TENSION BETWEEN LEADERSHIP ARCHETYPES: SYSTEMATIC REVIEW TO INFORM CONSTRUCTION RESEARCH AND PRACTICE

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ABSTRACT

In the literature on construction projects, the role of project managers in maintaining control over tasks and activities has been theorised comprehensively, placing a firm focus on vertical forms of leadership. Increasingly, construction firms are challenged with unprecedented operational uncertainty, brought about by changes to project environments, technology and labour. Similar challenges in other contexts have led to growing research on shared or horizontal approaches to leadership, which have been particularly effective in making organisations more agile in uncertain environments. Through a systematic review of 289 peer-reviewed articles on leadership in construction, this paper considers the extent to which traditional vertical approaches to leadership are supplemented with horizontal and emerging balanced approaches to leadership across six bodies of construction leadership research. It contends that despite evidence for the increasing implementation of horizontal leadership practices on construction projects, vertical leadership theory dominates construction leadership research. In comparison, there is a dearth of research addressing horizontal leadership and

scarce consideration of balanced leadership. Based on the review, stronger integration of the balanced leadership archetype in research on leadership in construction is proposed as a logical means of advancing leadership theory in relation to six research vectors.

KEYWORDS
Construction projects, project management, vertical leadership, horizontal leadership, balanced leadership, literature review

INTRODUCTION

Few other fields in organisation studies have been explored as extensively as leadership. As Northouse (2015) observes, 'leadership is a topic with universal appeal', and one that, according to Wheatley (2010), 'has intrigued us since people began organising'. Defined broadly as an 'influence process', leadership is a pervasive phenomenon that cuts to the core of both how groups operate moment-to-moment and how they survive long-term (Denis et al. 2012). By exploring how different approaches to leadership drive or constrain success, researchers have been able to promote more informed research agendas that align emerging industry needs with theory and practice.

Research on leadership in construction projects has largely mirrored major evolutions in the broader discourse on leadership (Allport 1937; Bass 1991; Carlyle 1840; Fiedler 1964; Skinner 1938). Leaders have long been regarded as a key driver of performance and are considered integral to the effective delivery of projects (Quang et al. 2015). In particular, research has focussed on the roles of key individuals such as senior executives (Biggs et al. 2013; Gu and London 2010; Toor 2011), project managers (Larsson et al. 2015; Potter et al. 2018; Tabassi et al. 2016) and foremen (Jeschke et al. 2017; Kines et al. 2010; Mitropoulos and Cupido 2009) in fulfilling a broad spectrum of functions from stakeholder engagement to on-site safety reporting in construction projects. The hierarchic decision-making control of these individuals is seen as key to delivering high quality outcomes on budget and within schedule (Larsson et al. 2015; Love et al. 2016). By establishing a clear chain of command, leaders can maintain influence over all aspects of project delivery from supply chains (Guo et al. 2017) to risk management (Karakhan and Gambatese 2017). Through a clear line of leadership, information can reach relevant decision makers up and down the line rapidly (Dubey et al. 2015). Further, the ability of these leaders to use this information to develop grander visions of how their organizations will operate more innovatively, sustainably and

ethically is seen as a long-term competitive differentiator (Chang et al. 2016; Simmons et al. 2017; Zhang et al. 2017).

With a large and rapidly growing body of leadership research, a number of perspectives have been put forward as to what the ideal leadership traits, behaviours and styles for leaders in construction are (Simmons et al. 2017). For example, Chan et al. (2014) identify transformational leadership as a desirable driver of innovation in construction leaders, noting that 'with charismatic, inspirational, intellectually stimulating, and individualized consideration leadership, a transformational leader motivates followers to achieve higher levels of performance by nurturing their personal value systems and facilitating their creative ways of thinking'. Alternately, Liu and Chan (2017) put forward contingent reward leadership as a desirable leadership style for stimulating innovation in construction, noting that 'contingent reward leadership influences innovation through inducing compliance'. Similarly contrasting perspectives can be found across every domain of construction leadership research. However, overwhelmingly existing research characterizes the fundamental nature of leadership in construction as a vertical influence process in which individuals enact leadership hierarchically over followers (Simmons et al. 2017).

Emerging challenges to construction leadership

The construction industry is undergoing significant changes that bring into question the effectiveness of this traditional vertical approach. Chief among these is the increasing social and technical complexity of projects (Yan et al. 2019).

Socially, construction projects are becoming more complex in both how firms engage and manage their workforces (Ball 2014; Pesämaa et al. 2018) and how they engage externally with clients and community stakeholders (Adapa 2018; Xavier et al. 2017). As Pesämaa et al. (2018) highlight, while traditionally construction firms have applied a routine set of processes

for coordinating projects, increasingly projects 'involve multiple temporary teams of actors adapting to diverse demands and on-site conditions' requiring new approaches to coordination centred on organizational learning and collaboration. Emerging research indicates that organizational learning and collaboration stem primarily from the horizontal diffusion of information between peers (Perra et al. 2017). With increasing environmental complexity, construction firms also face similar challenges when it comes to their external engagement with clients, regulators, partners and community stakeholders (Adapa 2018). It has been suggested that traditional vertical leadership practices are not well suited to complex and dynamic environments where firms primarily require collaboration and agility. As Xavier et al. (2017) argue, the sharing of leadership responsibility amongst teams is important if construction firms are 'to deal with the complexity of environmental issues; to integrate seemingly contradictory outlooks; to understand and address the expectations of a wide range of actors and to profoundly change organizational practices'.

From a technical perspective, the way construction projects are being delivered is also rapidly changing, leading to an overall more complex delivery ecosystem for leaders to navigate (Lines et al. 2017). With planning and delivery frameworks such as building information modelling (BIM) (Wu and Issa 2014) and integrated project delivery (IPD) (Esther Paik et al. 2017) burgeoning, the managerial competencies expected of construction leaders are expanding. Simultaneously, industry shifting innovations such as big data and site automation have put a wealth of information at the fingertips of leaders with the potential to both empower and cripple decision making (Bilal et al. 2016). As Bilal et al. (2016) describe,'facilities utilise advanced automation and integration to measure, monitor, control, and optimise building operations and maintenance. They provide adaptive, real-time control over an ever-expanding array of building activities in response to a wide range of internal and external data streams'. To an extent, these shifts have emerged in response to the tightening requirements of leading

sustainability accreditation frameworks such as Leadership in Energy and Environmental Design (LEED) (Abdallah and El-Rayes 2016) and Building Research Establishment Environmental Assessment Method (BREEAM) (Tabassi et al. 2016) that add another layer of critical thinking to the role of project leaders. Recent research is indicating that seamlessly integrating these complex computerized and human systems is beyond the competencies of most leaders and requires a degree of organic collaboration between teams beyond that currently observed in the industry (Iorio and Taylor 2015). Indeed, in the case of IPD, the sharing of leadership authority is considered absolutely neccesary for a constellation of firms, partners and stakeholders to engage concertively (Esther Paik et al. 2017).

Exploring new possibilities for construction leadership

As the construction industry forges its path into this increasingly innovative, integrated and complex world, it is important it is equipped with leadership frameworks that accurately reflect the diverse array of leadership practices implemented. In light of the above challenges, this may require revision of the dominance of vertical leadership perspectives that have underpinned research on leadership in construction until now. As Tabassi et al. (2014) note, 'the nature of the industry, changing requirements of construction works and the complexity of most of the processes in a construction organization places them beyond the control of any one individual'.

However, construction leadership research has significantly lagged behind broader leadership research in theorizing the value and impact of different forms of leadership on projects' processes and outcomes. In leadership research, the recognition that vertical leadership requires rethinking can be traced back as far as the 1950s and has led to the development of a horizontal leadership archetype in which leadership influence is mobilised collectively and non-hierarchically (Denis et al. 2012; Gibb 1954). In this rich body of

literature, horizontal leadership can take many forms, including 'emergent leadership' (Beck 1981), 'collaborative leadership' (Rosenthal 1998), 'co-leadership' (Heenan and Bennis 1999), 'collective leadership' (Denis et al. 2001), 'distributed leadership' (Gronn 2002), 'shared leadership' (Pearce and Conger 2002) and 'lateral leadership' (Day et al. 2004). While there are nuanced differences between these perspectives, they all fundamentally feature a departure from the vertical leader-follower binary that has dominated leadership research (Bolden 2011).

Overall, proponents of these approaches argue that horizontal leadership is well suited to complex and dynamic environments as it has been found to facilitate organisational agility and innovativeness more effectively than vertical leadership (Cavaleri and Reed 2008; Pearce and Sims 2002; Toegel and Jonsen 2016). For example, Kaviani et al. (2017) study horizontal leadership in relation to Six Sigma teams working on healthcare projects. Centrally, they contest that horizontal leadership should be implemented in contexts with a high degree of environmental complexity where ongoing change management is required as it improves the ability of teams to communicate, adapt and innovate. Likewise, Galli et al. (2017) design an experimental approach for identifying antecedents to horizontal leadership in engineering design teams. They argue that as organizations rally in response to volatile industry demands, horizontal leadership should be implemented as it creates ‘an atmosphere that consists of high levels of involvement, cooperation, shared understandings about team goals and purpose, and a sense of recognition’. Additionally, horizontal leadership has been demonstrated to be effective in situations where agile project management methods are employed, particular in software development (Bäcklander 2018; Dybå et al. 2014; Li et al. 2018; Moe et al. 2015; Moe et al. 2019; Xu and Shen 2018). For instance, Li et al. (2018) consider integrated software development teams employing agile project management practices and highlight how ‘shared leadership provides the opportunity for team members to utilize their expertise and identify the best solution for a problem’. Given the growing presence of agile approaches in construction

projects, it is important to consider whether the benefits demonstrated by horizontal leadership in other agile contexts are translatable (Mendez 2018; Saini et al. 2018). While it is likely that even in agile construction projects a degree of vertical leadership will continue to be required (De Marco 2018), overall, horizontal leadership literature demonstrates a wide range of benefits offered by the archetype for projects facing complex and dynamic environments increasingly found in construction (Denis et al. 2012).

Research on leadership in projects has so far said little about how vertical and horizontal leadership practices interact and what the impact of this interaction is on projects (Müller et al 2018a). A small number of researchers have started examining how horizontal leadership approaches are implemented in construction and have found that reconciling a project manager's formal leadership authority with informal leadership emerging amongst project teams can bring complex organisational tensions to the fore (Chan et al. 2014). Conflicting views on how different work teams should coordinate their work on-site may arise, inhibiting efficient interaction between experts (Lindgren and Packendorff 2011). In practice these tensions can prove detrimental to large projects, inciting relational strain, project lag, misguided outputs and resource overruns (Abdul Rahman et al. 2013; Doloi 2012; Larsson et al. 2015). This makes the need to investigate the interaction of vertical and horizontal leadership in construction evident. However, currently, construction lacks a mature agenda for researching and implementing the combination of vertical and horizontal leadership approaches (Simmons et al. 2017). Across other industries the same tension between vertical and horizontal leadership has prompted calls for a new approach to leadership based in 'patterns of practice which fuse or coalesce hierarchical and heterarchical elements of emergent activities' (Harris and Gronn 2008). In response, researchers have recently proposed a third, balanced leadership archetype, that aims to simultaneously leverage both vertical and horizontal leadership through practices which manage the tensions resulting from the

combination of multiple leadership approaches (Drouin et al. 2018; Müller et al. 2018a; Pretorius et al. 2017; Yu et al. 2018).

According to the balanced leadership approach, project managers serve as a central conduit between a pool of strategic leaders and the project team, facilitating agile decision making between senior and team-level leadership (Müller et al. 2018b). The approach sees teams progress independently through a sequence of phases where empowerment, self-management and shared mental models are used to create shared socio-cognitive space; a common mental space between teams and project managers which supports interaction between vertical and horizontal leaders (Müller et al. 2018a; Yu et al. 2018). This shared socio-cognitive space has been found to enable six key practices that encourage effective interaction between vertical and horizontal leaders: enabling consensus building, developing team competence, fostering knowledge transfer, defining a control layer, building strategic agility and enabling localized autonomy (Drouin et al. 2018; Müller et al. 2016; Yu et al. 2018). While research on balanced leadership is in its infancy with only a handful of researchers studying its applications, early findings indicate it offers a valuable lens for conceptualising and managing the integration of vertical and horizontal leadership in project-based organizations operating in complex environments (Drouin et al. 2018).

Towards a three-archetype leadership paradigm in construction

Given the potential positive impact of horizontal and balanced leadership approaches on construction projects, it is important to review how the different leadership archetypes have been discussed in construction research so far and consider their implications for future research. To achieve this, construction leadership research must be synthesized to understand first, what the key concerns of the field are, and second, how vertical, horizontal and balanced leadership have been discussed in relation to each of these concerns. In order to categorize the

literature against these three leadership approaches a classification scheme has been developed (see Table 1 below). The classification scheme considers how the archetypes differ across three key ontological dimensions of leadership as described in the integrative ontology of Drath et al. (2008). First, the scheme considers how leadership is described in each archetype. Flowing from this, the scheme then considers how leadership manifests according to each archetype. Third, the scheme considers the level/s of leadership influence once it has manifested. Finally, to aid in categorization, the scheme also sets adjectives commonly used throughout the literature to describe vertical, horizontal and balanced leadership.

Table 1. Leadership archetype classification criteria

Ontological dimension	Vertical leadership	Horizontal leadership	Balanced leadership
Leadership is described as	A process of influence between a leader and followers (Hollander 1992) The behaviour an individual adopts when he is directing a group towards a goal (Hemphill and Coons 1957) A person who attempts to influence other people towards a certain outcome (Korman 1971) A process of social influence in which an individual guides a group towards a goal (Bryman 2013)	An emergent processes of social interaction (Davis and Eisenhardt 2011) A collective group property (Paunova 2015) A group activity enacted through relationships and not individual action (Bennett and Anderson 2003) A collection of people operating in multiple influential and interdependent roles (Pearce and Conger 2002)	Individual and group/shared interaction guided by structures, processed and shared frameworks that create a shared social-cognitive space (Müller et al. 2016) An iterative approach involving five events, each outlining specific roles for vertical and horizontal leaders. The five events are: nomination, identification, selection, horizontal leadership and its governance, and transition (Müller et al. 2018)
Leadership manifests through	Great individuals (Carlyle 1840) Individuals who naturally possess a particular set of traits (Allport 1937) Individuals who exhibit particular behaviours (Skinner 1938) Individuals who are able to adapt their leadership to suit the circumstances at hand (Fiedler 1964) Individuals who can offer followers extrinsic rewards for achieving goals (Bass 1991) Individuals who can create transformation by motivating followers towards a common vision (Bass and Riggio 2006) Individuals who exemplify positive behaviour and build authentic relationships with followers (Toor and Ofori 2008)	Interaction between many individuals (Davis and Eisenhardt 2011) Diads, triads and constellations of leaders (Denis et al. 2001) Networks of mutually dependent individuals (Carson et al. 2007) Subconscious relays of influence over time (Spillane et al. 2007) Distributed functions that architect the culture of an organization (Schein 2010) The social architecture of an organization (Bolman and Deal 2017)	Vertical and horizontal leaders interacting during five events (Müller et al. 2016) Teams and key individuals who span boundaries between teams (Müller et al. 2018)
Leadership influence moves between	Individuals on different levels of a hierarchy (Ramthun and Matkin 2012)	Individuals on the same level of a hierarchy or between individuals cooperating without hierarchy (Denis et al. 2012)	Groups of individuals on the same levels of a hierarchy and between groups on different levels of the hierarchy (Müller et al. 2018)
Common adjectives include	Vertical, transactional, transformational, visionary, authentic, consultative, authoritarian, executive, individual, structured, directive, person-centred, autocratic, hierarchic	Horizontal, shared, collective, distributed, collaborative, dispersed, diffuse, lateral, non-hierarchic, emergent, organic, interactionist, team-centred, non-binary	Balanced, integrated, hybrid, socio-cognitive, mixed, multi-level, iterative, situational, recurring, generative, cyclic

To date, no study has systematically reviewed the distribution of construction leadership research across these three archetypes to set out a research agenda (Simmons et al. 2017) that can inform further research as well as industry practice. By understanding the key dimensions of construction leadership research and systematically assessing how they draw on

vertical, horizontal and balanced leadership according to the classification criteria set out above, gaps in construction leadership theory can be identified and compiled into a robust research agenda. Such a research agenda can guide future research on leadership in construction towards extending existing frameworks and models to better align leadership research with different contexts and changing requirements of work. In addition, with this agenda, further research can support practitioners in facing emerging challenges, such as increasing pressure for programmatic engagement of stakeholders (Adapa 2018; Yan et al. 2019) or the need to rapidly share cutting-edge technical knowledge across teams (Ni et al. 2018; Zhang et al. 2018c). This could help practitioners better address the ever-increasing social and technical complexity of leading construction projects.

With this research objective in mind, this review will first set out its three-stage systematic review methodology. Next, results from the bibliometric analysis will be presented, identifying key clusters of leadership research in construction, before these clusters will be synthesized into a robust research agenda. Finally, the implications of this research agenda for construction leadership theory and practice will be discussed before limitations of the study are flagged and directions for future research highlighted.

METHODOLOGY

To offer as thorough, objective and meaningful a review of construction leadership literature as possible, this paper adheres to a three-stage systematic review methodology (Randhawa et al. 2016). Overall, the systematic review synthesizes a wide body of high quality peer-reviewed articles in order to offer a rigorous assessment of theoretical connections that can inform deeper critical reflection on existing research in a field (Randhawa et al. 2016). The theoretical underpinnings of the approach are widely recognized in the literature (Booth et al. 2016; Brereton et al. 2007; Kitchenham et al. 2009; Pawson et al. 2005). The methodology is

designed to minimize researcher influence on findings by setting out agreed standards for establishing the relevance, plausibility and credibility of research claims (Pawson et al. 2005). It prioritizes the implementation of a transparent process for sample selection and analysis over the overall breadth of a sample (Booth et al. 2016). Lastly, the systematic review methodology involves computerized techniques for bibliometric analysis (Perianes-Rodriguez et al. 2016), the development of clear criteria to inform thematic analysis (Brereton et al. 2007), and comparison of analyses between multiple authors (Booth et al. 2016).

In the current review, literature is first collected according to sampling criteria which set boundary conditions on the study while ensuring the relevance and quality of the sample (Booth et al. 2016). Second, the entire sample undergoes bibliographic-coupling analysis to identify key bodies of theory in relation to leadership in construction (Boyack and Klavans 2010). Finally, aggregative thematic analysis is used to draw out salient themes from key citations in each body of research and synthesize key questions for future construction leadership research. Through this comparison key touchpoints between leadership archetypes and construction leadership theory are identified and the value of integrating the bodies of research is assessed.

Literature sampling

Sample literature for this review was collected via a four-stage sampling process. First, Scopus was used to search for an initial sample. Scopus is the largest abstract and citation database of peer-reviewed literature available representing between 18,000 and 22,000 journals (Aghaei Chadegani et al. 2013). This was done by conducting searches for journal articles published in English since 1997 in the field of construction which contained either 'leadership', ‘leader’ or ‘leading’ in either their title or keywords. This search returned a total of 375 articles. To ensure the sample remained relevant to the objective of this review, the results of this search

were then restricted using Scopus subject area fields to articles stemming from a business, management, decision sciences or sociological framing. This ensured a number of results discussing leadership in the context of technical advances in software, biomedical, industrial, chemical and materials sciences were excluded from the results. Further, to ensure sample literature was of reasonable quality, only journals with a H-index of 5 or greater were included. Finally, the abstracts of all articles were reviewed separately by all three authors according to exclusion criteria to ensure articles in the sample were relevant (Randhawa et al. 2016). The exclusion criteria required any articles which did not explicitly concern construction or did not have leadership as their analytic focus be removed from the sample. Examples of removed papers include: papers focussed on military leadership (Abrahms and Mierau 2017; Cohen and Scheinmann 2014; Keller and Matusitz 2015), political leadership (Chedia 2014; Cohen and Scheinmann 2014; Woltjer 2015), and papers that only mentioned leadership in passing (Annan et al. 2015; Bruyelle et al. 2014; Holly et al. 2017) or in the context of industry leadership on an institutional level (Morrison and Rabellotti 2017; Niskanen et al. 2014; Wang and Liu 2012). This sampling process can be seen below in Figure 1 and resulted in the removal of 85 results leaving a final sample of 289 articles from 79 journals. The final list of sample literature can be seen in Table 2 below.

Figure 1. Sampling process

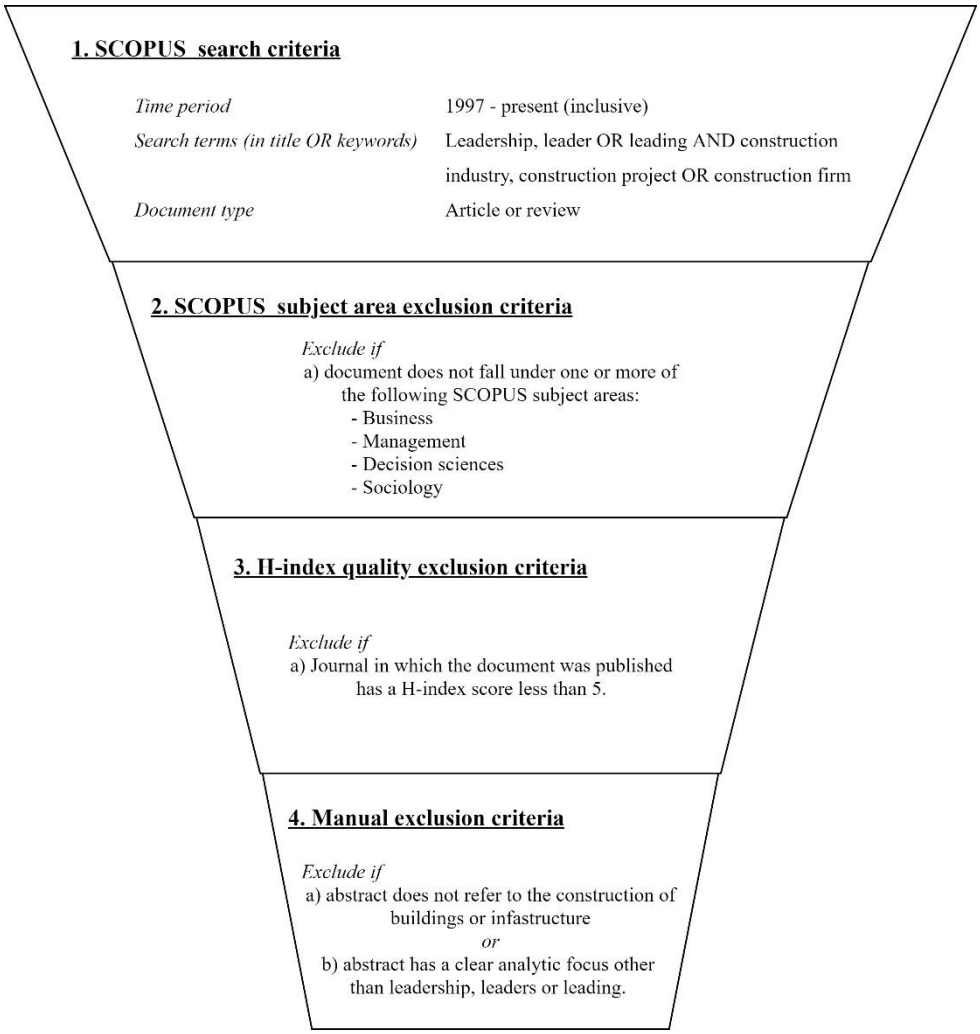

Table 2. Consolidated sample literature

1st Author	Year	Abbreviated Title	Journal	1st Author	Year	Abbreviated Title	Journal
Abdallah M.	2016	Multiobjective optimization model for	J Manage Eng	Lizarralde G.	2013	Understanding differences in construction	Constr. Manage. Econ.
Afsar B.	2018	Linking ethical leadership and moral voice:	Leadersh. Organ. Dev. J.	Love P. E. D.	2016	Praxis of rework mitigation in construction	J Manage Eng
Aktas B.	2015	Green building certification process of	J Manage Eng	Lukiyanto K.	2018	Leadership style that effective and capable to	Int.J. Civ. Eng. Technol.
Almaian R. Y.	2016	Analyzing Effective Supplier-Quality-	J Manage Eng	Lutz R.A.	2017	Leadership and management or leading and	IEEE Eng Manage Rev
Ameh O. J.	2014	The leadership profile of Nigerian	Sci. Iran.	Mahmoudi S.	2014	Framework for continuous assessment and	Saf. Health Work
Ammeter A. P.	2002	Leadership, team building, and team	EMJ Eng Manage J	Manley K.	2006	The innovation competence of repeat public	Constr. Manage. Econ.
Andersen L. P.	2018	Social identity, safety climate and self-	Constr. Manage. Econ.	Marín L. S.	2017	Promoting construction supervisors' safety-	J Constr Eng Manage
Andrews A.	2006	A framework to identify opportunities for ict	Electron. J. Inf. Technol.	Martin H.	2014	Pinpointing safety leadership factors for safe	J Constr Eng Manage
Antonio R. S.	2013	A proposal for improving safety in	Saf. Sci.	Marvel M.R.	2018	Self-leadership and overcoming the time	IEEE Trans Eng Manage
Attallah S. O.	2017	Multicriteria Decision-Making Methodology	J Archit Eng	Master R. C.	2004	Sustainable building design goes mainstream -	Constr Specifier
Aucoin B.M.	2018	Missing pieces in strategic planning and	IEEE Eng Manage Rev	Matinaro V.	2015	Virtual design and construction: Innovation	Int. J. Innov. Learn.
Azab M. A.	2010	Structural sustainability techniques for RC	World Acad. Sci. Eng.	Mazzetto S.	2018	Multidisciplinary Collaboration in Project	J Prof Issues Eng Educ
Badger W.	2009	Profiling the leadership of project managers	Int. J. Constr. Educ. Res.	McKew H.	2011	Tomorrow's environment: Positive attitude +	Eng syst
Ballensky D.	2003	On the road to cooler cities: The cool roof	Constr Specifier	McManamy R.	2004	Leaders step up in public arena	Public Works
Barjot D.	2013	"Why was the world construction industry	Constr. Hist	Menches C. L.	2007	Women in construction-tapping the untapped	J Constr Eng Manage
Bartleson K.	2016	Better young than never: The what, why, and	IEEE Eng Manage Rev	Meng J.	2015	Relationships between top managers' leadership	Eng. Constr. Archit.
Becker K.	2014	Fostering successful career paths in	Pract Period Struct Des	Mikaelsson L. Å.	2017	Integrated planning for sustainable building	J. Civ. Eng. Manage.
Bennett L.	2006	Political leadership and stadium	Int. J. Urban Reg. Res.	Miller D. M.	2000	Leadership and organizational vision in	J Manage Eng
Bergeron H. E.	1998	Leadership and the professional engineer	J Manage Eng	Mills T.	1999	Vertically integrating a capstone experience: A	J. Constr. Educ.
Biggs H. C.	2013	Interlocked projects in safety competency	Saf. Sci.	Mitchell S. O.	2006	Ed Davenport: Masonry construction's industry	Masonry Constr. World
Biggs S. E.	2013	Safety leaders' perceptions of safety culture	Saf. Sci.	Mitropoulos P.	2009	The role of production and teamwork practices	J. Saf. Res.
Bonham M. B.	2013	Leading by example: New professionalism	Build Res Inf	Mohamed S.	2011	System dynamics modelling of construction	Eng. Constr. Archit.
Bossink B. A. G.	2004	Effectiveness of innovation leadership	Constr. Innov.	Morello A.	2018	Exploratory Study of Recruitment and	J Prof Issues Eng Educ
Briscoe G. H.	2004	Client-led strategies for construction supply	Constr. Manage. Econ.	Murata F. M.	2013	Cross-cultural leadership for global	Proc. Inst. Civ. Eng.:
Bröchner J.	2009	Construction metaphors in Aristotle:	Constr. Manage. Econ.	Nasvik J.	2004	Becoming great	Concr. Constr. World
Burstein D.	1999	What every CEO should know about	J Manage Eng	Nguyen L.D.	2017	Knowledge Areas Delivered in Project	J Manage Eng
Butler C. J.	2006	Emotional intelligence and leadership	J Manage Eng	Nguyen T. H.	2010	Evaluating sustainability of architectural	Open Construct. Build.
Chan A. T. S.	2005	Impact of perceived leadership styles on	J Constr Eng Manage	Ni G., Cui Q.	2018	Knowledge-Sharing Culture, Project-Team	J Manage Eng
Chan E.	2011	Implementation of enterprise resource	Int. J. Manag. Project Bus.	Nicholson T.	2008	Demand in Middle East and Asia drives market	ENR

Chan E.	2008	Impact of leadership and power on	Int. J. Hum. Resour. Dev.	Odusami K. T.	2002	Perceptions of construction professionals	J Manage Eng
Chan I. Y. S.	2014	Role of leadership in fostering an innovation	J Manage Eng	Odusami K. T.	2003	The relationship between project leadership,	Int. J. Proj. Manage.
Chang Y. F.	2016	Understanding innovations in Malaysia's	Asian J. Technol. Innov.	Ofori G.	2015	Nature of the construction industry, its needs	J. Constr. Dev. Ctries.
Cheng E. W. L.	2015	Use of safety management practices for	Int. J. Injury Cont. Saf.	Ofori G.	2012	Leadership and construction industry	J. Constr. Dev. Ctries.
Cheng J. C. P.	2015	A non-linear case-based reasoning approach	Build. Environ.	Ofori G.	2009	Research on cross-cultural leadership and	Constr. Manage. Econ.
Cheung S. O.	2001	A satisfying leadership behaviour model for	Int. J. Proj. Manage.	Ofori-Kuragu J. K.	2016	The case for a construction industry council in	J. Constr. Dev. Ctries.
Chiang Y. H.	2008	Volume building as competitive strategy	Constr. Manage. Econ.	Oladinrin O. T.	2016	Critical Enablers for Codes of Ethics	J Manage Eng
Chih Y. Y.	2017	Feeling Positive and Productive: Role of	J Constr Eng Manage	Opoku A.	2015	Leadership style of sustainability professionals	Built Environ. Proj.
Chinowsky P.	2007	Learning organizations in construction	J Manage Eng	Opoku A.	2015	Organizational leadership role in the delivery of	Built Environ. Proj.
Chiu C.-H.	2016	Coordinating Supply Chains with a General	IEEE Trans Eng Manage	Oyewobi L. O.	2016	The impact of rework and organisational	J. Eng. Des. Technol.
Choi B.	2017	Construction Workers' Group Norms and	J Manage Eng	Ozorhon B.	2014	Integration and leadership as enablers of	J Manage Eng
Choi S.	2009	Correlation between innovation and	Can. J. Civ. Eng.	Ozorhon B.	2017	Critical Success Factors of Building	J Manage Eng
Chowdhury T.	2013	Impact of senior design project for the	Eur. J. Eng. Educ.	Ozorhon B.	2016	Investigating the Components of Innovation in	J Manage Eng
Clauson D.	2013	Greening: The built environment: ASTM	Stand News	Ozorovskaja R.	2007	Leadership and cultures of lithuanian and	J Constr Eng Manage
Conchie S. M.	2013	Supervisors' engagement in safety	Saf. Sci.	Pais C. L. A.	2010	Self-managed teams in the auto components	Team Perform. Manage.
Cross S.	2018	Lead yourself	IEEE Eng Manage Rev	Papajohn D.	2017	MARS: Metaframework for Assessing Ratings	J Manage Eng
Cross S.E.	2018	Build your own leadership model	IEEE Eng Manage Rev	Parkin J.	1997	Choosing to lead	J Manage Eng
Cross S.E.	2018	What Kind of Leader Do You Want to Be?	IEEE Eng Manage Rev	Pesämaa O.	2018	Role of Performance Feedback on Process	J Manage Eng
Custovic E.	2016	From engineer to manager, mastering the	IEEE Eng Manage Rev	Pham N. T.	2006	Facilitators of organizational learning in design	Learn. Organ.
Da Silva L.	2009	Review of the LEED points obtained by	J Archit Eng	Pheng L. S.	1997	Ancient Thai battlefield strategic principles:	Int. J. Proj. Manage.
Dainty A. R. J.	2005	Competency-based model for predicting	J Manage Eng	Philips A.	2004	The value of green landscape architecture - A	Constr Specifier
Dall'O G.	2013	On the integration of leadership in energy	Energies	Pirzadeh P.	2017	Understanding the Dynamics of Construction	J Manage Eng
Daniel L.	2015	Safety leadership defined within the	Constr. Econ. Build.	Polesie P. M. A.	2012	Reducing the use of resources in medium-sized	Constr. Manage. Econ.
Davidson K.	2013	Tocci Building Cos. grows into national	ENR	Post N. M.	2007	Baseball park in nation's capital is on its way to	ENR
Dawood N.	2008	Measuring the effectiveness of 4D planning	Electron. J. Inf. Technol.	Potbhare V.	2009	Emergence of green building guidelines in	J. Eng. Des. Technol.
Del Vecchio J. A.	1997	TQM ... reengineering ... what now?	J Manage Eng	Potter E. M.	2018	Emotional intelligence and transformational	J. Financ. Manag. Prop.
Delaney T.	2003	Don't put all your (green) eggs in one basket	Constr Specifier	Powers E. M.	2005	Donor relations: Cash-strapped schools rely on	ENR
DeVilbiss C. E.	2000	Partnering is the foundation of a Learning	J Manage Eng	Pries F.	2004	The role of leaders' paradigm in construction	Constr. Manage. Econ.
Dewlaney K. S.	2012	Prevention through design and construction	Constr. Manage. Econ.	Pryke S.	2015	The effect of leader emotional intelligence on	Constr. Manage. Econ.
Dewlaney K. S.	2012	Safety risk quantification for high	J Constr Eng Manage	Pushkar S.	2018	A comparative analysis of gold leadership in	Appl. Sci.
Dey S. S.	2015	Public agency performance management for	J Manage Eng	Rajagopalan S.	2018	Leadership Simplified: Leaders Must SLEEP	IEEE Eng Manage Rev
Dingsdag D. P.	2008	Understanding and defining OH&S	Saf. Sci.	Rajendran S.	2009	Impact of green building design and	J Constr Eng Manage
Dixon C.	2003	Effective Strategies for Leed™	Constr Specifier	Ramakrishnan R.	2007	Introspection on professional performance of	Indian Concr J
Doan D. T.	2017	A critical comparison of green building	Build. Environ.	Randeree K.	2012	Leadership - Style, satisfaction and	Eng. Constr. Archit.
Dossick C. S.	2010	Organizational divisions in bim-enabled	J Constr Eng Manage	Rapp R. R.	2014	Leadership success within disaster restoration	J. Emerg. Manage.
Dumiak M.	2016	As brexit dust settles, european leaders and	ENR	Riley D. R.	2008	Embedding leadership development in	J Prof Issues Eng Educ
El-Adaway I. H.	2014	Managing the LEED analysis for the new	J Manage Eng	Rojas E. M.	2013	Identifying, recruiting, and retaining quality	J Manage Eng
El-Gohary K. M.	2014	Factors influencing construction labor	J Manage Eng	Rowlinson S.	2015	Construction accident causality: An	Saf. Sci.
Ellis L. A.	2011	A way forward: Assessing the demonstrated	Leadersh. Manage. Eng.	Rozgus A.	2005	AEC leaders of the peak	Public Works
Elzarka H. M.	2009	Best practices for procuring commissioning	J Manage Eng	Rubin D. K.	2005	Stantec pushes big plans - Carefully - For	ENR
Enshassi A.	2009	Factors affecting the performance of	J. Civ. Eng. Manage.	Samberg S.	2011	Method for evaluation of sustainable	Transp Res Rec
Esther Paik J.	2017	Interorganizational Projects: Reexamining	J Manage Eng	Savelsbergh C. M. J.	2015	Does team stability mediate the relationship	Int. J. Proj. Manage.
Evans M.	2008	Heathrow Terminal 5: Health and safety	Proc. Inst. Civ. Eng. Civ.	Schor D.	2017	Experiential leadership training for young	IEEE Eng Manage Rev
Famakin I. O.	2016	Effect of path-goal leadership styles on the	Int. J. Constr. Manage.	Senaratne S.	2015	The role of team leadership in achieving LEED	Built Environ. Proj.
Farr J. V.	1997	Leadership development for engineering	J Manage Eng	Senaratne S.	2015	Construction project leadership across the team	Built Environ. Proj.
Fellows R.	2003	Leadership style and power relations in	Constr. Manage. Econ.	Shen W.	2017	Critical success factors in Thailand's green	J. Asian Archit. Build.
Filos E.	2009	Advanced ICT under the 7th EU R&D	Electron. J. Inf. Technol.	Shiplee H.	2011	Delivering London 2012: Health and safety	Proc. Inst. Civ. Eng. Civ.
Fiolet J. C.	2016	Risk-chasing behaviour in on-site	Constr. Manage. Econ.	Shoop B.L.	2016	Setting the conditions for others to succeed	IEEE Eng Manage Rev
Fortunato Iii B. R.	2012	Identification of safety risks for high-	J Constr Eng Manage	Siddiqi K.	2006	Benchmarking adaptive reuse: A case study of	Int. J. Environ. Technol.
Gabriel E.	1997	Lean approach to project management	Int J Proj Manage	Siew R. Y. J.	2018	Green Township Index: Malaysia's sustainable	Proc. Inst. Civ. Eng.Eng.
Galli B.J.	2018	What Risks Does Lean Six Sigma Introduce?	IEEE Eng Manage Rev	Simmons D. R.	2017	Leadership Paradigms in Construction: Critical	J Manage Eng
Gaynor G.	2017	Taking the lead and managing innovation	IEEE Eng Manage Rev	Singh A.	2009	Leadership grid between concern for people	Leadersh. Manage. Eng.
Genega S. G.	1997	Leadership is essential to managing success	J Manage Eng	Singh A.	2010	Leadership flexibility space	J Manage Eng
Gharehbaghi K.	2003	The construction manager as a leader	Leadersh. Manage. Eng.	Singh A.	1999	Assessment of organizational change for public	J Manage Eng
Giraldo D.	2010	Washington state's I-405 project: Women in	Leadersh. Manage. Eng.	Skeepers N. C.	2015	A Study on the Leadership Behaviour, Safety	Procedia Manuf.
Giritli H.	2013	The interplay between leadership and	Int. J. Proj. Manage.	Skipper C. O.	2006	Assessment with 360° evaluations of leadership	Leadersh. Manage. Eng.
Giritli H.	2004	Leadership styles: Some evidence from the	Constr. Manage. Econ.	Skipper C. O.	2006	Influences impacting leadership development	J Manage Eng
Godfrey Ochieng	2009	Framework for managing multicultural	Eng. Constr. Archit.	Skipper C. O.	2008	Leadership development and succession	J Manage Eng
Gonchar J.	2005	Rapidly evolving rating system draws:	ENR	Skopek J.	2006	Understanding green globes™ sustainable	Constr Specifier
Good M. L.	1998	Collaborations subcommittee keynote	J Manage Eng	Slates K.	2008	The effects of leadership in the high hazard	Leadersh. Manage. Eng.
Grill M.	2017	Supervisors and teachers' influence on	Empir. Res. Vocat. Educ.	Slattery D. K.	2011	Leadership characteristics of rising stars in	Int. J. Constr. Educ. Res.
Grisham T.	2008	Temporary project cultures	Int. J. Hum. Resour. Dev.	Spatz D. M.	1999	Leadership in the construction industry	Pract Period Struct Des
Gu N.	2010	Understanding and facilitating BIM adoption	Autom Constr	Styhre A.	2011	The overworked site manager: Gendered	Constr. Manage. Econ.
Gunawansa A.	2014	A comparison of climate change mitigation	Sustainable Dev.	Styhre A.	2007	Coaching the site manager: Effects on learning	Constr. Manage. Econ.
Gushgari S. K.	1997	Skills critical to long-term profitability of	J Manage Eng	Sui Pheng L.	1997	East meets West: leadership development for	J. Manage. Psychol.
Hallowell M. R.	2013	Enterprise risk management strategies for	J Manage Eng	Sunindijo R. Y.	2007	Emotional intelligence and leadership styles in	J Manage Eng
Hart S. D.	2014	Conceptual models for infrastructure	J Manage Eng	Sunindijo R. Y.	2012	How project manager's skills may influence the	Int. J. Proj. Organ.
Hay M. A.	2004	Lighting Design for Sustainable Buildings	Constr Specifier	Tabassi A. A.	2014	Transformational leadership and teamwork	J. Manage. Dev.
Hellmund A. J.	2008	Facing the challenges of integrated design	Energy Eng	Tabassi A. A.	2016	Leadership competences of sustainable	J. Clean. Prod.
Hensey M.	1999	Why and how of facilitative leadership	J Manage Eng	Tener R. K.	1997	Leading program for undergraduate engineers	J Manage Eng
Ho P. H. K.	2016	Analysis of Competitive Environments,	J Manage Eng	Terouhid S. A.	2016	People capability: A strategic capability for	J. Model. Manage.
Hoffmeister K.	2014	The differential effects of transformational	Saf. Sci.	Tombesi P.	2006	Good thinking and poor value: On the	Build Res Inf
Holt R.	2000	Total quality, public management and	Int. J. Qual. Reliab.	Toor S. R.	2008	Leadership skills and competencies for cross-	Int. J. Hum. Resour.
Hu Y.	2015	Understanding the determinants of program	J Manage Eng	Toor S. U. R.	2011	Differentiating leadership from management:	Leadersh. Manage. Eng.
Hu Y.	2015	From construction megaproject management	J Manage Eng	Toor S. u. R.	2008	Leadership for future construction industry:	Leadersh. Manage. Eng.
Huff W.	2006	Specifying for water efficiency	Constr Specifier	Toor S. U. R.	2008	Taking leadership research into future: A	J Prof Issues Eng Educ
Hunter P.	2006	Changing approaches to health care prompt	ENR	Toor S. U. R.	2008	Developing construction professionals of the	J Constr Eng Manage
Ibrahim C. K. I.	2015	Establishment of quantitative measures for	J Manage Eng	Toor S. U. R.	2009	Authenticity and its influence on psychological	Constr. Manage. Econ.
Idoro G. I.	2009	Clients' perception of construction project	J. Eng. Des. Technol.	Toor S. U. R.	2010	Positive Psychological Capital as a Source of	Int. J. Proj. Manage.
Ites A.	2006	New heights of conservation: MRL elevators	Constr Specifier	Toor S. U. R.	2011	Impact of aspirations and legacies of leaders in	Eng. Constr. Archit.
Janzen A.	2006	Innovations from brandenburg brand leader	Betonwerk Fertigteil Tech	Toor S. U. R.	2011	Women leaders breaking the glass ceiling in	J Prof Issues Eng Educ
Jeschke K. C.	2017	Process evaluation of a Toolbox-training	Saf. Sci.	Toor S. U. R.	2009	Ineffective leadership: Investigating the	Eng. Constr. Archit.
Jiang W.	2017	The impact of transformational leadership on	Sustainability	Tran N.	2009	Strategies for design and construction of high-	Transp Res Rec
Jitwasinkul B.	2016	A Bayesian Belief Network model of	Saf. Sci.	Tuchman J. L.	2008	Strong owner leadership can: Optimize project	ENR
Judy S.	2018	Pond's culture builds a basis for success	ENR	Tulacz G. J.	2010	The Top 100 Green Contractors	ENR
Kaman V. S.	1999	Going to the future to develop transportation	J Manage Eng	Tuohy P. G.	2015	Closing the gap in building performance:	Archit Sci Rev
Kapp E. A.	2012	The influence of supervisor leadership	Saf. Sci.	Umar T.	2017	Briefing: Defining safety leadership in	Proc. Inst. Civ. Eng.
Karakhan A. A.	2017	Integrating Worker Health and Safety into	J Constr Eng Manage	Verstraete T.	2017	Assessing business model relevance for	Int. J. Entrepreneurship
Karakhan A. A.	2017	Identification, quantification, and	J Constr Eng Manage	Wakeman Iii T. H.	1997	Engineering leadership in public policy	J Manage Eng
Karallis T.	2009	Making mentoring stick: A case study	Action Learn. Res. Pract.	Walesh S. G.	2000	Engineering a new education	J Manage Eng
Karallis T.	2011	Building better futures: Leveraging action	Educ. Train.	Wallhagen M.	2011	Design consequences of differences in building	Build Res Inf
Kasapoğlu E.	2014	Leadership styles in architectural design	J Constr Eng Manage	Wan Muda W. H. N.	2016	Developing a leadership capability for team	J. Tech. Educ. Train.
Kerdngern N.	2017	Influence of contemporary leadership on job	Intern. J. Eng. Bus.	Waziri A. Y.	2015	The influence of transformational leadership	Asian Soc. Sci.
Khosravi Y.	2014	Factors influencing unsafe behaviors and	Int. J. Occup. Saf. Ergon.	Weingardt R. G.	1997	Leadership: The world is run by those who	J Manage Eng
Khullar Relph M.	2011	Green building Booms in India	ENR	Weingardt R. G.	2000	Leaving a legacy	J Manage Eng
Kines P.	2010	Improving construction site safety through	J. Saf. Res.	Wen Lim H.	2018	Impact of Safety Climate on Types of Safety	J Manage Eng
Kissi J.	2012	Examining middle managers' influence on	Constr. Innov.	Williams Jr Q.	2010	The impact of a peer-led participatory health	J. Saf. Res.
Klemens T.	2005	Go ahead, take the LEED	Concr. Constr. World	Wong J.	2007	An investigation of leadership styles and	Constr. Manage. Econ.

Knauseder I.	2007 Learning approaches for housing, service	Constr. Manage. Econ.	Wu C.	2015 Roles of owners' leadership in construction	Int. J. Proj. Manage.
Koh T. Y.	2010 Empiricist framework for TQM	J Manage Eng	Wu C.	2017 Leadership improvement and its impact on	Int. J. Proj. Manage.
Larsson J.	2015 Leadership in civil engineering: Effects of	J Manage Eng	Wu C.	2016 How safety leadership works among owners,	Int. J. Proj. Manage.
Lee T. S.	2005 Superior-subordinate relationships in Korean	J Manage Eng	Wu W.	2014 BIM execution planning in green building	J Manage Eng
Leonard J.	2004 Masonry construction's industry leader of the	Masonry Constr. World	Wu W.	2016 Pedagogy and assessment of student learning in	J. Inf. Technol. Constr.
Leonard M.	2003 Leed™ Takes off at George C. Marshall	Constr Specifier	Xia B.	2015 Design-build contractor selection for public	J Manage Eng
Leotta A.	2017 Management accounting and leadership	Qual. Res. Account.	Yan H.	2019 Critical Success Criteria for Programs in China:	J Manage Eng
Li A. S.	2016 Strategies for Foreign Construction-Related	J Manage Eng	Yang J.	2017 Sustainability evaluation of the Great Wall of	Civ. Eng. Environ. Syst.
Limsila K.	2008 Performance and leadership outcome	Eng. Constr. Archit.	Yengst C. R.	2003 Terex - From a follower to an industry leader	Diesel Progr Int Edit
Lindebaum D.	2011 'it's good to be angry': Enacting anger in	Hum. Relat.	Yudelson J.	2005 Understanding the marketplace for green	Constr Specifier
Lines B.C.	2017 Drivers of Organizational Change within the	J Manage Eng	Zhang B.	2017 Causes of Business-to-Government Corruption	J Manage Eng
Lines B.C.	2017 Implementing Project Delivery Process	J Manage Eng	Zhang L.	2018 The mediation role of leadership styles in	Int. J. Proj. Manage.
Ling F. Y. Y.	2012 Careers development in construction firms:	Eng. Constr. Archit.	Zhang L.	2018 Perceiving interactions and dynamics of safety	Saf. Sci.
Lingard H. C.	2009 Group-level safety climate in the Australian	Constr. Manage. Econ.	Zhang L.	2016 Perceiving interactions on construction safety	J Manage Eng
Linowes J. G.	1998 Leadership in transition: Preparing your firm	J Manage Eng	Zhang Y.	2018 How does transformational leadership promote	Sustainability
Liu A.	2003 The power paradigm of project leadership	Constr. Manage. Econ.	Zheng J.	2017 Impacts of leadership on project-based	Sustainability
Liu A. M. M.	2017 Understanding the Interplay of	J Manage Eng	Zilke J. P.	2015 Shifting sands and shifting grounds: Analysis	J Manage Eng
Liu A. M. M.	2006 A power-based leadership approach to	Constr. Manage. Econ.			

Bibliographic coupling analysis

In order to accurately map the research front of literature addressing leadership in construction the current review uses bibliographic coupling. Bibliographic coupling determines the relatedness of publications based on the number of references they share (Boyack and Klavans 2010). This allows the identification of trends and relationships within a scientific discourse with rigour and objectivity (Gmür 2003). It has been demonstrated that of the three pure citation-based methods for mapping research fronts (co-citation analysis, bibliographic coupling and direct citation), bibliographic coupling is most accurate (Boyack and Klavans 2010). In the current paper, VOSviewer (VOS) has been used to identify the bibliographic coupling of publications represented in the sample. While bibliographic coupling cannot offer precise theoretical insights regarding the state of knowledge in construction leadership, it is able to provide high-level insights into the connectedness of publications within a sample and so has been used to contextualise more in-depth analysis and discussion (Boyack and Klavans 2010).

In the bibliographic coupling map output by VOS, citations are clustered according to Louvian grouping principles (Blondel et al. 2008). When given a set of bibliometric data, VOS will first produce a matrix in which the similarity of citations in the dataset is determined by calculation of the frequencies with which citations appear relative to one another (Van Eck and Waltman 2009). Next, VOS calculates the optimum arrangement of citations. This is defined as the arrangement in which the distance between any two citations most accurately represents

their similarity established in the matrix and the weighted sum of the squared Euclidean distances between all pairs of citations is minimized (Van Eck and Waltman 2009). Using this arrangement, VOS outputs a coloured bibliographic coupling map to graphically represent how frequently citations are cited and how they are clustered based on their similarity to other citations. Given the complexity of the network output by VOS, outlining clusters for black and white reading proved impractical and so the figure is not presented in this review. The purpose of these clusters is to indicate groups of citations with high internal affinity which may indicate the presence of a particular perspective, discipline or theoretical frame (Perianes-Rodriguez et al. 2016). It is beyond the purview of this review to explore the functions by which VOS clusters and maps citations in greater depth as this has been well established in scientometric literature (Van Eck and Waltman 2009).

Aggregative thematic analysis

Once bibliographic coupling analysis had been completed, the abstracts of all papers contained in the resulting clusters underwent aggregative thematic analysis in order to identify the overriding topics addressed by literature in each cluster (Tranfield et al. 2003). This process involved the first and second author developing an initial set of codes that provide literal descriptions of concepts contained within the paper abstracts (for instance ‘informtion & communications technology’, ‘total quality management’ or ‘rework mitigation’). Subsequently, the first and second author independently reviewed these codes to identify similar or overlapping concepts and build an aggregated set of themes that accurately depict the substantive focus of each cluster. The themes identified by the first and second author aligned closely for all clusters with the exception of cluser 2 where the themes of ‘Innovation’ and ‘Sustainability’ were both deemed to accurately depict the substantive focus of the cluster. Given the frequency of articles simultaneously addressing innovation and sustainability in

cluster 2, the first and second author agreed that the theme 'Innovation and Sustainability' suitably reflects the research in cluster 2. Based on this thematic analysis, summaries of findings were produced for each cluster which are presented in the results.

Finally, using the categorizonation criteria set out above in Table 1, articles were read in full to identify where authors discussed vertical, horizontal and balanced leadership (Denis et al. 2012). A research agenda was then developed for each of the six clusters identified based on this categorization and key concerns highlighted by the most recent literature within the cluster. Given that it is the intention of this review to provide a clear indication of the distribution of construction leadership research across the three leadership archetypes, articles were not allowed to span archetypes where they may have alluded to multiple archetypes. Instead articles were categorized based on the leadership archetype discussed most frequently. This scenario arose only a small number of times and always involved articles focussed on vertical leadership that occasionally drew on concepts from horizontal leadership theory. For example, Zhang et al. (2018a) primarily discuss vertical leadership in relation to IPD, however, they also draw on concepts such as 'collaboration' and 'integration' to describe how vertical leadership must engage with the delivery team. The above process resulted in the research agenda found at the end of the results in Table 4.

RESULTS

Of the 289 articles subject to bibliographic coupling analysis, VOS identified that 197 articles share references with at least one other article in the sample. This indicates that 93 articles within the sample did not share references. Contained in the network of 197 connected articles are 6 clusters. These clusters represent groups of articles citing each other more frequently than articles outside of their cluster and give an indication of the boundaries between theoretical perspectives. Lists of all articles contained in the six clusters can be found in Table 3 below.

These lists are sorted by number of citations (C). As can be seen in Table 3, C1 is the largest cluster by number of articles (n=40) and citations (n=713). Overall, however, articles from the sample are distributed reasonably evenly across the clusters indicating that all six theoretical perspectives are well established.

Table 3. Article clusters ranked by citations (C)

Cluster 1		Cluster 2		Cluster 3		Cluster 4		Cluster 5		Cluster 6	
Article	**C**	**Article**	**C**	**Article**	**C**	**Article**	**C**	**Article**	**C**	**Article**	**C**
Kines (2010)	113	Gu (2010)	249	Dainty (2005)	79	Briscoe (2004)	105	Dossick (2010)	125	Odusami (2003)	53
Williams Jr. (2010)	55	Limsila (2008)	48	Enshassi (2009)	73	Manley (2006)	43	Butler (2006)	62	Chan (2005)	46
Rajendran (2009)	52	Hu (2015b)	32	Odusami (2002)	70	Chinowsky (2007)	39	Ammeter (2002)	54	Giritli (2004)	37
Kapp (2012)	48	Wu (2014)	31	Toor (2008b)	63	Devilbiss (2000)	38	Chan (2014)	19	Fellows (2003)	33
Dingsdag (2008)	45	Ozorhon (2014)	30	El-Gohary (2014)	54	Godfrey Ochieng (2009)	28	Toor (2009b)	15	Liu (2006)	31
Hoffmeister (2014)	39	Wallhagen (2011)	25	Sunindijo (2007)	53	Pham (2006)	28	Kissi (2012)	14	Wong (2007)	30
Fortunato Iii (2012)	38	Bossink (2004)	23	Lindebaum (2011)	50	Dawood (2008)	20	Koh (2010)	13	Giritli (2013)	28
Mitropoulos (2009)	31	Doan (2017)	21	Toor (2009a)	31	Styhre (2011)	20	Lee (2005)	13	Ozorovskaja (2007)	23
Conchie (2013)	30	Potbhare (2009)	20	Menches (2007)	28	Pries (2004)	17	Larsson (2015)	12	Liu (2003)	20
Lingard (2009)	30	Aktas (2015)	17	Skipper (2006a)	27	Chiang (2008)	14	Tabassi (2016)	11	Cheung (2001)	19
Biggs (2013b)	25	Tuohy (2015)	17	Skipper (2006b)	24	Holt (2000)	12	Savelsbergh (2015)	10	Randeree (2012)	19
Khosravi (2014)	22	Cheng (2015b)	16	Toor (2010)	22	Knauseder (2007)	12	Zheng (2017)	10	Ofori (2009)	11
Mahmoudi (2014)	20	Hu (2015a)	13	Toor (2008d)	19	Love (2016)	8	Spatz (1999)	9	Toor (2008a)	11
Dewlaney (2012b)	19	Ibrahim (2015)	11	Ofori (2012)	17	Ofori (2015)	8	Pais (2010)	6	Parkin (1997)	6
Dewlaney (2012a)	17	Tombesi (2006)	10	Ellis (2011)	12	Oladinrin (2016)	8	Bröchner (2009)	3	Kasapoğlu (2014)	5
Mohamed (2011)	16	Ozorhon (2017)	9	Toor (2008c)	11	Andrews (2006)	7	Jiang (2017)	3	Singh (2010)	5
Wu (2016a)	14	Xia (2015)	9	Skipper (2008)	9	Choi (2009)	6	Tabassi (2014)	3	Sui Pheng (1997)	4
Rowlinson (2015)	12	Bonham (2013)	6	Sunindijo (2012)	8	Lizarralde (2013)	6	Chih (2017)	2	Chan (2011)	3
Wu (2015)	12	Abdallah (2016)	5	Toor (2011a)	6	Oyewobi (2016)	4	Liu (2017)	2	Ameh (2014)	2
Shiplee (2011)	11	Dall'o' (2013)	5	Antonio (2013)	5	Styhre (2007)	4	Zhang (2018c)	2	Chan (2008)	2
Biggs (2013a)	10	Senaratne (2015a)	5	Chowdhury (2013)	4	Weingardt (1997)	4	Rapp (2014)	1	Grill (2017)	1
Jitwasinkul (2016)	9	Dey (2015)	4	Meng (2015)	4	Almaian (2016)	3	Simmons (2017)	1	Grisham (2008)	1
Martin (2014)	7	Idoro (2009)	3	Slattery (2011)	4	Ho (2016)	3	Waziri (2015)	1	Murata (2013)	1
Karakhan (2017b)	6	Papajohn (2017)	3	Leotta (2017)	3	Li (2016)	3	Zhang (2018a)	1	Zhang (2017)	1
Rojas (2013)	6	Wu (2016b)	3	Mikaelsson (2017)	3	Ling (2012)	3	Esther (2017)	1	Singh (2009)	1
Opoku (2015b)	5	Matinaro (2015)	2	Opoku (2015a)	3	Ofori-Kuragu (2016)	1	Afsar (2018)	1		
Shen (2017)	5	Pirzadeh (2017)	2	Pryke (2015)	3	Polesie (2012)	1	Skeepers (2015)	1		
Karakhan (2017a)	3	Verstraete (2017)	2	Toor (2011c)	3	Terouhid (2016)	1				
Fiolet (2016)	2	Ozorhon (2016)	2	Becker (2014)	1	Zilke (2015)	1				
Wu (2017)	2	Famakin (2016)	1	Karallis (2011)	1	Pesämaa (2018)	1				
Andersen (2018)	1	Senaratne (2015b)	1	Lukiyanto (2018)	1	Kerdngern (2017)	1				
Cheng (2015a)	1	Siew (2018)	1	Potter (2018)	1	Ni (2018)	1				
Daniel (2015)	1	Chang (2016)	1	Toor (2011b)	1	Nguyen (2017)	1				
Jeschke (2017)	1	Mazzetto (2018)	1	Wan Muda (2016)	1						
Umar (2017)	1	Morello (2018)	1								
Wen Lim (2018)	1	Pushkar (2018)	1								
Marín (2017)	1										
Choi (2018)	1										
Zhang (2018b)	1										
Total	**713**		**630**		**694**		**451**		**395**		**393**

Cluster 1 - Safety

Literature in cluster 1 focuses on leadership as the most important factor influencing safety on construction projects. Overall, contributions to the cluster characterise leadership as a vertical process whereby leaders maintain assessment, reporting and behavioural standards through a combination of hard enforcement of conduct and softer curation of safety culture.

For example, Kines et al. (2010), who make the central contribution to this cluster, investigate whether a relationship exists between the incidence of work-related accidents and leader-based verbal safety communication. To do so they identify vertical 'leader-worker exchanges' in construction projects where supervisors communicate safety expectations to workers (Kines et al. 2010). Centrally, they find that 'coaching construction site foremen to include safety in their daily verbal exchanges with workers has a significantly positive and lasting effect on the level of safety' (Kines et al. 2010). This characterisation of safety leadership as a vertical practice is the dominant paradigm informing research throughout the cluster (Dingsdag et al. 2008; Hoffmeister et al. 2014; Jitwasinkul et al. 2016; Kapp 2012; Khosravi et al. 2014). For example, studying four large commercial construction contractors, Kapp (2012) finds that in positive safety climates, transformational and contingent reward leadership practices improve safety outcomes. Similarly, Dingsdag et al. (2008) consider safety leadership to be a competence enacted by individuals on construction sites, identifying site Occupational Health and Safety (OHS) advisors and site foremen as being primarily responsible for safety outcomes as indicated by their subordinates.

This cluster does contain some research considering how horizontal forms of leadership could simultaneously contribute to safety leadership in construction projects. For example, Williams Jr et al. (2010) find that a horizontal peer-led approach to informing safety culture is an effective way of improving safety outcomes in groups of Latino day construction workers and would ideally coexist alongside vertical leadership practices (Williams Jr et al. 2010).

Similar hybrid approaches to safety leadership are raised by a number of authors in the cluster, indicating that responsibility for safe working environments should be distributed and then reinforced by key individuals, such as site OHS officers and foremen. However, a framework clearly describing the interaction between vertical and horizontal approaches to leadership in safety is yet to be outlined (Biggs et al. 2013; Conchie et al. 2013; Lingard et al.

2009; Mitropoulos and Cupido 2009). An analysis of recent contributions to the cluster helps identify specific research avenues needing to be addressed. First, the interaction between group leadership, social safety climate and accident self-reporting is yet to be fully understood (Andersen et al. 2018). As Andersen et al. (2018) indicate, hard forms of safety leadership such as punishments for safety misdemeanours, may not prove as effective as softer methods of curating a social climate conducive to strong safety outcomes. Future research needs to consider how 'managerial actions to strengthen workers' social identification with [a] construction project… may lead to the development of a stronger safety climate at the construction site level' (Andersen et al. 2018). The role of self-motivation and self-leadership is also emerging as an important research avenue for construction safety leadership theory (Wen Lim et al. 2018). As self-leadership theory develops, it is important that research considering self-leadership in construction takes into account multi-dimensional characterisations of worker motivation and how these interface with extant vertical leadership practices and shifting group dynamics (Wen Lim et al. 2018; Zhang et al. 2018b).

Overall, research in Cluster 1 considers the vertical leadership of individuals, such as OHS officers or foremen, as critical to strong safety performance. However, recent research has begun considering how vertical leadership may be complemented by horizontal leadership practices, such as team-leadership or self-leadership, but is yet to present a framework that clearly describes this interaction (Andersen et al. 2018; Paunova 2015; Wen Lim et al. 2018). In the balanced leadership framework, horizontal leaders are empowered to foster consensus and workgroup culture at the team level through reflexive communication between teams, project managers and organisation-wide leadership (Müller et al. 2018a). In the framework, the localised autonomy of horizontal leaders to self-manage at a team-level is tempered by their connection to a centralised control layer of permanent vertical leaders (Müller et al. 2018a). In practice, this would see workgroup leaders afforded temporary authority to establish social

safety cultures for their workgroup to identify with, while ensuring these cultures remain linked to sitewide safety standards enforced by vertical leaders such as foremen and project managers.

Therefore, to better understand how vertical leaders can drive safety outcomes through horizontal self-leadership and identification with social safety cultures, future research should build on Andersen et al. (2018) and identify drivers of consensus building within specific on-site workgroups (estimators, electricians, labourers etc). Examples of drivers include storytelling, training or shared technical knowledge (Rowlinson and Jia 2015; Williams Jr et al. 2010). Such research will provide site managers, project managers and supervisors insight into how workgroup autonomy can be balanced with vertical safety oversight, offering a new perspective on how workgroup cultures interact with site level safety.

Cluster 2 – Innovation & sustainability

Cluster 2 focusses primarily on how leadership can drive innovation in construction leading to stronger sustainability outcomes. Again, the most frequently cited research in this cluster characterises leadership vertically (Bossink 2004; Gu and London 2010; Limsila and Ogunlana 2008; Ozorhon et al. 2014). However, unlike the other clusters where citations are distributed relatively evenly across the articles contained, cluster 2 is dominated by one contribution in particular which attracts nearly 40% of all citations in the cluster: Gu and London (2010). Gu and London (2010) analyse the readiness of the Architecture, Engineering and Construction (AEC) industry to leverage Building Information Modelling (BIM), particularly in relation to sustainable building design, across three dimensions: technology, processes and people. They find a high degree of variance in the readiness of AEC firms to leverage BIM, and propose a framework for BIM adoption, the Collaboration BIM Decision Framework (Gu and London 2010). In the framework, interdisciplinary groups of leaders collaborate to enable BIM adoption across four key domains: work processes, resourcing,

480 scoping/project initiation and tool mapping (Gu and London 2010). While the degree of vertical
481 leadership required throughout the model varies, central authorities such as senior executives,
482 clients and BIM managers play crucial roles in spearheading BIM adoption (Gu and London
483 2010). Understanding the implications of BIM for sustainable construction leadership is a
484 recurring concern within the cluster and remains the focus of ongoing research (Tuohy and
485 Murphy 2015; Wallhagen and Glaumann 2011; Wu and Issa 2014).

486 Research in Cluster 2 also explores the role of vertical leaders in construction
487 innovation more broadly (Limsila and Ogunlana 2008; Ozorhon et al. 2014). Ozorhon et al.
488 (2014), for instance, consider how key individuals such as clients, managing directors and
489 contractors, can be 'innovation champions' in construction projects by setting an empowering
490 example for subordinates. As they note, 'open leaders empower their employees and encourage
491 their creativity: they form an environment that is conducive for innovation' (Limsila and
492 Ogunlana 2008; Ozorhon et al. 2014). Despite evidence from other industries of the benefits
493 of horizontal leadership practices for innovation outcomes (Davis and Eisenhardt 2011;
494 Lindgren and Packendorff 2011; Zhou 2014), there is barely any discussion of horizontal
495 leadership practices in the cluster. The only mention of horizontal leadership comes from Idoro
496 (2009) who flags shared leadership between construction project managers and bank
497 representatives on Nigerian construction projects as hindering project progress and
498 undermining leadership integrity. Given the innovation outcomes achieved through
499 implementation of horizontal leadership practices in entrepreneurial teams (Zhou 2014), R&D
500 teams (Lindgren and Packendorff 2011), ICT developers (Davis and Eisenhardt 2011),
501 healthcare teams (Kaviani et al. 2017) and design teams (Galli et al. 2017), greater research is
502 needed to understand how horizontal leadership may be combined with existing vertical
503 leadership practices to drive similar outcomes in construction projects.

Overall, research in this area has been reticent to draw on emerging leadership theory with many studies focusing on how longstanding vertical leadership practices support or inhibit emerging innovation and sustainability outcomes (Gu and London 2010; Limsila and Ogunlana 2008; Ozorhon et al. 2014). While it is clear vertical leaders are indispensable as champions of innovation adoption, there has been a lack of research considering how distributed leadership practices complement the role of vertical leaders in facilitating innovation adoption (Gu and London 2010; Wu and Issa 2014). Consideration of balanced leadership theory may encourage greater exploration of how such practices support or inhibit innovation and sustainability outcomes in construction while remaining cognisant of the demonstrated benefits of vertical leadership. For example, future research should consider how building strategic agility by distributing decision making authority horizontally across an assembly of site-level leaders could improve the capacity of construction firms to capitalise on forefront innovation and sustainability frameworks. In particular, researchers should consider whether factors that have been found to influence the readiness of senior leaders to distribute decision making authority in other contexts, such as career expectations, project risk, age and power distance, are equally relevant in construction (Galli et al. 2017; Müller et al. 2018b; Paunova 2015). Advancing construction research in this way will reveal how vertical, horizontal and balanced leadership practices can be best leveraged to accommodate the observed rapidly changing innovation and sustainability agendas.

Cluster 3 – Leadership competence

Cluster 3 also focusses predominantly on vertical leadership. The cluster draws together strands of broader leadership theory, all of which characterise leading as an individual activity, to critically reflect on key leadership competencies needed to succeed in construction. Overall, research in the cluster indicates that the leadership of project managers is a key determinant of

project performance and that the most effective project managers demonstrate an ability to adapt their competencies in response to the peculiarities of different project teams, locations and objectives (Enshassi et al. 2009; Odusami 2002). Enshassi et al. (2009), for example, find that a project manager's leadership skills are the paramount driver of performance and client satisfaction on construction projects. Looking more specifically at what skills leaders require, Dainty et al. (2005) develop a competence-based model comprised of 12 core competencies desired for construction project managers. Of these competencies, superior performing project managers exemplify self-control, flexibility, client-oriented focus, impact and influence, and team leadership (Dainty et al. 2005). In a similar study, Odusami (2002) identifies decision making, communication, leadership and motivation, and problem solving as the four most important competencies for effective construction project managers. These studies play a valuable role in informing which competencies are prioritised during the education and selection of project managers, but do not consider how enactment of these competencies may extend beyond individual project managers in practice.

Of note in cluster 3 are the contributions of Toor (2011; 2008a; 2008b; 2008c; 2009; 2010; 2011a; 2011b) that collectively attract over 22% of citations in the cluster. While these contributions address construction leadership from varying perspectives, a consistent thread throughout them is the notion of authenticity as a core leadership competence. Toor and Ofori (2008b) describe authentic leaders as leaders who 'understand their purpose, practice solid values, lead with heart, establish connected relationships, and demonstrate a high level of self-discipline'. Throughout his contributions to the cluster, Toor considers how more authentic approaches to leadership can combat critical sentiment around construction project governance, generating 'a fresh perspective of implicit leadership drives, suitable leadership behaviours for construction projects, practical and authentic performance standards, effective leadership interventions that can help to accelerate leadership development, influence of

leadership on project outcomes, influence of leadership on followers and organizational outcomes in the long-term' (Toor and Ofori 2008b). This research is largely 'focused on executives, project managers, site managers, quantity surveyors' (Toor and Ofori 2008b), and the authors note that 'it is important to analyze authentic leadership at all levels of construction organizations. Such examinations at dyadic, group, and organizational levels also have the potential to enhance the understanding of authentic leadership in the construction industry'. Recent research has begun to consider the need for authenticity across other on-site leadership roles such as foremen and supervisors, however the role played by authenticity in integrating vertical and horizontal sources of leadership is yet to be studied (Wan Muda et al. 2016). This could render valuable insights regarding the effectiveness of authentic leadership in situations where contrasting purposes, practices and underlying values exist between horizontal leaders.

In sum, cluster 3 demonstrates that leadership competence is considered an individual quality in construction. Recently, recognition has been given to the possibility of individual competencies coalescing in team-level competencies, however, the way in which these team-level competencies enable or constrain the integration of vertical and horizontal sources of leadership is unknown (Wan Muda et al. 2016). In contrast, a team-based approach to leadership competence is fundamental to balanced leadership where a focus is placed on a 'candidate's identity, construction and positioning relative to other candidates for horizontal leadership' (Müller et al. 2018b). In other project-based organisations this approach has been found to provide a broad range of leadership competencies across a team by flexibly drawing on a pool of horizontal leaders (Galli et al. 2016).

Therefore, it may be valuable for future research in this cluster to distinguish between competencies that are essential in vertical leaders, such as, for example, communication or self-control (Dainty et al. 2005; Odusami 2002), and competencies that deliver benefit when distributed across workgroups, such as technical proficiency or negotiation (Wan Muda et al.

579 2016). In practice, this line of research could inform a new perspective on leadership
580 competence in construction firms, prioritising the identification of groups of leaders who
581 collectively share a diverse and dynamic set of competencies tailored to the project at hand
582 rather than searching for individual leaders with perhaps only some of the necessary
583 competencies.
584
585 *Cluster 4 – Organisational learning*
586 Research in cluster 4 is the most diverse, however the strongest focus of the cluster is
587 on organisational learning (Almaian et al. 2016; Chiang et al. 2008; Chinowsky et al. 2007;
588 DeVilbiss and Leonard 2000; Knauseder et al. 2007; Love et al. 2016; Pham and Swierczek
589 2006; Pries et al. 2004; Styhre 2011; Styhre and Josephson 2007). This body of research
590 accounts for 41% of citations in the cluster and will be the focus of this discussion. This
591 research contemplates how different leadership approaches support organisational learning in
592 construction projects.
593 Chinowsky et al. (2007), for example, compare the learning techniques and
594 technologies of construction and non-construction firms to develop an organisational learning
595 maturity model for construction firms. The model argues that leading for organisational
596 learning requires a somewhat hybrid approach where individual leaders leverage their influence
597 to champion change, followed by distributed organisational learning in response to a new
598 shared vision. However, other than time elapsing, the authors do not explain the mechanisms
599 through which vertical leadership enables distributed learning and so emphasis in their model
600 remains on the vertical leadership of senior executives in facilitating leadership exchange. As
601 Chinowsky et al. (2007) note, ‘executive support is the key first step to a successful
602 implementation of a learning organization culture’. Adopting a similar view, DeVilbiss and
603 Leonard (2000) suggest that combining vertical transformational leadership with distributed

group processes is critical to effective organisational learning. However, their research lacks critical reflection on the impact of specific aspects of group processes and transformational leadership on organisational learning. Therefore, their partnering framework does not clearly distinguish how vertical and horizontal leadership facilitate organisational learning (DeVilbiss and Leonard 2000).

As cluster 4 demonstrates, organisational learning has recently emerged as a salient concern in the construction industry (Love et al. 2016). Extant literature considers how vertical leaders influences organisational learning and in doing so overlooks how horizontal leaders could either contribute to, or potentially detract from, this influence. This stands in stark contrast to broader organisational learning literature that recognizes organisational learning as collective capacity, so that 'the ideal leader might recognize his or her limitations and share the leadership of organizational learning with colleagues' (Vera and Crossan 2004).

Currently, understanding how this sharing of responsibility for organisational learning should occur in construction is challenging as research identifying precisely how horizontal leadership practices contribute to organisational learning in projects is lacking. Horizontal leadership theory indicates that a combination of horizontal leadership and vertical lines of communication is required to facilitate organisational learning, however, no framework has been proposed for achieving this combination (Denis et al. 2012).

Outside of construction, the balanced leadership archetype explains organisational learning through the notions of mental models and knowledge transfers. It suggests that, while individuals may work in independent teams, they share loose mental models that inform interaction and the transfer of tacit knowledge. Müller et al. (2018a) describe this process as 'a generative dance' between horizontal and vertical leadership, in which 'the horizontal leader interacts with the vertical leader over a period of time to develop the project forward and… re-shape, or even abandon their actions and interactions'. On a construction site, this approach

may manifest as shared learning in workgroups (for instance, estimators, joiners or electricians) facilitated by mid-level managers (for instance site managers, superintendents and project managers) who actively relay learnings to senior off-site leaders. Through this information relay, micro-level learning is inducted and disseminated across the organisation while being validated through vertical leaders (Drouin et al. 2018).

Future research should look to establish empirically how factors such as organisational risk tolerances, resourcing constraints and conflicting knowledge cultures might enable or inhibit the relay and induction of on-site knowledge through mid-level managers (Chinowsky et al. 2007; Godfrey Ochieng and Price 2009; Oladinrin and Ho 2016). Advancing construction leadership research in this manner would establish more clearly how vertical and horizontal leadership practices should be combined to maximize organizational learning.

Cluster 5 – Vision and external engagement

Cluster 5 looks at the ability of leaders to collaborate with co-workers and external stakeholders through a shared vision. Contributions to the cluster draw on transformational leadership theory (Jiang et al. 2017; Tabassi et al. 2014; Waziri et al. 2015; Zhang et al. 2018c) and emotional intelligence theory (Butler and Chinowsky 2006; Chih et al. 2017; Lee et al. 2005; Zhang et al. 2018a). While still firmly focussed on vertical leadership, research in this cluster also considers horizontal and balanced leadership approaches. Broadly, it is argued that horizontal leadership practices positively impact the effectiveness of vertical leadership in bringing about organisational change (Jiang et al. 2017; Spatz 1999; Tabassi et al. 2014). For example, Jiang et al. (2017) focus on vertical leadership, finding that organizational citizenship behaviour (OCB) has a mediating effect on the effectiveness of transformational leadership initiatives designed to improve sustainability outcomes in Chinese construction. Importantly, key OCB behaviours identified, such as ‘helping’, ‘sportsmanship’, ‘individual initiative’,

654 'civic virtue' and 'self-development', align closely with behaviours commonly associated with
655 shared leadership and self-leadership indicating the possibility of a relationship between the
656 approaches in the context of OCB (Denis et al. 2012; Jiang et al. 2017). Similarly, Zhang et al.
657 (2018a) indicate that leader emotional intelligence is positively associated with both
658 transformation leadership and integrated project delivery (IPD), a form of external engagement
659 requiring cooperation between internal and external stakeholders (Zhang et al. 2018a). As a
660 construct, IPD aligns closely with pooled leadership in which responsibility over project critical
661 factors is distributed horizontally across a collaborative leadership team. However, Zhang et
662 al. (2018a) primarily consider whether vertical laissez-faire leadership can stimulate
663 collaborative IPD in construction projects and do not consider horizontal forms of leadership.
664 Contrastingly, Spatz (1999) considers horizontal leadership, indicating that
665 construction firms can pursue their competitive vision most effectively when teams self-lead
666 through shared-leadership. In particular, teams must exhibit communication, honesty, quality,
667 respect and mutual support in order to maintain a consistent vision within and outside of the
668 organisation (Spatz 1999). Likewise, offering a more balanced consideration of both vertical
669 and horizontal leadership approaches, Tabassi et al. (2014) conceptualise leadership as
670 primarily a dynamic *group* process involving mutual influence geared towards the achievement
671 of goals. They suggest that the paramount goal for transformational leaders in construction is
672 'developing followers into leaders, inspiring followers to go beyond their own self-interest and
673 giving employee empowerment', thus explicitly recognizing the role of vertical leaders in
674 fostering horizontal leadership (Tabassi et al. 2014).
675 Based on literature in Cluster 5, what is lacking currently from research addressing
676 vision and external engagement in construction is a clear understanding of how different forms
677 of horizontal leadership influence interactions with clients, contractors, regulators, council
678 representatives and other stakeholders (Tabassi et al. 2014; Zhang et al. 2018a). Such research

679 would give a more holistic indication of the mediating influence of mechanisms such as team
680 building, sensemaking, trust, self-leadership and emotional intelligence on the relationship
681 between construction leadership and external engagement (Butler and Chinowsky 2006; Denis
682 et al. 2012; Zhang et al. 2018a). While recent research has indicated that organizational citizen
683 behaviour (OCB) positively influences leadership vision and external engagement on
684 construction projects, it does not establish clearly what aspects of OCB can be considered
685 leadership behaviours and the effect produced by each of these aspects (Zhang et al. 2018a).
686 Overlaps with horizontal leadership theory are frequent in cluster 5, however no studies
687 identify horizontal leadership practices contributing to leadership vision and external
688 engagement, and so there is no consideration as to how these might integrate with extant
689 vertical leadership practices (Jiang, Zhao & Ni 2017; Tabassi et al. 2014; Waziri, Ali & Aliagha
690 2015; Zhang et al. 2018c).

691 Two practices from the balanced leadership archetype are relevant for considering how
692 vertical and horizontal leadership practices can operate cohesively to improve leadership vision
693 and external engagement: enabling consensus building and defining a control layer. First,
694 through 'group meetings for consensus finding, one-on-one meetings, use of task forces,
695 delegation of leadership and decision making authority', balanced leadership offers a flexible
696 framework centred on building consensus around a shared vision (Müller et al. 2018a). Second,
697 the practice of defining a control layer demonstrates how vertical leaders can govern horizontal
698 leaders without curbing autonomy (Müller et al. 2016).

699 Therefore, to understand how construction firms integrate vertical and horizontal
700 leadership practices around vision and external engagement, researchers could study how
701 existing consensus finding processes are delegated to workgroups, and subsequently, the
702 mechanisms by which site leaders establish trust and control over these workgroups. In light
703 of the focus of cluster 5, understanding how OCB fits into workgroup level consensus making

and how transformational leaders maintain trust and control onsite would be promising starting points for future research (Tabassi et al. 2014; Zhang et al. 2018a). As vertical and horizontal forms of leadership coexist more frequently on construction projects, advancing this research avenue would equip practitioners with a clearer understanding of where responsibility for external engagement lies (Tabassi et al. 2014).

Cluster 6 – Leader-follow power dynamics

Literature in cluster 6 considers construction leadership from the perspective of leader-follower power dynamics and examines the role of both vertical and horizontal leadership practices. This discussion is particularly salient for construction moving forwards as shifts away from vertical leadership carry inherent challenges to traditional authorities such as project managers and site supervisors (Giritli and Oraz 2004; Kasapoğlu 2014). Citations in the cluster are evenly spread and overall, research in the cluster indicates that leaders who rely on establishing relational, consultative power rather than directive, autocratic power have greater influence on their followers and on project performance (Fellows et al. 2003; Liu et al. 2003; Liu and Fang 2006; Odusami et al. 2003). This is supported by findings by Odusami et al. (2003) who indicate a stronger relationship between power diffused, consultative leadership styles and project performance than non-consultative autocratic styles in construction projects. Likewise, studying Chinese construction projects, Liu and Fang (2006) identify two dimensions of leadership power: power oriented towards performance and power oriented towards maintaining role structure. Overall, they find that performance-oriented leadership power results in the distribution of leadership power and elicits higher project performance through stronger subordinate commitment (Liu and Fang 2006).

While there is some consensus that sharing of power in construction projects through consultative leadership styles has a positive influence on performance, recent research does not

729 sufficiently describe which leadership responsibilities are beneficial to distribute and which are
730 not (Kasapoğlu 2014). Singh and Jampel (2010), for instance, argue that 'leadership exists and
731 exercises itself at all levels of the organization' and that 'leadership skills can be built by
732 delegating more work to individuals through increased workload and delegation of adequate
733 power'. However, their research does not describe what constitutes 'adequate power' to
734 provide subordinates and how a balance between inadequate, adequate and excessive
735 distribution of power can be maintained (Singh and Jampel 2010). This is a key gap across the
736 power dynamics literature and so a framework is needed that better describes how project
737 managers, supervisors and other leaders can maintain a suitable balance of power with
738 subordinates (Ameh and Odusami 2014; Giritli et al. 2013; Singh and Jampel 2010).

739 Overall, a gradual shift away from a focus on autocratic leadership to a more
740 consultative approach has been observed in construction (Liu and Moskvina 2016) and this
741 shift is reflected across cluster 6 (Fellows et al. 2003; Randeree and Chaudhry 2012; Singh and
742 Jampel 2010). While it has been established that a more consultative leadership style 'creates
743 emotional bonds and harmony between the leader and the group and improves positive
744 communication' (Kasapoğlu 2014), ambiguity remains with regard to the types of
745 responsibilities (e.g. supplier management, external engagement, task scheduling) that can be
746 distributed horizontally and how a balance between centralized control and team freedoms can
747 be achieved (Ameh and Odusami 2014; Giritli et al. 2013; Singh and Jampel 2010).

748 In contrast, the balanced leadership archetype describes how responsibilities can be
749 distributed flexibly while ensuring the remits of horizontal leaders align with project needs.
750 Authority to identify and empower horizontal leaders is retained by permanent vertical leaders
751 to ensure consistency and alignment with firm strategy (Yu et al. 2018). For such an approach
752 to be effective in construction, this control layer of permanent vertical leaders would need to
753 reserve power to grant leadership authority to workgroup members dependent on their

754 capabilities and the needs of the project, requiring an acute understanding of the power
755 dynamics at play.

756 In sum, future research should explore methods for mapping and understanding
757 complex power dynamics within workgroups where temporary horizontal leaders operate in
758 conjunction with vertical authorities (Grisham and Srinivasan 2008; Singh and Jampel 2010).
759 Such research could use the model of Liu and Moskvina (2016) found in Cluster 6 as a starting
760 point, and in doing so, advance a more granular understanding of the effects of balancing leader
761 power dynamics in construction.

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763 *Cluster synthesis*

764 Summarizing insights from the above systematic review, Table 4 below represents how
765 the six research clusters on construction leadership relate to the vertical, horizontal and
766 balanced leadership archetypes. On this basis, vectors for future research are outlined for each
767 cluster. The vectors address a broad range of emerging concerns within construction leadership
768 research and have a practical focus on improving performance outcomes in construction
769 projects.

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778 **Table 4. Tri-archetype research agenda for construction leadership**

Cluster	Vertical leadership	Horizontal leadership	Balanced leadership	Research vectors
Safety	• Hard control over safety through the setting of assessment, reporting and behavioural standards (Kines et al. 2010) • Soft control over safety through verbal leader-worker exchange (Kines et al. 2010) • Managing safety cultures through coaching and contingent reward schemes (Kapp 2012) • Leaders as on-site safe work exemplars (Dingsdag et al. 2008) • Both transactional and transformational leadership behaviours are positively associated with safety outcomes except for active management-by-exception (Hoffmeister et al. 2014) • Good safety leadership facilitated by individual's discipline, values, vision, honesty, engagement, demonstration and promotion relating to safety outcomes (Daniel 2015)	• Within-group homogeneity & between-group variation encouraging group-level safety climates (Lingard et al. 2009) • Pooled supervisory support improves leadership engagement in safety outcomes (Conchie et al. 2013) • Task-demand capability model for high reliability crews (Mitropoulos and Cupido 2009)	• Vertical leaders fostering peer-led safety cultures within teams (Williams Jr et al. 2010)	• How do vertical leaders in construction drive safety outcomes by enabling identification with social safety cultures and horizontal self-leadership? (Andersen et al. 2018; Rowlinson and Jia 2015; Wen Lim et al. 2018; Williams Jr et al. 2010)
Innovation & sustainability	• BIM adoption across work processes, resourcing, scoping/project initiation & tool mapping (Gu and London 2010) • Availability of effective leaders, qualified staff and information/technology are critical success factors for BIM implementation (Ozorhon and Karahan 2017) • Senior leaders should serve as innovation champions by demonstrating creativity, vision and long-term commitment to innovation (Ozorhon et al. 2014)	• Shared leadership constraining innovation through miscommunication and ambiguous authority (Idoro 2009)	*Not represented*	• How does the horizontal distribution of leadership responsibilities influence the readiness of construction firms to capitalize on the ongoing evolution of innovation and sustainability frameworks? (e.g. BIM adoption, LEED certification etc)? (Doan et al. 2017; Pushkar 2018; Wu and Issa 2014)
Leadership competence	• Superior project managers exemplify self-control, flexibility, client-oriented focus, impact/influence and team leadership (Dainty et al. 2005) • Superior project managers exemplify decision making, communication, leadership and motivation, and problem solving (Odusami 2002) • Authentic leadership achieved through purpose, values, heart, relationships and self-discipline is the paramount leadership competency (Toor and Ofori 2008) • Managerial competence focussed on modelling and enabling expected behaviours is more desirable than an ability to encourage others through shared vision (Slattery and Sumner 2011).	• Leadership as a multi-directional social process informed by team composition and project variables (Toor and Ofori 2008) • Family-led firms as a form of pooled-leadership (Leotta et al. 2017)	*Not represented*	• What competencies are essential in vertical leaders and what competencies can be distributed across workgroups? How can this information inform a team-based approach to leadership competence in construction? (Dainty et al. 2005; Odusami 2002; Toor and Ofori 2008; Wan Muda et al. 2016)
Organisational learning	• Organisational learning maturity model in which vertical leaders leverage influence to induce learning around a shared vision (Chinowsky et al. 2007) • Transformational leadership is integral to inducing group-level initiative and organisational learning (DeVilbiss and Leonard 2000) • Client leadership complements effective firm leadership to accelerate development of advanced innovation competence and supply chain integration (Manley 2006)	*Not represented*	*Not represented*	• What aspects of vertical and horizontal leadership encourage organisational learning in construction and how do factors such as organisational risk tolerances, resourcing constraints and conflicting knowledge cultures mediate this relationship? (Chinowsky et al. 2007; Godfrey Ochieng and Price 2009; Oladinrin and Ho 2016)
Vision & External engagement	• Transformational leadership, comprised of idealized influence, inspiration, motivation, intellectual stimulation and individualised consideration, has a positive influence on ICT adoption (Waziri et al. 2015) • Emotional intelligence as a driver of performance in construction executives (Butler and Chinowsky 2006) • Vertical leadership style as an antecedent of IPD between internal and external stakeholders (Zhang et al. 2018) • Organisational citizenship as a mediator of external engagement through transformational leadership (Jiang et al. 2017)	• Self-managed teams exhibiting shared leadership through communication, honesty, quality, respect and mutual support are essential for maintaining an internally and externally consistent vision (Spatz 1999)	• Leadership must be a dynamic group process instigated by vertical leaders and implemented by horizontal leaders (Tabassi et al. 2014).	• How do vertical leaders establish trust and control with horizontal leaders while delegating consensus finding processes used to improve vision and external engagement? What are the mechanisms that mediate the impacts of these processes and how do they operate when leadership stems from both vertical and horizontal sources? (Esther Paik et al. 2017; Jiang et al. 2017; Spatz 1999; Tabassi et al. 2014; Zhang et al. 2018)
Power dynamics	• Effective project managers demonstrate a combination of authoritative leadership and technical expertise resulting in lower levels of delegation (Giritli and Oraz 2004) • Performance-oriented expression of leader power elicits higher performance than structure-oriented expressions of leader power (Liu and Fang 2006) • Leadership power should be maintained at all levels of an organisation through delegation (Singh and Jampel 2010). • Lower power-distance leadership styles such as consultative or supportive leadership achieve stronger follower-perceived performance and group satisfaction (Fellows et al. 2003)	*Not represented*	*Not represented*	• How do vertical leaders in construction empower horizontal leaders while retaining control over redistribution of leadership authority as project circumstances change? What methods are available for mapping and understanding complex power dynamics within workgroups where temporary horizontal leaders operate in conjunction with vertical authorities? (Ameh and Odusami 2014; Giritli et al. 2013; Liu and Moskvina 2016; Singh and Jampel 2010)

DISCUSSION

The current review has been inspired by 'the call for better leadership [that] can be heard throughout the engineering and construction communities' (Simmons et al. 2017). While it is evident that construction leadership practice is changing, research has lacked a robust research agenda to ensure changes are commensurate with emerging challenges, creating a disconnect between theory and practice (Simmons et al. 2017). As the industry responds to challenges in the six areas highlighted by this review, it is critical researchers and practitioners alike are bolstered with more than a single leadership framework to inform the delivery of projects. To address this gap, this review has systematically sampled, synthesized and analysed 289 relevant articles to produce a tri-archetype research agenda aligned to these challenges. In doing so, it makes key contributions to leadership theory in construction and to research in engineering management more broadly.

From a theoretical perspective, this review demonstrates that construction leadership research does not sufficiently explain how the vertical and horizontal leadership archetypes can be successfully integrated despite growing evidence of traditional forms of vertical leadership being supplemented by new types of leadership in practice (Tabassi et al. 2014). The vertical leadership archetype has dominated construction leadership research with only a small number of studies considering the horizontal leadership archetype. Given the thoroughly developed body of horizontal leadership literature found in broader research (Denis et al. 2012) as well as evidence of horizontal leadership in practice (e.g., Harris and McCaffer 2013), this demonstrates both a lag in construction leadership theory and a valuable opportunity to more deeply integrate construction leadership research with contemporary leadership practice. Research in other project industries has found horizontal leadership practices to boost team coordination (Carte et al. 2006; Galli et al. 2016; Hsu et al. 2017; Sullivan et al. 2015), increase the ability of organisations to cope with change (Chreim et al. 2010; Kempster et al. 2014;

804 Rambe and Dzansi 2016) and enhance innovativeness and creativity (Hu et al. 2017; Kakar
805 2017; Lee et al. 2015; Sun et al. 2016; Wu and Cormican 2016). Importantly, horizontal
806 leadership has also been found to dramatically improve the effectiveness of agile approaches
807 to project delivery in other industries (Bäcklander 2018; Dybå et al. 2014; Li et al. 2018; Moe
808 et al. 2015; Moe et al. 2019; Xu and Shen 2018). With construction projects increasingly taking
809 advantage of more flexible agile methods (De Marco 2018; Mendez 2018; Saini et al. 2018), it
810 is imperative that more research is conducted to establish what horizontal leadership practices
811 are currently being used in the industry, whether their effects are comparable to other project-
812 based industry contexts and what other leadership practices may be valuable to implement
813 moving forwards. The current review sets out a clear agenda for this research.

814 Despite the benefits of horizontal leadership, researchers have warned that horizontal
815 leadership practices should not supersede the valuable roles vertical leaders play, but rather, be
816 integrated to enhance organisational leadership holistically (Müller et al. 2018b). As Denis et
817 al. (2012) echo, 'the field of leadership does not necessarily gain by moving from a view of
818 leadership as individual heroism toward an equally naive democratic ideal in which leadership
819 is an organizational quality shared by all'. Research in other contexts has highlighted tension
820 between vertical and horizontal leadership which could make their integration challenging.
821 Largely, tensions arise from the shift in control required when moving from a leader–follower
822 paradigm to a leader to leader paradigm (Gronn 2002). Ongoing challenges also rise once
823 vertical and horizontal leadership are operating in conjunction. For both archetypes to exist
824 simultaneously, a high degree of trust is required amongst team members, otherwise,
825 challenges to leadership legitimacy can impede work (Kakar 2017).

826 The current review shows that these tensions between vertical and horizontal leadership
827 are understudied in construction research which limits the usefulness of extant research for
828 organizations seeking to (further) integrate horizontal leadership practices. The research

agenda put forward by this review identifies six key areas where a more rigorous theoretical conception of the integration of horizontal leadership practices is crucial: building culture and consensus around worker safety identities (Andersen et al. 2018; Choi et al. 2017; Wen Lim et al. 2018; Wu et al. 2016), integration of technical innovations and sustainability frameworks with extant delivery processes (Bilal et al. 2016; Ozorhon and Karahan 2017; Papajohn et al. 2017; Pushkar 2018), tailoring leadership competence to anticipated project demands (El-Gohary and Aziz 2014; Mikaelsson and Larsson 2017; Wan Muda et al. 2016), transmission of knowledge throughout teams (Love et al. 2016; Ni et al. 2018; Oladinrin and Ho 2016), establishing trust and vision in external engagement (Afsar and Shahjehan 2018; Esther Paik et al. 2017; Liu and Chan 2017; Zhang et al. 2018a) and finally, managing transient shifts in on-site power dynamics (Ameh and Odusami 2014; Liu and Fang 2006; Liu and Moskvina 2016). By identifying these six emerging research areas, this review draws together a diverse range of theoretical perspectives to bring much-needed structure to the future of construction leadership research.

The findings of this review should be seen as a stepping stone towards bringing construction leadership research in line with broader leadership theory. In response to the repeated finding that the use of horizontal leadership practices in construction is currently theoretically underdeveloped, this review considers how the emerging balanced leadership archetype may have utility for construction researchers looking to understand how vertical and horizontal leadership practices can coexist effectively. At its core, the archetype is concerned with rapidly connecting the efforts of permanent or semi-permanent vertical leaders with those of temporary horizontal leaders through a framework spanning from the inception to the completion of projects (Müller et al. 2018a). It is the suggestion of this review, based on research linking balanced leadership to positive outcomes in transferring knowledge, consensus building and organizational agility, that the balanced leadership archetype has

relevance to the challenges faced in construction. Overall, the findings of this review signpost a new direction for construction leadership research and practice that responds to the suggestion that 'construction might benefit from more contemporary frames that foster a more holistic view' on leadership (Simmons et al. 2017).

While the analytic focus of this review is limited to the construction industry, its findings have significance for the broader body of knowledge in engineering management. Research indicates that leaders across the broader field of engineering face many of the same challenges described throughout this review. Lines and Reddy Vardireddy (2017), for instance, study a wide range of engineering professions, arguing that 'to adopt organizational change has become a core competency'. They cite how key technical developments including 'building information modelling', 'virtual design', 'e-document management', 'modular techniques' and 'advanced work packaging' are disrupting traditional operating and competitive environments, requiring stronger leadership (Lines and Reddy Vardireddy 2017). Likewise, Perry et al. (2017) highlight the incompatibility of existing frames of thought around engineering leadership given the increasingly collaborative and interdisciplinary nature of projects, leading to the suggestion that 'a revised leadership development model is needed'. Given the evidence that engineering faces a similar set of leadership concerns to those identified in the context of construction, it is likely the findings of this review, which recommend balanced leadership as a promising approach that enables the integration of vertical and horizontal leadership practices, are relevant to the development of leadership research agendas across a broad range of engineering professions (Hartmann et al. 2017; Kameo 2017; Knight and Novoselich 2017; Lines and Reddy Vardireddy 2017; Perry et al. 2017; Rosch and Imoukhuede 2016; Stephens and Rosch 2015).

This research agenda may also herald significant change for practitioners in construction which could be extended to practitioners in engineering contexts. While the six

research vectors identified in this review consistently indicate that construction leadership theory is significantly lagging behind practice within and beyond construction, the review offers insight into what may be expected of construction leaders in the future. With firmer theoretical frameworks around the sharing of responsibilities, the roles of existing leaders in construction, such as executives, project managers, site managers and foremen, will be reframed as they become increasingly valued as expert integrators in a complex web of leaders rather than as experts in a particular discipline. Therefore, as the industry moves away from task-oriented leadership towards more co-operative approaches, vertical leaders will need to complement their deep technical competence with an ability to integrate a wide range of information, foster collaboration, share responsibilities and exert control through softer, less formal means such as relationships and social cultures (Shirazi et al. 1996). Leaders' professional development efforts need to be tailored towards becoming proficient in these softer practices associated with building team competence for knowledge sharing and problem solving. As Clarke (2012) echoes, 'the problem is one of developing an enhanced problem-solving capacity that necessitates high levels of knowledge sharing, and a greater potential for more rapid and effective responses to escalating events through emergent leadership capabilities'.

This review highlights a lag in construction leadership theory accurately reflecting current practice. As theory catches up and develops stronger frameworks to describe horizontal and balanced leadership practices in construction, it is important that consideration is given to identifying where tension may arise between these archetypes. For instance, tension may arise as formal and informal leadership authorities share power in different arrangements (Shirazi et al. 1996). The training and development of future leaders changes in response to the increasing transience of leadership positions available (Fellows et al. 2009) and information must be increasingly shared horizontally between leaders (Harris and McCaffer 2013). It is therefore

crucial that construction leadership theory supports vertical and horizontal leaders by providing frameworks that inform what leadership responsibilities should be distributed, how they are to be distributed and when they can be distributed. The emerging balanced leadership approach provides relevant insights into the practices vertical leaders can adopt to facilitate horizontal leadership in a way that avoid tensions and more research in this area will provide further valuable insights to practitioners. Further, vertical leaders must develop stronger capabilities for facing complex power dynamics in their organizations so that they can adapt their leadership to match transient distributions of decision-making authority. With significant changes on the horizon for construction firms, it is hoped the research agenda outlined by this review will inform forthcoming leadership research and guide practitioners towards practices better suited to the challenges identified.

It is important to highlight some limitations of this review. First, while the bibliometric review methodology used in this paper has been found to identify connections between articles more accurately than through an entirely manual review, it can never offer a perfectly objective assessment as researcher input will inevitably be required in the sample selection stage (Booth et al. 2016; Boyack and Klavans 2010). In the current paper researcher influence has been minimized through clearly defined search parameters, journal quality controls and the independent comparison of abstracts with exclusion criteria by each author (Randhawa et al. 2016). Second, while there is evidence to suggest that the results of this review hold relevance beyond the construction industry (Lines and Reddy Vardireddy 2017; Perry et al. 2017), the sampling process implemented ensures the results presented and the associated research agenda refer explicitly to the construction industry. Given that similar leadership concerns have been identified throughout the broader body of research in engineering management, it is important that future studies conduct similar systematic reviews across other engineering industries to establish parallels and differences in professional practice and needs more acutely. Finally, as

this review is conceptual in nature, it can only theorize potentially valuable directions for construction leadership theory and practice. Further empirical research will be needed to establish the extent to which a balanced leadership framework is already being implemented in construction practice and evaluate its efficacy with regard to emerging challenges along the six vectors identified in this review. Such research would not only advance construction leadership research but also the new and rapidly growing body of balanced leadership research.

CONCLUSION

With construction leaders facing increasingly complex challenges, recognition of the need for more diverse frames in construction leadership research has seen increasing use of horizontal leadership practices. The key challenge for construction research will be keeping up with this move away from traditional conceptions of leadership centred on vertical leaders, to develop more integrative frameworks that incorporate both vertical and horizontal leadership practices in a cohesive and practical manner. This review has systematically identified six areas in which there is ambiguity about what construction leadership will look like in the future. In response, the review has provided key research questions to spur on further research and inform practice. While construction leadership research must incorporate many different approaches, consideration of the balanced leadership framework as proposed in this review outlines a promising avenue for future research and practice.

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