

NARRATIVES SHAPE INNOVATION: A STUDY ON MULTIPLE INNOVATIONS IN THE UK CONSTRUCTION INDUSTRY

ABSTRACT

The nature of construction industry is different from other sectors due to the unique and temporary nature of projects which makes incremental improvements difficult necessitating the need to understand the practice of innovation. This research aims to explore the role of narratives in shaping innovation, as these provide a way to manage the tensions prevalent in the industry. We study 133 innovations across different construction projects in the UK and seek to understand the role of narratives in motivating these innovations. For instance, ‘innovations that enable project completion’, ‘innovations that improve productivity’, ‘innovations in health and safety’ and ‘innovations in sustainability’ are discussed. Whilst we acknowledge that factors such as incentives and rewards can motivate innovation, we argue that narratives shape or guide innovation in a particular direction. Innovations are guided by industry-level ‘narratives of improving productivity’ ‘narratives of health and safety,’ and ‘narratives of sustainability’. Since the construction industry is project-based, interorganizational and multileveled, the industry-level narratives need to be adopted by firms to enable innovations at project sites. Firms adopt these innovations based on the firm-level ‘narrative of profit maximization’ and ‘narrative of image creation’. Innovators actively look for areas where they can intervene, and narratives improve the visibility of some areas thereby guiding innovations to them.

KEYWORDS

Innovation, Narratives, Industry-level narratives, Firm-level narratives, Construction industry

1. INTRODUCTION

Construction is often cited as a poorly performing industry that is very resistant to change (Winch, 2003; Li et al., 2019) with recurrent problems affecting the safety, quality, cost and productivity (Pan et al., 2012). The poor performance is aggravated in complex projects resulting from the demands of its customers along with increasing construction costs, decreasing labour supply, and longer development cycles (Cao et al., 2021). Additionally, organizations involved in construction are operating in an economically competitive environment, resulting in thin profit margins and limited investments in research and development (Oesterreich and Teuteberg, 2016). There is a need to change practices, processes, and products within the construction industry. Multiple literature sources emphasize innovations as a way to bring efficiency and effectiveness to the tradition-bound construction industry (Ozorhon et al., 2016; Liu & Chan, 2017). Innovations, defined as the invention, development and implementation of new ideas (Garud et al., 2013), can serve as an engine for change, a catalyst for growth and a way towards transforming the construction industry. The industry is currently undergoing a period of transformation as organizations develop and implement new technologies and delivery models (Chan, 2020; Havensvid et al., 2019). This transformation occurs through small interventions in technologies and delivery models which disrupt, change, and transform the industry in the long term (Glass et al., 2020). However, construction has for a long time been seen to lag behind other industries (Winch, 1998), and seems to fall further behind (McKinsey, 2017) necessitating the need to understand what 'is' happening in construction innovation, rather than what 'should' happen.

The construction sector is project-based, interorganizational and multileveled often delivered through complex organizing, making the innovation process different from other sectors. First,

construction involves the production of unique projects and hence innovation has to develop at the project level to tackle the day-to-day challenges at the project site (Ozorhon, 2013). Second, these projects are collaborative engagements bringing together different fragmented teams temporarily, and therefore, innovations have to be negotiated with one or more actors (Winch, 1998; Lindblad & Guerrero, 2020). There are multiple interactions within and between the project level, the firm-level, and the industry-level involving different combinations of activities, resources and actors (Bygballe & Ingemansson, 2014; Bygballe & Jahre, 2009). It is difficult for policymakers to promote innovation when cooperation is required between numerous actors with divergent interests and contradictory demands (Enninga & van der Lugt, 2016). Finally, innovation in the industry is diverse as it is partly manufacturing with the presence of materials or equipment and partly services with processes such as engineering, design, and management (Blayse & Manley, 2004). Motivating employees to straddle these complexities is critical for construction industry to be innovative. After all, only firms that can make deep-rooted cultural changes while maintaining engineering and technical strengths can successfully innovate (Gann & Salter, 2000).

Ive (1996) emphasizes that innovation in construction results from the means, motive, and opportunity to innovate. A comprehensive reward and incentive system can motivate employees to be innovative (Liu & Chan, 2017). Higher performance standards and regulations can also spur innovation (Gann & Salter, 2000). Hartmann (2006) highlights the role of culture in innovation and stresses the need to investigate how such social and political factors enable individuals to behave in a certain way and motivates individuals to be innovative. For example, both internal and external communication can have positive impact on innovation in organizations (Damanpour, 1991). An investigation on how individuals focus on innovation and how collective action is

sustained within an institutional context is critical in the construction industry context where there are numerous actors with divergent interests.

In this research, we explore the role of narratives in shaping innovation. Whilst organizational designs and processes are necessary, Bartel and Garud (2009) note that they alone may not be sufficient for innovation, as innovation narratives are vital cultural mechanisms that can make these work practices more effective. Narratives, as defined by Vaara et al. (2016: 496) are *“temporal discourses that provide the essential means for maintaining or reproducing stability and/or promoting or resisting change in and around organizations”*. Narrative approaches can help us understand how human thought, knowledge, and action are shaped by language and discourse (Paschen & Ison, 2014). They shape an individual’s ‘entire web of beliefs’ (Tversky and Kahneman, 1981) and hence have performative implications as they constitute words that get things done (Sergeeva & Winch, 2021). Narratives of purpose, relevance and scope act as ‘gatekeeper’ in terms of inclusion and exclusion of meaning, and thereby influence the meaning production within the community (Veenswijk et al., 2010). We seek to investigate the role of narratives in shaping innovation and transforming construction by considering multiple innovations stories in the UK construction industry. In the process, we ask (1) what are the innovations in the construction industry? and (2) how do narratives shape these innovations?

First, the paper briefly explains the concept of narratives, reviews their role in innovation within the construction industry and arrives at a theoretical gap to address which necessitates answering the two research questions proposed. Second, it presents the research method to capture and analyse multiple innovations compiled from an innovation repository in the UK, Infrastructure Industry Innovation Portal (i3P), in order to address the research questions. Third, it records the

different innovations that transform the construction industry and discusses the narratives surrounding these innovations. The role of industry-level and firm-level narratives to act as a motivator and stimulate change at the project-level is stressed upon along with the relationship between them. Finally, it proposes some actions to enable innovations in construction industry by focusing on narratives that improve the visibility of some areas thereby guiding innovations to them.

2. LITERATURE REVIEW

INNOVATION IN THE CONSTRUCTION INDUSTRY

Recently, Noktehdan et al. (2019) introduced an innovation classification model for the construction industry differentiating between three dimensions - innovation type, innovation novelty, and innovation benefit. Innovation can vary according to the type of innovation, such as for product, process, position, and paradigm (Tidd et al., 2018). Innovations can vary in their novelty, such as radical, new, discontinuous, incremental, and imitative (Garcia & Calantone, 2002). Innovations can also be for different benefits, such as for safety, environment, or cost savings (Noktehdan et al., 2019).

In enabling innovation within these dimensions, Fetterhoff and Voelkel (2006) note two key requisites for innovation, first, insight into customer requirements to identify unmet need and second, the technology awareness to identify the respective enabling technology. Both these requisites are socially constructed by the innovator and hence this research explores the role of narratives in this socially constructed reality, i.e., how narratives shape innovation. Past (Dulaimi et al., 2002; Winch., 1998) and present (Meng & Brown, 2018; Fonseca et al., 2021) studies on construction innovation have stressed the poor adoption in the industry necessitating the need for

research in improving innovation. This poor innovation in the industry has in itself become a narrative.

NARRATIVES OF INNOVATION

Researchers have stressed the role of narratives in facilitating innovation in the construction industry. Van Marrewijk (2007) has studied project culture of the Environ megaproject and discusses how employees were able to strongly identify themselves with the innovative and entrepreneurial megaproject culture by associating themselves with the narratives of ‘Gideon’s gang’ - a biblical metaphor for a brave group of men that knows no fear and uses creative, innovative methods to reach their goals. Leiringer and Cardellino (2008) record that ‘tales of the expected’ can construct the world such that outcomes of innovation conform to the description. They note that rhetorical strategies by innovation champions can justify and legitimate the diffusion of innovations in construction projects. Innovation champions are actors who take an innovation on board, modify and fit it into a context (Rogers, 2003). Even stories about earlier events are used by innovation champions to motivate and persuade team members (Deuten & Rip, 2000; Enninga & van der Lugt, 2016). Innovation champions by promoting innovation narratives proactively encourage innovative ideas (Sergeeva & Zanello, 2018). Whilst these works focus on innovation from narratives ‘for’ innovation champions (Van Marrewijk, 2007) and ‘by’ innovation champions (Leiringer & Cardellino, 2008; Sergeeva & Zanello, 2018), there is a dearth in the literature on how narratives that exist in the environment influence innovation in the construction industry.

Sergeeva and Winch (2020) further explore innovation narratives in the ways project-based construction firms respond to the national agenda for innovation. They found an ongoing process

of interaction between top-driven and bottom-up innovation, highlighting organisational journey of building and enhancing innovation capabilities in response to the targets set by the Government such as net-zero carbon and digital transformation agenda. They also highlight the role of innovation champions in innovation narrative interactions between Government and firm-levels. Sergeeva and Green (2019) also followed a narrative approach to explore the ways in which senior executives in the construction industry ascribe themselves with informal roles (e.g., ‘maverick’, ‘honest John’, ‘empathetic reflective practitioner’) whilst advocating innovation. They emphasize the process of oscillation between performative narratives and anecdotal stories as an important means through which they search for meaning whilst legitimizing their self-identities as innovation champions.

Based on this background, we argue that narratives are important for studying innovation in the construction industry because they motivate actors to act on specific problems and collaborate to find a joint solution (Torfing, 2016). They can help individuals draw inspiration from ideas in other organizational and industrial domains to develop ideas that ring true in their own work contexts (Boland & Tenkasi, 1995). Narratives can be identified and studied at multiple levels: individual, project, firm, industry; and their interactions are of particular interest and importance for meaning making, strategy and policy making (Sergeeva & Green, 2019; Sergeeva & Winch, 2020). Industry-level narratives are ‘grand narratives’ that occur in texts at particular times in history, and that provide meaning for all the practitioners in the industry (Fenton & Langley, 2011). In contrast, firm-level narratives are narratives within organization which provides meaning for the practitioners associated with the firm. Sergeeva and Winch (2020) note that industry-level narratives are mainly articulated in the textual form such as industry reports and secondarily in

verbal and symbolic forms; whereas firm-level narratives are mainly articulated in the verbal form and secondarily in textual and symbolic forms.

PERFORMATIVE NATURE OF NARRATIVES

Narratives can be understood as ‘social process’ or ‘performance in action’ (Cortazzi, 2001) that can rely on information as well as achieve an action. Narratives provide rationale for behaviour as it serves as a repertoire for individuals to draw upon in their action (Deuten & Rip 2000). Narratives thereby convey deeper generating mechanisms that explain patterns of events (Pentland, 1999) and can help make sense of how innovations are mobilized. Innovation narratives provide a way for people to manage the tensions between coherence and flexibility that characterize innovation (Bartel & Garud, 2009).

Paschen and Ison (2014) argue that human thought, knowledge, and action are shaped by narratives. They highlight how we ‘story/narrate’ the environment determines the practice, such as how risks are defined, who is authorized as actors, and the range of policies considered. They argue that narratives shape an individual’s ‘entire web of beliefs’ (Tversky and Kahneman, 1981). Similarly, Weick and Roberts (1993) highlight that narratives can be seen as a fabric that holds groups together as they improvise their ways through difficult situations. The social fabric of innovation provides the necessary coherence and flexibility required to promote and sustain innovations (Tushman & O’Reilly, 1996). In sum, narratives are performative in that they constitute words that get things done (Austin, 1962; Sergeeva & Winch, 2021). The performative nature of narratives has been used to understand different areas in the construction industry such as stakeholder engagement and sustainability. Ninan et al. (2019) studied project narratives of an infrastructure project aimed at the project community in Twitter and recorded that these narratives

brought about a change in preference of the community in the form of less resistance to traffic diversions during project construction. Green and Sergeeva (2020) note that narratives play a role in the effective visioning of sustainability and thereby the extent to which zero carbon is privileged over competing priorities.

In summary, there is a dearth in the literature on how narratives that exist in the environment influence innovation in the construction industry. We trace the narratives in the construction sector and highlight how they act as enablers and shape innovation. Thus, this research seeks to understand the performative role of narratives as part of this social fabric of innovation and explore how narratives transform the construction industry by shaping innovation agenda.

3. RESEARCH METHOD

To address our research objective, i.e., to understand how narratives shape innovation, we choose to study multiple innovations in the UK. The UK presents a fascinating research setting to investigate the role of narratives in construction innovation, as innovation is routinely stressed through multiple industry reports such as Egan (1998), HM Government (2013) and Farmer (2016) in an attempt to improve the performance of the construction industry. In the UK, the construction industry is an important focus for government policymakers due to its size, low skill level, labour intensiveness, and its large multiplier effect into the wider economy (Raiden et al., 2018). We chose to study innovations in the construction sector across different organizations rather than focus on one company. For this, we captured innovations from an online platform, Infrastructure Industry Innovation Portal (i3P)¹, where companies post their innovation stories. The innovation

¹ i3P is an online platform where different organizations in the UK share ideas, partner with others, and innovate for potential industry improvements. The platform can be accessed at <https://www.i3p.org.uk/> (accessed on 17 May 2021)

cases posted online can be categorized as ‘online naturalistic’ data (Ninan, 2020) because they exist naturally without the interference of the researcher (Silverman, 2015). Here, we try to make sense of the original text as the actors wrote or said it (Whittle et al., 2008) as opposed to their recollection and question bias issues observed in the data collected through interviews.

i3P was set up in October 2016 to drive innovation in the UK infrastructure sector. The platform is a spin-off from Crossrail’s Innovate 18 program and was subsequently jointly developed by the Knowledge Transfer Network (KTN), Tideway and Crossrail in an attempt to connect industry partners and enable industry collaboration on innovation. The online platform is publicly accessible². However, innovation contributions can only be made through membership, which is open to owners of major infrastructure projects, construction programmes, and their tier 1 contractors and consultants across the infrastructure sector. Thus, i3P provides a platform for different organizations to share ideas, partner with others, and innovate for potential industry improvements.

We studied 133 innovations posted on i3P between 1 January 2019 and 31 December 2019. In the platform, each innovation was recorded with three sub-headings – motivation, solution, benefits. Within these innovations, we have removed identifiers from the innovations such that the organizations are not identified in the innovations thereby maintaining the confidentiality of the organizations. Regarding the use of data from online sources, Eysenbach and Till (2001) highlight that informed consent is not required for the use of data that are available in public spaces such as in the case of i3P. In contrast, collecting data from private spaces, which require some form of registration or subscription, require informed consent (Ninan, 2020). All the 133 innovations

² For example, the innovation on ‘automated weather warnings’ can be accessed publicly at <https://www.i3p.org.uk/en/custom/innovation/view/1345> (accessed on 17 May 2021)

considered in this research study are publicly available and are summarized along with their date of posting in Appendix 1.

Within each innovation story, we looked at the innovation and the narratives that motivated this innovation. For example, we discuss an innovation to use exoskeleton in construction sites, which is an *innovation in health and safety*. From our empirical data on the motivators for this innovation, we saw that there was a firm-level narrative aimed to reduce the estimated 6.6 million working days which were lost due to musculo-skeletal disorders, which we categorized as a *narrative of profit maximization*. There was also an industry-level *narrative of health and safety* that enabled this innovation. Thus, we found evidence of firm-level and industry-level narratives.

We adopted qualitative coding (Eisenhardt, 1989) to analyse the data collected systematically. We used open coding, axial coding, and constant comparisons simultaneously to generate the theoretical model (Groat & Wang, 2002). Open coding involved breaking down, examining and categorizing the data into open categories (Strauss & Corbin 1990). First, we went through each innovation story and open coded the type of innovation and the narrative surrounding them. With each new story, the codes evolved as they were assigned to categories that fully represent the meaning. For example, we initially assigned innovations that improve time to a category ‘improving time,’ which was expanded to ‘innovations that improve productivity’ to include improvements of productivity, time, and cost together. Through this systematic coding and categorizing of innovations and narratives, we were able to arrive at broad categories of innovations such as ‘innovations that enable project completion,’ ‘innovations that improve productivity,’ ‘innovations in health and safety,’ and ‘innovations in sustainability.’ We also arrived at broad categories of narratives that enable innovation such as ‘narratives of improving

productivity,’ ‘narratives of health and safety,’ ‘narratives of sustainability,’ ‘narratives of profit maximation,’ and ‘narratives of image creation.’ Second, we used axial coding to find the relation between these innovation categories and narratives categories. Axial coding involved putting categories back together in new ways to provide new insights (Strauss and Corbin, 1990). While open coding fractures the data, axial coding allows theory to emerge from data as the researcher investigates ‘what is really going on’ in the data (Tie et al., 2019). Third, constant comparison was used to improve the quality of the theory by comparing codes generated from the open codes and axial codes with the new data as data collection and analysis are taken up in parallel. The coding process is summarized in Table 1, which shows the first order concepts and summarizes the second order themes following the recommendation of Corley and Gioia (2004).

Table 1: The first order and second order coding process.

First order concepts	Second order themes	Aggregate category
GoPro cameras to navigate lifting operation considering site constraints (Innovation 85)	Innovations that enable project completion	Innovations in the construction industry
Modification of clamshell to address the nature of stones in the area (Innovation 4)		
New technology adopted to demolish concrete slab to reduce noise and vibration (Innovation 63)		
Positioner Actuator Manipulator (PAM) used to save time (Innovation 84)	Innovations that improve productivity	
New vibrating ripper used to increase productivity 5 times (Innovation 71)		
Digital document management software used to reduce operational inefficiencies (Innovation 116)		
Hydraulic paving stone splitter used to reduce occupational hazards (Innovation 2)	Innovations in health and safety	
Vibrating tag placed on the helmet of workers to notify when they enter an exclusion zone (Innovation 35)		
Train station adopted an exhaust extraction system used for diesel powered plant to reduce smoke (Innovation 32)	Innovations in sustainability	
Transport materials through river to reduce pollution (Innovation 38)		

Owner and government push for BIM motivated adoption of BIM to improve productivity (Innovation 47)	Narratives of improving productivity	Narratives of innovation
Owner's vision of end-to-end automation resulted in the innovation of self-boarding gates (Innovation 42)		
Importance of providing information quickly and efficiently resulted in the use of a digital dashboard (Innovation 37)		
Poor safety performance in construction industry resulted in innovation to use ergonomic tools (Innovation 122)	Narratives of health and safety	
Accident reports in news articles lead to innovation on audio-visual turn warning device for heavy vehicles (Innovation 35)		
Word of mouth of loss of life on another site lead to an innovation of an operator warning system		
Client stressing a 10% reduction in carbon footprint led to an innovation to reduce rebar and concrete through innovation in design (Innovation 29)	Narratives of sustainability	
An electric diaphragm wall excavation mill was set up because of the principle 'Not Environmentally Worse Than' (Innovation 99)		
Cost savings as a motivation for innovation on diaphragm wall (Innovation 88)	Narratives of profit maximization	
The aim to stay ahead of the competition lead to digitalizing traditional processes (Innovation 26)		
Loss of working days resulted in an innovation addressing Musculo-skeletal disorders (Innovation 58)		
The impact on reputation resulted in innovations to prevent accidents in work sites (Innovation 10)	Narratives of image creation	
An organization claimed that their recognition for urgently managing natural resources led to innovation to minimize pollution (Innovation 12)		

We enfold the findings, discussions and propositions in supported and contrasting literature for validation following the guidance of Eisenhardt (1989). Thus, by systematically analysing the data collected, we were able to understand the relation between narratives and innovation in the construction industry.

4. FINDINGS & DISCUSSION

The analysis of the innovation stories from i3P enabled us to understand the innovations and their corresponding narrative. We discuss each of them separately.

INNOVATIONS IN THE CONSTRUCTION INDUSTRY

We observed different innovations in the construction industry such as innovations that enable project completion, innovations that improve productivity, innovations in health and safety, and innovations in sustainability. They are discussed below.

1. Innovations that enable project completion: Construction projects face different challenges on a day-to-day basis due to the uniqueness associated with the industry. Mitigating these challenges is critical to enable the project completion. In one of the sites, GoPro cameras, which are small video cameras predominantly used for recording different points of view for activities such as biking, running, and climbing, were installed to navigate the structure during the lifting operation due to limited clearance on site, as reported below,

*“During the lift of the Water Treatment Plant shed at *** (name of organization and name of the site), there was limited clearance between the building being lifted and the handrails of the structure it was being lifted over. This meant that the clearance at both ends of the structure needed to be monitored carefully at all stages of the lift” (Quoted from an innovation story dated 22 July 2019)*

In another instance, the use of a clamshell equipment meant for lifting stones from an excavated area, had to be stopped at site as the stones in the area were breaking within the jaws of the

clamshell and the resulting flying debris was injuring workers. The project team subsequently made some alterations to the existing clamshells to address the unique nature of stones in the area of work and thereby enabled the project completion. The organization reported on the need for innovation as below,

“Whilst using a clamshell bucket for embankment stabilisation we encountered a safety problem. The 6G stone [a category of aggregate size] would get trapped in the sides of the bucket jaws then ‘explode’ like shrapnel. This occurred whilst loading and unloading the stone to and from the rail trailers. A number of minor injuries were reported with the potential for far worse. Initially we had no option but to stop using the clamshell.” (Quoted from an innovation story dated 7 January 2019)

Innovations were also carried out to manage community issues around the project to enable project completion. In an instance where a concrete slab had to be demolished near listed buildings and sensitive stakeholders, the project opted to adopt a new technology which causes less noise and vibration, as recorded below,

*“Seeking a more innovative approach to breaking out a 25,000 m² of 300m thick concrete slab in Birmingham City Centre adjacent to key stakeholders, sensitive receptors, and a listed building ... we found the *** [name of the new product] breaker more frequently used for roads in the USA”* (Quoted from an innovation story dated 6 June 2019)

As seen from the instances discussed, most innovations in the construction industry emerge as a result of a project solving its day-to-day problems. Loosemore (2015) records that these grassroots innovations are opportunistic, unplanned, and are often in response to the construction personnel

dealing with limitations of resources, changing working conditions, or unplanned challenges during different construction activities. As noted by Pellicer et al. (2014), such innovations emerge sporadically in the construction industry rather than as the result of an idea generation process that is methodical and continuous as with other industries.

2. Innovations that improve productivity: These are innovations that are not necessary for project completion, but can save on construction time, cost and thereby improve the productivity of operations. In an instance with a construction project which required 3300 holes to be drilled for placing 32mm diameter dowel bar, the project used a Positioner Actuator Manipulator (PAM) to increase productivity. PAM is an equipment for drill work designed to precisely and efficiently push a drill against the surface thereby boosting productivity in contrast to manual drilling. The innovation reported that mobilization for each drilling was easy because the PAM was mounted on a track trolley and an RRV (Road Rail Vehicle) trailer. The organization reported,

*“There were approximately 3300 holes to be drilled. Each hole must take a 32mm diameter dowel bar. The team had a 10-day period to complete this work, on a tunnel refurbishment contract for *** [name of client] ... There was also a challenge to increase productivity given the short time available to complete the works whilst negotiating the irregular brickwork patterns and varying drill heights.”* (Quoted from an innovation story dated 16 July 2019)

In another instance, an organization reported on the use of a new vibrating ripper instead of the traditional breaker to demolish 1250 columns at a site. The new breaker attachment for excavators is based on ‘impact technology by accumulation of energy,’ thereby making it more productive

that other hydraulic hammers available in the market. The innovation was adopted to increase the productivity of operations as reported below,

“The Vibrating Ripper is up to 5 times more productive than the impact hammer and has a lower noise level during use. With 1250 DSM [Deep Soil Mixing] columns to be removed the team looked for the machine with the highest production but lowest impact on the surrounding residents.” (Quoted from an innovation story dated 18 June 2019)

Digital innovations were also employed to improve productivity in construction sites. In an instance, an organization used a digital document management software to reduce the operational inefficiencies of using traditional methods of storing and searching documents. Through the new documentation software, the project team was able to increase efficiency, reduce waste and lead to operational quality improvements, as reported below.

*“By using *** [name of documentation software], the team have been able to realise significant benefits everyday through time and cost saving. Documentation can be found in a matter of seconds, and controlling the flow of information through *** [name of documentation software] allows us to find, sort, control and distribute information with ease”* (Quoted from an innovation story dated 10 October 2019)

Other digital innovations such as digital fabrication can improve time and cost performance along with automating the construction process (de Soto et al., 2018). Similar innovations that improve construction productivity in the form of cost and time savings are highlighted as one of the primary reasons for innovations in the construction industry (Zhou & Gheisari, 2018).

3. *Innovations in health & safety*: These are innovations that improve the health and safety of construction workers. For example, an organization reported as innovation the use of a new product instead of the traditionally used handheld saw for reducing occupational hazards to construction workers. The product was a hydraulic paving stone splitter equipped with a hydraulic system to split stones easily without the emission of airborne dust or vibration related effects on the operator.

“The traditional method of using a Stihl saw [a handheld mechanical saw] to cut paving stones produces dust pollution and puts the operative at risk of HAVS [Hand Arm Vibration Syndrome] and hearing damage from noise. The hydraulic paving stone splitter can split any masonry product that fits between the blades in seconds, whilst removing the risk of HAVS, reducing dust and eliminating the need for water suppression and removing the risk of hearing damage from noise.” (Quoted from an innovation story dated 7 January 2019)

In another instance, to reduce the injuries to workers entering working zones around construction plants, an innovation to have a tag on the helmet which vibrates when a worker enters an exclusion zone was adopted. Subsequent to the entry, a light and warning system is also triggered to alert the machine operator of the entry of the worker enabling the operator to take necessary action. The organization reported on the innovation as below,

*“Site Zone has been trialled at *** [name of construction site] to offer a further solution to operative/plant interface. Small tag allocated to each individual which is worn on helmet, vibrates when you have entered a set exclusion zone around a piece of plant”* (Quoted from an innovation story dated 11 March 2019)

Automated health and safety management systems, such as the helmet tag discussed above, offer more accuracy, better communication, and provide data for effective decision making in contrast to manual safety systems which are subjective, time consuming and inefficient (Yang et al., 2020). Digital innovations such as 4D CAD for visualization are seen to improve safety performance in construction sites (Datta et al., 2020).

4. *Innovations in Sustainability*: Innovations also sought to improve the sustainability of construction projects. In one instance, to reduce smoke from an operational train station which can cause a health hazard to operatives and the travelling public, the organization used a solution that is specifically designed for use on diesel power plants as highlighted below,

*“At *** [name of train station] an exhaust extraction solution specifically designed for use on diesel powered plant and construction equipment was installed to reduce smoke and particulate emissions from engines. The filters trap particulates as fine as 3 microns when first fitted and increasingly smaller particulates as the filter is ‘conditioned.’”* (Quoted from an innovation story dated 11 March 2019)

In another instance, an organization opted to transport materials through the river rather than by road to reduce pollution. The innovation aimed to reduce pollution and congestion along with reducing lorry movements in the city. The report on the innovation is recorded below,

“Through our ‘Sustainable transport—more by river’ strategy, we are ensuring that we transport as many materials as we can by river, taking lorry movements off London’s roads to limit pollution, congestion and to protect road-users. River transport produces less emissions than the road equivalent (per tonne km), even when compared with Euro VI

HGVs [European Union's Heavy Goods Vehicle emission standards]" (Quoted from an innovation story dated 3 April 2019)

Innovations in sustainability involve solutions addressing the social, economic and ecological concerns (Rosca et al., 2016). Innovations in sustainability are utmost important for the construction sector due to the embodied energy of its materials, energy intensive ways of operation, and the high societal impacts of constructed infrastructure (Matinaro & Liu, 2017).

As seen from the instances discussed above, the majority of the innovations were from the construction project site (Winch, 1998). Also, these innovations are taken up by principal architect and principal contractor (Nam & Tatum, 1997). While 'innovations that enable project completion' are critical for successful completion of the project, others improve performance either in productivity, safety, or sustainability. We now turn to discuss the narratives surrounding these innovations.

NARRATIVES OF INNOVATIONS

From the innovation cases collected, we observed narratives of improving productivity, narratives of health and safety, narratives of sustainability, narratives of profit maximization, and narratives of image creation associated with each innovation. These are discussed below.

1. Narratives of improving productivity: There has been a constant push for adopting technologies in construction from its different stakeholders. For example, the UK government report (HM Government, 2018) advocates the use of digital technologies such as BIM through the Digital Build Britain programme. In one instance, one innovation story reported the owner and

government push for Building Information Modelling (BIM) as the primary driver of innovation on 3D modelling of photographs, as recorded below,

*“Motivation - Practicality & Benefits, *** [name of owner] & government push for BIM; Problem - Large area to gather data from and to feed back to design and client no access or limited access limited time to process data; Innovative solution - 3d model from photograph, standard SLR [Single Lens Reflex] photograph, iPhone or drone”* (Quoted from an innovation story dated 16 April 2019)

Gann (2000) stresses that owner pressure to improve quality, reduce costs, and speed up the activity result in innovations in the construction industry. The owner’s vision can also be a reason for suppliers to take up innovation. An innovation on self-boarding gates at airport cited the vision of the airport organization and airline community as the motivation for the innovation as below,

*“Offering passengers, a choice in Self Service products and initiatives forms part of *** [name of airport organization] and the Airline Community vision for end-to-end automation to support the needs of all passengers, now and in the future”* (Quoted from an innovation story dated 8 April 2019)

Multiple industry reports and academic texts stress the poor adoption of technology and subsequent inefficiencies. For example, the UK industry report Farmer (2016) stresses the need for a digital revolution to improve efficiency across construction sites in the UK. Even academic texts have similar narratives to improve productivity in the sector through digital intervention (Ozorhon et al., 2016; Liu & Chan, 2017; Leiringer & Cardellino, 2008). Similar to these industry report and academic texts, the importance to provide information efficiently and quickly is noted as the

motivation for an innovation to use a digital dashboard for accessing real-time project information is highlighted, as noted below,

“In a dynamic environment like construction, it is important that information is provided efficiently and quickly in order to make informed decisions. Unfortunately, this is often hindered by disconnected documents and spreadsheets, multiple files and paperwork, and slow methods of gathering data and information” (Quoted from an innovation story dated 29 March 2019)

As seen from the instances above, innovations which improve productivity is a result of constant verbal narratives from owners, and the textual narratives in the industry reports and academic literature (Sergeeva & Winch, 2020). For example, academic resources such as Fulford and Standing (2014) highlight that the construction industry is widely regarded as an industry which has poor measures of productivity, whilst Naoum (2016) records improvements in construction productivity is of importance for the economic growth of a nation. There is a persistent narrative for construction firms to be more competitive and drive down its cost in industry reports such as the World Economic Forum report (Renz et al., 2016).

2. *Narratives of health & safety*: The construction industry is regarded as one of the most unsafe industries (Perttula et al., 2006). The narrative of poor safety performance of construction industry, i.e., musculoskeletal disorders affect hundreds of thousands of workers each year in the industry, has led to many innovations on construction safety, as highlighted in innovation to use ergonomic tools to reduce issues for workers such as repetitive strain injuries in one of the organizations,

“An opportunity was taken to apply new methodology in the building process, to reduce the factors that give rise to issues for workers such as repetitive strain injuries. Musculoskeletal disorders affect hundreds of thousands of workers each year and a large proportion are those in the construction industry” (Quoted from an innovation story dated 11 November 2019)

Narratives in the form of incidents of safety from news articles also influence innovations in safety. We observed that a particular innovation on an audio-visual turn warning device to warn the heavy vehicle driver of cyclists/pedestrians on the blind side of the vehicle was motivated by newspaper reports of accidents due to turning vehicles as reported in an innovation below,

“Through our work directly involved in the logistics running of the business, we can recognise the need to improve cycle safety regarding HGV [Heavy Goods Vehicle] vehicles. We read in newspapers daily of incidents and accidents of this type, as specialists in the business we need to push these improvements through to standard fitment” (Quoted from an innovation story dated 11 March 2019)

Narratives of safety also spread through word-of-mouth. The project team highlighted news of a loss of life on another site as motivation for taking up an innovation using light and sound warning to alert operator of a worker’s entry to an exclusion zone, as highlighted below,

“Motivation & Context: News from the client that an operative had lost their life on another site in relation to working zones around plant ... Innovation Solution: A light and warning is then set off on the machine and within the cab, the operator of the plant is

notified with an alarm and dash light.” (Quoted from an innovation story dated 11 March 2019)

The above discussion on narratives of safety of workers adds new sources of narratives along with the narratives by the clients, narratives in industry reports, and narratives in academic literature discussed earlier. Narratives from safety incidents reported in news articles or narratives from word-of-mouth such as with the loss of life in nearby site resulted in innovations. Word-of-mouth communication results in networked narratives which enable story co-construction between the storyteller and the listener (Kozinets et al., 2010). As noted in Ninan et al. (2021), actions of project team are influenced by their rationalities which are often shaped by the strategic discourses they read and hear.

3. *Narratives of sustainability:* Construction industries have a pivotal part to play in global sustainability by reducing carbon use in built environments (Whyte & Sexton, 2011). Client organizations stressing the need to reduce carbon footprint in the project lead to many innovations on sustainability. In one instance, the owner’s target to reduce carbon footprint in their project by 10% lead to an innovative dome design to reduce the amount of rebar and concrete. The organization reported on the motivation for this innovation as below,

*“In order to meet the project target of an 10% reduction in *** [name of owner] carbon footprint the team must continually seek innovative solutions to the daily operational needs ... the dome used at *** [name of site] will use 1500m³ of concrete in comparison to 3500m³ used at another shaft. The use of the dome design also relates to a further saving of 750 tCO₂e”* (Quoted from an innovation story dated 18 February 2019)

Narratives of sustainability principles also play a role in shaping innovations. In one instance, the project described compliance to a sustainability principle of ‘Not Environmentally Worse Than’ as the motivation for adopting an electrically powered excavation tool at the site, as reported below.

“In order to comply with the NEWT (Not Environmentally Worse Than) principle and ensure that local communities are not exposed to increased levels of noise and vibration, a world first engineering opportunity to design and commission an electric diaphragm wall excavation mill arose.” (Quoted from an innovation story dated 30 August 2019)

As seen above, narratives by the client, academic texts, and industry sustainable principles such as ‘Not Environmentally Worse Than’ motivated innovations in sustainability. The call by industry reports such as Wolstenholme (2009) to adopt carbon efficiency into all construction process also contribute to narratives that shape innovation.

4. Narratives of profit maximization: Construction supplier organizations are interested in taking up innovations for maximizing their profits (Teece, 1986). Cost-saving was one of the prime motivations for taking up ‘innovations that improve productivity.’ In an instance, the supplier described cost savings resulting from improved performance as the motivation for innovation on a piece of equipment used for diaphragm wall construction operations, as below,

“An area identified for cost savings was Power Factor Correction (PFC) for the separation plant used for D-wall [Diaphragm wall] operations ... Correction of the separation equipment from an inductive load 0.85Pf, corrected to 0.95Pf allowed us to produce a saving of 10%” (Quoted from an innovation story dated 29 July 2019)

In another instance, an organization reported its aim to stay ahead of the competition and win projects as the motivation for innovation on digitalizing traditional processes, as highlighted below,

*“*** [name of organization] has been innovating to reduce cost and improve operational efficiency to win and deliver high quality projects. As we aim to stay ahead of the competition, it’s time to leverage technologies from thousands of technology start-ups worldwide to generate further benefits to *** [name of organization]”* (Quoted from an innovation story dated 8 February 2019)

Thus, the motivation for digitalization in a construction site can result from industry-narratives such as textual reports to improve performance of the industry or from firm-level narratives such as the organization’s desire to win projects and stay ahead of competition. Similar to digitalization, the motivation for organizations to focus on the health of workers was to reduce the harm to workers along with the loss of working days and the profit maximation associated with it. Discussing an innovation to use exoskeleton in construction sites to reduce Musculo-skeletal disorders, the supplier reported their interest in reducing the working days lost by workers due to the disorder as the motivation,

“Work related musculo-skeletal disorders (WRMSD) are a significant issue within the construction industry. According to the Health and Safety Executive, an estimated 6.6 million working days were lost due to WRMSDs, an average of 14 days lost for each case.” (Quoted from an innovation story dated 17 May 2019)

Evangelista et al. (1997) record that firms innovate to strengthen the competitiveness of the company for its long-term survival. As discussed above, for their financial survival, construction firms focus on innovations in productivity and safety.

5. *Narratives of image creation:* Innovations to prevent safety incidents were motivated by a narrative on firm's reputation along with the financial narrative and the aim to reduce harm. In an innovation on the use of virtual reality for displaying risks and hazards, the organization noted how a safety incident could affect its reputation and thereby needs to be prevented, as recorded below,

*“The C&E [Construction & Engineering] team had engaged around Never Harm for a number of years. The cost of incidents impacts *** [name of organization] financially, in reputation and most important can harm our people ... We considered how do people learn best ... The VR [Virtual Reality] is designed using real life risks and hazards that our teams have faced in the past”* (Quoted from an innovation story dated 29 January 2019)

Sustainability innovations was also undertaken for improving the image of the organization. In an instance, the organization claimed their recognition for the urgent need to manage our planet's natural resources led to innovation on a framework to set sustainability targets for projects carried out by the organization. The framework was a Resource Efficiency Matrix (REM) which helped focus on reducing energy, carbon, materials, and water in their projects as reported below,

*“*** [name of organization] recognise there is an urgent need to manage our planet's natural resources more efficiently and minimise our contribution to climate change and air pollution ... In 2018 we launched the Resource Efficiency Matrix (REM), a maturity*

matrix which sets out actions and provides targets for projects to achieve Bronze, Silver or Gold level status. The actions focus on the effective management of energy, carbon, materials, waste and water, leading to sustainable project delivery.” (Quoted from an innovation story dated 30 January 2019)

Lim and Ofori (2007) argue that construction firms remain competitive through innovations that provide financial profitability and innovations that encompass intangible benefits. As discussed above, innovations in health and safety, and sustainability improves the firm’s image and thereby its intangible benefits. Construction project firms strive to create a favourable image either to win new business (Turner et al., 2017) or to win community acceptance (Ninan et al., 2019). Due to this need for firms to improve their image, firms try to retrospectively label events as innovations as recorded in Sergeeva (2014). In addition to the image of construction firms, the image of the sector can also be improved through innovations in sustainability and health and safety. Industry reports such as Wolstenholme (2009) highlight the need for the industry as a whole to improve its image and thereby attract talents. From our empirical data, it was seen that industry reports, academic texts, news articles, and word of mouth created narratives of the construction industry lagging behind, and it necessitated innovation.

The different innovations in the construction industry and the industry-level and firm-level narratives that enable them along with the propositions showing the relationship are shown in Figure 1.

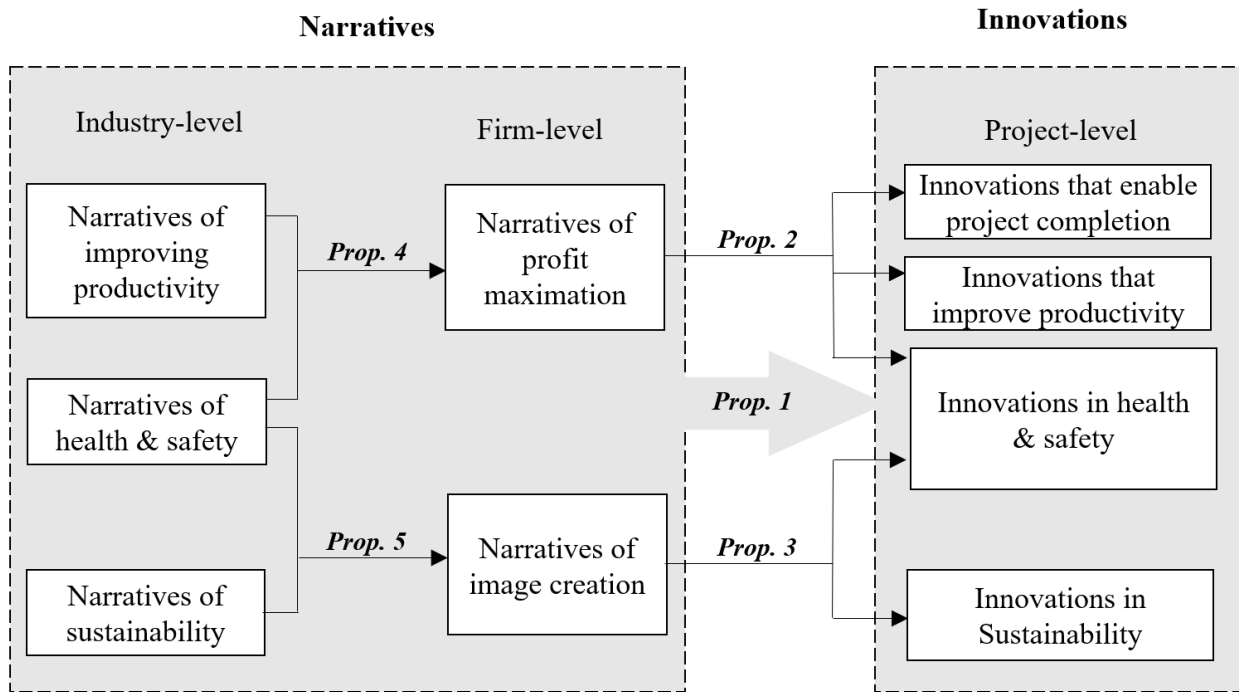


Figure 1: Narratives and innovations in the construction industry

The innovations that enable project completion, innovations that improve productivity, innovations in health and safety, and innovations in sustainability can be seen at the project level since all innovations have to be implemented at the project level in the construction industry. These innovations are undertaken by project firms based on their narratives of profit maximation and narratives of image creation at the firm-level. These narratives at the firm-level are based on the narratives of improving productivity, narratives of health and safety at the industry-level. Thus, innovations at the project level result from a complex interaction between narratives at the industry-level and firm-level.

INDUSTRY-LEVEL AND FIRM-LEVEL NARRATIVES

Fetterhoff and Voelkel (2006) records how the customer insight to identify unmet need and the technology awareness to identify the respective enabling technology are two key requisites for innovation. Both these requisites are socially constructed by the innovator as they pick up areas with unmet needs from the different narratives surrounding them. As discussed above, these narratives arise from different sources such as the constant verbal narratives from owners, the textual narratives in the industry reports and academic literature, or the narratives spread through newspaper and word-of-mouth. Megaprojects can be influential in setting innovation narratives directly by building innovation platforms such as i3P by Crossrail in this case, or indirectly by transferring key people to another project such as India's first metro rail project, the Delhi Metro rail pioneering construction safety improvements in India only to be taken up by other metro rail projects in the country (Izumi et al., 2014). We argue that innovators actively look for areas where they can intervene, and narratives improve the visibility of some areas thereby guiding innovations to them. This study extends prior research that has called attention to the role of narratives 'for' and 'by' innovation champions (Van Marrewijk, 2007; Leiringer & Cardellino, 2008; Sergeeva & Zanello, 2018) by specifying the role of narratives in shaping or guiding innovation along a particular direction (Sergeeva and Winch, 2020). Narratives of vision can motivate construction employees to think in a specific way among multiple alternatives. As noted by Erdogan et al. (2010), "the future can be influenced if we know what we want it to be". We, therefore, posit that,

Proposition 1: The innovations that stimulate change in the industry are shaped by visioning narratives.

Future research can investigate the role of different visioning narratives, such as those in industry reports, academic literature, newspapers, word-of-mouth, etc. and how these stimulate change in the construction industry through a longitudinal study. The ‘innovations that enable project completion’, ‘innovation that improves productivity’ and ‘innovations in health and safety’ were all motivated from firm-level ‘narrative of profit maximation’. The firm-level narratives are narratives within organization which provide meaning for the practitioners associated with the firm. In contrast, industry-level narratives are ‘grand narratives’ that occur in texts at particular times in history, and that provide meaning for all the practitioners in the industry (Fenton and Langley, 2011). Since, the construction firms stressed their profit motive while innovating in these areas, we therefore posit that,

Proposition 2: The innovations that enable project completion and innovations that improve productivity arise from the firm-level narratives of profit maximization.

The ‘innovations of health and safety’ and ‘innovations of sustainability’ were motivated by firm-level ‘narratives of image creation’ as the construction firms stressed their interest in improving their reputation by investing in these innovations. We therefore posit that,

Proposition 3: The innovations in health and safety and the innovations in sustainability arise from the firm-level narratives of image creation.

More research is required to validate propositions 2 and 3 and trace the role of firm-level narratives of profit maximization and image creation in shaping innovations in project site. Since there are multiple day-to-day innovations in the construction sector, we call upon ethnographic studies to investigate these propositions. However, the firm-level narratives were dependent on the industry-

level narratives. Similar to the findings of Sergeeva and Winch (2020), we saw that the industry-level narratives were mainly articulated in the textual form in industry reports such as HM Government (2018) and Farmer (2016). Extending the literature, from our empirical data we note that industry-level narratives are also found in academic texts such as Ozorhon et al. (2016) and Liu and Chan (2017). In contrast, the firm-level narratives were mainly found in the form of vision of an organization or a target for the organization. We also noted that in the firm-level narratives, the name of organization was stressed. In contrast, the industry-level narratives pointed to the industry reports, the client's push for certain innovations, or a general understanding that the issue is important for the construction industry.

Since the construction industry is project-based, interorganizational and multileveled, the industry-level narratives need to be adopted by firms to enable innovations at project sites. We saw firms adopt these innovations for either profit maximization or image creation. The narratives at the industry-level such as the 'narratives of improving productivity', 'narrative of health and safety of workers', and 'narrative of sustainability' found in the industry reports and academic texts were taken up by the construction firm only if they had sufficient incentive. The construction firms' 'narrative of profit maximation' led to the industry-level 'narratives of improving productivity' and 'narrative of health and safety of workers' to be adopted. The construction firms could see financial incentives in adopting these narratives to cash in on the benefits of improving performance or avoid the penalties of safety incidents. We therefore posit that,

Proposition 4: The industry-level narrative of improving productivity and health and safety were adopted because of the financial incentive provided by the firm-level narratives of profit maximization.

The firms' 'narratives of image creation' led to the industry-level 'narrative of health and safety of workers' and 'narrative of sustainability' to be adopted. The firms were motivated to innovate in the areas of sustainability or health and safety of workers for better image of the firm. The motivation of a better organizational image is very evident because of the use of the firm's name and vision while focusing on these innovations. We therefore posit that,

Proposition 5: The industry-level narrative of health and safety and sustainability were adopted because of the non-financial incentive provided by the firm-level narratives of image creation.

The lack of financial incentives for adopting sustainable practices can be seen in the absence of 'narrative of profit maximation' as motivating factor for sustainability innovations. This is in contrast to innovations that enable project completion and innovations that improve productivity which have clear financial benefits. Whilst for innovations in health and safety there are economic incentives such as saving worker workdays lost due to accidents and penalties such as worker compensation, a lack of such financial incentives leads firms to focus on sustainability only for enhancing their image. Levitt (2007) records that the focus on construction projects has always been on economic stability with little focus on environment. One solution for improving the focus on environment is to provide financial incentives for construction firms to take up the narratives of sustainability.

5. CONCLUSION

The research aimed to understand the role of narratives in innovation by studying 133 innovation stories compiled from the Infrastructure Industry Innovation Portal (i3P) platform. We empirically

show that narratives offer a better understanding of innovation, which is key in the transformation process of the construction industry. Innovations such as ‘innovations that enable project completion’, ‘innovation that improves productivity’, ‘innovation in health and safety’ and ‘innovation in sustainability’ are observed in construction projects. These innovations are dependent on the firm-level narratives and industry-level narratives. Whilst we acknowledge that factors such as incentives and rewards motivate innovation, we argue that narratives shape or guide innovation in a particular direction. Innovators actively look for areas where they can intervene, and narratives improve the visibility of some areas thereby guiding innovations to them. This paper aims to fuel a critical reflection on the role of narratives in shaping innovation and highlight that industry-level and firm-level narratives act as a motivator that stimulates change in the industry.

The research makes multiple contributions to theory, practice, and policy. To theory, first, this research empirically highlights that narratives shape innovation. Second, since the construction industry is project-based with majority of innovations happening at site, supplier firm-level narratives are critical. Third, these firm-level narratives are dependent on the industry-level narratives as construction firms adopt them either for profit maximation or for enhancing their image. As contributions to practice, this research identifies that industry narratives exist because of industry reports, academic literature, news articles, and word-of-mouth. The propositions also enable the practitioners to understand the relationship between narratives and innovations, and ways narratives at different levels shape future innovations. To policy, our paper helps to build an understanding for the future innovation agenda. Innovations in sustainability can be improved if a financial incentive is provided for sustainability narratives to be adopted by firms. From our empirical data we saw that, sustainability narratives are only adopted to enhance the image of the construction firms.

This research has some limitations. The innovation stories collected from the i3P platform are unmoderated and not peer-reviewed resulting in some entries which can be argued as best practice. However, this did not interfere with our research agenda as i3P in the current form helped us understand what people perceived as innovation and what motivated these innovations. Adding to this, we considered the narratives that shaped innovation as constant during the study period. Future research can explore how these narratives evolve, change, and affect innovations longitudinally to understand the social process of innovation. Such studies can be taken up using ethnographic methodologies enabling interactions with the people involved in innovations as innovation in construction is a day-to-day activity. Whilst this research claims that narratives shape innovation, Harty (2008) notes that narratives are shaped by their interpretation by practitioners. Future research can consider how practitioners dynamically shape narratives and their influence on innovation. Additionally, we have not considered the type of project, nature of activity, and innovation in this research. An in-depth study of these innovations combined with interviews can help us understand more about the sector and the nature of innovation in the sector.

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APPENDIX 1

Appendix 1: Innovations considered in this research study.

Sl. No	Title of innovations	Date
1	Magnetic safety barrier	7 January 2019
2	Hydraulic stone splitter	7 January 2019
3	Rebar edge protection	7 January 2019
4	Modified clam shell bucket	7 January 2019
5	Risk boxes	7 January 2019
6	Raked unexploded ordnance (UXO) probing	7 January 2019
7	Concrete Management System (CMS) Pro	7 January 2019
8	Modular integrated construction (MiC) flying factory	25 January 2019
9	Foam concrete CP trial	29 January 2019
10	Use VR engage risk perception	29 January 2019
11	Gecko truck loader	29 January 2019
12	Resource efficiency matrix REM	30 January 2019
13	Mental health effective use blank photo frames	31 January 2019
14	*** (name of project) contamination management system	31 January 2019

Sl. No	Title of innovations	Date
15	Rapid set repair concretes	4 February 2019
16	Hydro demolition aqua prep	4 February 2019
17	Mobile barrier	5 February 2019
18	Incident detection testbed	5 February 2019
19	Safetycam	5 February 2019
20	Motorway road lighting control system (MORLICS)	6 February 2019
21	Permanent ballast retention system	6 February 2019
22	No more props	6 February 2019
23	Boom mounted excavator camera	6 February 2019
24	Digital tools design construction	6 February 2019
25	Briefing pack	6 February 2019
26	Digital G *** (name of organization) technology start-up	8 February 2019
27	Pilot project visualisation via drone photogrammetric surveys	14 February 2019
28	4D animation construction capping *** (name of project)	18 February 2019
29	Reduction carbon rebar design changes *** (name of project)	18 February 2019
30	Highways CCTV placement	27 February 2019
31	Lighting Asset Performance Measurement Tool (LAPM)	4 March 2019
32	Exhaust fume extractor	11 March 2019
33	Site zone plant exclusion zones	11 March 2019
34	Exclusion zone cones information board	11 March 2019
35	Audio visual turn warning device	11 March 2019
36	Slope indicator	12 March 2019
37	ACE dashboard tableau business analysis	29 March 2019
38	Barge movements *** (name of project)	3 April 2019
39	Use GGBS cutter soil mixing works	4 April 2019
40	Chambers wharf retained earth slope	4 April 2019
41	Self-service bag drop	8 April 2019
42	Self-boarding gates (SBG)	8 April 2019
43	Smart technologies clean solutions	12 April 2019
44	Women's convenience packs	12 April 2019
45	Personal noise monitors	16 April 2019
46	Bailey bridge improvements	16 April 2019
47	Context capture	16 April 2019
48	Hospital grab and go	16 April 2019
49	Implementing waste hierarchy CLAIRE	25 April 2019
50	Integrated safety management system (iSMS) app	29 April 2019
51	Site dashboard	13 May 2019
52	TRIKCL video induction	13 May 2019
53	HV cable drum test leads	13 May 2019
54	Wildflower planting	13 May 2019
55	Pipe cones	13 May 2019
56	Flashing lights isolation units	13 May 2019

Sl. No	Title of innovations	Date
57	Disposable plastic reduction on *** (name of organization)	16 May 2019
58	Exoskeleton	17 May 2019
59	Dust cannons	24 May 2019
60	Totem site 4D modelling	24 May 2019
61	Finger saver	4 June 2019
62	Air shovel	4 June 2019
63	Ruzziliser badger breaker	4 June 2019
64	Leica DD	4 June 2019
65	Ecosmart 12 site cabins	4 June 2019
66	Low HAVS grinders discs	4 June 2019
67	Cage lifting dolly trailer	7 June 2019
68	Thermostat control save polar bears	11 June 2019
69	Save boreholes campaign	11 June 2019
70	Introduction sit stand desks	12 June 2019
71	Use Xcentric ripper	18 June 2019
72	Replacing cable ties Velcro	20 June 2019
73	Bespoke spill trays secondary lining	25 June 2019
74	Reuse concrete slabs	25 June 2019
75	Colour coding concrete pumplines secondary lining	25 June 2019
76	Dual view dumper trucks	25 June 2019
77	RAMS Bites bite sized briefings	26 June 2019
78	Bridge condition surveys using drones	26 June 2019
79	Ecolite TH200 hydrogen powered portable lighting tower	3 July 2019
80	*** (name of organization) live sites	3 July 2019
81	Lightweight rechargeable light	3 July 2019
82	Noise reduction site	3 July 2019
83	Automatic retractable Stanley knife	3 July 2019
84	Positioner actuator manipulator (PAM)	16 July 2019
85	Use GoPro cameras lifting operation	22 July 2019
86	Effective use Microsoft Teams Phoenix wharf team	22 July 2019
87	Power factor correction	29 July 2019
88	GREPS shaft excavation chrono analysis	29 July 2019
89	Strength Deployment Inventory (SDI) indicator	1 August 2019
90	Automated weather warnings	1 August 2019
91	First aid app	1 August 2019
92	Pipework 3D scanner	1 August 2019
93	QR code hospital grab go packs site	1 August 2019
94	Community wood recycling	1 August 2019
95	Close call texting	1 August 2019
96	*** (name of organization) carers policy	5 August 2019
97	Reclining hydraulic rams	6 August 2019
98	Muck bin cantilevered roof	20 August 2019
99	World's first electrically powered Hydrofraise	30 August 2019
100	180-degree excavator loading shovel tarmac protection	2 September 2019
101	Aconex workflows	2 September 2019

Sl. No	Title of innovations	Date
102	Aconex large file transfer	2 September 2019
103	Single version truth	2 September 2019
104	Contract mail types	2 September 2019
105	Remote controlled lift beam	3 September 2019
106	Sliding gantry	4 September 2019
107	Skid pans Tremie pipes	4 September 2019
108	Using HoloLens real time communication site office	6 September 2019
109	Prefabrication steel leaves DropShaft reinforcement	24 September 2019
110	Boltless tunnel segments	24 September 2019
111	Weholite plastic pipes flume installation	24 September 2019
112	Content item categorisation	26 September 2019
113	River wall toe cutting frame	3 October 2019
114	Painting visual indicators aid lifting operations	3 October 2019
115	Anti-dust FOD enclosure Heathrow airport control tower repainting	8 October 2019
116	Flexible digital searchability	10 October 2019
117	Hard surface guard sediment trap	10 October 2019
118	Manhole lid key manup key	10 October 2019
119	Field inspections	10 October 2019
120	Digital handover for O&M and H&S manuals	10 October 2019
121	Integrated project map	23 October 2019
122	EcoSpot board use of ergonomic tools to avoid repetitive strain	11 November 2019
123	Mental health champion QR code	11 November 2019
124	Push pull stick	11 November 2019
125	Aconex field issues function	11 November 2019
126	Kalis dry cooling system helmet pad	11 November 2019
127	Use of cutter soil mixing technology to mitigate risk of ground contamination	13 November 2019
128	Drones for autonomous survey inspections	14 November 2019
129	Enhancing lessons learned strategy using 360-degree camera	21 November 2019
130	Pinpoint location on site using what3words app	21 November 2019
131	Cantilevered cable feeds	21 November 2019
132	Colour code site priorities phases	10 December 2019
133	Lessons learned site level	10 December 2019