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Promoting the digital transformation of the South African quantity surveying profession through the implementation of change management theories

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ABSTRACT

The construction industry is lagging behind in the digital race, thus not living up to its potential to drive the knowledge economy of the Built Environment (BE). This paper explores the motivations for change: why the 4+5IR is worth not resisting and what 4IR technologies could benefit the Quantity Surveying Profession (QSP). The introduction to the new concept of change management is used to illustrate how the QS workplace can go about embracing digital transformation (4IR), concentrating on human-centric, sustainable and resilient nuances (5IR). A form of documentary research, namely a literature review study, has been undertaken to review pertinent research and extract relevant information though content analysis about the digitalisation relevant to the Built Environment, the construction industry and its value chain, and the Quantity Surveying Profession specifically; knowledge innovation and creativity economy, as well as how change management strategies assist the implementation of digital transformation. The QSP, as part of the BE, appears to have compelling reasons to adopt 4IR to improve and enhance their service offering to the construction industry value-chain, thereby contributing to the BE's attainment of the SDGs. To accept the challenge of digital transformation, the application of change management theories in the QS workplace offer the opportunity to learn new concepts as well as adopt 4IR technology, through a scientific approach for QS practices to accept the challenge of digital transformation. The paper offers a roadmap toward achieving digital transformation by the QS community based on a literature review study, however, it is suggested these be tested through empirical data collected among QS practices who have determinedly set about adopting 4IR technology. The QSP risks becoming inexorable, if it continues to ignore the 4+5IR. The 'science' of change management offers a forensic approach to efficiently manage a transformative process and should be an approach which QSs' respect and value, given they apply it in their every-day activities.

Keywords: 4+5IR, change management, digital transformation, Quantity Surveying

1. INTRODUCTION

"Albeit anatomically identical, we humans of the twenty-first century are no longer the same humans of forty thousand years ago. We are inherently different. We have changed the world through technology, and technology has thereby changed who we are. And we are not going to stop there."
Ienca et al. (2022: 305)

The construction industry's notoriously antipathetic culture seems reluctant to allow the Fourth Industrial Revolution (4IR) any traction, however, digital disruption in the construction industry is inevitable (Newman *et al.*, 2020). The 4IR heralds an opportunity for the construction industry and its value chain to become proactive instead of reactive due to improved availability of digital data and adoption of digital technologies that connect the physical and digital realms (Bolpagni *et al.*, 2021). Experts opine that the Quantity Surveying profession (QSP) is most likely to be the one to adopt digitalisation, especially for use at the early stages of projects (Newman *et al.*, 2020), with the RICS GCM Survey revealing that the traditional functions of 'cost estimation, prediction, planning, and control' are most likely to be performed by digital technology (Sawhney *et al.*, 2022). Yet the same study also revealed that 40% of the respondents are using no digital technologies on any of their projects (Sawhney *et al.*, 2022). Papadonikolaki (2022) found that digitalisation of the Built Environment (BE) is slowly picking up, the question remains whether the construction industry's training efforts are urgent and comprehensive enough to embrace the exponentially changing digital world (Rogers, 2022). Already there is talk of the Fifth Industrial Revolution (5IR) which requires 'harmonious and synergistic' collaboration between humans and technology, allowing each to excel in their own domains, for the well-being of the planet and its' inhabitants, by focusing on sustainable and renewable resources (Noble *et al.*, 2022). This position is advocated by du Plessis and Sherratt (2020: 188) for all Built Environment Professionals (BEPs) to "*ensure that the ethical and social challenges that surround the use of Construction 4.0 in the operation and maintenance of assets are raised and mitigated where possible through practice*".

Higher Education Institutions (HEIs) are tasked with driving digital transformation (Bawa, 2021), which takes care of future BEPs, but what about the workforce at the coalface right now? Upskilling and re-skilling of the current workforce is urgently needed for them to acquire the knowledge and skills needed to embrace the 4IR, not only for personal reasons such as better career opportunities and improved work-life balance (Xu *et al.*, 2021), but also to ensure the construction industry meets global best practice standards (Ebekozien *et al.*, 2023). Bolpagni *et al.* (2021) estimate it will take between 15-20 years to upskill the BEPs and suggest a three-phase approach that considers the development of a digital transformation (DT) strategy first, then dealing with management and operational issues thereafter. However, Cameron and Green (2019) argue that before a DT strategy and governance structure can be developed and successfully deployed, there needs to be some anticipation of resistance to change within an organisation, and an understanding of what needs to be done to make change a more palatable concept.

The aim of this article is to explore whether applying the principles of change management theories could assist the South African QSP to embark on or accelerate the inevitable digitalisation journey, reducing the additional stress, anxiety and alienation among the workforce caused by the ubiquitous 4IR. Edgar H. Schein's change model requires a process which allows for "*creating the motivation to change, learning new concepts and internalizing new concepts and meanings*" (Cameron and Green, 2019: 7). Therefore, the article seeks to address the following four questions, and the literature review is structured accordingly as well:

i. *Creating motivation for change*: For the BE - Why is the 4+5IR is worth not resisting?
ii. *Creating motivation for change*: For the QSP – Why are 4+5IR knowledge and skills needed by the QSP?
iii. *Learning new concepts*: What 4+5IR knowledge and skills are particularly needed by the QSP?
iv. *Learning new concepts*: How can change management theories help with the digital transformation process (4IR), concentrating on human-centric, sustainable and resilient nuances (5IR), in formulating a digital transformation strategy?

The intended outcome of this article is for the reader to conclude the change process by reflecting on (internalising) any new knowledge or concepts they may have gleaned, and how these can be deployed in their own professional environment.

2. RESEARCH METHODOLOGY

This research is considered as secondary research, which using the definition espoused by Bassot (2022), draws upon the qualitative data gathered by others and published in a wide range of white, grey, and black literature. Snyder (2019) suggests that an integrative or critical literature review approach such as the one adopted for this research, aims to assess, critique and synthesize literature with the aim of developing new perspectives and/or theoretical frameworks. As is typical of this form of documentary research, a deliberate, non-systematic search strategy is embraced to ensure alignment with the study's aim. Krippendorff (2019) advises the use of content analysis technique to provide new insights and has been used in this research to infer characteristics in selected topics, guaranteeing a thorough exploration of the research questions.

3. LITERATURE REVIEW

Construction as an industry is compared - in terms of its' (lack of) efficiency - to other industries that also 'build' things, such as aircraft, ships, automobiles. However, it is unique in that nearly every project is a prototype, constructed (mostly) onsite and vulnerable to weather and site conditions, and the "assembly" team varies from project to project (Koskela, 1999). Therefore, most stakeholders acknowledge construction to be a complex 'system of systems', a meta-system of paradoxical variables (project and process), an adaptive system requiring adaptive change due to its' high degree of inventiveness, promotion of creativity and celebration of diversity (Rooke *et al.*, 2008; Fernández-Solís, 2011; Oesterreich and Teuteberg, 2016). It is puzzling, that given BEPs work in a constant state of flux, the resistance to, or fear of the inevitable change that adoption of the 4IR will herald, is ostensibly paralyzing the construction industry.

Franklin D. Rooseveldt made famous the saying of the 16th century writer, Michel de Montaigne, in his 1933 presidential inaugural speech by quoting that "*… the only thing … to fear is … fear itself*" (Tearle, 2023). Fear of change or worry about uncertainties, feelings of insecurity are seen as perfectly normal or "natural" human experiences, however, humanity is facing novel layers of uncertainties, over and above its 'usual' survival concerns, due to its' entire habitat being under threat of climate change, revolutionary transformations to the global society and crippling inequalities that intensify polarization of human development (UNDP, 2022).

3.1 Creating motivation for change for the BE - Why BEPs should not resist the 4IR and 5IR?

The BE plays an integral role in the 'Race to Zero', the global campaign to halve carbon emissions by 2030 or reach zero status by 2050 as evidenced in Figure 1. below, as the BE contributes 40% of global energy-related carbon emissions and uses 50% of all extracted

materials (Climate Champions, 2023). The BE intersects with 11 of the United Nations' 17 Sustainable Development Goals (SDGs) (WGBC, 2023) and through the development of smart cities and sustainable communities; the adoption of sustainable procurement, design and construction approaches and methods, and the implementation of renewable energy technology, the BE impacts on the lives of billions of stakeholders (Smith *et al.*, 2021; Papadonikolaki, 2022) and is considered a key contributor to social value (Raiden and King, 2021). Social sustainability, through the BE infrastructure, is linked to offering quality of life to the users of the BE (Grum and Kobal Grum, 2020).

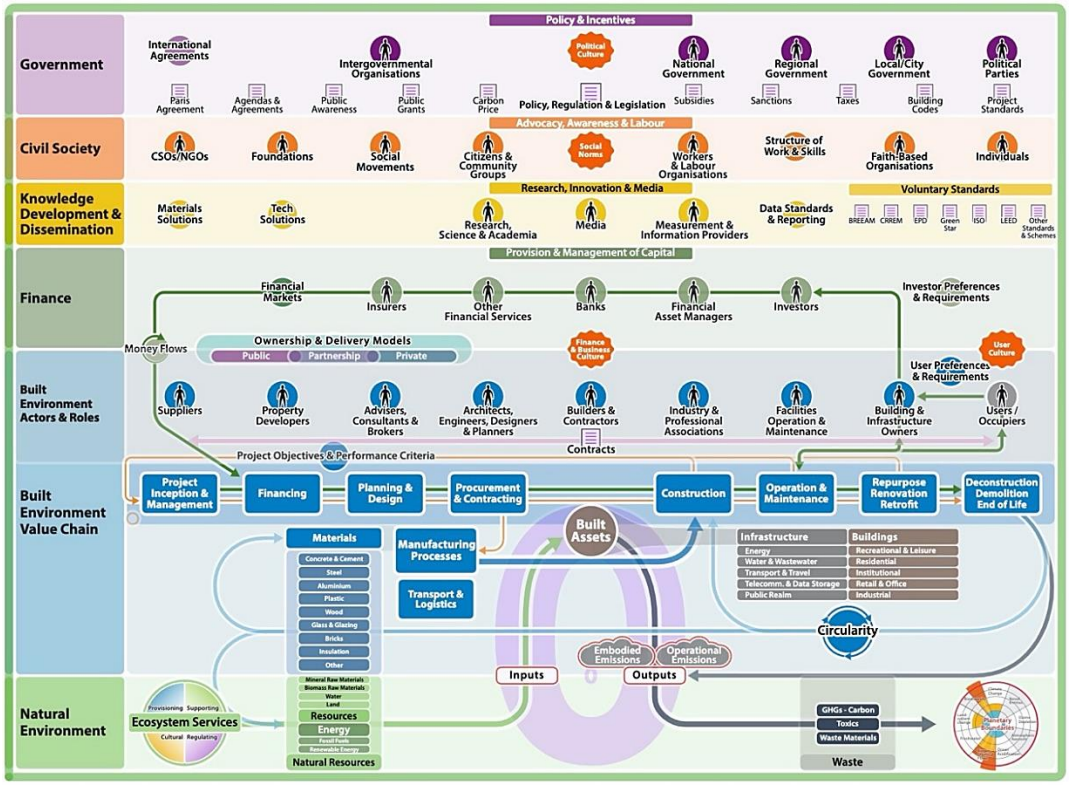

Figure 1. Race to Zero – Interactive Built Environment System Map
Source: Climate Champions (2023)

The United Nation's Sustainability Development Goals Report of 2023 is anxious to suggest that improving digital inclusion, utilising robust digital infrastructure and data processing capacity is the only way Agenda 2030 can be salvaged (United Nations, 2023). The 4IR's currency is digital technology, tools and information, which can integrate with physical and biological realms, potentially disrupting and transforming all aspects of human life at exponential rates unmatched in history (Ross and Maynard, 2021). Construction 4.0 is the term used to describe a construction industry that aims to embrace the potential of digitalisation at all stages of the construction value chain without compromising on the 5IR tenements of human-centric approach, sustainability and resiliency (Bolpagni *et al.*, 2021). The construction industry and the BE serve are perfect domains for the adoption of extensive digital technologies such as Cloud Computing, Blockchain Technology, Internet of Things (IoT), Big Data, Building Information Modelling (BIM), Artificial Intelligence (AI), Advanced Data Analytics, Extended Reality (XR), Robotics, Drones and Autonomous Vehicles, Additive Manufacturing, Advanced Materials (Newman *et al.*, 2020).

In 4IR terms, the BE comprises a very wide spectrum of data, from design, construction and operation type data, beleaguered as it is with various application domains, diverse stakeholders and uses representing multi-layers of details, making the sheer volume of data communicated and exchanged 'unfathomable' (Kosicki *et al.*, 2021; Pauwels *et al.*, 2021). The digitalisation of building 'products' and processes' promotes the acquisition and analysis of information which feeds into the BE knowledge domain (McHugh *et al.*, 2021), drives project success and sustainability of said products (Tanga *et al.*, 2020; Sawhney *et al.*, 2022).

The trifecta of the 21st century is knowledge, innovation and creativity (Dubina *et al.*, 2011). Future BEPs will be operating in a knowledge society (Bolpagni *et al.*, 2021). A knowledge society is one that subscribes to a culture of life-long learning, is committed to human development through information cultivation and knowledge production and lives out its vision of empowerment through 'plurality, inclusion, solidarity and participation' (IBE-UNESCO, 2012). Dubina *et al.* (2011) notes that modern economic development has shifted from economies with tangible assets to intangible assets, where humans' basic needs are serviced by the agricultural economy (food safety), the industrial economy (human safety), the information economy (communication), arriving at creativity-innovation-knowledge economies which realises creative self-actualisation, as illustrated in Figure 2 below.

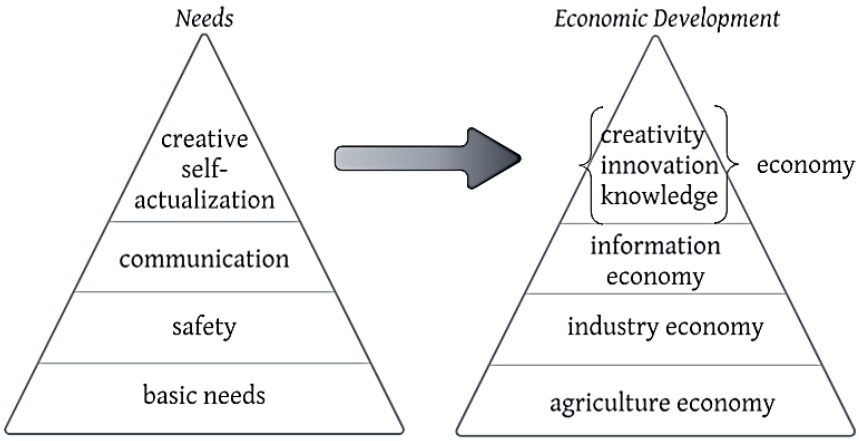

Figure 2. Modern economic development presented as an analogy of Maslow's Hierarchy of Needs' pyramid
Source: Dubina *et al.* (2011)

Creativity is a conflux of paradoxical positions: "*(a) Creativity involves difference from the everyday, but is found in everybody; (b) novelty, the single essential element in creativity, is necessary but not sufficient to define it; (c) creativity is not the same as intelligence, but it is also not completely different; (d) creative production requires deep knowledge, but freedom from its constraints; (e) creativity implies bringing something new into existence, but can be studied without reference to products; (f) creativity requires deviating from social norms, but doing this in a way that the society can tolerate (g) creativity requires combining contradictory personality characteristics; (h) opposite kinds of motivation can lead to creativity*" (Cropley, 2011: 30). Runco and Jaeger (2012) query who is to be the judge, or who is to judge the judges, of creativity, which traditionally needs two criteria, namely originality and usefulness. Creative self-development is a birth-right, and arguably more necessary now than ever before for humankind to survive and thrive (Richards, 2023).

Considering that innovation is a new combination of old ideas (Iyengar, 2023), it becomes an accessible concept to everyone through the correct 'training'. Investment in creativity and innovation equates to investments in people, education, and creative work environments, and 'creative knowledge environments.' Creative knowledge innovation, i.e. innovation based on both knowledge and creativity, ticks all the boxes of sustaining a creativity economy which interrelates technological innovations with social innovations (Dubina *et al.*, 2011).

3.2 Creating motivation for change for the QSP – Why the 4IR and 5IR is relevant to the Quantity Surveying Profession?

Quantity Surveyors (QSs) are purveyors of data for a variety of purposes (Saka and Chan, 2019), and are anticipated to be most impacted by the 4IR (Newman *et al.*, 2020). It is generally agreed that the core functions of the QSP, such as fast and efficient quantification, quantity validation and verification, benefit from the use of digital data and technology (Sawhney *et al.*, 2023). Other benefits include enhanced cost certainty and the ability to set realistic and reliable cost targets due to access to benchmark information and historical data, improved cost data quality, reliability and relevance which can be rapidly revised and updated according to market conditions and inflation, allowing for rapid and accurate evidence-based decision making and enhanced cost control and progress monitoring (Elrefaey *et al.*, 2022; Sawhney *et al.*, 2023).

The key obstacles to the use of digital technology in the construction sector are listed as the cost, effort and changes needed to implement digital transformation, the shortage of skilled persons and the fact that there is no clear demand from stakeholders (Sawhney *et al.*, 2022; Sawhney *et al.*, 2023). QSs face serious challenges in the digital landscape, such as the lack of integration, interoperability between various tools and systems; the unique, occasionally once-off digital technology requests per project team/client combination; the significant reliance on internal intelligence, through multiple unstructured databases, to compile dashboards and aid data analytics; the absence of 'professional' information management practices; and the lack of linkages between internal and external systems (Sawhney *et al.*, 2023).

However, some contend that 'ignorance' is QSs' worst enemy given that the lack of knowledge and awareness of digital solutions that could improve their efficiency and productivity in the workplace is playing into their fears of, for example, practicing in a BIM environment. The deeply entrenched, traditional work processes of quantity surveyors and other BEPs are blamed for holding practitioners back from adopting a collaborative and integrated approach to projects (Saka and Chan, 2019). Wao (2016: 1371) quaintly states that QSs *"provide far much better services than other construction professionals"* and had identified 'IT developments' as the potential salvation of the QSP during or following periods of crisis. Cook *et al.* (2015) predicted that as the construction value chain generates exponential volumes of 'Big Data' so the demand will grow for professionals to apply analytical skills to make sense of the complex data sets, offer advisory services and to leverage the value of sectoral information by attracting new clients and investors. Thus, the call for digital transformation to be adopted is not new, and as Elrefaey *et al.* (2022) contend, once the benefits of digital technology have been realised, there is no turning back.

3.3 Learning new concepts relevant to the QSP - What 4IR and 5IR knowledge and skills are particularly needed by the Quantity Surveying Profession?

Knowledge is created when entropic information gains meaning in the 'eye of the beholder' (Gleick, 2011) and so the QSP could creatively and innovatively create bespoke knowledge utilising digital technology. Diversification, improved competition and creating competitive advantage are some of broader benefits of adopting digital transformation (Tanga *et al.*, 2020). In order illustrate the contention that the QSP stands to benefit the most from the

adoption of 4IR, Figure 3 below synthesises most (but not all) of the services (or potential services to be) rendered by QSs and which digital software and tools are being used (or suggested for use).

The left-hand column summarises traditional QS and cost management practices and catalogues the digital tools and technologies currently in use or which are best suited to supplement and enhance the efficiency and effectiveness of the activities undertaken. The most well-known 4IR associated technology in the construction industry is arguably Building Information Modelling (BIM) (Bolpagni *et al.*, 2021), although Hosseini *et al.* (2020) advocate the use of the broader term Digital Engineering (DE) to include the technological innovations and operational processes associated with BIM. The uptake of DE in the QSP is less than stellar (Sawhney *et al.*, 2023) with continued reliance on 'old technology' such as spreadsheets and quantity take-off (QTO) software. It could be deduced that there remains ample scope for the increased adoption of 4IR tools and technologies to undertake traditional QS and cost management activities, such as common data environments (CDEs), extended reality (XR), digital twins, etc. Sadri et al. (2023) propose that individually these technologies result in a smart BE, but a fusion thereof (such as digital twins, AI and IoT) results in a smarter BE.

The right-hand side column in Figure 3 summarises some (but not all) of the potential services referenced in the literature which appear to suit the unique independent, forensic-oriented and multifaceted skillset of the QSP. Most of the 'new' services are linked to the climate crisis and the UN SDGs, such as carbon measurement, whole-life and whole-asset evaluations, environment-social governance (ESG), disaster risk management, to name but a few. The Royal Institution of Chartered Surveyors (RICS) suggest that guidance be offered to the QSP on information management and integration with other information classification systems; that collaborative strategies be developed to promote 'model-driven and data-centric work practices'; and that their QS professional skills' and competencies' frameworks be updated to incorporate the importance of digital tools, analytics and decarbonisation (Sawhney *et al.*, 2023: 20,21).

Bolpagni *et al.* (2021) advocate a three-phase approach to digital transformation (DT) which starts with formulating a strategy. The follow-on phases of DT, the management and operation phases, allows for technical issues such as interoperability, exchange standards, compliance requirements, specialist software and hardware and collaboration tools to be evaluated, trialled and adopted (Bolpagni *et al.*, 2021).

Lest the 'dark side' of the 4IR be overlooked (Carayannis *et al.*, 2023), the QSP needs to take cognisance of the 5IR as well. The 5IR requires a reconnection to what it means to be human in a digital world, and thus the QSP also need to consider soft skill improvement such as cultivating intelligent and well-rounded leadership and management abilities; honing the client-focus, improving client liaison and perfecting advisory skills; working in collaborative, trans- and interdisciplinary environments and demonstrating excellent interpersonal skills; and displaying effective communication techniques and strong ethical behaviour (Cook *et al.*, 2015). The 5IR also places a strong emphasis on organisational learning which is expressed as a *"… learning process in which the experience and practical knowledge of people represent important resources for the introduction, the development and the integration of innovative technologies, matching both knowledge exploration and exploitation"* (Ivaldi *et al.*, 2021: 21).

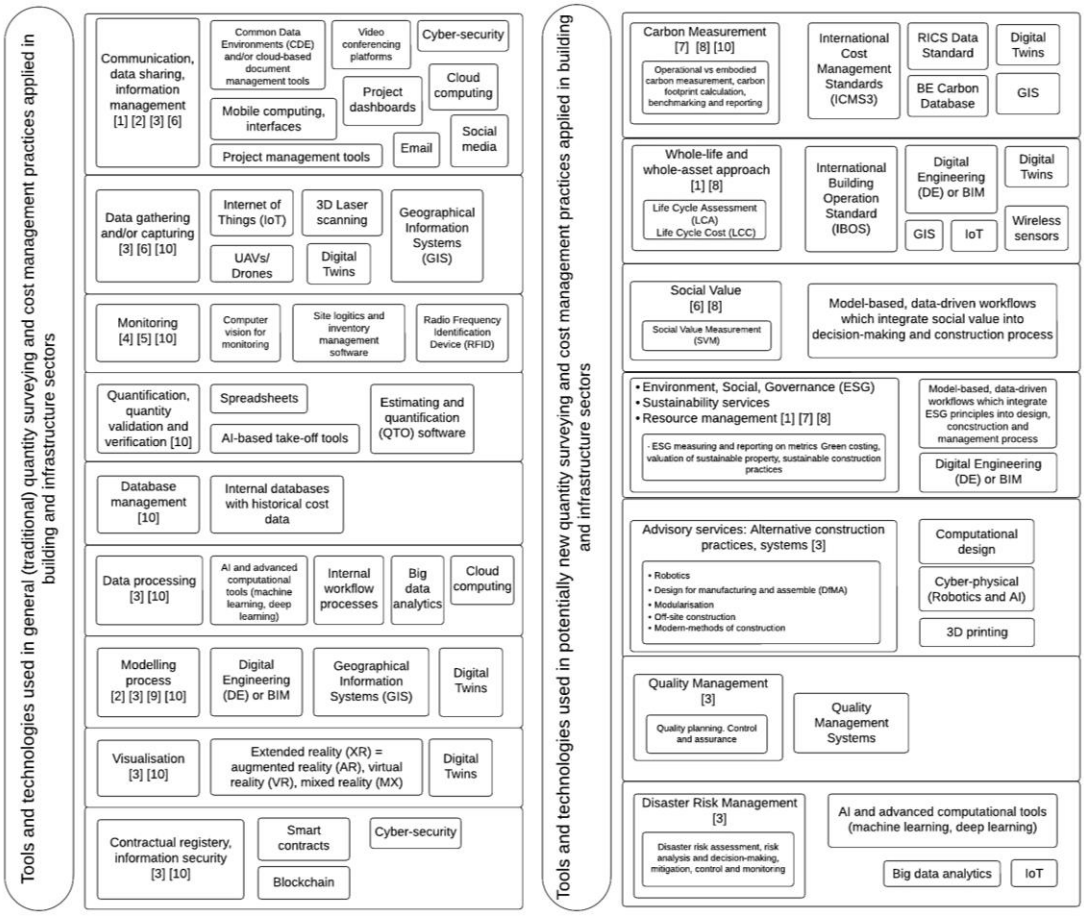

Figure 3. Summary of traditional and potential future Quantity Surveying Profession services and the digital tools and technologies that are or can be used. Sources: Cook *et al.* (2015), WEF (2016), Bolpagni *et al.* (2021), Oke and Arowoiya (2021), Elrefaey *et al.* (2022), Fujiwara *et al.* (2022), Omotayo *et al.* (2022), Sawhney *et al.* (2022), Sadri *et al.* (2023), Sawhney *et al.* (2023)

3.4 Learning new concepts - How can change management theories help with the digital transformation process (4IR), concentrating on human-centric, sustainable and resilient nuances (5IR), in formulating a digital transformation strategy?

Change is inevitable (Galli, 2018; Iyengar, 2023) yet resistance to the change that digital technology adoption will wreak on the QSP seems to be a very real barrier (Sawhney *et al.*, 2023). Nearly 20 years ago, Smith (2004) alluded to the conservatism of the QSP as stifling technological growth. Some studies offer reassurance that the learning curve for QSs to adapt to digital technology, tools, systems and approaches is actually not that steep, as the knowledge areas, domain specific-skills and domain-specific BIM functionalities that QSs are required to master are not brand new to them, just packaged differently (Saka and Chan, 2019).

Ebekozien *et al.* (2023) argue that reskilling and upskilling of BEPs is a joint effort between individuals, companies, professional bodies and government, with Ebekozien and Aigbavboa (2023) adding HEIs onto the list. Ibrahim *et al.* (2022) clearly identifies the need for "change agents" within organisations to assist with the acceptance of new technologies in their perception-based model to promote 4IR technologies for key BEP consultants, such

as QSs, with Newman *et al.* (2020) suggesting that given the 4IR is such a significant game-changer, significant organisational change management is also needed.

In the spirit of 'learning new concepts", the concept of change management will be defined, the major appraoches briefly discussed, the change management process delved into and then the application of change management in the context of a DTS explored.

3.4.1 What is change management?

Change management is about managing the psychodynamics activated by the fear of change, and ensuring that individuals, teams and organisations feel psychologically safe to enter a learning phase (Cameron and Green, 2019). It is understandable that BEPs 'in the field' are stressed at the thought that they need to adapt their currently applied processes (upskill) or abandon their usual modus operandi and learn new methodologies (reskill) (Bolpagni et al., 2021). The nexus of change is about learning something new or different (acquiring knowledge) through experience, accompanied by all the emotions associated with this process and the resultant behavioural transfiguration (Cameron and Green, 2019). Given the multiple 'tricky' personalities within an organisation, change management is a useful mechanism to 'break habits', help employees reach their full potential and improve professional service (Galli, 2018).

Resistance to change can be overcome if the driving force of 'survival anxiety' experienced by emotionally and economically vulnerable 'wage slaves' (McCabe, 2020) is greater than the restraining force of 'learning anxiety'. It is recommended that survival anxiety should not be heightened, rather learning anxiety should be decreased through communication, training and development, employee involvement, support and challenge approaches, negotiation and as a last resort, coercion (Cameron and Green, 2019). Not all resistance should be viewed in a negative light as it could be productive or facilitative; challenging the purpose of change which seeks to perpetuate a specific social order at the expense of exploitation of people and the environment for the purpose of maximising profitability, for example, shows the power of critical thinking among those who have to bear the brunt of change (McCabe, 2020).

Managing change is not easy and requires re-iteration and resilience (Greenway *et al.*, 2021), however, paying attention to the hard factors (time, capabilities, commitment of management and employees) as well as the soft factors (leadership style, corporate culture, employee motivation) is prudent (Sirkin *et al.*, 2011). The "science" of change management suggests that the power of change management rests in the hands of management structures within an organisation, and as such those enacting change, possess the power to change people, strategies, structure, cultures or technologies (McCabe, 2020). Leadership is critical to change management success, and the specific attributes needed of managers of digital transformation are that they need to have technical knowledge, be open to new things and not risk-averse, future-orientated and entrepreneurially-minded, able to engage in honest self-reflection, interact with smart people, support digital culture, constantly expand their know-how through self-education and professional development, thus leading by example (Ben Slimane *et al.*, 2022; Zöller, 2022). Decision-making power may rest in the hands of managers, however, management does not need to be omnipotent (McCabe, 2020), and operational decisions should be made by interdisciplinary, self-organising teams or individuals with entrepreneurial mindsets, dedicated to creating value for the organisation (Müller et al., 2018).

Change management is stratified between the organisation, people and projects (Galli, 2018). Consider that organisations are microcosms of society (McCabe, 2020), with its' organisational culture an amalgamated reflection of each individual's personality, talents, ambitions, passion for tasks and the organisation (Nienkerke-Springer, 2022). The response to change depends on nature of change, consequences of change, individual and organisational culture and personality type as well as the individual's and organisation's

resilience to change (Cameron and Green, 2019). The crisis of COVID-19 proved that fundamental and fast change is possible, however, 'big bang reorganisations' are not recommended, with incremental, exploratory and iterative approaches suggested that 'satisfice' and 'evolute', rather than seek perfect outcomes (Kueng, 2020).

3.4.2 Change management approaches

Cameron and Green (2019) suggest there are four key schools of thought about how to manage change, namely, the behavioural approach (reward and punishment), the cognitive approach (positive reframing), the psychodynamic approach (transitionary phases) and the humanistic psychological approach (holistic view of the individual's health and well-being within organisation). The behavioural approach advocates a 'carrot and stick' philosophy and relies on external forces to change behaviour in a 'Pavlovian' way. The other change management approaches focus on the individual within the organisation, their inner make-up and their lived experience through a change process.

There is, however, no 'one-size-fits-all' approach, and it is best to make informed decisions once more information is available about individuals such as their personality types, and personal history, to understand how they would cope with change (Cameron and Green, 2019). It is crucial to collect information from a variety of sources in an ethical manner (Bugalska, 2019). There are many psychometric assessments available to test and assess psychological constructs such as intellectual or cognitive ability or functioning, aptitude, interest, personality make-up or personality functioning, and according to South African legislation, for example, may only be administered, interpreted and reported on by registered psychologists. The non-profit oversight organisation, Assessment Standards South Africa, list 15 certified tests on their website which have been deemed "valid and reliable scientifically", fair and unbiased (ASSA, 2023). As an aside, the scientific psychology field is developing at a rapid pace to include genetics in the study of personality and individual differences (Boyle et al., 2016).

The investment in human capital, defined by The World Bank (2019) as "*the knowledge, skills, and health that people invest in and accumulate throughout their lives, enabling them to realize their potential as productive members of society*", is crucial to cross the 'digital divide' (Carayannis et al., 2023). Digital transformation readiness (DTR) relies on social capital (defined as "*social norms, mutual trust, and the capacity of communities to form relationships and networks*" (Raiden and King, 2021: 6)) and working skills (a dimension of human capital), with the understanding that digital transformation brings about social change, connecting organisations to the societal framework, and consequently influences economic values, of nations (Švarc *et al.*, 2020).

By embracing the 5IR, organisations commit to evolutionary development rather than revolutionary change, where the focus is on people, building potential by amplifying their strengths rather than focussing on overcoming their weaknesses and promoting of soft skill development such as the competence to listen actively, give constructive feedback, master classic questioning techniques as well as frame evolutionary questions that push the status quo. By instilling an "intelligent error" culture or better learning culture in an organisation, where mistakes or failures are part of crafting resilience and endurance to tolerate ambiguous, uncertain situations (Nienkerke-Springer, 2022). Therefore, the change process should be carefully managed, founded on accepted models or processes, which in turn are underpinned by various theories (Galli, 2018).

3.4.3 Change management processes or models

There are a multitude of change methodologies advocated in popular literature, however, this article focuses on the three major models used in relation to engineering project management (Galli, 2018; 2019), and thus most closely aligned to the BEP. Table 1

summarises the change management models and offers a brief summary and commentary on the perceived strengths and weaknesses of the models.

Table1: Summary of most popular change management models

Name of model	Concept	Comments
Lewin's Model of Change (Kurt Lewin 1951)	Three-step model: Unfreeze (examine the status quo), move/transition (take action, make changes), refreeze (embed changes).	Relies on the collective agreement to change. Requires involvement of employees in change process, transparency about the process and commitment that the change will 'stick'.
Kotter's Eight Step Change Model (John Kotter 1995, 1996, 2012)	Dual operating system: management-driven hierarchy partnered with strategy network. Eight accelerators: Sense of urgency; building guiding coalition, strategic vision, communication of and secure buy-in of vision; remove barriers; celebrate short-term goal achievements; keep learning from experience; institutionalise changes in culture.	A complementary approach, which establishes a clear framework for the formation of strategy networks, liberates enthusiastic volunteer change agents from mundane organisational matters. Relies on popular buy-in, no divisive organisational politics (in-fighting) or battles for control among divisions. Leadership is key with visionary guidance.
ADKAR Model (Prosci founder Jeff Hiatt 2003)	ADKAR stands for Awareness, Desire, Knowledge, Ability and Reinforcement	Focusses on 'people change adaptation' as opposed to change itself. Best used at team/project level as opposed to organisational platform.

Sources: Galli (2018); Cameron and Green (2019); Galli (2019)

Schein's sociopsychological model of learning and change, as alluded to in the introduction of this article, was derived from Lewin's CATS ("change at three steps") model which is still relevant in the VUCA (volatile, uncertain, complex, ambiguous) world of today (Coghlan, 2021). Lewin contends that organisations strive to remain in a state of homeostatis in response to disruptive changes, and thus a new state of equilibrium can only be achieved through intentional 'movements forward'. The deceptively simple three-step process requires organisations to 'unfreeze' or destabilise the current status quo to 'unleash energy for change', then through iterative processes and action research embark on a journey of transition, which culminates in a new state of affairs (refreeze) (Galli, 2018; Cameron and Green, 2019).

The Kotter Eight Step model accelerates change by (1) creating a sense of urgency, (2) establishing a guiding coalition, (3) formulating a strategic vision and initiatives, (4) communicating the vision and strategy to enlist a volunteer 'change' army, (5) removing barriers to change to enable action, (6) celebrating visible and significant short-term achievements, (7) continuing to learn from experience (never give up) and (8) institutionalising the strategic changes into organisation culture (Cameron and Green, 2019). Galli (2019) contends that Kotter's Eight Steps can be linked to Lewin's model where steps 1-4 involve 'unfreezing', steps 5-7 'moving' and step 8 'refreezing.

The Prosci ADKAR® model is a personal change management tool, as change takes place "one individual at a time" (Creasey, 2022). Each step is designed to scaffold off or amplify the former, thus **A**wareness of the need to change alone will not lead to action without the awakened **D**esire to participate and support change; without **K**nowledge and the **A**bility to learn about new concepts and applying them, individuals cannot affect change; and, finally, for change to be 'permanent', it requires **R**einforcement by way of recognition of the journey travelled or incentivisation (Galli, 2019).

The common denominator of each change management model is that it relies on successful communication and acceptance of the individual, team or organisation (Galli, 2018). The risks of a poorly managed change process is lower productivity, loss of valued employees, decreased moral, slow adoption, passive resistance (such as lack of commitment), active resistance (such as sabotage) and failure to change (Creasey, 2022). The change management model chosen should be fit for purpose (context) as no single model offers a 100% guarantee of success (Cameron and Green, 2019).

3.4.4 Application of change management in the context of developing a digital transformation strategy

Digital transformation (DT) has become more than just adopting the latest technology but in changing the way organisations do business as well (Greenway *et al.*, 2021). According to Cameron and Green (2019) citing Hess et al. (2016) a digital transformation strategy (DTS) requires a framework that, firstly, assesses the usefulness of new technologies; secondly, maps how digitalisation will impact the organisation's 'value creation'; thirdly, evaluates the structural changes needed to the organisation to accommodate the DT and its' legacies; and, lastly, spells out the degree of financial investment and commitment required. Bonnet (2016) imagines the DT strategy slightly differently as illustrated in Figure 4 below, suggesting that business model reinvention is a radical move.

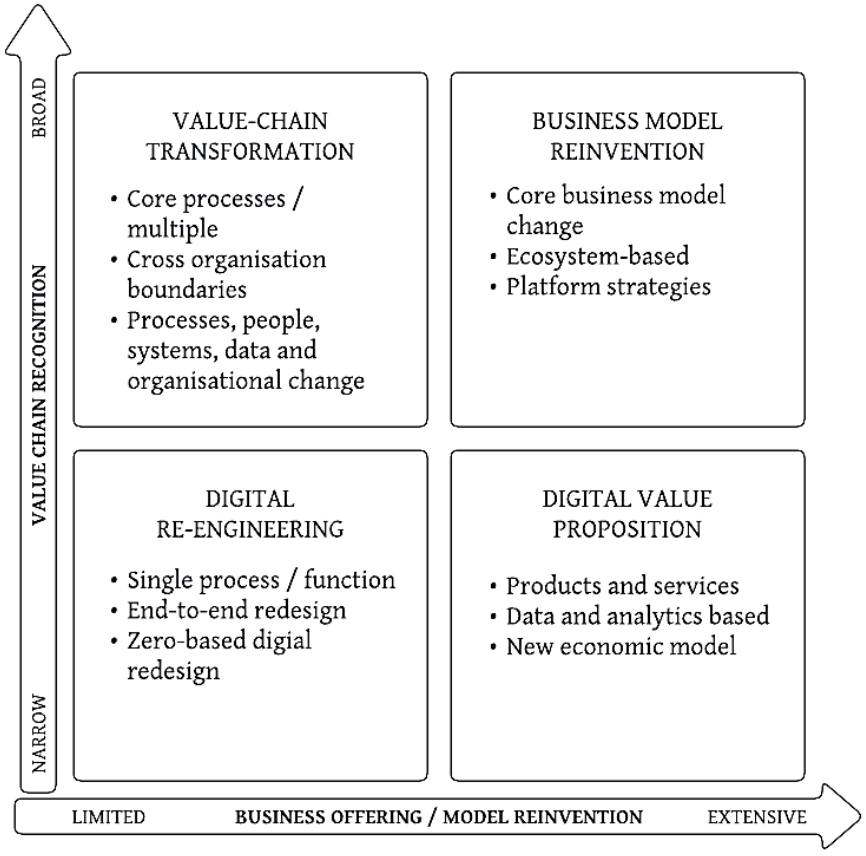

Figure 4. Mapping digital initiatives as part of Digital Transformation Strategy development.
Source: Bonnet (2016)

Ben Slimane *et al.* (2022) developed a framework model that spells out the key dimensions that need to be incorporated in a digital business strategy for small and medium enterprises (SMEs) but note its success hinges on a clear corporate vision driving the leadership level, managerial level and information technology level of a SME and application of responsive, adaptive and innovative human resource (HR) practices. Cameron and Green (2019) suggest that restructuring of an organisation as part of DT should include the revision of corporate governance to include ethics, cyber-security and sustainability issues as a matter of course. They mention the use of 'skunk works' and 'sandbox' as alternative change management tools better or specifically suited to DT. Sandboxes allow for the testing of transformative scenarios or technologies in a controlled environment (Bonnet, 2016). The Skunk Works® approach embraces the 14 rules and practices enshrined by Clarence L. 'Kelly' Johnson (Lockheed Martin, 2023) to guide a small, handpicked team of specialists, working outside of the conventional research and development environment of an organisation, to focus on disruptive innovation of organisational products and/or processes (Pratt, 2023). It is recommended that a DTS requires an analytical and consistent approach, making full-use of the 'panoply' of execution or change models available (Bonnet, 2016).

4. FINDINGS AND DISCUSSION

The literature review set out to answer four questions:

I. *Creating motivation for change*: For the BE - Why is the 4+5IR is worth not resisting?

The motivation for integration of 4IR tools and technologies could be considered compelling - the BE is intrinsically intertwined with the "fate of humanity", and as such the adoption of 4IR related digital technology is critical to avoid the digital divide widening and deepening, preventing the achievement and maintenance of the SDGs which are becoming crucial for the survival of the planet.

II. *Creating motivation for change*: For the QSP – Why are 4+5IR knowledge and skills needed by the QSP?

The infinite amount of data that can potentially be generated by each and every project and product of the construction industry through the application of digital technology is likely to generate a knowledge explosion on a scale BEPs have yet to comprehend, thus offering infinite opportunities for creative knowledge innovation, which can improve the quality of life of users of the BE.

III. *Learning new concepts*: What 4+5IR knowledge and skills are particularly needed by the QSP?

The QSP, which offers services based off data gleaned from the BE, could be enhanced and expanded through adoption of digital technology. The digital technology challenges faced by the construction industry's value-chain are likely to be overcome with more widespread and in-depth adoption of 4IR technology, however, this requires strong leadership and a willingness to embrace change to achieve digital transformation.

IV. *Learning new concepts*: How can change management theories help with the digital transformation process (4IR), concentrating on human-centric, sustainable and resilient nuances (5IR), in formulating a digital transformation strategy?

The science of change management resonates with the problem-solving skill set which is core to the QSP whose members are trained to deal with uncertainty where it manifests along the construction value-chain. This creates a win-win scenario – in exchange for learning new concepts and applying the systematic approaches advocated by the change management discipline, the QSP can overcome the fear of change and introduce digital transformation into the QS workplace in a positive way.

Figure 5 below offers a roadmap summarising the use of change management principles to action digital transformation in a QS organisation.

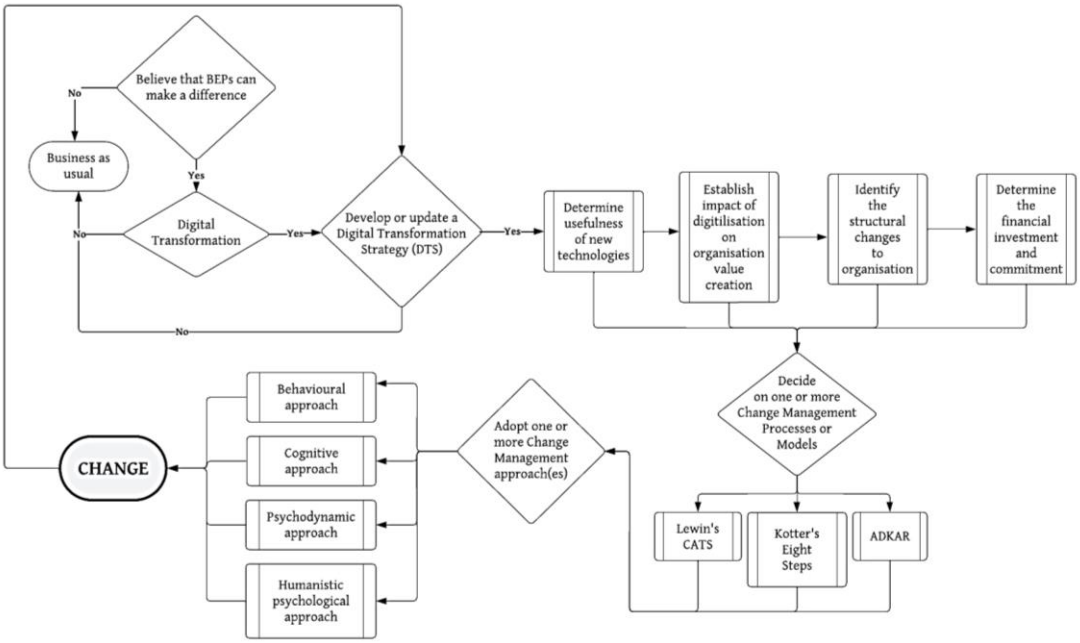

Figure 5. Proposed roadmap summarising the use of change management principles to action digital transformation.
Source: Authors.

5. CONCLUSION AND RECOMMENDATION

"Revolutionary change is a phenomenon that can occur suddenly, but requires time, commitment and patience to endure" (Meyerson, 2011: 9).

The QSP are said to be the profession in the BE that could benefit the most from digital transformation, which could be considered as a key motivation for change, and as such QSs could become the change agents responsible for orchestrating the adoption of 4+5IR in the construction value-chain. The incremental evolution towards adoption of digital technology in the delivery of QS services requires a digital transformation strategy. Using the pragmatic approaches advocated by change management theory, individual QSs, QS practices and the QSP benefit as they tailor a digital transformation strategy based on scientific principles to suit each unique scenario.

The QSP should therefore agitate for the responsible adoption and promotion of 4IR digital technology that is human-centric, sustainable and resilient, using multiple platforms – within the profession, among the BEP fraternity and private and public client entities. Associations, institutions and organisations responsible for the promotion of the profession, governance of QSP education and development could offer master classes in change management. HEIs could, through empirical research, develop a bespoke conceptual framework that could assist the QS fraternity in the application of change management while engaged in the 4+5IR digital transformation adventure.

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