Accepted manuscript

As a service to our authors and readers, we are putting peer-reviewed accepted manuscripts (AM) online, in the Ahead of Print section of each journal web page, shortly after acceptance.

Disclaimer

The AM is yet to be copyedited and formatted in journal house style but can still be read and referenced by quoting its unique reference number, the digital object identifier (DOI). Once the AM has been typeset, an 'uncorrected proof' PDF will replace the 'accepted manuscript' PDF. These formatted articles may still be corrected by the authors. During the Production process, errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal relate to these versions also.

Version of record

The final edited article will be published in PDF and HTML and will contain all author corrections and is considered the version of record. Authors wishing to reference an article published Ahead of Print should quote its DOI. When an issue becomes available, queuing Ahead of Print articles will move to that issue's Table of Contents. When the article is published in a journal issue, the full reference should be cited in addition to the DOI.

Submitted: 29 April 2021

Published online in 'accepted manuscript' format: 06 August 2021

Manuscript title: The Effects of Skills Shortages on Construction Costs in the United Kingdom

Authors: Adrian George[1], Emmanuel Aboagye-Nimo[2], Sam Mamphey[3]

Affiliations: [1]RG Carter Construction, Norwich, United Kingdom. [2]School of Environment and Technology, University of Brighton, Brighton, United Kingdom. [3]School of Architecture Design and the Built Environment, Nottingham Trent University, Nottingham, United Kingdom.

Corresponding author: Emmanuel Aboagye-Nimo, Cockcroft Building, School of Environment and Technology, University of Brighton, Lewes Road, Brighton, BN2 4GJ, United Kingdom.

E-mail: e.aboagye-nimo2@brighton.ac.uk

Abstract

The United Kingdom's (UK) construction industry is facing an ever-increasing skills shortage and is experiencing the highest density of shortages across all other sectors. The skills shortage is extensively explored, but research rarely considers whether the skills shortage directly contributes to the rising cost of construction. This research explores the severity of the current skills shortage; identifies the causes; assesses the affects upon rising costs and finally, ascertains the consequences and recognises the strategies that help to alleviate the skills shortage. A mixed methodological approach was adopted in this study. A total of seventy-eight (78) questionnaires and three (3) semi-structured interviews were conducted using purposive sampling. The complimentary data were statistically and thematically analysed, respectively. Existing literature tends to separate time, cost and quality (TCQ) but the findings from this study reveal that industry professionals are reluctant to separate cost from other project variables. They believe all issues have direct and indirect implications on project costs. Additionally, measures intended to reduce the industry's skills shortage e.g., the direct employment mandate for public works may be driving up project costs even further. This research offers pragmatic recommendations to organisations using insights from practitioners and policy influencers which can help mitigate the skills shortage crisis and improve project costs as well.

1. Introduction

The construction industry plays a key role in the United Kingdom's (UK) economy through contributing £138bn in value, amounting to 9% of the total gross domestic product and employing 3.1m people in 2016 (Chartered Institute of Building (CIOB), 2019a). However, the industry is facing an ever-increasing skills shortage and is experiencing the highest density of shortages across all other sectors (Department for Education (DFE), 2018a). Construction employers are struggling to fill over a third of all vacancies due to insufficient skills, threatening not only the stability of the industry but the wider economy (ibid). Worryingly, Light (2017) predicts that the greatest challenge lies ahead with the industry needing to recruit over 400,000 people each year to successfully meet the increasing demand.

There are many underlining causes of the skills shortage, namely, the poor image of the industry; the failure to attract and train the younger generation; an ageing workforce and a lack of apprenticeships. Aboagye-Nimo, Wood and Collision (2019) believe that the industry harvests a sexist culture that discourages women from joining. Whilst, the dwindling number of apprenticeships inevitably contributes to the skills shortage (Construction Industry Training Board (CITB), 2018). Subsequently, costs are spiralling; the industry is failing to meet demand; quality issues are widespread; increased delays; stagnant productivity, and compromises to health and safety. Wages are rising greater than the whole economy average and triggering the cost of construction to soar (Office for National Statistics (ONS), 2019a; Royal Institute of Chartered Surveyors (RICS), 2015; Dainty et al, 2000). While Saraswat (2016) suggests that the skills shortage contributes to the UK's long-standing productivity gap with France,

Germany and the United States of America (USA). Nevertheless, the industry continues to attempt to alleviate the skills shortage through enhancing education and training; attracting more women and ethnic minorities; investing in technology and a return to direct employment. The DFE (2019) suggests that the introduction of T-Levels strides to be a game changer. T-Levels are an alternative to A levels, apprenticeships and other 16 to 19 courses. It is equivalent to 3 A-levels and focuses on vocational skills (HM Government, 2021). Whereas Dromey, et al (2017) recommend investing in technology to reduce the demand for labour.

This research investigates whether the current skills shortage facing the UK construction industry is a key contributory factor leading to the rising cost of construction projects. In achieving this, the paper identifies the causes of the skills shortage and also explores the consequences of the crisis as well as proposed strategies to alleviate the predicament.

2. The UK construction industry

2.1 Overview of UK construction skills shortage

The UK construction industry is facing an escalating skills shortage that urgently needs addressing (DFE, 2018a; Newton, 2019). The industry is experiencing the highest density of shortages across all other sectors (DFE, 2018a). The DFE (2018a) concluded that over a third of construction firms are struggling to fill vacant positions. The comprehensive government source of intelligence derives from one of the largest business surveys in the world (ibid). However, the construction industry has historically always grappled with skills shortages (Newton, 2019). Back in 2009, 77% of members from the CIOB believed a skills shortage existed (CIOB, 2013). While Dainty et al (2004, p. 275) suggest that the skills shortage "has

been a recurrent problem over the past thirty years" and remains a perennial dilemma. Nonetheless, the Select Committee on National Policy for the Built Environment (2016) admits that the skills shortage is at its highest since 1998. The current skills shortage appears severe and emerges as a major threat to the industry.

2.2 Causes of the skills shortage

There are numerous causes of skills shortage. These range from the industry not being attractive to failure to recruit in the midst of an aging population in the sector.

2.2.1 Poor image of the industry

One of the major causes of the skills shortage is that construction attracts too few women and ethnic minorities; 86% of the workforce are male, while 96% identify as white (CITB, 2017). Prospective entrants believe that construction is dominated by white males, who promote a competitive and threatening environment that rejects and undermines underrepresented groups (Gurjao, 2017; CIOB, 2013). The culture of sexism not only discourages women, but it disheartens younger males from entering the industry (Aboagye-Nimo et al, 2019). Their study further sheds light on the barriers encountered by women in construction thereby highlighting another contributor to the skills shortage. Such poor practices have been found to lead to decreased self-esteem and confidence amongst women.

2.2.2 Failure to attract and train the younger generation

Research examining the opinions of CIOB members on the skills shortage concluded that the industry is notoriously bad at attracting students (CIOB, 2019b). Only 40% of 14- to

19-year-olds consider pursuing construction roles (Department for Business, Innovation and Skills, 2013). This is due to an education system that focuses on academic ability with respondents believing that construction is for "people who do not get into college or university" (ibid: 16). Alternatively, the CITB's (2017) study found that a third of employers believed that youngsters were poorly prepared for the reality of working in construction. Dainty et al (2017) 2017) agreed by highlighting the fragmented approach and underinvestment in education and training as a major issue.

2.2.3 Ageing workforce

Mohamed et al (2017) state that the aging society reflects the construction workforce. The CITB (2018) strengthens this belief by stating that the ever-increasing ageing workforce contributes to the skills shortage with 47% of the industry over the age of 45. This results in a ticking "time bomb" with insufficient "new blood" entering the industry (Moncaster and Dillon, 2018). Eaves et al (2016) concluded that the manual duties of construction make working into later life a challenge. This is due to construction workers being at high risk to injury and ill health from their duties (ibid). Their research investigated operatives' understandings of their health at work and forming methods of making their duties safer. More importantly, many of those approaching retirement decide against prolonging their working life (CIOB, 2019b).

2.3 Consequences of the skills shortage

There are numerous consequences of the looming skills shortage. Literature on some of these consequences are discussed in this section to set the scene for later discussion.

2.3.1 Rising cost

The skills shortage is driving a "sharp acceleration in wage growth" and the cost of construction to soar (RICS, 2018). Construction wages rose by 5.2% more than the whole economy average of 3.4% between March to May 2018 and 2019 (ONS, 2019a). Skills shortage reduces productivity and thus increases overall project costs as a result (Zhang et al, 2019). However, Hamid and Waterman (2018) argue that the skills shortage is not the only contributing factor to the rising cost of construction. They also identified changes in design, inflation, and the increase of material prices to be the key contributors.

2.3.2 Failure to meet demand

The ONS (2019b) reports that construction orders fell by 13.2% in 2018; the first decline in growth since 2011. This may indicate that businesses are unable to source sufficiently skilled labour to meet demand. Dromey et al (2017) agree by insisting that the skills shortage represents the second most significant constraint on output. Whilst the Select Committee on National Policy for the Built Environment (2016) concludes that the skills shortage is another key component for the under-delivery of new housing. Only 41% of RICS members named the skills shortage as an obstacle to growth; the joint lowest in over five years (RICS, 2019).

2.3.3 Quality issues

Through the 'Modernise or Die' report, Farmer (2016) shares concerns that the quality promises made by the industry are not often delivered. This underperformance is begrudgingly accepted by both clients and the industry (Farmer, 2016). Survey data found that a significant

percentage of construction employers are finding it difficult to meet quality standards with the current skills shortage (Alencastro et al, 2018). Statistics suggest that the direct cost of avoidable quality errors stands at £5bn per annum and is higher than the average profit levels of 3% across the industry (Get It Right Initiative, 2019). In the above report, major UK construction firms including Balfour Beatty, Morgan Sindall and Wilmott Dixon agreed that although materials, energy and time play a role in quality issues, the need to recruit skilled workers remains paramount (ibid: 9). Furthermore, it was revealed that the excessive commercial (financial and time) pressure on the existing limited workforce results in additional quality issues.

2.3.4 Productivity decrease

The productivity of the industry appears to be deteriorating simultaneously with the widening skills shortage; a correlation exists. Productivity fell by 4.8% in 2018 (ONS, 2019b). Saraswat (2016) suggests that the skills shortage contributes to the UK's long-standing productivity gap with France, Germany and the USA. On the contrary, Naoum's (2015) research into the factors influencing labour productivity on construction sites implies that the skills shortage has a negligible impact upon productivity. However, the study focuses solely on main contractors rather than small-to-medium enterprises, who undertake most of the construction activities.

2.4 Strategies to alleviate the skills shortage

Education and training offer an avenue to help ease the skills crisis. However, the DFE's (2018b) records show that the spend per construction trainee reached £4,510 in 2017. This is

amongst the top two spending sectors since 2013; indicating that money alone cannot solve the problem (DFE, 2018b). There appears to be a continued discord between training authorities, employers and trainees (Saraswat, 2016). Daniel et al (2020) warned that the apprenticeship system relies on the "goodwill" of the employer and suggest a need for greater integration between the parties.

The construction industry also fails to attract women and ethnic minorities. Only 14% of all construction positions are held by women and ethnic minorities represent only 5.4% (House of Commons, 2019; CLC, 2018). Gurjao (2017, p. 32) recommends that employers must "…implement creative solutions, such as re-training…, flexitime, part-time working… and job sharing" to attract a wider audience. It is important for the industry to eradicate the stigma of a white-male dominated sector in order to entice more women and ethnic minorities (Aboagye-Nimo et al, 2019). Ultimately, the industry requires a major overhaul to remove the demeaning and reluctant to change culture (Gurjao, 2017).

In another instance, almost 80% of all trade labour are self-employed (Vershinina et al, 2018). They further argue that the erosion of skills stems from 'bogus' self-employment. The term bogus refers to a false form of self-employment to reduce tax liabilities or employers' responsibilities (ibid). This is supported by Simpson et al (2020) and they suggest that subcontractors shy away from upskilling their labour force due to such complexities.

Having explored relevant literature skills shortage in the UK construction industry, it is evident that the problem has been in existence for decades. As such this research aims to explore the severity of the current skills shortage; assess the causes; and explore its effects on

project costs. Finally, the research ascertains practical solutions to help to alleviate the skills shortage crisis.

3. Research method

The study set out to explore the skills shortages facing the UK construction industry and its wider effects on construction cost. In order to enable an in-depth appraisal of the topic and in an attempt to validate the findings of the research, a mixed method approach was adopted. Noble and Heale (2019) suggest that combining different methods helps ensure that fundamental biases associated with any one single method is overcome, to offer a more balanced view. The data collection tools were complimentary of each other. The quantitative approach sought to gain an overview of issues relating to the skills shortage while the qualitative approach sought to gain in-depth and rich data from the chosen professionals.

Prior to administering the questionnaires, a pilot study was conducted to test the proposed questionnaire design and process. The feedback from the pilot study was used to adjust and improve the final questionnaire. The quantitative data sought to determine the severity of the skills shortage; the causes; the consequences and the strategies offered to help alleviate the problem. The questionnaire comprised of closed-ended, checklist style questions. This required respondents to select from a list of options and rating scale questions to assess the respondents' level of agreement or disagreement. Semi-structured interviews provided qualitative data to gauge the opinion on whether the skills shortage is a contributory factor leading to the rising cost of construction and to substantiate the quantitative data.

Using the questionnaires, the study collected primary data from construction

professionals including Contracts Managers, Project Managers and Quantity Surveyors. Scoring a response rate of 46.4%, 78 valid responses were returned from the survey participants who were selected through a convenience sampling technique. Figure 1 shows the roles of survey participants for this study. The spread of the respondents is not representative of the UK construction industry's professionals.

The survey was designed to gain an understanding of the participants views on the skills shortage, the causes, and possible solutions. Some of the questions used are as follows:

- The current skills shortage facing the construction industry is severe. Do you agree?

  Strongly Agree, Agree, Neither agree nor disagree, Disagree, Strongly Disagree.

- Rank the following causes of the skills shortage in order of significance. 1-4 (1 being the most significant).

  Poor image of the industry, Failure to attract the younger generation, Ageing workforce, Lack of apprenticeships.

- Which of the following factors do you think are the direct consequences of the skills shortage?

  Rising cost, Failure to meet demand, Poor growth, Quality issues, Increased delays, Productivity decrease.

Semi structured interviews were then conducted with three industry professionals, each lasting between 50 – 60 minutes. The interviews were carried out interactively and in an open manner. Interviewee profiles are provided within Table 1. The names used for the interviewees in the findings are fictitious names, as this ensures their anonymity. The interview questions

were designed to further explore and to gain rich data into the responses received from the questionnaires.

All the semi-structured interviews were recorded and later transcribed. Descriptive and thematic analyses were used in analysing the quantitative and qualitative data, respectively.

4. Findings and analysis

This section presents the collected data and its subsequent analysis. Since the quantitative and qualitative data are complimentary of one another, the identified themes will be used for both data sources (i.e. questionnaires and interviews). This approach was adopted as it offers better clarity in the data presentation.

4.1 Overview of respondents

Questionnaire participants – industry professionals with a clear overview of contracts from inception to completion. All participants had some decision-making roles in their various organisations (see figure 1). Furthermore, to ensure that the participants had an extensive understanding of industry practices and the ongoing skills shortage crisis, respondents required a minimum of three years' work experience. The interviewees had different professional roles and had relatively different industry experiences (see Table 1).

Mike and Jake hold decades of experience in the industry and have undertaken many different construction roles. Tom was included in the study as he possessed a completely different view from traditional construction professionals i.e., Consultant in Training and Education. He had also spent 10 years in the Department for Education working on policies

including 14-19 diplomas, raising the participation age and finally as Head of Apprenticeship Strategy.

4.2 Causes of skills shortage

The literature review revealed several reasons have been attributed to the skills shortage in the UK construction industry. The plethora of reasons include the industry's poor image spanning decades, the inability to attract a younger generation to replace to retiring workforce, and lack of practical routes into the industry such as apprenticeship programmes. The literature section presented some causes of the skills shortage, and these were also confirmed by a significant proportion of the questionnaire respondents.

The survey respondents believed the failure to attract the younger generation is the most significant cause of the skills shortage with 77.5%. The survey participants considered that the lack of apprenticeships is the second most important reason with 62.5%. The poor image of the industry was considered the least of all the issues causing the skills shortage amongst the survey respondents.

The ageing and soon to retire workforce, and the poor image of the industry ranked the least problematic of the causes of skills shortage. This thus challenges the notion that the rapidly ageing workforce as a "ticking timebomb". However, failure for the industry to attract a younger generation is synonymous to losing the ageing workforce through retirement. This is largely due to a continuation of the demographics of the workforce. The responses from the respondents can be attributed to a view through different lenses.

Jake identified a perspective not captured by previous scholars that is believed to be

leading to the skills shortage; *'The bogus self-employment and the lack of direct employment. I think it's quite prominent right now'.* Although this falls under the perspective of a practical route into the industry, the key issue is that workers are encouraged to join the industry through the self-employment route with the notion of attaining the training and support from more experienced workers on site. Unfortunately, this support is not guaranteed.

Jake attributed the problem to the 'education system'. Not particularly the formal education system but an overall lack of education and knowledge about the complexities of the construction industry. The industry's poor image prevailed upon discussing the cause of the skills shortage. *'Obviously, you hear about the risks of construction that may put off the younger generation... but the industry is cleaner, and the health and safety has improved drastically'.* As a recruiter of several casual workers on '*zero hour'* contracts, he believed the image of the industry was not the main issue. The industry was recruiting *'healthily 50 years ago'* where the *'image and practices were exponentially'* worse. However, society's needs as well as the sector's demands have changed significantly since the 1970s and this may play a role here. Having confirmed the existence of some of the causes of the skills shortage, it was imperative to explore the perceptions of the severity among other relevant topics.

4.3 Severity of the skills shortage

The industry professionals attribute the failure to attract the younger generations as the most significant cause of skills shortage. This is further impacted by the poor image of the industry. As far as the gravity of the issue, an overwhelming majority (82%) described the current crisis as severe. Only 2.9% disagreed that the current situation was severe. This issue was not only

affecting the recruitment of skilled labour, but it was gravely affecting the recruitment of reliable sufficiently skilled trades people. The current crisis is severe in the sense that workers are stretched thin on projects and as such struggle to deliver on time and more importantly, this affects with quality of their projects. When workers try to make up for this shortfall, they end up recruiting less experienced or skilled workers. This however can lead to mistakes and poor quality which will lead to reworks thereby costing the clients and working teams time and money.

As far as reliability goes, recruiting high quality labour was coupled with the inability to keep this level of skilled trades in one firm. Jake had extreme concerns about the longevity of workers' commitment to single firms: *'Unfortunately, no one is committed to working for one business and the days of starting at 20 years old and staying until retirement are gone. This makes the decision to take on casual labour much easier'*. He believed this culture had become so widespread in the industry and as such organisations who fail to attract new talent face the brunt of the problem.

With the current surge in reports and discussions about skills shortage in the construction industry, around 15% of the survey respondents still 'disagreed' that this was '*actually happening'*.

Firms, whether large, medium, or small are believed to be experiencing financial implications stemming from the severity of the skills shortage.

4.4 Project cost implications of skills shortage

There is a faction of industry professionals that argue that the skills shortage does not have a

direct correlation with increased cost of construction. In response to this, Mike stated emphatically: '*It's short-sightedness. I can't understand why some industry professionals express this opinion. If there was a greater talented pool to choose from, the competitiveness and costs would even out'.* There was an example to debunk the idea of project cost not being adversely affected by the skills shortage. *'Quality control and the remediation of poor works in construction'* were described as some of the indirect implications of the skills shortage, thereby requiring further works and consequently additional costs. An overwhelming majority (73.5%) believe that the skills shortage in the construction industry is contributing to the rising cost of projects. It is understandable how skills shortage affects project cost in an adverse manner. The effects can be direct or indirect. If time and/or quality are affected by the lack of workers (including less competent workers), there will be an impact on the project cost. Furthermore, when there is a high demand for skilled workers, the cost of hiring competent workers for the project will understandably increase thereby affecting the project cost.

A further explanation of how project costs were being driven up by the lack of skilled trades was offered by the interviewees:

> *'I think that the competitiveness drives up the cost of construction. Skilled operatives are in high demand and often it's whoever offers the most money, gets the resource. This is why the cost of construction is spiralling… 'Bricklayers are putting their prices up because they know projects need to be completed on time.'* – Mike
>
> *'Unfortunately, firms are not prepared to spend thousands of pounds, if they're not going to save thousands of pounds.'* – Tom

Jake offered an additional explanation in relation to the increasing costs as a result of the lack of skilled personnel; *'...pay will go up naturally with a skills shortage'*. There was a basic play of economics at hand i.e., due to the lack of skilled trades people and the increasing demand stretching further above the supply; there was a logical increase in the cost of labour and the overall project costs for that matter.

For the sceptics, Mike was critical in his response to them: *'I definitely do not agree that the skills shortage does not contribute to the rising cost of construction'*. Jake who had earlier alluded to the ease of entry into the industry being partly responsible for the current predicament, added that the requirements to enter the industry are quite low and as such should not affect construction costs. He also compared the construction industry to becoming a lawyer where '*it might take 7-8 years of training'*. He believed if people found it challenging to enter the industry, they would cherish the accomplishment dearly and moreover, the ease of entry often leads to the ease of exit thereby using the construction industry as a temporary employment platform.

4.5 Effects of the skills shortage on time, cost and quality (TCQ)

As highlighted by industry professionals, academics and policy makers over the years; TCQ of projects are always affected adversely by the level and availability of skilled trades. The previous section discussed cost implications of the skills shortage. However, TCQ have been known to affect one another. A supermajority of the questionnaire respondents (70.6%) admitted that quality issues are a major concern for them when considering the skills shortage in the sector. This was also acknowledged by the interviewees as they shared further details. As

Mike had played the role of principal contractor in many large projects, there was concern about the quality of project delivery: '*the quality issues are the biggest consequence'*. This was a particular concern when working with unknown recruits from subcontractors. He further added: *'Basically, you're stepping into the unknown. You don't know the quality of that operative's work or the experience they hold. Businesses can do more by sharing greater feedback on their supply chains. This way we'll known the best operatives in the market and the ones to avoid'*. The idea of knowledge sharing feedback on subcontractors was common practice but was banned as the revelation of blacklists that large contractors were using as punitive measures for workers whom they had disagreements with.

For less skilled labour to undertake certain activities on projects, considerations must be made. These will in essence affect TCQ of the activity. Time will be affected due to the lack of familiarity and experience with the given task. Additionally, since there are no test run projects, clients cannot expect any less from the project teams, thus quality cannot be compromised. A typical scenario was presented by Jake:

> *'For example, a qualified electrician might cost a business £30 an hour with direct labour expenses and a van. Whereas you might be able to source a labourer or fitter for £12 an hour. You could almost employ two and a half labourers or fitters for the price of one electrician'*.

By this logic, it would be more beneficial financially to employ a qualified electrician to supervise the labourers or fitters. He admitted this could affect the time of completion and the quality of finish. Furthermore, less experienced labourers may not understand the underlying

reasons behind sequential steps in work and may end up cutting corners without understanding the practical implications on safety or the life cycle of the completed project.

As clearly indicated in the findings so far, the problem of the skills shortage is evident and must be reduced if the industry is to succeed.

4.6 Tackling the industry's skills shortage

4.6.1 Government mandate

It is well documented that government support through public procurement measures are very important in implementing change in many industries including construction.

'We used to have a large directly employed workforce, but due to the costs and managing the workforce, it wasn't feasible… We've now got around 30-40% of directly employed operatives because it's cheaper'- Jake. Jake believes this mandate can only cover the main contractor, but the main contractors predominately subcontract all roles that require skilled trades thereby circumventing the obligation.

> *'The problem with mandated employment is it's expensive. There's no doubt that you can employ someone from an agency for 30-40% less than you can by directly employing them… [Direct employment] is a costly solution'* - Tom.

It is added that the there is evidence of the costly nature in the recent uptake of in extensive use of subcontractors and 'zero-hour' contracts for various forms of labour on projects. This has even become more beneficial to shareholders and overall organisational profits as workers and the subcontractor firms are only paid when projects are in play i.e., no loss of funds by the contractors when there are no ongoing projects. In line with the above, it

was also noted that *'it's unaffordable to employ somebody directly. Perhaps this is led by the JIB [Joint Industry Board], which are compulsory trade bodies. Recently, operatives received a yearly 3% rise in wages due to imposed regulations.'* All interviewees alluded to the notion that regulatory and professional bodies could make the issues worse by trying to enforce changes that do not reflect the needs of practitioners.

4.6.2 Educational initiatives – T-levels

Education has always been key to support training for people entering the construction industry. Over the decades, government initiatives have hoped for buy in from employers. However, it has been widely documented that smaller firms are often not interested in such schemes e.g., apprenticeship levies etc. Unfortunately, technical education has often been considered complex. The current T-levels initiative for the sector is facing challenges that past approaches have encountered. Not all interviewees were familiar with the concept. As with other questions asked, the context for this study were very important, so further clarifications were provided. Although it was not widely known, the concept was commended by the interviewees.

> *'I don't know whether they're promoting T-Levels within schools. If T-Levels are to be successful they've got to promote them.'* - Jake

As Tom worked on education reform and related policies, he was knowledgeable on the initiative and added the following:

> *'Perhaps formal work experience or placements. We've discussed the introduction of T-Levels that appears to not be getting a lot of attention in the industry. It seems like a sensible plan to offer school leavers an opportunity to undertake a generic construction*

course.'

Mike added that it may be part of the solution but cannot be revered as the panacea. He adds: *'[In terms of] companies adopting the T-levels, it should be promoted as an option not a fallback option'*. The interviewees all insisted that the other measures to promote the industry including upskilling, government incentives etc. must be promoted in tandem.

5. Recommendations

Several recommendations were identified in the project. All the recommendations considered the data and its interplay with existing scholarly works and outputs form professional bodies' including policies and initiatives. These are given as follows:

- Identification of specific areas of shortage - A clear distinction between the shortage in the industry focusing on professionals and skilled trades. Furthermore, a better indication of which trades are struggling to recruit needs to be publicised further e.g., steel fixing.
- Widening of the recruitment pool - People of minoritized backgrounds (e.g., women and non-whites) need to be further encouraged to join the skilled trades. Women make up about 1% of skilled trades in the construction industry. The industry is believed to be warming up to women and non-white workers according to the interview data.
- Cleaning up the industry image - The industry is known for recruiting people who did not perform well at school i.e., the industry not associated with academic achievement. Accomplishments of trades workers starting from small houses to 'behemoth' structures such as the Shard need to be celebrated to highlight that it takes both formal

and informal knowledge for the industry to be successful.

- Promotion of trades to school level children - Professional bodies, universities and even the entertainment industry (e.g., Bob the Builder) need to further promote the industry to children of school going age to embed construction practices and trades in their curricula to help enhance their appreciation of the construction industry.

6. Conclusions

The UK construction industry's skills shortage has been a highlight in many discussions in the recent decades. Unfortunately, many initiatives both formal and informal, have been introduced by government arms, professional bodies, educational institutions and industry workers unsuccessfully. The industry has shown resilience in times of desperate need of skilled labour, but this has resulted in increased project costs, further delays to timelines and adverse implications on output quality. Furthermore, the industry is still divided particularly with respect to the severity of this skilled shortage.

In this paper, a clear demonstration of the perceived severity and implications on the projects has been achieved using a mixed methodological approach. Complimentary qualitative and quantitative data revealed the concerns of industry players and other stakeholders. Understandably, the alarming situation of the skills shortage has resulted in the introduction of several measures in an attempt to curb the crisis. However, some of these measures have affected the industry adversely especially mandating direct employment in public projects. In circumventing this directive, main contractors have subcontracted labour and skilled trades contracts thus not requiring to directly employ these workers. Furthermore, the industry is not

efficiently tapping into the talent pool of women and BAME members of the community.

It is recommended that the industry's image needs to be promoted further as it not the same unpleasant image that the public knew decades ago. Furthermore, trades must be promoted within schools to create a newfound respect for the industry and its accomplishments for upcoming generations.

This paper is the beginning of a bigger project that seeks to introduce a radical and yet pragmatic measures of minimising the skills shortage in the construction industry.

References

Aboagye-Nimo, E., Wood, H. and Collison, J., 2019. Complexity of women's modern-day challenges in construction. Engineering, Construction and Architectural Management, 26 (11): 2550-2565.

Alencastro, J., Fuertes, A. and de Wilde, P., 2018. The relationship between quality defects and the thermal performance of buildings. Renewable and sustainable energy reviews, 81: 883-894.

CIOB, 2013. Skills in the construction industry [online]. Available: https://www.ciob.org/industry/research/Skills-UK-Construction-Industry-2013 [Accessed 20 December 2020].

CIOB, 2019a. Shortage occupations in construction: a cross-industry research report. Bracknell: CIOB.

CIOB, 2019b. The recruitment and retention of more women into the construction sector [online]. Available: https://www.ciob.org/media-centre/news/women-construction-sector-%E2%80%93-how-industry-coming-together-recruit-and-retain-women [Accessed 20 December 2020].

CITB, 2017. Achievers and leavers: barriers and opportunities for people entering construction [online]. Available: https://www.citb.co.uk/about-citb/construction-industry-research-reports/search-our-construction-industry-research-reports/qualifications/achievers-and-leavers/ [Accessed 22 December 2020].

CITB, 2018. Fuller working lives in construction [online]. Available:

https://www.citb.co.uk/about-citb/construction-industry-research-reports/search-our-construction-industry-research-reports/employment/fuller-working-lives-in-construction/ [Accessed 19 December 2020].

CLC, 2018. Skills workstream; 2018 strategy and action plan [online]. Available: https://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2018/07/Skills-2018-Strategy-Action-Plan-July-2018-v2.pdf [Accessed 2 January 2021].

Dainty, A., Ison, S. and Root, D., 2004. Bridging the skills gap: a regionally driven strategy for resolving the construction labour market crisis. Engineering, Construction and Architectural Management, 11(4): 275-283.

Dainty, A.R., Bagilhole, B.M. and Neale, R.H., 2000. A grounded theory of women's career under-achievement in large UK construction companies. Construction Management and Economics, 18(2): 239-250.

Daniel, E.I., Oshodi, O.S., Arif, M., Henjewele, C. and Haywood, K., 2020. Strategies for improving construction craftspeople apprenticeship training programme: Evidence from the UK. Journal of Cleaner Production, 266: 122135.

Department for Business, Innovation and Skills, 2013. Construction sector infographic: why the sector is important to the UK economy. London: Department for Business, Innovation and Skills.

DFE, 2018a. Employer skills survey 2017. London: DFE.

DFE, 2018b. Employer skills survey 2017. London: DFE

DFE, 2019. T-Level action plan 2019. London: DFE.

Dromey, J., Morris, M. and Murphy, L., 2017. Building Britain's future? The construction workforce after Brexit. London: Institute for Public Policy Research.

Eaves, S., Gyi, D. and Gibb, A., 2016. Building healthy construction workers: Their views on health, wellbeing and better workforce design. Applied Ergonomics, 54: 10-18.

Farmer, M., 2016. Modernise or die. London: Construction Leadership Council.

Get It Right Initiative, 2019. Working together to eliminate error: a strategy for change [online]. Available: https://getitright.uk.com/reports/strategy-for-change [Accessed 28 December 2020].

Gurjao, S., 2017. Inclusivity: the changing role of women in the construction workforce. London: CIOB.

Hamid, W. and Waterman, A., 2018. Analysis of the main causes of cost overruns in construction industry in developing countries and the UK. International review of Civil Engineering, 9(3): 105-113.

HM Government, 2021. T-Levels: The next level qualification (online). Available at: https://www.tlevels.gov.uk/ [Accessed 11 July 2021].

House of Commons, 2019. Women and the economy. London: House of Commons.

Light, S., 2017. Arcadis talent scale: the real extent of Britain’s construction labour crisis [online]. London: Arcadis. Available at: https://www.arcadis.com/media/4/B/9/%7B4B999107-2F44-42E2-94D7-43FDD0963378%7D9784_Talent%20Scale%20FINAL%20WEB_2102.pdf [Accessed 19 December 2020].

Mohamed, M., Pärn, E.A. and Edwards, D.J., 2017. Brexit: measuring the impact upon skilled

labour in the UK construction industry. International Journal of Building Pathology and Adaptation, 35(3): 264–279.

Moncaster, A. and Dillon, M., 2018. How gender equality can help fix the construction industry. The Conversation.

Naoum, S., 2015. Factors influencing labour productivity on construction sites. International Journal of Productivity and Performance Management, 66 (3): 401-421.

Newton, O., 2019. Skills shortages in the UK economy [online]. Available: https://www.edge.co.uk/documents/49/skills_shortage_bulletin_3_final_sTUEWDN.pdf [Accessed 20 December 2020].

Noble, H. and Heale, R., 2019. Triangulation in research, with examples. Evidence Based Nursing, 22(3): 67-68.

ONS, 2019a. Average weekly earnings in Great Britain: July 2019 [online]. London: ONS. Available at: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/bulletins/averageweeklyearningsingreatbritain/july2019 [Accessed 19 December 2020].

ONS, 2019b. Construction statistics, Great Britain: 2018 [online]. London: ONS. Available at: https://www.ons.gov.uk/businessindustryandtrade/constructionindustry/articles/constructionstatistics/2018 [Accessed 27 December 2020].

RICS (Royal Institution of Chartered Surveyors) (2018) Q4 2018: RICS UK Construction and Infrastructure Market Survey. RICS, London, UK.

RICS, 2015. Q4 2015: RICS UK construction market survey [online]. Available

https://www.donseed.com/wp-content/uploads/2016/01/RICS-UK-Construction-market-survey-Q4-2015.pdf [Accessed 19 December 2020].

RICS, 2019. Q3 2019: RICS UK construction and infrastructure market survey [online]. Available: https://www.rics.org/globalassets/rics-website/media/knowledge/research/market-surveys/archive/rics_uk_construction_and_infrastructure_survey_q3-2019.pdf [Accessed 27 December 2020].

Saraswat, A., 2016. Higher apprenticeships and the new apprenticeship standards. Higher Education, Skills and Work-Based Learning, 6 (4): 401–416.

Select Committee on National Policy for the Built Environment, 2016. Building better places. London: The House of Lords.

Simpson, K., Janda, K.B. and Owen, A., 2020. Preparing 'middle actors' to deliver zero-carbon building transitions. Buildings and Cities, 1(1): 610-624.

Vershinina, N.A., Rodgers, P., Ram, M., Theodorakopoulos, N. and Rodionova, Y., 2018. False self-employment: the case of Ukrainian migrants in London's construction sector. Industrial Relations Journal, 49(1): 2-18.

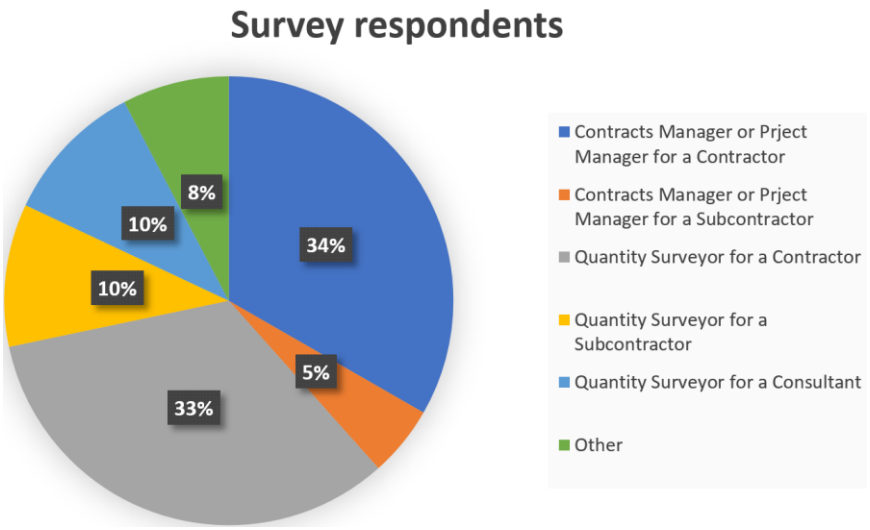
Zhang, R., Zhou, A.S., Tahmasebi, S. and Whyte, J., 2019. Long-standing themes and new developments in offsite construction: The case of UK housing. In Proceedings of the Institution of Civil Engineers-Civil Engineering, 172(6): 29-35.

Table 1. Interviewee profiles

Name	Position	Years in industry	Type of projects	Contractor type	Sectors & Key areas
Mike	Senior Contracts Manager	5+	Large	Principal contractor	Property development Aviation Education Healthcare Defence Science & Research Commercial and industrial
Jake	Senior Contracts Manager	5+	Varied	Subcontractor	Property development Education Healthcare Commercial and industrial Retail Education
Tom	Executive Director	5+	Varied	Consultant/ Independent Education Foundation	Policy influence Education Government Advisor

Accepted manuscript
doi: 10.1680/jmapl.21.00011

Figure 1. Survey respondents' roles



Accepted manuscript
doi: 10.1680/jmapl.21.00011

Figure 2. Ranking the causes of skills shortage