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Proposal for chapter 3: Technology driven organizations and governance mechanisms

Title: Digital technology to enhance project leadership practice – the case of civil construction

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Digital transformation is fundamentally influencing all aspects of business and society. It can enable individuals and organisations to transcend from one way of working to another. In construction, emphasis is shifting from project management to project leadership, as professionals need assisting tools to not only aid in managing tasks and activities, but to aid in leading people. As such, the adoption of digital technologies may hold the key in taking project leadership practice into the future. To date, there have been few attempts to explore the potential of digital technology as an aid for project leadership development and practice. This research therefore aims to investigate this potential in the context of the Australian civil construction industry. We review the existing body of knowledge on both industry-specific leadership demands and relevant digital technology capabilities to identify areas of improvement and to guide interviews with construction project managers. So far, literature has focused on endorsing particular leadership behaviours and/or styles, whilst ignoring the difficulties faced by professionals in practicing these behaviours. We find that project managers of civil contractors within Sydney understand the significance of leadership, but are often overwhelmed by its complexity. They demonstrate a strong willingness to adopt digital technologies as assisting mechanisms for leadership. Participants also lament on leadership challenges relating to project scope, industry attitudes and culture, level of authority, leadership habits/behavior, communication and team development. All of which are identified as areas in which the implementation of digital technologies can make significant contributions to improve leadership practice.

1. Introduction

In business, the last few decades have belonged to a certain type of character or worker. A manager who initiates, plans, executes, monitors and controls. These people may be seen as reactive “firefighters”, who put out flames, focus on completing tasks and respond to unfolding events (Barber & Warn 2005). However, the future belongs to a very different kind of person, with a different kind of mind. Leaders, who are “creators, empathizers, pattern recognizers, and meaning makers” (Pink 2006). These people are proactive “firelighters”, who create change, envision the future and evoke passion (Barber & Warn 2005). And as the complexities of organizational projects become more volatile, the demands for these characters heightens. As such management now also implies leadership.

Leadership however, is conventionally associated with organizations, not projects (Cavaleri & Reed 2008). Its theories and respective characteristics are rooted from the context of permanent organizations (Tyssen et al 2014). These lasting forms of organizing facilitate a sense of autonomy and unbounded freedom that may enable leaders to imagine alternative visions for the future (Cavaleri & Reed 2008). Yet, projects do not have the same magnitude of autonomy. A project environment of limited and predefined duration creates a sense of short-term orientation and hampers the development of deeper social relations such as trust and camaraderie (Tyssen et al. 2014). Additionally, a project evokes focus towards the management of daily objectives and immediate achievements, thus inhibiting actions of leadership and long-term vision (Toor & Ofori 2008). Each project is unique and conditions for team selection and motivation are often far from ideal (Anantatmula 2010). At times, project members are engaged in more than one project, causing additional burdens on focus and commitment (Anantatmula 2010). Because of this, role ambiguity becomes an issue as well as the uncertainty of allocated control (Zhang & Fan 2013).

Therefore, the role of a ‘project leader’ is significantly different to that of an ‘organizational leader’. Leading an organization allows for freedom, whereas leading a project, involves fulfilling a ‘promise’ to a customer, ultimately constricting a leader to operate within the confines of such promise (Cavaleri & Reed 2008). In this sense, a project leader is one who practices leadership within predetermined parameters. This makes the role of a project leader a rare commodity that is valued now more than ever before. So far, literature has focused on endorsing particular leadership behaviours and styles, whilst ignoring the difficulties faced by professionals in practicing these behaviours.

This study will explore digital transformation as a mechanism to facilitate leadership development using the case of the Australian civil construction industry. The focus is to shift the emphasis of digital advancements towards the social phenomenon of leadership. Digital technology alters the way people communicate, interact and relate to one another (Nagy & Koles 2014). To neglect its potential to enhance project leadership development may be a substantial oversight in the evolution of leadership practice. To date, there have been few attempts to explore digital technology as project leadership technology, particularly within an industry such as construction, in dire need of support to elevate project managers into project leaders.

This chapter aims to explore the potential for digital technology to enhance project leadership practice in construction projects. To investigate this potential, we will shed light on the following questions:

1. What are current leadership demands in construction?
2. What are current digital technological capabilities relevant to construction?
3. What challenges are construction professionals facing in meeting the leadership demands?

4. What is the feasibility of digital technology assisting professionals in overcoming these challenges?

The methodology employed to answer these questions involves a literature review coupled with a case example from the Australian civil construction industry (see Figure 1).

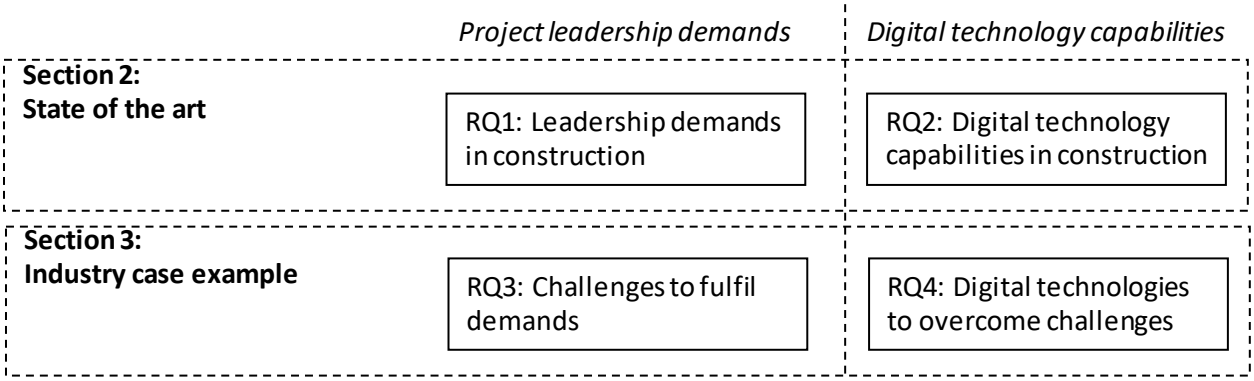

Figure 1: Research design overview

2. Leadership demands and technological capabilities in construction

In the following section, we provide an academic assessment of the existing body of knowledge regarding leadership demands in the construction industry as well as capabilities of new digital technologies relevant for the construction sector. The focus is to discover important insights that can be used to guide and facilitate the investigation into the industry case example. In reviewing existing literature on those topics, the criteria listed in Table 1 have been established to ensure that relevancy and validity is maintained throughout the study.

Source	The source is attainable in digital form.
Content	Content principally focuses on leadership and/or technology.
Keywords	Search is conducted using a combination of relevant words that depict leadership/technology (including plural or connotative equivalents)
Context	Sources are published within an international journal in the domain of construction, engineering, project management and the built environment.
Reliability	The source is academic/scholarly.
Relevancy	The source is published English language within the date range specified; • RQ1 sources published within the last 10 years (from 2007 onwards) • RQ2 sources published within the last 3 years (from 2014 onwards)

Table 1: Overview of literature review

Leadership demands in construction

Leadership challenges are amplified within the construction sector, an industry that will spend US$97.7 trillion globally in the next decade and account for 13.2% of world GDP by 2020 (Richardson 2017). Construction projects are often large, multi-disciplinary and time-limited undertakings that exacerbate coordination and communication, as well as impose a great degree of uniqueness in setup, activities and content (Tyssen et al. 2014). Yet without tangible support, education and/or training, project managers are expected to “select, equip, train and influence” followers with diverse gifts, abilities and skills whilst

operating within predefined parameters of time, budget and scope (Ameh & Odusami 2013). The industry is suffering from a leadership crisis. Not from the professionals themselves, but from the disparity between the demands in project leadership and the investment and research in leadership development and training (Toor & Ofori 2008). There is too much focus on the outcomes of leadership in neglect of the means in delivering these outcomes. Therefore, project managers need assisting tools and mechanisms that can balance the playing field and enable them to maximise their project leadership potential. As Khan et al. (2015) claim, 80% of project failures are a result of poor project leadership or lack of project leadership skills. With management and technical competency alone no longer sufficient for project success (Schuhmann 2010). The following results highlight the variety of leadership demands relevant to the construction industry.

A U. S. case study conducted by Cavaleri and Reed (2008), utilizes Seivert's five elements model to present a leadership strategy for improving project performance. The model constitutes of "Essence" (defining purpose and values), "Air" (planning, analyzing and envisioning new possibilities), "Fire" (motivation and passion), "Water" (team building, loyalty, collegiality and camaraderie) and "Earth" (structure and policies). The expectation is that the project leader must be sensitive to the needs facing the team at the time and find a balance between the five elements. In teams in which the leader places emphasis on "Air" and "Fire" in neglect of "Water" and "Earth", projects are seen to fall behind, because important details that are necessary for execution are ignored. In a similar vein, when a project leader focuses on "Fire", "Water" and "Earth", whilst overlooking "Essence" and "Air", teams are likely to veer off in a direction that is misaligned with the project mission and objective.

Similarly, a study conducted by Patterson (2010), uses a case study of the Oresund Bridge construction (linking the cities of Copenhagen, Denmark and Sweden) to present a 5-E model of leadership. "Envision", "Engage", "Energize", "Enable" and "Execute". By envisioning, "leaders see what the future could be rather than what it is". By engaging, leaders build relationships and seek collaboration. By energizing, leaders inspire and motivate. By enabling, leaders provide the necessary resources to facilitate followers in completing objectives. And by executing, leaders combine all elements together successfully.

These elements are further emulated in a study conducted by Slattery & Sumner (2011), who utilize the Leadership Practice Inventory (LPI) developed by Kouzes & Posner (2003) to examine the most favorable leadership characteristics amongst a group of 151 high potential construction project managers. The LPI purports to measure the ability of an individual to model the way (clarify values and set the example), Inspire a shared vision (envision possibilities), challenge the process (take initiative, innovate and improve), enable others to act (foster collaboration, trust and facilitate relationships), and encourage the heart (provide emotional support).

Furthermore, surveys and structured personal interviews of 69 engineering professionals conducted by Anantatmula (2010) were used to develop a project management leadership model that consists of significant people-related leadership factors that influence project performance. These factors include: create clarity in communication, define roles and responsibilities, communicate expectations, employ consistent processes, establish trust, facilitate support and manage outcomes.

The demand for authenticity and trust is accentuated throughout literature. Toor & Ofori (2008) conduct a literature review based in Singapore to rationalize the need for Authentic Project Leadership Development (APLD) for construction project leaders. The study explores four components of authenticity; "Awareness" (trust in one's motives and cognitions), "Unbiased Processing" (refraining from

denying or distorting private knowledge), “Behavior” (acting in accord with one’s values), and “Relational Orientation” (openness and truthfulness in relationships). Findings from this study argue that authentic leaders must know themselves, define their values, understand their motivations, build their support team, and “stay grounded by integrating all aspects of their life”. Authenticity demands positive energy, integrity, moral character, self-discipline, optimism, resilience, clear purpose, concern for others and personal values.

As articulated by Kappagomtula (2017), without trust, leadership cannot function. Using investigative surveys of 36 experts in leadership across China and India, Kappagomtula models an analogy of a leadership “wheel” which must be maintained within cross-cultural and multicultural project teams. The model stipulates that the hub of the steering wheel is “Trust”. The spokes of the wheel are “Loyalty”, “Communication”, “Integrity”, “Competency” and “Consistency”. The wheel itself represents “Culture”, and the lubricant for the wheel is “Conflict Management”. The emphasis of this analogy is the need for the leader to understand its components (the hub and spokes), maintain its integrity (lubricant) and steer the project team towards the destination of the drive. However, the leader must also learn when to let go of the “wheel” and surrender control.

This notion is also explored by Clarke (2012) who develops a theoretical understanding of shared leadership within projects. He argues that no individual performs all leadership functions, but rather members of the team collectively contribute to the leadership system. Therefore, a leader must focus on enriching established connections between team members and developing new connections to create a cohesive system in which leadership is distributed across all members.

Multiple studies have identified the need for project leaders to embody different leadership styles based on the varying stages of construction projects. Arain (2012) uses pilot questionnaires and interviews of 78 project management professionals working on the Suvarnabhumi Airport (the largest construction project in Thai construction history) to develop a Quadrilateral Model of project leadership. The model focuses on a leader’s ability to balance between four key leadership styles: “Coaching” (aligning goals and facilitating interaction amongst a team), “Connecting” (listening, empathizing, engaging and revering), “Controlling” (implementing rules) and “Charismatic” (supporting, inspiring and selling a vision). The research posits that leaders need variations in their leadership styles, at different stages of the project, until a balance between personal values, concerns for tasks and concern for people is maintained.

This concept is also explored in interviews across three Sri-Lankan construction projects conducted by Senaratne & Samaraweera (2015). This empirical study highlights the four stages of team development within projects: “Forming”, “Storming”, “Norming” and “Performing”. The authors posit that a construction project manager should employ different leadership roles based on the needs and behaviours of the team members of each stage. For example, a leader should break down interpersonal barriers and establish team goals in the forming stages, but should only intervene where necessary in the performing stage.

This demand of leadership style adaptability is further reinforced by Oke’s (2010) Multifactor Leadership Questionnaire (MLQ) of 57 Nigerian construction professionals. Findings from this study demonstrate that construction project leaders should possess the ability to adapt different leadership styles depending on the situation at hand. Leaders should embody a relations-oriented style at the beginning of a project, whilst adopting a much more task-oriented style during the closing of the project.

Leadership demands have also focused on the need for positive psychology and emotional intelligence amongst construction professionals. Berg & Karlsen (2014) conduct in-depth interviews with three experienced project managers to accentuate the need to encourage and develop positive emotions amongst followers. The study reveals how "Positive Meaning" (creating something), "Positive Emotions" (humour and optimism), "Positive Relations" (collaboration) and "Signature Strengths" (emotional intelligence) can create positive results within a project. These emotional elements play a major role in the development and trajectory of relationships within project settings (Pryke et al. 2015).

In a study, conducted by Pryke et al. 2015, which uses surveys and live observations of 68 construction professionals, leaders are described as "managers of group emotions". Findings in this study demonstrate a clear correlation between emotional intelligence and project performance, and further suggest that "Emotional Sensitivity" (ability to sense and interpret the non-verbal messages of others) and "Emotional Expressiveness" (ability to express emotions) are fundamental ingredients for "leader-follower chemistry". The expectation is that a leader should create a harmonious, smooth and in-tune connection between members of the team through emotional exchange and interaction.

Zhang & Fan (2013), further lament on emotional intelligence as a leadership requirement in their questionnaire-based survey covering 112 Chinese project managers. They find that characteristics of "Self-awareness", "Self-confidence", "Self-control", "Empathy", "Positivity" and "Cultural understanding" are key ingredients for project performance.

This is again emphasised by Galvin et al. 2014, who survey 38 project managers to define leadership competencies of "Emotional Resilience", "Intuitiveness", "Interpersonal Sensitivity", "Motivation" and "Conscientiousness". The study further postulates that an effective project leader must possess varying levels of sensitivity to political, technical and emotional elements of a project.

This is supported by Muller & Turner (2010), who use a web-based "Leadership Dimensions Questionnaire" on 400 project managers around the world to emphasise the need for project leaders to not only develop "Emotional Intelligence", but to balance between "Emotional", "Managerial" and "Intellectual Competencies".

Researchers have even attempted to appropriate religious teachings into necessary spiritual demands of leadership. Yngvasona et al. (2013) review the four gospels of the Bible to propose how project leaders can enhance their own practices by embracing the teachings of Jesus. The study proposes that Jesus utilized leadership tactics that enabled him to create a sense of purpose for a small number of followers, that eventuated into a way of life for billions. The authors assume that like a project, the initial goal of spreading "the good news" was a planned endeavour, in which Jesus demonstrated transformational characteristics that included; "Individualised Consideration" (attentiveness to followers needs), "Intellectual Stimulation", "Inspirational Motivation", and "Idealized Influence" (a role model for ethical behavior).

Similarly, in a case study of 8 Hungarian construction companies conducted by Lazanyi & Doka (2015), it is suggested that teachings from the Old Testament provide clues on leadership behaviour. Leaders should be worthy, righteous men, who refrain from covetousness.

This is further explored from an Islamic perspective by Senam et al. 2014, who review the Quran to highlight the need for authentic, servant and ethical leadership practices amongst construction

professionals. The study unearths spiritual and moral values of leadership and emphasises the need for leaders to carry out leadership activities with minimal waste or destruction, and the upmost of ethical integrity.

Table 2 summarizes the demands identified in the above empirical studies of leadership relevant to the construction industry and groups them into three focus groups.

Source / ***Leadership demand***	*Cavaleri & Reed 2007*	*Patterson 2010*	*Slattery & Sumner 2011*	*Anantatmula 2010*	*Toor & Ofori 2008*	*Kappagomtula 2017*	*Clarke 2012*	*Arain 2012*	*Senaratne & Samaraweera 2015*	*Oke 2010*	*Berg & Karlsen 2014*	*Pryke et al. 2015*	*Zhang & Fan 2013*	*Galvin et al. 2014*	*Muller & Turner 2010*	*Yngvasona et al. 2013*	*Lazanyi & Doka 2015*	*Senam et al. 2014*
Team focus																		
Empower relationships	●	●	●		●		●		●	●	●	●						
Enable effect. communicat.				●		●		●										
Establish trust & loyality			●	●	●	●							●					
Provide emotional support			●					●			●	●	●		●	●		
Align team's goals							●	●	●									
Leader focus																		
Envision new possibilities	●	●	●					●			●					●		
Give control to team							●		●									
Lead by example	●	●	●			●		●			●	●	●			●	●	●
Manage conflicts						●												
Balance all demands	●	●				●		●							●			
Project focus																		
Define work struct. & policy				●				●		●								
Define purpose and values	●		●		●			●										
Communicate expectations				●														
Provide necessary resources		●		●														
Adapt style to project phase								●		●								

Table 2: Overview of key leadership demands in construction

Digital technology capabilities relevant to construction

Digital transformation is the "application of digital technologies to fundamentally impact all aspects of business and society" (Gruman 2016). The digital component involves technology, whilst the transformation component involves people (Del Rowe 2017). It can enable individuals and organizations to transcend from one way of working to another.

This section focuses on reviewing the technological opportunities relevant to the construction industry. It provides a non-exhaustive list of technology examples, current and future trends of digital technology and their capabilities and application potentials for the construction industry.

Smart Phones

Smart Phones serve as the hubs of interconnectivity (Musheer & Sheeraz 2014). They allow for knowledge sharing and exchange, as well as collaboration through a plethora of functionalities and applications. Smartphones can be used as a single mode of analysis for digital technology such as; Augmented Reality (AR), to aid learning, understanding and remote collaboration (Joan 2015), Computer Aided Design (CAD), to clarify important design details (Moreno 2014), Near-Field-Communication (NFC), to track and monitor construction worker health and safety (Akhavian & Behzadan 2016), and Credential Verification Services (CVS), to monitor employee training records and renewals. Smartphones are an extension of their users, and with the many applications that can be integrated within these devices, they act as a remote for digital transformation (Azhar et al. 2015).

Wearable Technology

Wearable technology (or 'wearables') describes the integration of smart electronics within items that may be worn or implanted (Wright & Keith 2014). Smart glasses for example incorporate an optical display that can advance information exchange at construction sites (Mon & Seo 2015). In a split second, electronic documents, video and images can be shared, saved and retrieved (Heembrock 2015). Allowing construction professionals to be freed from the burden of holding paper documents, such as drawings and specifications (Moon & Seo 2015). Wearable wristbands that measure sleep patterns and circadian rhythm can aid in managing unsafe working conditions by identifying fatigue, illness and other physical risk factors (Cullen 2016). These functions can also be extended to mental health and wellbeing, by reminding construction professionals to stretch, hydrate and replenish (Heembrock 2015). With the integration of woven sensors, wearable clothing can inform workers if they are exceeding lifting thresholds, have been overexposed to UV rays or are at risk of a slip and fall incident (Heembrock 2015). Self-charging shoes that detect temperature and track location and motion can also ensure worker wellbeing is maintained when working alone (Linder 2017). With the variety of sensors that can be integrated within clothing or accessories, leaders can understand the wellbeing of their team and advance their role in improving health and safety within construction projects (Linder 2017).

Drones

Drones function as aerial imaging vehicles that can transcend data collection capabilities within construction projects. They allow for site progression and operations to be accurately tracked and reported (Dillow 2016). And can enhance efficiency with site surveys, photography and mapping. With sensory features integrated, drones can turn data into 3D structural models, topographical maps and volumetric measurements (Dillow 2016). Which can translate to enhanced productivity, safety, quality and security within projects. Additionally, "Smart Drones" possess the capability of recognising objects and can incorporate a "sense-and-avoid-system" to self-monitor project operations (Hambling 2015). These aerial capabilities add a greater dimension to project tracking and can allow project leaders to effectively communicate, mitigate potential issues, reduce costs and limit delays (Dillow 2016).

Virtual Reality, Augmented Reality and Mixed Reality

Advanced visualization technologies can impact upon the way groups and individuals collaborate, communicate and engage (Phelps 2014). Augmented Reality (AR) overlays the visible natural world with

a layer of digital content, whilst Mixed Reality (MR) integrates virtual objects into the natural world (Heiskanen 2016). These capabilities for digital content to interact with the real world, enable new possibilities for safety, planning, quality and management (Heiskanen 2016). AR used through smart glasses can enable for a digitally enhanced view of the world that can facilitate the learning and awareness for student and professional development in construction (Kivrak et al. 2014, Musheer & Sheeraz 2014). For example, the DAQRI Smart Helmet creates an intuitive experience as it connects users to the work environment and provides relevant information instantaneously (Heiskanen 2016). Additionally, holographic technology such as Microsoft Hololens, can allow remote teams to experience the spatial presence of the design model, collaborate, and share information instantaneously over three-dimensional holograms (Heiskanen 2016).

Virtual Reality (VR) however creates a completely simulated environment (Sampaio et al 2014). And can allow for four-dimensional viewing and interaction with all stages of the construction process. Project team members can therefore optimise planning and design and create an interactive environment for construction resourcing and scheduling VR can also be used to support learning and awareness for safety and risk management and develop a platform for users with limited knowledge to easily simulate the activities needed (Kassem et al. 2017). These visual capabilities can aid in prediction and decision making by allowing users to view, interact and simulate their projects throughout its life cycle (Sampaio et al. 2014).

Building Information Modelling (BIM)

BIM is a three-dimensional (3D) model-based technology process for creating and managing project information (Succar 2008). BIM will reduce the 'blind spots' of two-dimensional (2D) construction drawings (Lee et al. 2015), and facilitate for extensive stakeholder collaboration (Kim et al. 2016). It can improve resource coordination, quality control, information exchange, safety, security, decision making and reduce manual tasks (Park et al. 2016). However, its collaborative platform (Lee et al. 2015) is what can facilitate project leaders to effectively communicate in real-time amongst project stakeholders (Park et al. 2016). Furthermore, new advancements of four-dimensional (4D) BIM and five-dimensional (5D) BIM enable further improvements in areas such as design, information management and sustainability. 4D BIM incorporates time to establish links between project activities and scheduling, which enables construction professionals to conduct constructability checks before construction (Kim et al. 2016). Whereas 5D BIM incorporates costing within the model to ensure the effective management of costs throughout a project life cycle, including cost estimation and budgeting (Kim et al. 2016).

Artificial Intelligence and software

Artificial intelligence (AI) can redefine how processes are undertaken within the construction industry (Blanco et al. 2018). Collisions and inefficiencies within models such as BIM can be pre-empted, tracked and controlled (Garcia De Soto & Adey 2016). Knowledge contained in daily reports, schedules, weather forecasts, and many more, can be transformed into a living knowledge base and means of deductive and plausible conclusions (Klashanov 2016). Garcia De Soto & Adey (2016), also believe that by integrating the case-based reasoning and neural networks of AI, resource estimates and decision support can be drastically enhanced.

Emotion aware technologies possess mood tracing capabilities with the potential to track and analyse an individual's emotional state (Morsy 2016). This can enable construction professionals to keep mood journals and emotional data to understand what influences their emotion (Morsy 2016). Additionally,

authentication technology such as RFID, quick response codes, fingerprint, vein, iris and facial recognition can allow for manpower management, credential verification and access control (Chin et al. 2017).

Auto-Analytics

Auto-analytics and cognitive computing can be used to radically improve emotional intelligence and social relationships within the future construction workforce (Hansen, 2017). It is the process of intelligent logical analysis through technology, in which data is collected autonomously and used for analysis (RGA, 2013). Data can be collected through wearables such as watches, headbands and rings that can detect physiological data, such as heart rate, skin temperature and brain waves to accurately read a person's mood and provide real-time data to the user (ABI Research, 2017)

3. The case of Australian civil construction

Construction has become one of the most important industries in Australia (Leviakangas et al. 2017), and by 2020, Australia will become one of seven key countries that will account for 65% of the growth in global construction (Richardson 2017). Using the case of a Sydney-based contract civil engineering firm specialized in design and asset management of transport infrastructure, land development and renewable energy projects, exploratory interviews were conducted to first unearth challenges faced by construction professionals in meeting leadership demands and expectations and then to explore the feasibility of existing digital technologies to assist in overcoming these challenges. The interviewees were a Senior Project Manager with 16 years' experience, a Project Manager with five years' experience and a junior project manager with two years' experience.

Challenges in addressing leadership demands in civil construction projects

Interviewees expressed the significance of project leadership and its importance for the wellbeing of construction projects. They considered leadership as a critical component of their role and when asked whether they perceive themselves as a leader, one interviewee proclaimed "only because I have to be". Leading was considered as a way of being "consistent" and not allowing life experiences to interfere with project team experiences. The more junior respondents emphasised their thoughts on how leadership "comes with experience". Yet, the senior respondent, did not entirely feel he had gained project leadership mastery or even gained a superior grasp of project leadership behaviour. Rather, this respondent felt it was an ongoing challenge of his role.

The following sections outline the key challenges extracted from the interviews. They were clustered around the previously identified focus areas of leadership demands "team focus", "leader focus" and "project focus" (see Table 2).

Challenges relating to the team focus

Respondents emphasized the necessity of cohesion and its importance to project success, highlighting that a difficult project with a "good team" can be successful, yet an easy project with a "poor team" may perform terribly. Interviewees felt that the difficulty in maintaining cohesion stemmed from the constant "chopping and changing" of project team personnel, which made it difficult to align team goals. Respondents also felt that leadership elements of team chemistry and cohesion, were dependent upon 'the people'. As described, there are "different people" and "no one's good, no one's bad". It's all about "who they are, where they came from, and what their strengths and weaknesses are". This creates difficulties in dealing with the different types of personas, and aligning the way they operate with each

other, with the best interests of the project. However, difficulties associated with cohesion were often related to difficulties associated with lack of control. With one respondent suggesting that “you don’t necessarily build the team, you get given the team”.

Respondents felt that the key challenges associated with communication arose from the need to communicate differently, with different types of people, and in different types of situations. As one respondent proclaimed; “it’s not always rainbows and unicorns”, at times you can “hurt people’s feelings”. This was further reinforced as interviewees lamented challenges with communicating with team members in the ways they expect to (or would like to) receive information. Getting the desired outcome from communicating was also seen as a pressing difficulty. With one respondent pointing out the difference in communicating, and “communicating effectively”. “It’s easy to tell someone to dig a hole, but it’s more difficult to convince someone why they should be digging a hole”. The challenge in communication is convincing people the reasoning behind what they are doing and “how it impacts the bigger picture”.

Challenges relating to leader focus

Respondents felt a key challenge in leadership awareness, was in understanding people and how they operate. They believed that understanding which leadership style to adopt “takes up so much of your time” and if you get it wrong, “it can come back and bite you”. Another interviewee raised the issue of proactivity, and the difficulty in being proactive in an environment that often imposes reactivity. Getting appropriate feedback was also deemed challenging as respondents felt they could never really judge how others perceived them or their practices. Furthermore, respondents felt that maintaining a consistent persona was a challenging feat, as personal issues could change their behaviours and often result in poor leadership practice that could have ‘spill-over’ effects throughout the project. Respondents articulated that; “when you are at home, you are not always expected to be consistent with your leadership”. But at work, leadership is a full-time commitment, and regardless of your situation, you still must be “calm”, give “direction” and be able to “think” clearly.

Interviewees revealed the notion of fluctuating control. They felt that at times there were inconsistencies with regards to their control over and control within the project, with one junior respondent describing how it can often be confusing “who is in charge”. The more senior interviewee emphasised; how the lack of control can be “frustrating at times” and how “you just need to manage” working within the limits of your authority. Whereas, the junior project manager articulated the notion of leading “upwards”. Describing how leading also incorporates leading “your bosses” and the difficulties that arise when “convincing them to do things that you need”. This respondent felt that you could only lead as much as you could, and ultimately the final “decision can be out of your hands”.

Challenges relating to project focus

Respondents believed that operating as a leader within the civil construction industry was much more difficult than it would be in any other industry. One respondent highlighted the construction industry’s culture of “resistance”. He felt that there was a constant “resistance to change and resistance to do things differently” within the sector. Respondents also felt that there was a culture of “responsibility avoidance”, in which industry professionals would constantly disassociate themselves from any levels of ownership or autonomy. Thus, making it much more difficult to lead, as individuals would often refuse to take ownership of their work. One respondent also touched on the topic of health and safety appreciation and

described how the civil construction industry is not “mature enough”. This respondent felt that leading a safer environment was difficult due to the resistance from workers in which they perceive health and wellbeing initiatives “as making their job harder”.

The overall consensus was that a project can significantly dictate leadership behaviour. Respondents highlighted that the project setting meant that they were forced to “assess people quickly” and make “on the spot” decisions and judgements. They felt short projects imposed “minimal time up-front” to plan and implement leadership structure. Therefore, lamenting on “time” as an influential factor in leadership practice. There were many leadership activities wanted to adopt but felt they were unable to do so due to time and budget constraints. The emphasis from respondents was they were not afforded the freedom to properly indulge in leadership practice, but given the time, they would have the opportunity to lead.

Table 3 summarizes the identified key challenges to meet leadership demands.

Challenges relating to	
Team focus	• Effectively communicating in ways people expect to, or would like to receive information • Convincing members the reasoning behind what they are doing and how it impacts the bigger picture • Communicating differently, with different types of people, and in different types of situations • Constant changing of project team members • Understanding differences in styles, strengths and weaknesses • Difficulties with influencing the team you are given
Leader focus	• Understanding people and how they operate • Getting appropriate feedback • Pressures of maintaining consistency with leadership, even in times of difficult personal circumstances • Limits of authority • Final decisions are at times out of your control • Fluctuating levels of control can make authority ambiguous
Project focus	• Resistance of construction professionals to change • Responsibility avoidance amongst construction professionals • Lack of worker appreciation for health and wellbeing • Planning and thinking ahead with project time constraints • Budget doesn’t allow for major leadership implementation • Project environment means you need to assess people very quickly

Table 3: Overview of challenges to meet leadership demands

Potential for digital technology to address the leadership challenges

In the second part of the exploratory interviews, the previous results were used to discuss how the capabilities of digital technologies could help overcome leadership challenges in the construction industry.

Respondents were able to articulate general, and often vague methods they used in dealing with leadership challenges, ranging from “being consistent”, to separating “work life from personal life”. In short, the consensus was that “you just have to deal with it” as it comes. However, the junior respondent did suggest the use of the smartphone application “FaceTime” as a remedy to some communication

difficulties faced. According to this interviewee, the lack of face-to-face communications was prominent in his position and made it difficult for him to effectively communicate. Therefore, the use of FaceTime allowed him to overcome these challenges and “bridge the gap” between less meaningful and meaningful communications. Respondents also felt that effectively communicating goals to all significant stakeholders could allow leaders to gain more authority within their positions. Furthermore, respondents believed that a great project leader could expand the objectives of the project itself beyond time, budget and quality, to involve "building" a "team" to 'higher levels" of achievement in which everyone has "learnt", "grown" and "gained something".

Although the senior respondent was somewhat sceptical, the two more junior respondents could see immediate potential for digital technology to enhance leadership practice in some areas. One respondent made immediate connections with visual technologies, such as augmented reality, artificial reality, holographic display, as well as 3D, 4D and 5D BIM. He felt that these technologies would allow leaders to “sell the story” and help explain the reasoning behind objectives and goals. Moreover, this respondent felt that these technologies would be beneficial for leadership to “be able to show someone rather than tell them”. “Having the capability of showing someone, having them see exactly what you are talking about, would help to sell that story”. Respondents also felt that if the capabilities of auto-analytics were available, they would “use it tomorrow”. The respondents were particularly excited about the capabilities to gauge factors like mood, sleep, physical and mental performance, as well as to provide real-time feedback on positive and negative words used in conversion, thus enhancing their leadership behaviour. Furthermore, respondents believed that wearable technologies could assist with health and safety and would aid in a leader’s responsibility to maintain workplace wellbeing and a positive environment. Respondents felt that utilising wearables to build a cohesive team could influence the organisational culture, in which other organisations would “try to replicate” and “learn” from them, thus changing cultural perspectives within the industry.

However, all respondents argued that it would take more than technology to have an influence on the challenges outlined, and although they may assist with providing information, it would be up to the leader to use this information accordingly.

Table 4 outlines the key capabilities of digital technologies to assist with overcoming leadership challenges.

Technology	*Capability*	*TF*	*LF*	*PF*
Smart Phones	Can allow leaders to have a single mode of analysis for the project team, the project and themselves.	●	●	●
Wearables	Can allow leaders to maintain health and wellbeing of workers and positively influence organisational culture.	●		●
Drones	Can allow leaders to better track & report progress to team members, keeping them constantly informed and aware of their influence.	●	●	●
AR, VR & BIM	Can allow leaders to ‘show’ rather than ‘tell’, making it easier to ‘sell’ the project story.		●	
Auto-Analytics	Can allow leaders to understand themselves and their interactions with others.		●	

Table 4: Digital technologies to assist with leadership challenges
(TF=team focus; LF=leader focus; PF=project focus)

4. Discussion and outlook

Digital transformation is fundamentally influencing all aspects of business and society. It can enable individuals and organizations to transcend from one way of working to another. In construction, emphasis is shifting from project management to project leadership, as professionals need assisting tools to not only aid in managing tasks and activities, but to aid in leading people.

Using the example of the Australian civil construction industry, we reviewed the existing body of knowledge on both industry-specific leadership demands and relevant digital technology capabilities to identify areas of improvement and to guide interviews with construction project managers. Findings indicate that digital technologies will have a positive influence on project leadership challenges. We find that project managers of civil contractors within Sydney understand the significance of leadership, but are often overwhelmed by its complexity. They demonstrate a willingness to adopt digital technologies as assisting mechanisms for leadership. Participants also lament on leadership challenges relating to project scope, industry attitudes and culture, level of authority, leadership habits/behavior, communication and team development. Construction professionals demonstrated specific examples in which they could utilize certain technologies to address challenges in their leadership practice.

Digital technologies can act as the catalyst that disrupts the behavior of a project team, which ultimately influences the environment in which the team operates. The input of digital technology within the leadership system can therefore transform leadership challenges into opportunities. As such, the adoption of digital technologies may hold the key in taking project leadership practice into the future. This chapter aims at opening up a discussion about exploring areas in which disruptive technologies can be used to create benefits beyond their primary technical applications.

5. References

ABI Research. (2017, December). *Wearable Data Analytics Bring Humans into the IoT*. Retrieved from ABI Research: https://www.abiresearch.com/press/wearable-data-analytics-bring-humans-iot/

Ahmed, M., & Ahmend, S. (2014). Transformation of smart phone to super phone: a future oriented gadget. *Pranjana, 17*(2), 1.

Akhavian, R., & Behzadan, A. (2016). Smartphone-based construction workers' activity recognition and classification. *Automation in Construction, 71*(1), 198-209.

Ameh, 0., & Odusami, K. (2014). The leadership profile of Nigerian construction project managers. *Scientia Iranica: Transactions A Civil Engineering, 21*(4), 1241-1248.

Anantatmula, V. S. (2010). Project manager leadership role in improving project performance. *Engineering Management Journal, 22*(1), 13-22.

Arain, F. M. (2012). The quadrilateral model of leadership: Findings from a study on a mega project. *International Journal of Construction Project Management, 4*(2), 125.

Azhar, S., Jackson, A., & Sattineni, A. (2015). Construction apps: a critical review and analysis. *ISARC. Proceedings of the International Symposium on Automation and Robotics in Construction, 32*, 1.

Barber, E., & Warn, J. (2005). Leadership in project management: from firefighter to firelighter. *Management Decision, 7*(8), 1032-1039.

Blanco, J., Fuchs, S., Parsons, M., & Ribeirinho, M. (2018, April). *Artificial intelligence: Construction technology's next frontier*. Retrieved from McKinsey & Company: https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/artificial-intelligence-construction-technologys-next-frontier

Cavaleri, S., & Reed, F. (2008). Leading dynamically complex projects. *International Journal of Managing Projects in Business, 1*(1), 71-87.

Chin, S., Kim, I., & Choi, C. (2017). What Authentication Technology Should Be Chosen for Construction Manpower Management? *Procedia Engineering, 196*, 309-314.

Clarke, N. (2012). Shared leadership in projects: a matter of substance over style. *Team Performance Management: An International Journal , 18*(3/4), 196-209.

Cullen, G. (2016). *the role of technology in Health & Safety.* Municipal World.

de Soto, B. G., & Adey, B. T. (2016). Preliminary resource-based estimates combining artificial intelligence approaches and traditional techniques. *Procedia Engineering, 164*, 261-268.

Del Rowe, S. (2017, Septemebr 29). *Digital Transformation Needs to Happen Now* . Retrieved from Destination CRM: https://www.destinationcrm.com/Articles/ReadArticle.aspx?ArticleID=120789

Dillow, C. (2016, Septemeber 13). *The Construction Industry Is in Love with Drones*. Retrieved from Fortune: http://fortune.com/2016/09/13/commercial-drone-construction-industry/

Emil Berg, M., & Terje Karlsen, J. (2014). How project managers can encourage and develop positive emotions in project teams. *International Journal of Managing Projects in Business, 7*(3), 449-472.

Galvin, T., Gibbs, M., Sullivan, J., & Williams, C. (2014). Leadership competencies of project managers: An empirical study of emotional, intellectual, and managerial dimensions. *Journal of Economic Development, Management, IT, Finance, and Marketing, 6*(1), 35.

Hambling, D. (2015). A drone that learns. *NowScientist, 226*(3017), 20.

Hansen, S. (2017, May 25). *Analytics in the Construction Sector*. Retrieved from Sourceable: https://sourceable.net/analytics-construction-sector/

Heembrock, M. (2015). The risks of wearable tech in the workplace. *Risk Management, 62*(1), 10.

Heiskanen. (2016, July 27). *Augmented and Mixed Reality in Construction*. Retrieved from AEC Business: https://aec-business.com/augmented-mixed-reality-construction/

Joan, D. (2015). Enhancing education through mobile augmented reality. *Jorunal of Educational Technology, 11*(4), 8-14.

Kappagomtula, C. L. (2017). Overcoming challenges in leadership roles–managing large projects with multi or cross culture teams. *European Business Review, 29*(5), 572-583.

Kassem, M., Benomran, L., & Teizer, J. (2017). Virtual environments for safety learning in construction and engineering: seeking evidence and identifying gaps for future research. *Visualisation in Engineering, 5*(1), 16.

Khan, S. S. (2015). Importance of transformational leadership in project success: A theoretical framework. *Актуальні проблеми економіки, 1*, 67-76.

Kim, K. P. (2016). Investigation of readiness for 4D and 5D BIM adoption in the Australian construction industry. *Management Review: An International Journal, 11*(2), 43.

Kivrak, S. A. (2014). Implementing Augmented Reality in Construction Projects. *Applied Mechanics & Materials*.

Klashanov, F. (2016). Artificial Intelligence and Organizing Decision in Construction. *Procedia Engineering, 165*, 1016-1020.

Kouzes, J. M. (2003). *The leadership practices inventory (LPI): Participant's workbook (Vol. 47).* John Wiley & Sons.

Lazányi, K. &. (2015). LEADERSHIP PRACTICES IN THE HUNGARIAN CONSTRUCTION INDUSTRY. *Managerial Challenges of the Contemporary Society. Proceedings, 8*(2), 55.

Lee, W., Kang, S., Moh, R., Wu, R., Hsieh, H., & Shu, Z. (2014). Application of BIM coordination technology to HSR Changhua station. *Visualization in Engineering, 3*(5).

Leviäkangas, P. P. (2017). Keeping up with the pace of digitization: The case of the Australian construction industry. *Technology in Society, 50*, 33-43.

Linder, C. (2017, June). *Wearable technology could save lives and dollars in construction industry*. Retrieved from Pittsburgh Post-Gazette: http://www.post-gazette.com/business/tech-news/2017/06/12/Wearable-technology-construction-industry/stories/201706040035

Müller, R. &. (2010). Attitudes and leadership competences for project success. *Baltic Journal of Management, 5*(3), 307-329.

Moon, S., & Seo, J. (2015). Integration of Smart Glass Technology for Information Exchange at Construction Sites. *ISARC. Proceedings of the International Symposium on Automation and Robotics in Construction. 32*, p. 1. Vilnius Gediminas Technical University, Department of Construction Economics & Property.

Moreno, C. (2014, June 21). *Free CAD Software for Mobile Devices*. Retrieved from Cadalyst: http://www.cadalyst.com/cad/free-cad-software-mobile-devices-20019

Morsy, A. (2016). Emotional Matters: Innovative software brings emotional intelligence to our digital devices. *IEEE Pulse, 7*(6), 38-41.

Nagy, P., & Koles, B. (2014). The digital transformation of human identity: Towards a conceptual model of virtual identity in virtual worlds. *Convergence, 20*(3), 276-292.

Oke, A. (2010). An examination of project management leadership styles of Nigerian quantity surveyors. *Journal od Building Performance, 1*(1).

Park, J. K. (2016). Framework of automated construction-safety monitoring using cloud-enabled BIM and BLE mobile tracking sensors. *Journal of Construction Engineering and Management, 143*(2).

Patterson, J. (2010). Leadership: the project management essential. *Production and Inventory Management Journal, 46*(2), 73.

Phelps, K. (2014). “So much technology, so little talent”? Skills for harnessing technology for leadership outcomes. *Journal of Leadership Studies, 8*(2), 51-56.

Pink, D. (2006). *A whole new mind: Why right-brainers will rule the future.* Penguin.

Pryke, S. L. (2015). The effect of leader emotional intelligence on leader–follower chemistry: A study of construction project managers. *Construction Management and Economics, 33*(8), 603-624.

RGA - Reinsurance Group of America. (2013, October 31). *Auto-Analytics - Quantifying the Self*. Retrieved from RGA - Reinsurance Group of America: https://www.rgare.com/knowledge-center/media/articles/auto-analytics---quantifying-the-self#

Richardson, C. (2017). Technology offers the construction industry a brighter future. *Construction Engineering Australia, 3*(1), 16.

Sampaio, A., & Viana, L. (2014). Virtual Reality technology used as a learning tool in Civil Engineering training. *Human System Interactions (HSI), 2014 7th International Conference* (pp. 156-161). IEEE.

Schuhmann, R. (2010). Engineering Leadership Education--The Search for Definition and a Curricular Approach. *Journal of STEM Education: Innovations & Research, 11*.

Senam, M., Rashid, K., Sarkawi, A., & Zaini, R. (2014). Construction project leadership from the perspective of Islam. *International Journal of Islamic Thoughts, 6*, 46.

Senaratne, S. &. (2015). Construction project leadership across the team development process. *Built Environment Project and Asset Management, 5*(1), 69-88.

Slattery, D., & Sumner, M. (2011). Leadership characteristics of rising stars in construction project management. *International Journal of Construction Education and Research, 7*(3), 159-174.

Succar, B. (2009). Building information modelling framework: A research and delivery foundation for industry stakeholders. *Automation in Construction, 18*(3), 357-375.

Toor, S., & Ofori, G. (2008). Taking leadership research into future: A review of empirical studies and new directions for research. *Engineering, Construction and Architectural Management, 15*(4), 352-371.

Tyssen, A., Wald, A., & Spieth, P. (2014). The challenge of transactional and transformational leadership in projects. *International Journal of Project Management, 32*(3), 365-375.

Wright, R., & Keith, L. (2014). Wearable technology: If the tech fits, wear it. *Journal of Electronic Resources in Medical Libraries, 11*(4), 204-216.

Yngvason, Y. R. (2013). Jesus Christ as a Project Leader. *Procedia-Social and Behavioral Sciences, 74*, 398-407.

Zhang, L., & Fan, W. (2013). Improving performance of construction projects: A project manager's emotional intelligence approach. *Engineering, Construction and Architectural Management, 20*(2), 195-207.