adopted an inductive approach when reasoning the key individual characteristics formulated. Inductive theory development based on qualitative data is a longstanding methodological approach in management research [79]. Zeidan [80] emphasised the effectiveness

of an inductive reasoning approach when actively exploring practitioners' insights and themes are developed inductively and in isolation from previous theories and constructs. Data analysis, therefore, was initiated through condensation [81]. To sustain a rigorous analysis process, the study adopted the procedures recommended by Braun and Clarke [82], who sort the thematic analysis process into familiarisation, data generation, data alignment, and final reporting. The themes generated in this study were completed by the authors and were not populated in the data collection, an approach that minimised interviewer bias [83]. Each theme formed was based on repetitive patterns that reflected an individual characteristic, with data coded and refined to align with each of the emerging themes [12]. To facilitate the coding process, this study benefited from the use of Nvivo software as an effective qualitative data analysis tool [84].

3. Results

The interviews with 19 construction individuals holding managerial roles reflected their perspectives on employees' digital competency and readiness for technological change. The following sections introduce the readers to the 19 themes representing the individual characteristics that were believed to act as predictors of individuals' digital literacy in construction organisations.

3.1. Youthful

Interviewees argued that age is a key indicator of digital literacy—"younger guys will generally pick it up and get it up and running quicker than someone a bit more senior" (participant 2 (P02))—as less effort is needed for younger generations to attain digital skills: "I shouldn't have to tell them about BIM, I shouldn't have to tell them about digital skills, they come with that, they are actually teaching them things from 10, 15 years ago" (P03). There was a consensus among interviewees on the competency of younger people: "we need people that are certainly more technology-competent, so we are starting to engage younger people" (P07). However, such an approach may not always be feasible amidst the ageing population in the construction sector: "the biggest issue we have in construction is the ageing labour force" (P10). Age, in this context, emerged as an important element—"being a little bit more dinosaur with it as I get older" (P11)—identifying younger employees as "the most technologically savvy" (P15). P01 explained this using benchmarking, where younger people tend to be more ready to accept a new reality compared to older people, who are already accustomed to a traditional way of working. Hence, younger individuals show a greater tendency to be digitally literate compared to older individuals.

3.2. Appreciative

Digital literacy was associated with the clarity of its benefits. Interviewees suggested that the more digital benefits are acknowledged, the greater digital literacy can be assumed to be; e.g., "if we hadn't got that capability, we wouldn't be winning those projects" (P01); "It's a lot quicker. It helps a lot" (P02); and "it just comes out in individuals and how they see BIM impacting their work, as well as making it better" (P03). Arguably, P05 explained this by relating digital literacy to sensible evidence; "they want evidence that changing the way they work will do something different for them". Arguments emerged that highlighted the value of digital technologies for saving time—"They're not running between office and site anymore, wasting their time" (P07); work efficiency—"we haven't got to do manual checks all the time" (P09); and reducing errors—"it's accurate, it's accessible, and I can trust it" (P12). Moreover, P08 argued that the characteristic of acknowledging benefits is associated with translating benefits into value: "there's no difference between using a physical report and the digital record because it will just be a record, it needs to be a bit more thoughtful". Hence, individuals who acknowledge the benefits of using digital innovations tend to be more digitally literate than those with less clarity.

3.3. Persuasive

The ability to persuade and understand clients' needs for digital innovations was suggested to imply higher digital literacy: "they won't really know what it is or what they want it for, they just think it's something they should be getting, because everyone else keeps talking about it" (P02). Such an ability to identify client needs and communicate their needs regarding digital innovation was suggested to be critical: "that gives me a very good perspective when speaking to clients who are trying to achieve some very challenging objectives and goals" (P14). In contrast, less digital literacy was associated with an inability to influence clients' decisions: "they can't advise of what is best or fit for purpose for that individual project, because they don't know the whole picture" (P07). Individuals who are more digitally literate can provide their clients with arguments involving success stories: "we can show to people, here's the project that we're using to verify the data and physically show them it on the screen" (P16). This supports the assumption of digital literacy and involves an evidence-based approach: "more difficult when you have not had anything to demonstrate" (P17). Hence, having the ability to persuade and convince clients using digital innovations is an indicator of digital literacy.

3.4. Boastful

Employees with higher digital literacy may have higher levels of achievement motivation. Interviewees suggested that those who have a tendency to seek achievements are digitally literate: "I'm getting onto frameworks" (P01) and "It should put us in a good position to continue winning work and stay at the forefront of the industry" (P02). Some measured achievements in time: "you know that job we did a couple of years ago?, we did it in 40 weeks, well, we've now got 32, and this is continually happening, then the next job, instead of being 32, it'd be 30" (P07). Others measured achievements with money: "we were able to save about £1.5 million worth of R&D work's being done and I can confirm that mainly it is because we are using digital information" (P08). Overall, interviewees spoke about focusing on driving these achievements: "It's driving excellence. Excellence is one of our core values" (P11). Hence, achievement motivation levels attained by individuals indicate their digital literacy.

3.5. Connective

A greater tendency among employees to connect with others may indicate their digital literacy. Communication and the exchange of information were argued to drive individuals to seek strategies to reach connectedness: "we've had weekly digital workstream meetings, and that's been led by a senior officer within the organisation, it's been given every opportunity to be nurtured and developed and supported, I must say" (P14). Such connectedness enables interaction with those who may be able to drive innovation: "you might have great information, but if it's sitting in a storeroom where only one person has the key, it's no good to anybody else" (P12). The matter of connectedness, therefore, emerged as a key driver for digital innovations: "I think most of the issues you get out of any project, whatever it is, is people making assumptions and not communicating" (P06). Hence, greater interconnection between employees and their social system—through communication—reflects digital literacy.

3.6. Team Player

Employees who have the capability to work as part of larger teams may have higher levels of digital literacy: "I think that's a big part of the BIM philosophy, having the right supply chain, because everybody's got to buy into it, if they're not buying into it and you get a weak link, it starts to fall down" (P07). The reason behind this need for cooperation among all members of a team is the effectiveness of collective efforts in fostering digital innovations: "it's a team game at the end of the day" (P12). Interviewees explained this when discussing the need for everyone's engagement and to not rely on singular

individuals to foster change—"you can't just rely on someone to fill it out" (P13)—as change is influenced by working together: "everybody helps each other across the across the UK, and we're very connected" (P16). The indicator, therefore, is relevant to personality: "if their personality doesn't work with a team, then it won't happen. So, personality is a real big thing" (P01). The power of working in a team is hence driven by realising the power of the team—"if one of us fails, we all lose out" (P03)—and the feeling of belonging: "I'm part of a team. I'm contributing to it" (P05). Hence, demonstrating the ability to work as part of a team is an indicator of digitally literate employees.

3.7. Non-Egocentric

Having less ego as an individual characteristic may indicate employees' digital literacy. The matter of self-worth is critical when studying personalities: "I've been using it for nearly 20 years now, but there are new things that I don't know how to do and ask colleagues, how do you do this? Because you can never master it all" (P03). Interviewees explained that the matter of ego could limit digital innovations: "We'll still sit there and openly admit we don't know everything, if anybody else has got anything to say, and I say it to my staff each and every week when we sit in meetings, if you see or find something else that you think is bad for this job, just tell me" (P07). In contrast, those with greater egos may be less competent: "they don't do it as well as they think they do" (P16). Hence, a personality with less ego indicates higher digital literacy.

3.8. Altruistic

Being motivated to train others may indicate employees' digital literacy: "it is just people might feel they need a little bit more support" (P05). This is a matter that limits the uptake of digital innovations: "I think one of the reasons why people have been hesitant to jump onto the BIM bandwagon is because you need to train people" (P03). Organisations with higher digital literacy among their employees generally have a greater tendency to provide training; "but we do train them before giving them the access to use, so it's not difficult" (P08). Such a realisation was noted by P12: "we didn't immediately start out thinking we'd be doing training, but what we found was as we were helping people, we were training them anyway". Individuals with higher digital literacy, therefore, not only detect other's struggles but also take the initiative to help and train: "asking them to do to fill out something that's going to take them too long and be complicated, it just won't get done, it's got to be simple, it's got to be easy to use" (P13). Hence, the characteristic of seeking to train and help others in the workplace is an indicator of digital literacy.

3.9. Open to Practise

Employees' tendency to practise may influence their digital literacy. Practising, in the digital context, was argued to be key to sustaining effectiveness: "they come to it and get up to speed, just about, then they don't use it for six months and come back, and they're back to square one" (P02). Repetition and continuation of practise, therefore, would promote the use of digital innovations: "making sure that it's getting used on a weekly basis whereby as you will forget how to use something" (P19). However, not learning from repetition would deprive the adopters of the values of practise: "it's always occurring at a very low level in a project that never filters back up, and so each project basically learns again, so each project makes the same mistake over and over again" (P12). Hence, practising and learning from repetition is an indicator of digital literacy.

3.10. Feedback-Seeker

Continually seeking feedback may be argued to be an indicator of digital literacy. Digitally literate individuals acknowledge the effect of feedback on development and self-esteem: "we try to do a post-project review, and then we see what we could have done, there were things that, after we had done it, we looked back and said, we didn't do this very well, we should have done that, and so on" (P03). Utilising past experience as feedback to build upon that knowledge emerged as critical: "this is what you've done wrong, this is what you've done right, this is what we want to change" (P02). It was also suggested to be effective when applied: "while we're working with programmes, we can then feed those lessons across the whole programme, so it's quite a dynamic thing" (P05). Such an approach helps maximise digital value and minimise disruptions: "it's about reviewing the jobs, each and every job, as it's finished, seeing what went right, what went wrong, what's the best thing" (P07). Moreover, positive feedback plays a role in promoting confidence: "the feedback we have is when people say to us, you fundamentally transformed how we do our role. And that that for us is a big win" (P10). Hence, individuals who seek regular feedback and welcome criticism indicate their digital literacy.

3.11. Desire for Education

Higher levels of education emerged as a theme associated with digital literacy. At higher management levels, educated management was described as promoting digital innovation in firms: "higher management have been educated and trained in the BIM side, we've found that the partners are the ones that are bought into the big change" (P01). In contrast, less education was associated with less motivation to adopt digital innovations: "I'd be surprised if any of them could say that they've attended a course" (P07). In more extreme situations, education may lag beyond the knowledge of digital innovations: "some people don't know how to read and write, we've got to teach people how to read and write first before we can treat digital literacy" (P10). Knowledge and awareness are, however, different from education, as someone may be aware of digital innovations but not have enough education to exploit their value: "In our office here, I think people all know about BIM, but don't fully understand it yet" (P06). Hence, it is reasonable to assume that a higher level of education is an indicator of the potential for someone to have a degree of digital literacy.

3.12. Inquisitive

A stronger motive to learn new things may be an indicator of digital literacy. Interviewees shared views on situations that indicated the desire for learning among those who are digitally literate: "we started with architecture, very quickly followed by structures, because structures are really biting to get on board" (P01). This was explained by P05, who "started researching BIM in 2011" and stated that "If you sort of enter into it half-heartedly, the chance of achieving success, I think, is by luck". In contrast, rejecting the associated learning curve was among the characteristics of those judged to be less digitally literate: "we've managed to build things for the last however many years without BIM, why do we need to learn something new" (P02). This aligned with P03, who stated: "there are very few directors that are taking time to understand what BIM means and to push it forward". Hence, eagerness to learn is a characteristic that indicates digital literacy.

3.13. Self-Aware

Another indicator of digital literacy may be the ability to realise one's weaknesses: "we keep getting there just after everything's been written down and put in place and missed the boat a little bit" (P02). Acknowledging a weakness means that the issue has been identified: "actually we need to redesign ourselves a little bit as a business, we need to be more efficient to rise to some of the challenges that the industry faces, I think we are starting to see it as an industry, but essentially we're being left behind" (P10). Moreover,

the interviewees related this to the traditional ways of working: "we just keep doing the same things, and sometimes we keep doing the same things wrong." (P07). These were linked to habit: "the chances of them completing to the brief, and completing to the budget, and completing to the programme are really slim, but we don't acknowledge that, so we always try and just do the same thing" (P05). Overall, there was judged to be a link between those who acknowledge their weaknesses and a greater tendency to be digitally literate: "I think as an organisation we're probably just not quite there yet" (P10). Hence, comprehension of one's weakness reflects a greater likelihood of being more digitally literate.

3.14. Realises Inevitability

Interviewees reflected that individuals who recognise the inevitability of digital innovations, particularly those that are mandatory, also have a higher tendency to be digitally literate: "they have no choice, so they are going to bite the bullet and go with it" (P01). Change, in this context, was considered as forcing itself rather than being pursued: "they will have to essentially leave, they have no choice, which is often coming very fast" (P15). Employees are driven by fear of losing their roles: "they realised that if they want to carry on working for us, that's just what they have to do" (P18). Moreover, individuals who are open to embracing change realise that they have reached digital innovations without prior intention: "It's not the job that I chose, but it's the job that we've ended up with" (P07). Hence, digital literacy is indicated by the perception of digital innovation as the only option moving forward.

3.15. Mimicker

Having a more favourable attitude toward imitating peers may indicate individuals' digital literacy. Interviewees suggested that individuals who "feel missing out" have a greater tendency to seek digital literacy: "more users we got on board, they see what we're doing with it, then they start to feel left behind, and they then realised that they've got to get on board and start moving with it" (P01). Similarly, such an attitude drives individuals to imitate and observe their peers: "we're just always looking at what is available and what the benefit is to the business" (P09). This is because they seek to replicate their successes: "It sort of helped them to market themselves, so potentially win them some jobs" (P04). Such individuals, therefore, observe others in search of opportunities to exploit: "they tend not to drift outside the realms of traditional construction until something comes along that really spearheads and knocks them for six, and if they see other contractors doing it" (P15). Hence, there is a relation between those who imitate others and do not miss out on opportunities and digital literacy.

3.16. Versatile

Individuals who have a greater capacity to take on more work tend to be more digitally literate than those who do not: "they are very against trial and out on a job, that's obviously they don't want that to get in the way of their project, obviously under very tight deadlines in terms of cost and time" (P15). In the context, the matter of work priority was suggested to influence behaviour: "some day-to-day life and day-to-day managing the business, you know, if anything is going to take a back seat, unfortunately, it's that sort of stuff that takes a backseat" (P18). Hence, individuals who are willing to take more work are more digitally literate than those who do not step beyond their usual tasks.

3.17. Risk Taker

Individuals who are more digitally literate tend to take risks more often. Interviewees suggested that those who accept the risks associated with being early are digitally literate: "if someone gets on the bandwagon early, and starts getting into the system, there will be opportunities for contractors that take a lead on this" (P04). In contrast, those who are less

likely to be digitally literate tend to be cautious: "we can't really, it's just a gamble for us" (P09). This is because they tend to take their time to assess an innovation: "we're just going to see how it affects the trade, the construction industry, as a whole, and then we'll adapt to that" (P04). Hence, there is a relationship between having a risk-taking personality and digital literacy.

3.18. Seeks Individuality

The interviewees suggested that those who perceive themselves as unique tend to have a greater tendency to be digitally literate: "we're quite forward-thinking, we're quite imaginative, so we do come up with digital solutions quite well really" (P17). This aligned with P10, who stated: "We have some people on site who are those early adopters when a new iPhone comes out and they go, Yeah, I've got a new iPhone and oh, send me the drawings up on my phone, Can I get the drawings up on my iPad?, and you've got some people that go, No, no, I don't want to on screen, I want to print it off, and I'm going to appended in a pencil and I'm going to draw it that way". Moreover, such uniqueness may be driven by the objective of attracting more clients: "that capability will make you more attractive to clients" (P09). Hence, seeking uniqueness and standing out is an indicator of digital literacy.

3.19. Non-Evasive

Individuals who are digitally literate tend to be problem solvers and, arguably, have fewer excuses than those who are not: "the guidance is not fully there" (P08). Excuses vary and reflect a variety of aspects, such as hardware; "we don't have the facility to gather that kind of information or store that kind of information" (P04). In contrast, those with a higher tendency to be digitally literate are doers; "we need to look at how we can get the best out of those things" (P05). They show the potential to overcome work problems: "it's not a problem, so our architects will 3D remodel if its refurbishment, or if we'd got 2D historic information, they'll remodel that, which enables all of our disciplines to 3D model as well" (P01). Hence, individuals who have the capability to look beyond the barriers and excuses tend to be more digitally literate.

4. Discussion

Through critically analysing construction leaders' views via a thematic approach, various insights emerged for the prediction of employees' digital literacy. This study focused on revealing the ramifications of and interdependencies within individual characteristics and conceptualised each characteristic's relevancy for digital literacy. Overall, 19 individual traits were identified throughout the exploration, which led to novel findings that can aid the formation of an individual-characteristic theoretical framework for digital literacy in the construction context (see Figure 1).
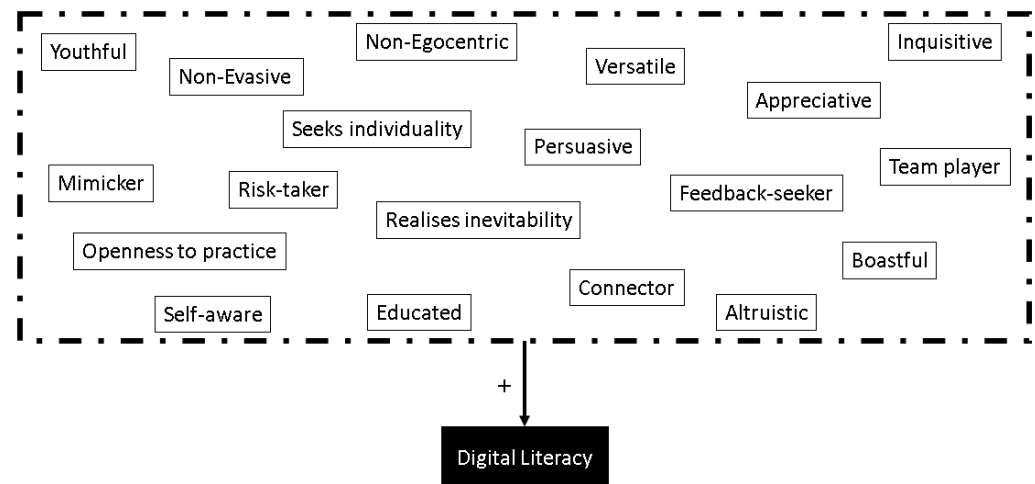
Figure 1. Individual characteristics perceived to predict the level of employees' digital literacy.

Our findings suggest that the youthfulness of construction employees is linked to higher digital literacy compared to older individuals. Previous work investigating young professionals highlighted their innovative thinking [85], as employers indicated the younger generation's digital competency [86]. In studies unrelated to the construction context, age was inferred to be significantly correlated with digital literacy [87]. This finding aligns with Davis and Songer [88], who opined that older generations face difficulties when adapting to digital innovations. Moreover, our results highlight the individual characteristic of appreciation through realization of the benefits and opportunities of digitalisation. Davis and Songer's work [88] relates to this by arguing that individuals who value their organisations tend to be less resistant to digitalisation than those who do not. Such a finding aligns with Chauhan et al. [89], who relate the adoption of digitalisation to the realisation of and confidence in the associated benefits.

Our results also demonstrate that individuals with a persuasive personality and the ability to influence clients' decisions are more digitally literate than those who do not have the same traits. It is logical that an individual who convinces others of the need for digitalisation will be someone with a competitive ability in the same [90]. Such a frame of reference is consistent with Manley and Mcfallan [85], who describe the competencies of clients and the complex process of client persuasion with regard to innovations. Additionally, individuals who continuously reference their achievements reflect a motivation to maximise outputs [91], with digital competency being described as a necessary route for increasing achievements [47]. Our results, therefore, link achievement-motivated personality traits to higher levels of digital literacy.

The study confirmed that individuals who seek connectedness with others through the exchange of information and enhanced communication are likely to ultimately appreciate the power of digitalisation [92], indicating their digital literacy [93]. Therefore, the individual characteristic of seeking connectedness is linked to an individual's digital literacy [94]. Moreover, individuals capable of effectively working as part of a team have been related to the success of innovations [95]. Historically, the role of digitalisation in promoting team collaboration has been established in the construction context [96]. Our findings, however, indicate a reversal link, which suggests that collaborators and team players have higher digital literacy than those without these traits [97]. Furthermore, our findings suggest that a demonstrated motivation to help and train others in digitalisation reflects high digital literacy. Such internal interaction has been inferred as vital for digitalisation's diffusion across firms [98]. Additionally, it is reasonable to assume that individuals who train others attain greater skills and knowledge relating to innovation [99]. Moreover, the findings consequently highlighted the influence of the trait of altruism, which can be described as a predictor of digital literacy across a firm's social system [100].

The findings demonstrate that there is a positive relationship between level of education and an individual's digital literacy. However, the relevance of this research is that it discusses digital literacy in an industry known to have relatively lower levels of education among its workforce [101]. Such a link has been established by Aliu and Aigbavboa [102], who emphasised the need for studies to cover the relationship between the extended abilities of those who are more educated and their digital literacy. It has been argued that individuals seeking high levels of digital literacy should possess knowledge. However, our findings suggest that individuals who take the initiative to learn and seek new things have higher digital literacy. Such a finding aligns with Yang et al. [46], who relate learning agility to the willingness for new knowledge. Equally important, our findings also suggest that those who have a higher tendency to promptly mimic others with regard to innovations attain higher digital literacy. This has been explicated by Merschbrock and Munkvold [96], who relate the same context to the drive towards achieving competitive advantage.

Previous research states that seeking feedback is a social practice in digital learning [99]. Such behaviour is associated with individual traits that act as predictors of digital literacy and has been discussed in the construction context as an important influence on an employee's innovative attitude [103]. Another trait that emerged from our findings is the level of ego that an individual has. Surprisingly, our findings highlight the need for egocentrism among construction professionals. It was found that a relationship exists between individuals with higher levels of ego and a lower tendency to be digitally literate. This may be explained by the influence of the egocentric personality trait on individuals' performance [104]. Moreover, the analysis revealed that awareness of one's weaknesses is a key predictor of construction employees' digital literacy. Despite the fact that this has not been argued in the construction literature, Jackson et al. [105] emphasised the link between higher digital literacy and "people who know what they don't know".

Furthermore, having a greater capacity to take over additional workloads predicts individuals' digital literacy. Such a finding aligns with the findings presented by Lundberg et al. [106], as versatile individuals rely on greater uptake of digitalisation to sustain such a trait [107]. Additionally, the individuals who are more digitally literate are those who seek to stand out from their peers and achieve uniqueness. Such results align with the work of Lorincová et al. [108], who revealed that employees' individuality determines their motivation. Moreover, our findings suggest that individuals who tend to utilise excuses to explain their lag in digitalisation are less digitally literate than those who tend to overcome challenges [109]. Dependency on excuses to avoid change has been recognised in the construction context [110] and emerged here as an indicator of digital literacy.

Practical Implications

The ability to link demonstrable traits and individual characteristics can aid informed decisions among practitioners, researchers, and policymakers by helping them better assess the maturity and readiness of employees' social systems, which, in turn, can help effectively forecast the effectiveness of employees' reactions to technological change as represented by the greater use of digitalisation in construction workplaces. Overall, this paper explored individual characteristics that predict employees' digital literacy from the eyes of construction leaders, offering the existing body of knowledge a theoretical framework that highlights 19 characteristics as key indicators.

There is likely to be a discrepancy between this paper and the limited empirical studies relevant to the same topic in the construction context. This study revealed the normative and imbalanced nature of the literature, which focuses more on technicalities and less on the social and non-technical attributes linked to the human factor in construction organisations. This paper should encourage future researchers to study the influence of each characteristic on the level of employees' digital literacy through quantitative means and reveals the relationships among different individual characteristics, each of which can

independently, or in combination with others, predict digital literacy among construction stakeholders.

5. Conclusions

This paper explored and thematically analysed construction leaders' perceptions to determine the prospects for a relationship between construction employees' individual characteristics and the degree of their digital literacy. Our findings build on past theoretical efforts to crystallise a link between social behaviour, as orchestrated by particular characteristics, and digital literacy, a topic that can be considered timely and significant. The exploration yielded an overview of 19 individual characteristics that are believed to predict the likelihood of higher digital literacy among construction employees. The authors acknowledge that few of the explored traits are new, and some have been directly linked to the adoption of innovations. However, no known construction studies have related individual characteristics to digital literacy, therefore making these traits new to the construction context and contributing to its readiness to deal with contemporary digital advancements.

Firstly, this study focused on contributing to practice by offering businesses an unusual set of arguments that can facilitate the identification of employees with a higher tendency to outshine others amidst technological change and the adoption of digital innovations. Secondly, the conceptual framework aligned with past research efforts in unrelated empirical settings, and this study is among the few to extend knowledge on the social and psychological complexities of human beings to the construction context. Such complexities have been extensively investigated in the social science, education, human resources, and management literatures. One of the merits of this study was that it rejected the regular tendency to treat construction employees as a singular homogenous workforce and rather explored the influences of their differences on their adaptability to technological change. The capacity of social behaviour to inform research on the fundamental factors dictating a person's ability to integrate new information and adapt to changing environments is a significantly understudied phenomenon in the construction literature.

This paper, nevertheless, is associated with some limitations. The study explored qualitative data from the UK construction sector, which may limit the generalisation of its findings to other regions, cultures, and industries. Moreover, due to the limited number of similar studies, this paper was intended as an exploratory qualitative study, and the authors caution that, despite many of the traits being hypothesised as significantly influencing digital literacy, some of the documented findings may yield null hypotheses. Furthermore, another limitation can be argued to be the sample size of 19 interviews, and while the authors acknowledge the need for further data to better conceptualise this understudied area, the saturation reached meant that it was not possible to include vast amounts of information in one academic paper.

Future research capitalising on this work by quantitatively assessing the statistical significance of each trait for the levels of employees' digital literacy is highly advised. Moreover, a person might attain a combination of different characteristics that may orchestrate their social behaviour towards and acceptance of change in the construction industry. Revealing the influence of clusters of these traits is thus another vital spinoff deemed critical for future studies. Finally, the matter of individual characteristics has been linked to an organisation's culture, leadership styles, and work–life conflicts, all of which are factors that are believed to be interconnected and understudied in the construction context. Therefore, construction researchers are encouraged to adopt this study as a foundation for assessing the possibility of promoting effective digitalisation through available social information.

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References

1. Asiedu, R.O.; Adaku, E.; Owusu-Manu, D.G. Beyond the causes: Rethinking mitigating measures to avert cost and time overruns in construction projects. *Constr. Innov.* **2017**, *17*, 363–380. https://doi.org/10.1108/CI-01-2016-0003.
2. Sánchez-Garrido, A.J.; Navarro, I.J.; Yepes, V. Multi-criteria decision-making applied to the sustainability of building structures based on Modern Methods of Construction. *J. Clean. Prod.* **2022**, *330*, 129724. https://doi.org/10.1016/j.jclepro.2021.129724.
3. Edwards, D.J.; Nicholas, J. The state of health and safety in the UK construction industry with a focus on plant operators. *Struct. Surv.* **2002**, *20*, 78–87. https://doi.org/10.1108/02630800210433855.
4. Ezzeddine, A.; García de Soto, B. Connecting teams in modular construction projects using game engine technology. *Autom. Constr.* **2021**, *132*, 103887. https://doi.org/10.1016/j.autcon.2021.103887.
5. Goulding, J.; Nadim, W.; Petridis, P.; Alshawi, M. Construction industry offsite production: A virtual reality interactive training environment prototype. *Adv. Eng. Inform.* **2012**, *26*, 103–116. https://doi.org/10.1016/j.aei.2011.09.004.
6. Qian, X.; Papadonikolaki, E. Shifting trust in construction supply chains through blockchain technology. *Eng. Constr. Archit. Manag.* **2021**, *28*, 584–602. https://doi.org/10.1108/ECAM-12-2019-0676.
7. Na, S.; Heo, S.; Han, S.; Shin, Y.; Roh, Y. Acceptance Model of Artificial Intelligence (AI)-Based Technologies in Construction Firms: Applying the Technology Acceptance Model (TAM) in Combination with the Technology–Organisation–Environment (TOE) Framework. *Buildings* **2022**, *12*, 90. https://doi.org/10.3390/buildings12020090.
8. Shahzad, M.; Shafiq, M.T.; Douglas, D.; Kassem, M. Digital Twins in Built Environments: An Investigation of the Characteristics, Applications, and Challenges. *Buildings* **2022**, *12*, 120. https://doi.org/10.3390/buildings12020120.
9. Orzeł, B.; Wolniak, R. Digitization in the Design and Construction Industry-Remote Work in the Context of Sustainability: A Study from Poland. *Sustain.* **2022**, *14*, 1332. https://doi.org/10.3390/su14031332.
10. Farooq, J.; Sharma, P.; Kumar, R.S. A BIM-based detailed electrical load estimation, costing and code checking. *Int. J. Electr. Comput. Eng.* **2018**, *8*, 3484–3495. https://doi.org/10.11591/ijece.v8i5.pp3484-3495.
11. Yuan, J.; Li, X.; Xiahou, X.; Tymvios, N.; Zhou, Z.; Li, Q. Accident prevention through design (PtD): Integration of building information modeling and PtD knowledge base. *Autom. Constr.* **2019**, *102*, 86–104. https://doi.org/10.1016/j.autcon.2019.02.015.
12. Zulu, S.L.; Khosrowshahi, F. A taxonomy of digital leadership in the construction industry. *Constr. Manag. Econ.* **2021**, *39*, 565–578. https://doi.org/10.1080/01446193.2021.1930080.
13. Sanchez-Riofrio, A.M.; Lupton, N.C.; Rodríguez-Vásquez, J.G. Does market digitalization always benefit firms? The Latin American case. *Manag. Decis.* **2021**,60, 1905–1921. https://doi.org/10.1108/MD-01-2021-0117.
14. Shojaei, R.S.; Burgess, G. Non-technical inhibitors: Exploring the adoption of digital innovation in the UK construction industry. *Technol. Forecast. Soc. Chang.* **2022**, *185*, 122036. https://doi.org/10.1016/j.techfore.2022.122036.
15. Saad, A.; Ajayi, S.O.; Alaka, H.A. Trends in BIM-based plugins development for construction activities: A systematic review. *Int. J. Constr. Manag.* **2022**, *22*, 1–13. https://doi.org/10.1080/15623599.2022.2093815.
16. Dulaimi, M. The climate of innovation in the UAE and its construction industry. *Eng. Constr. Archit. Manag.* **2022**, *29*, 141–164. https://doi.org/10.1108/ECAM-07-2020-0492.
17. Gledson, B.J.; Greenwood, D. The adoption of 4D BIM in the UK construction industry: An innovation diffusion approach. *Eng. Constr. Archit. Manag.* **2017**, *24*, 950–967. https://doi.org/10.1108/ECAM-03-2016-0066.
18. Durdyev, S.; Mbachu, J.; Thurnell, D.; Zhao, L.; Reza Hosseini, M. BIM adoption in the cambodian construction industry: Key drivers and barriers. *ISPRS Int. J. Geo-Inf.* **2021**, *10*, 215. https://doi.org/10.3390/ijgi10040215.
19. Oesterreich, T.D.; Teuteberg, F. Behind the scenes: Understanding the socio-technical barriers to BIM adoption through the theoretical lens of information systems research. *Technol. Forecast. Soc. Chang.* **2019**, *146*, 413–431. https://doi.org/10.1016/j.techfore.2019.01.003.
20. Aghimien, D.; Aigbavboa, C.; Oke, A.; Thwala, W.; Moripe, P. Digitalization of construction organisations–a case for digital partnering. *Int. J. Constr. Manag.* **2022**, *22*, 1950–1959. https://doi.org/10.1080/15623599.2020.1745134.
21. Ariono, B.; Wasesa, M.; Dhewanto, W. The Drivers, Barriers, and Enablers of Building Information Modeling (BIM) Innovation in Developing Countries: Insights from Systematic Literature Review and Comparative Analysis. *Buildings* **2022**, *12*, 1912. https://doi.org/10.3390/buildings12111912.
22. Zulu, S.; Saad, A.; Ajayi, S.; Unuigbe, M. A thematic analysis of the organisational influences on digitalisation in construction firms. *J. Eng. Des. Technol.* **2022**, *20*. https://doi.org/10.1108/JEDT-10-2022-0513

23. Gledson, B. Enhanced model of the innovation-decision process, for modular-technological-process innovations in construction. *Constr. Innov.* **2022**, *22*, 1085–1103. https://doi.org/10.1108/CI-02-2021-0021.

24. Kane, G.C.; Palmer, D.; Phillips, A.N.; Kiron, D.; Buckley, N. *Achieving Digital Maturity*; MIT Sloan Managment Review; Deloitte University Press: Westlake, TX, USA, 2017.

25. Farias-Gaytan, S.; Aguaded, I.; Ramirez-Montoya, M.S. Transformation and digital literacy: Systematic literature mapping. *Educ. Inf. Technol.* **2022**, *27*, 1417–1437. https://doi.org/10.1007/s10639-021-10624-x.

26. Liu, Z.J.; Tretyakova, N.; Fedorov, V.; Kharakhordina, M. Digital literacy and digital didactics as the basis for new learning models development. *Int. J. Emerg. Technol. Learn.* **2020**, *15*, 4–18. https://doi.org/10.3991/ijet.v15i14.14669.

27. Gilster, P. *Digital Literacy*; Wiley: New York, NY, USA, 1997.

28. Pangrazio, L.; Godhe, A.L.; Ledesma, A.G.L. What is digital literacy? A comparative review of publications across three language contexts. *E-Learn. Digit. Media* **2020**, *17*, 442–459. https://doi.org/10.1177/2042753020946291.

29. van Deursen, A.J.A.M.; Helsper, E.J.; Eynon, R. Development and validation of the Internet Skills Scale (ISS). *Inf. Commun. Soc.* **2016**, *19*, 804–823. https://doi.org/10.1080/1369118X.2015.1078834.

30. Kahne, J.; Lee, N.J.; Feezell, J.T. Digital media literacy education and online civic and political participation. *Int. J. Commun.* **2012**, *6*, 24.

31. Bejaković, P.; Mrnjavac, Ž. The importance of digital literacy on the labour market. *Empl. Relations* **2020**, *42*, 921–932. https://doi.org/10.1108/ER-07-2019-0274.

32. Bryan, W.; Donachie, T.C.; Vaughan, R.S.; Madigan, D.J. Don't look back in anger: A cross-sectional and dyadic examination of the Dark Triad, anger, and aggression in athletes. *Psychol. Sport Exerc.* **2023**, *64*, 102305. https://doi.org/10.1016/j.psychsport.2022.102305.

33. Maksimović, J.; Jevtic, B.; Stošić, L. Teachers' personality traits and students' motivation: Study of social outcomes in Serbia. *J. Educ. Teach.* **2022**, *00*, 1–17. https://doi.org/10.1080/02607476.2022.2154643.

34. Badreddine, B.; Blount, Y.; Quilter, M. The role of personality traits in participation in an Online Cancer Community. *Aslib J. Inf. Manag.* **2022, *74***. https://doi.org/10.1108/AJIM-05-2022-0242.

35. Gao, Y.; González, V.A.; Yiu, T.W.; Cabrera-Guerrero, G.; Deng, R. Predicting Construction Workers' Intentions to Engage in Unsafe Behaviours Using Machine Learning Algorithms and Taxonomy of Personality. *Buildings* **2022**, *12*, 841. https://doi.org/10.3390/buildings12060841.

36. Carr, P.G.; de la Garza, J.M.; Vorster, M.C. Relationship between Personality Traits and Performance for Engineering and Architectural Professionals Providing Design Services. *J. Manag. Eng.* **2002**, *18*, 158–166. https://doi.org/10.1061/(ASCE)0742-597X(2002)18:4(158).

37. Xiong, B.; Newton, S.; Skitmore, M. Towards a conceptual model of the job performance of construction professionals: A person-environment fit perspective. *Int. J. Constr. Manag.* **2022**, *22*, 1308–1322. https://doi.org/10.1080/15623599.2019.1695417.

38. Jacobsson, M.; Linderoth, H.C.J. Newly graduated students' role as ambassadors for digitalisation in construction firms. *Constr. Manag. Econ.* **2021**, *39*, 759–772. https://doi.org/10.1080/01446193.2021.1955398.

39. Ebekozien, A.; Samsurijan, M.S. Incentivisation of digital technology takers in the construction industry. *Eng. Constr. Archit. Manag.* **2022**. https://doi.org/10.1108/ECAM-02-2022-0101.

40. Perera, S.; Jin, X.; Das, P.; Gunasekara, K.; Samaratunga, M. A strategic framework for digital maturity of design and construction through a systematic review and application. *J. Ind. Inf. Integr.* **2022**, 31, 100413. https://doi.org/10.1016/j.jii.2022.100413.

41. Das, P.; Perera, S.; Senaratne, S.; Osei-Kyei, R. Paving the way for industry 4.0 maturity of construction enterprises: A state of the art review. *Eng. Constr. Archit. Manag.* **2022**. https://doi.org/10.1108/ECAM-11-2021-1001.

42. Shojaei, R.S.; Oti-Sarpong, K.; Burgess, G. Enablers for the adoption and use of BIM in main contractor companies in the UK. *Eng. Constr. Archit. Manag.* **2022**. https://doi.org/10.1108/ECAM-07-2021-0650.

43. Camngca, V.P.; Amoah, C.; Ayesu-Koranteng, E. Underutilisation of information communication and technology in the public sector construction project's implementation. *J. Facil. Manag.* **2022**. https://doi.org/10.1108/JFM-10-2021-0128.

44. Nishijima, M.; Ivanauskas, T.M.; Sarti, F.M. Evolution and determinants of digital divide in Brazil (2005–2013). *Telecomm. Policy* **2017**, *41*, 12–24. https://doi.org/10.1016/j.telpol.2016.10.004.

45. Casini, M. Extended Reality for Smart Building Operation and Maintenance: A Review. *Energies* **2022**, *15*, 3785. https://doi.org/10.3390/en15103785.

46. Yang, K.; Sunindijo, R.Y.; Wang, C.C. Identifying Leadership Competencies for Construction 4.0. *Buildings* **2022**, *12*, 1434. https://doi.org/10.3390/buildings12091434.

47. Shopova, T. Digital literacy of students and its improvement at the university. *J. Effic. Responsib. Educ. Sci.* **2014, *7***, 26–32. https://doi.org/10.7160/eriesj.2014.070201.

48. Olugboyega, O.; Windapo, A.; Aigbavboa, C.; Oseghale, G.E. BIM implementation: An empirical validation for a four-wheel model. *Front. Eng. Built Environ.* **2022**. https://doi.org/10.1108/febe-04-2022-0016.

49. Fitriani, H.; Ajayi, S. Preparing Indonesian civil engineering graduates for the world of work. *Ind. High. Educ.* **2022**, *36*, 471–487. https://doi.org/10.1177/09504222211046187.

50. Mukti, I.Y.; Firdausy, D.R.; Aldea, A.; Iacob, M.E. Architecting rural smartness: A collaborative platform design for rural digital business ecosystem. *Electron. J. Inf. Syst. Dev. Ctries.* **2023**, *89*, e12236. https://doi.org/10.1002/isd2.12236.

51. De Vere, I. *Enabling an Ageing Workforce*; 2022. ISBN 9780645464207.

52. Kuek, A.; Hakkennes, S. Healthcare staff digital literacy levels and their attitudes towards information systems. *Health Informatics J.* **2020**, *26*, 592–612. https://doi.org/10.1177/1460458219839613.

53. Bhatt, I.; MacKenzie, A. Just Google it! Digital literacy and the epistemology of ignorance. *Teach. High. Educ.* **2019**, *24*, 302–317. https://doi.org/10.1080/13562517.2018.1547276.

54. Meyers, E.M.; Erickson, I.; Small, R.V. Digital literacy and informal learning environments: An introduction. *Learn. Media Technol.* **2013**, *38*, 355–367. https://doi.org/10.1080/17439884.2013.783597.

55. Helsper, E.J.; Eynon, R. Distinct skill pathways to digital engagement. *Eur. J. Commun.* **2013**, *28*, 696–713. https://doi.org/10.1177/0267323113499113.

56. Ahmed, S.; Rasheed, T. Relationship between personality traits and digital literacy skills: A study of university librarians. *Digit. Libr. Perspect.* **2020**, *36*, 191–206. https://doi.org/10.1108/DLP-02-2020-0005.

57. Falloon, G. From digital literacy to digital competence: The teacher digital competency (TDC) framework. *Educ. Technol. Res. Dev.* **2020**, *68*, 2449–2472. https://doi.org/10.1007/s11423-020-09767-4.

58. Budak, J.; Rajh, E.; Slijepčević, S.; Škrinjarić, B. Conceptual research framework of consumer resilience to privacy violation online. *Sustain.* **2021**, *13*, 1238. https://doi.org/10.3390/su13031238.

59. Liu, X.; Wayne Xu, W. Adoption of ride-sharing apps by Chinese taxi drivers and its implication for the equality and wellbeing in the sharing economy. *Chinese J. Commun.* **2019**, *12*, 7–24. https://doi.org/10.1080/17544750.2018.1524392.

60. Gil De Zuniga, H.; Diehl, T.; Huber, B.; Liu, J. Personality Traits and Social Media Use in 20 Countries: How Personality Relates to Frequency of Social Media Use, Social Media News Use, and Social Media Use for Social Interaction. *Cyberpsychology, Behav. Soc. Netw.* **2017**, *20*, 540–552. https://doi.org/10.1089/cyber.2017.0295.

61. Statsenko, L.; Samaraweera, A.; Bakhshi, J.; Chileshe, N. Construction 4.0 technologies and applications: A systematic literature review of trends and potential areas for development. *Constr. Innov.* **2022**. https://doi.org/10.1108/CI-07-2021-0135.

62. Adeniyi, O.; Thurairajah, N.; Leo-Olagbaye, F. Rethinking digital construction: A study of BIM uptake capability in BIM infant construction industries. *Constr. Innov.* **2022**, *51*, 1–51. https://doi.org/10.1108/CI-09-2021-0161.

63. Hoepfl, M.C. Choosing Qualitative Research: A Primer for Technology Education Researchers. *J. Technol. Educ.* **1997**, *9*, 239. https://doi.org/10.21061/jte.v9i1.a.4.

64. Meissner, H.; Creswell, J.; Klassen, A.C.; Plano, V.; Smith, K.C. Best Practices for Mixed Methods Research in the Health Sciences. *Methods* **2011**, *63*, 126–140. https://doi.org/10.1002/cdq.12009.

65. Eisenhardt, K.M. Building Theories from Case Study Research. *Acad. Manag. Rev.* **1989**, *14*, 532. https://doi.org/10.2307/258557.

66. Motro, D.; Sullivan, D. Resurrecting the evil genius: Examining the relationship between unethical behavior and perceived competence. *J. Manag. Psychol.* **2022**, *37*, 591–603. https://doi.org/10.1108/JMP-06-2021-0350.

67. DeVoe, S.E.; Iyengar, S.S. Manager's theories of subordinates: A cross-cultural examination of manager perceptions of motivation and appraisal of performance. *Organ. Behav. Hum. Decis. Process.* **2004**, *93*, 47–61. https://doi.org/10.1016/j.obhdp.2003.09.001.

68. Patton, M.Q. Qualitative methods and approaches: What are they? *New Dir. Inst. Res.* **1982**, *1982*, 3–15. https://doi.org/10.1002/ir.37019823403.

69. O'Reilly, M.; Parker, N. "Unsatisfactory Saturation": A critical exploration of the notion of saturated sample sizes in qualitative research. *Qual. Res.* **2013**, *13*, 190–197. https://doi.org/10.1177/1468794112446106.

70. Haq, M.; Davies, J. "The person with maximum knowledge will win the race": Conceptualizing knowledge in microbusinesses. *J. Small Bus. Manag.* **2020**, *60*, 1–27. https://doi.org/10.1080/00472778.2020.1768799.

71. Haq, M.; Johanson, M.; Davies, J.; Dana, L.P.; Budhathoki, T. Compassionate customer service in ethnic minority microbusinesses. *J. Bus. Res.* **2021**, *126*, 279–290. https://doi.org/10.1016/j.jbusres.2020.12.054.

72. Vershinina, N.; Rodgers, P. Symbolic capital within the lived experiences of Eastern European migrants: A gendered perspective. *Entrep. Reg. Dev.* **2020**, *32*, 590–605. https://doi.org/10.1080/08985626.2019.1703045.

73. Oelze, N.; Gruchmann, T.; Brandenburg, M. Motivating factors for implementing apparel certification schemes-a sustainable supply chain management perspective. *Sustain.* **2020**, *12*, 4823. https://doi.org/10.3390/SU12124823.

74. Siepmann, L.; Nicholas, K.A. German winegrowers' motives and barriers to convert to organic farming. *Sustain.* **2018**, *10*, 4215. https://doi.org/10.3390/su10114215.

75. Polese, F.; Botti, A.; Grimaldi, M.; Monda, A.; Vesci, M. Social innovation in smart tourism ecosystems: How technology and institutions shape sustainable value co-creation. *Sustain.* **2018**, *10*, 140. https://doi.org/10.3390/su10010140.

76. Galvin, R. How many interviews are enough? Do qualitative interviews in building energy consumption research produce reliable knowledge? *J. Build. Eng.* **2015**, *1*, 2–12. https://doi.org/10.1016/j.jobe.2014.12.001.

77. Diefenbach, T. Are case studies more than sophisticated storytelling?: Methodological problems of qualitative empirical research mainly based on semi-structured interviews. *Qual. Quant.* **2009**, *43*, 875–894. https://doi.org/10.1007/s11135-008-9164-0.

78. Cooper, D.R., Schindler, P.S., & Sun, J. Business research methods (Vol 9). *Bus. Res. Methods* **2006**, 38.

79. Hoon, C. Meta-Synthesis of Qualitative Case Studies: An Approach to Theory Building. *Organ. Res. Methods* **2013**, *16*, 522–556. https://doi.org/10.1177/1094428113484969.

80. Zeidan, R.; Van Holt, T.; Whelan, T. Existence inductive theory building to study coordination failures in sustainable beef production. *J. Clean. Prod.* **2020**, *267*, 122137. https://doi.org/10.1016/j.jclepro.2020.122137.

81. Rabiee, F. Focus-group interview and data analysis. *Proc. Nutr. Soc.* **2004**, *63*, 655–660. https://doi.org/10.1079/pns2004399.

82. Braun, V.; Clarke, V. Thematic analysis. *APA Handb. Res. methods Psychol. Vol 2 Res. Des. Quant. Qual. Neuropsychol. Biol.* **2012**, *2*, 57–71. https://doi.org/10.1037/13620-004.

83. Ravichandran, S.; Phelan, K.V.; Kirby, K.; Singh, S.; Ghosh, A. Pre-employment testing practices in the hospitality industry in the U.S. and Australia. *J. Hum. Resour. Hosp. Tour.* **2022**, *21*, 524–547. https://doi.org/10.1080/15332845.2022.2106614.

84. Dalkin, S.; Forster, N.; Hodgson, P.; Lhussier, M.; Carr, S.M. Using computer assisted qualitative data analysis software (CAQDAS.; NVivo) to assist in the complex process of realist theory generation, refinement and testing. *Int. J. Soc. Res. Methodol.* **2021**, *24*, 123–134. https://doi.org/10.1080/13645579.2020.1803528.

85. Manley, K.; Mcfallan, S. Exploring the drivers of firm-level innovation in the construction industry. *Constr. Manag. Econ.* **2006**, *24*, 911–920. https://doi.org/10.1080/01446190600799034.

86. Borg, J.; Scott-Young, C.M. Employers' perspectives on work readiness in construction: Are project management graduates hitting the ground running? *Int. J. Manag. Proj. Bus.* **2020**, *13*, 1363–1379. https://doi.org/10.1108/IJMPB-10-2019-0238.

87. Nasah, A.; DaCosta, B.; Kinsell, C.; Seok, S. The digital literacy debate: An investigation of digital propensity and information and communication technology. *Educ. Technol. Res. Dev.* **2010**, *58*, 531–555. https://doi.org/10.1007/s11423-010-9151-8.

88. Davis, K.A.; Songer, A.D. Resistance to it change in the AEC industry: An individual assessment tool. *Electron. J. Inf. Technol. Constr.* **2008**, *13*, 56–68.

89. Chauhan, C.; Parida, V.; Dhir, A. Linking circular economy and digitalisation technologies: A systematic literature review of past achievements and future promises. *Technol. Forecast. Soc. Chang.* **2022**, *177*, 121508. https://doi.org/10.1016/j.techfore.2022.121508.

90. Vriesema, M.A.; Kloosterman, R.C. Recapturing creative space in architectural design unravelling the production network of a young, innovative architectural practice in Rotterdam. *Creat. Ind. J.* **2022**, *15*, 199–216. https://doi.org/10.1080/17510694.2022.2030102.

91. Berman, J.Z.; Levine, E.E.; Barasch, A.; Small, D.A. The Braggart's dilemma: On the social rewards and penalties of advertising prosocial behavior. *J. Mark. Res.* **2015**, *52*, 90–104. https://doi.org/10.1509/jmr.14.0002.

92. Müller, J.M.; Buliga, O.; Voigt, K.I. Fortune favors the prepared: How SMEs approach business model innovations in Industry 4.0. *Technol. Forecast. Soc. Chang.* **2018**, *132*, 2–17. https://doi.org/10.1016/j.techfore.2017.12.019.

93. Nowell, S.D. Using disruptive technologies to make digital connections: Stories of media use and digital literacy in secondary classrooms. *EMI. Educ. Media Int.* **2014**, *51*, 109–123. https://doi.org/10.1080/09523987.2014.924661.

94. Pegrum, M. "I link, therefore I am": Network literacy as a core digital literacy. *E-Learning Digit. Media* **2010**, *7*, 346–354. https://doi.org/10.2304/elea.2010.7.4.346.

95. Yao, M.; Ye, D.; Zhao, L. The relationship between inbound open innovation and the innovative use of information technology by individuals in teams of start-ups. *Syst. Res. Behav. Sci.* **2022**, *39*, 503–515. https://doi.org/10.1002/sres.2851.

96. Merschbrock, C.; Erik, B. Effective digital collaboration in the construction industry—A case study of BIM deployment in a hospital construction project. *Comput. Ind.* **2015**, *73*, 1–7. https://doi.org/10.1016/j.compind.2015.07.003.

97. Hangen, T. Historical Digital Literacy, One Classroom at a Time. *J. Am. Hist.* **2015**, *101*, 1192–1203. https://doi.org/10.1093/jahist/jav062.

98. Rogers, E.M. *Diffusion of Innovations LK*; 5th ed.; Free Press: New York,NY, USA, 2003; ISBN 0743222091/9780743222099. Available online: https://leedsbeckett.on.worldcat.org/oclc/52030797 (accessed on 20 December 2022).

99. Aghimien, D.; Aigbavboa, C.; Oke, A.E.; Aliu, J. Delineating the people-related features required for construction digitalisation. *Constr. Innov.* **2022**. https://doi.org/10.1108/CI-01-2022-0012.

100. Jones, P.; Wynn, M. The leading digital technology companies and their approach to sustainable development. *Sustain.* **2021**, *13*, 6612. https://doi.org/10.3390/su13126612.

101. McNamara, A.J.; Sepasgozar, S.M.E. Intelligent contract adoption in the construction industry: Concept development. *Autom. Constr.* **2021**, *122*, 103452. https://doi.org/10.1016/j.autcon.2020.103452.

102. Aliu, J.; Aigbavboa, C. Key generic skills for employability of built environment graduates. *Int. J. Constr. Manag.* **2021**, *21*, 1–19. https://doi.org/10.1080/15623599.2021.1894633.

103. Diniz Fonseca, E. Accident and innovation in construction industry: Learning by doing to prevent accidents and improve the production. *Saf. Sci.* **2021**, *142*, 105389. https://doi.org/10.1016/j.ssci.2021.105389.

104. Farrar, J.; Libby, T.; Thorne, L. Groupcentric budget goals, budget-based incentive contracts, and additive group tasks. *Rev. Account. Financ.* **2015**, *14*, 189–206. https://doi.org/10.1108/RAF-12-2013-0141.

105. Jackson, D.; Riebe, L.; Meek, S.; Ogilvie, M.; Kuilboer, A.; Murphy, L.; Collins, N.; Lynch, K.; Brock, M. Using an industry-aligned capabilities framework to effectively assess student performance in non-accredited work-integrated learning contexts. *Teach. High. Educ.* **2020**, *25*, 1–20. https://doi.org/10.1080/13562517.2020.1863348.

106. Lundberg, O.; Nylén, D.; Sandberg, J. Unpacking construction site digitalization: The role of incongruence and inconsistency in technological frames. *Constr. Manag. Econ.* **2021**, *0*, 1–16. https://doi.org/10.1080/01446193.2021.1980896.

107. Hamza, A.; Pernelle, P.; Ben Amar, C.; Carron, T. Serious games for vocational training: A compared approach. In Proceedings of the 2016 IEEE/ACS 13th International Conference of Computer Systems and Applications (AICCSA), Agadir, Morocco, 29 November–2 December 2016. https://doi.org/10.1109/AICCSA.2016.7945712.

108. Lorincová, S.; Hitka, M.; Štarchoň, P.; Stachová, K. Strategic instrument for sustainability of human resource management in small and medium-sized enterprises using management data. *Sustainability* **2018**, *10*, 3687. https://doi.org/10.3390/su10103687.

109. Shields, R.; West, K. Innovation in clean-room construction: A case study of co-operation between firms. *Constr. Manag. Econ.* **2003**, *21*, 337–344. https://doi.org/10.1080/0144619032000111232.
110. Love, P.E.D.; Smith, J.; Ackermann, F.; Irani, Z.; Teo, P. The costs of rework: Insights from construction and opportunities for learning. *Prod. Plan. Control* **2018**, *29*, 1082–1095. https://doi.org/10.1080/09537287.2018.1513177.