Talent as a Spearhead of Construction 4.0 Transformation: Analysis of Their Challenges

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Abstract. Global industries are investing in technology to accelerate digital transformation. Construction is also most likely to be digitalised based on current technology trends. However, technology adoption is not the only ingredient to successfully transform the construction industry towards the fourth industrial revolution (4IR). This transformation requires additional changes for the employees. It is expected to significantly impact the talent landscape, ranging from job categories to skill sets. While this transformation holds excellent benefits, it also poses many challenges. This paper discusses the challenges that individuals, construction companies and governments face from a talent perspective. The data is obtained from literature review results and content analysis through focus group discussion. A focus group discussion was conducted among experts with high knowledge in both the construction industry and 4IR. Information obtained from the discussion was used to identify and categorise the determining challenges. The study revealed nine (9) major talent challenges that the construction industry is currently facing, such as inadequate high skilled talent, lack of education and training to widen talent readiness, talent job security, lack of awareness or clarity of 4IR, dependency on outside talent, employer’s readiness, negative attitude of future talent towards changes, the potential of emigration of highly trained or qualified talent, and strong resistance towards new changes and technologies. 4IR can be implemented effectively in the Malaysian construction industry if key challenges that hold the talent are overcome. In conclusion, an active role from quadruple helix collaboration positively assist the transformation.

1. Introduction

Shifting to the fourth industrial revolution (4IR) can improve the work condition where dangerous and strenuous tasks are replaced with safer and more efficient technology innovations and inventions. For
example, autonomous construction implementation such as drones can help track current project progress [1], especially in hazardous conditions or large areas, without putting workers at risk.

The previous three revolutions should be defined first to concisely understand the term “Fourth Industrial Revolution”. The first revolution brought changes through the creation of steam engine; the second revolution characterised by electricity for mass production, and the third revolution began at the end of the 20th century with information technology as a backbone, culminating in the significant advances made in the Information and Communications Technologies (ICT) [2]. Then, digital integration and intelligent engineering led to the next level of revolution, named the fourth industrial revolution. This revolution represents a fusion of technologies that allow smart, autonomous, and decentralised environments to happen [3]. The fourth industrial revolution (4IR) term has been used interchangeably with Industry 4.0. To simplify, the Industrial Revolution represents the development of industries over the years in terms from as a result of technology maturity. Thus, 4IR represent the latest technology development. Nevertheless, industry 4.0 is a term that focuses on the manufacturing industry and has a similar concept to "Integrated Industry", "Smart Industry", or "Smart Manufacturing" [4]. From the construction industry perspective, similar ideas can be found under the terms Construction 4.0 [5][6] or digital construction [7].

Construction 4.0 brings tremendous positive impacts towards society, economic, and governance aspects of the construction industry. It heightens the expectations while enriching opportunities within this industry. For instance, Unmanned Aerial Vehicles (UAVs) helps in monitoring the progress of construction projects [5]; advanced material construction produces lightweight structural components that help to reduce waste CO₂ emission and energy consumption [5]; and BIM enhances the current communication process, provides a collaborative platform, and supports interoperability [8]. Overall, there is a modestly positive impact not only in the construction industry but, potentially create ripple effect across industries.

However, this transformation requires more than mere technology implementation. It is impossible to transform successfully without uplifting current talent. The talent is profoundly essential but often forgotten during the transformation process. Talent is defined as individuals who can make valuable contributions to the company and its operational performance [9]. Today’s technological advancement will change how people work and lead to new job creation. According to World Economic Forum [10], 65% of children will ultimately work in entirely new job categories that do not exist yet. For instance, artificial intelligence is seen as a technology that allows robots to replace human tasks. While this transformation holds excellent benefits in enhancing the working process, it comes with challenges. As mentioned in World Economic Forum [11], the construction industry will face challenges in recruiting talent in the future. Sirotek and Firlus [12] noted that the biggest trigger to the 4IR adoption is the availability of skilled labour. As the Construction 4.0 continues to grow, it is crucial for the Malaysian construction industry to address knowledge expansion on talent issues niche. Discussion on aspects of how Construction 4.0 continues to change how and where people work, new challenges are generated are precursors towards the Construction 4.0 success.

Hence, this paper aims to address the following research questions: 1) What challenges are posed by Construction 4.0 from a talent perspective? and 2) How to solve the talent gap in 4IR in the context of the construction industry? This paper will be presented in five sections. This paper begins with an assessment of the construction industry’s state towards 4IR, followed by building up the research question and theoretical background on 4IR in section 2. Section 3 discuss on the methodology of the study. Section 4 explores the finding and results of the study which followed by a discussion of the theoretical. Conclusion and future research are addressed in section 5.

2. Literature Review
The section involves a review of current literature and answering research questions concluding with talent gap identification.

2.1. Construction 4.0
Construction 4.0 is a term adopted from industry 4.0 and widely used to represent the 4IR in the construction industry. Several documents have mentioned this term, such as the Malaysian
Construction 4.0 Strategic Plan (2021-2025) and the report by Roland Berger [13]. The European construction industry federation (FIEC, 2015) mentioned: “Fourth industrial revolution, known for all EU industry as “Industry 4.0”, is known in our sector as Construction 4.0.” One of the difficulties in defining construction 4.0 is that different people have different interpretations. To clarify this term, this paper presents the following definition. Construction 4.0 is characterised by integrating two pillars: digitisation of the construction industry and industrialisation of the construction process [14]. As noted by Osunsanmi et al. [15], it represents digitalisation where a set of technologies work together to enhance project performance and increase client satisfaction. Another definition proposed by Chen et al. [16], Construction 4.0, is reusing technologies younger than 20 years in the design and construction processes to help increase productivity.

The construction industry is falling behind other sectors, such as services, manufacturing, and agriculture, regarding their contribution to Malaysia’s economy. Their contribution is relatively small as compared to other sectors. In 2020, the construction sector contributed 0.4 per cent to the growth of Malaysia’s economy, contracted 19.4 per cent from the preceding year due to restrictions on the economy imposed in response to the COVID-19 pandemic [17]. Despite the COVID-19 situation, digital adoption in all Malaysian sectors, including construction, has been accelerating. Thus, their impact should be highlighted, especially in 4IR, as it is related to other sectors’ success.

2.2. Challenges faced by construction industry talent

COVID-19 situation has helped in accelerating digital adoption in all Malaysian sectors, including the construction industry. Due to Movement Control Order (MCO) restriction enforced by the Malaysian government, all construction activities have stopped working unwillingly. Through the advent of technologies, project monitoring, status tracking, and scheduling tasks can still be done online instead of face-to-face meetings [18]. Therefore, embracing construction 4.0 will equip the industry with the right technologies, especially during these difficult days.

While the impending change holds great promise, it also posed many challenges. The main challenges are mainly associated with human resources [19][20]. Malaysian construction industry faced problems such as shortages of human resources and a dearth of productivity [21]. According to World Economic Forum [11], the new revolution will struggle to recruit the “digital” talent plus the image of low job security posed by the construction industry. Utting [22] explained that skills shortage usually occurs when employers cannot fill in the specialised skill needs within that occupation. Labours’ qualification holds a vital key towards the project productivity enhancement as lack of skilled labour influences the decline in construction project productivity [23]. Tariq & Sonntag [24] attempt to study the benefits and challenges through a survey study. Three significant challenges were identified: knowledge limitation, financial resource limitation, and technology awareness limitation. Even though it shows challenges from different perspectives, knowledge limitation can be considered under the talent concept. More barriers or obstacles in Construction 4.0 implementation are identified in table 1.

| Barriers                                           | References                  |
|---------------------------------------------------|-----------------------------|
| Skill shortage                                    | [25], [26], [27], [28], [29], [30], [31] |
| Lack of understanding of disruptive changes        | [10], [24], [26], [27], [29] [32], [31] |
| Workforce strategy not aligned to innovation strategy | [10], [26], [29]            |
| Lack of worker acceptance                         | [26], [27]                  |
| Talent off-boarding                               | [33]                        |
| Job disruptions                                   | [30], [31]                  |
| Resistance to change                              | [30], [32]                  |
To prevent a worst-case scenario, the individual can take a proactive approach by upgrading their skill through self-learning or attending training. Relying too much on the company’s initiative can hinder the progress of development. Therefore, there is a need to identify talent barriers and factors that could support strategies, inducing a smoother transformation of construction 4.0 technologies.

2.3. Solving the talent gap in 4IR in the context of the construction industry
Implementing new technology and jump on board with Construction 4.0 is not an easy journey. There are always challenges when it comes to transformation. The transformation is possible provided concerted efforts from quadruple helix (industry, government, academia, and users/civil society). Table 2 introduces the strategies developed from the literature review to solve the talent gap in Construction 4.0.

| Strategies                                      | References        |
|------------------------------------------------|-------------------|
| Human resource competencies assessment         | [34], [35]        |
| Training programmes                            | [10], [24], [34], [36] |
| Review of different human resource development initiatives | [34], [35], [36] |
| Attract multi-skilled or new talent recruitment through attractive strategies | [34], [36] |
| Promote transparent career paths to avoid employees’ uncertainty about career options | [36] |
| Collaboration with educational institutions    | [10], [36]        |
| Promote initiatives that spur innovation and improve industry attractiveness | [36] |
| Apprenticeships and academic programmes        | [10], [36]        |
| Collaboration in and across industry           | [10]              |

To support the above strategies, there must be strong collaboration from the quadruple helix. For the government, strong policies or attractive initiatives are needed to support the process. For industry, they need to put talent development and skills requirements at the centre of their growth. For academia, they need to introduce and increase the awareness of future talent towards 4IR. For users/civil society, they require a new mindset to meet the expectation of the future.

3. Methodology
This paper involved input from many leading companies along the construction value chain, such as contractors, project owners and developers, academics, and government and civil society leaders.

3.1. Data Collection
The data were collected from the focus group discussion session among construction experts across the Malaysian construction industry stakeholders. The participants of the focus group was chosen due to their ability providing trustworthy insight on human behaviour aspect [37]. Participants for this study were selected according to the criteria of: 1) position, 2) directors and senior leaders within engineering-led organisations, 3) knowledge, and 4) implementation of at least one of Construction 4.0 enabling technology in their organisation. The reason directors and senior leaders were selected because they have a deep understanding on organisational structures and problems faced in the process of introducing 4IR.

Few studies reported that the appropriate size ranges from as few as four and as many as fifteen [38,39]. In this study, a total of 32 participants were involved the session. The participants were further divided into five groups, A, B, C, D, and E, and led by a moderator in a loosely structured discussion style. Each group must consist of different domains of the construction industry. A large group may be beneficial in generating more opinions. In contrast, a smaller group is favourable to decipher sensitive
issues as 4IR is still embryonic and more opinion matters. Figure 1 and Figure 2 illustrated the tabulation of respondents involved during the discussion session.

![Figure 1. Participants’ working experience.](image1)

![Figure 2. Participants’ level of management.](image2)

Figure 1 shows that majority of the respondents have 16-20 years of working experience in the construction industry. According to their work experience, it can be assumed most of the participants who attended the discussion has a vast knowledge of the company from project, financial, and staff management. They manage the construction project at the site and delivers the information of all construction activities to associates. Figure 2 describes participants’ management level, and the result shows that more than half of the participants were senior executive level. They are individuals at the highest level of control and able to give the information needed.

3.2. **Data Analysis**

A blank butcher paper was presented during the discussion session, and participants need to discuss and brainstorm all challenges of 4IR in construction in a group assigned at the early stage. Their responses will be recorded both on butcher paper and laptop. The content analysis method will be used to analyse the result. Content analysis provides a systematic coding of data by categorising the information to discover patterns undetectable by merely listening to the conversation recorded [39]. In the first place, the challenges listed were documented. The study identified 20 elementary challenges. They were next, sorted, classified, and grouped by their central element. Similar challenges will be grouped into one prominent obstacle. Then they were commented and, in some parts, transformed into a proper form. The final list consisted of 9 talent challenges and problems in 4IR adoption.

4. **Result and discussion**

The results of the survey are discussed in this section. The analysis revealed important findings of challenges in the construction industry to 4IR from a talent perspective.

4.1. **Challenges of talent for 4IR in construction**
In response to the first research question, this paper identified the same challenges as the literature and also identified an additional challenge focused on talent among construction workers.

This paper identifies nine (9) major challenges that can harness the transformation and adoption process: (1) inadequate high skilled talent, (2) lack of education and training to widen talent readiness, (3) job security, (4) lack of awareness or clarity of 4IR, (5) dependency on outside talent, (6) employer’s readiness, (7) negative attitude of future talent towards changes, (8) the potential of emigration of highly trained or qualified talent, and (9) strong resistance towards new changes and technologies.

Based on Table 3, the result analysis shows that the participants highly agree that inadequate skill talent is the most challenging part of digital construction. It contributed to 80% of level agreement (four out of five groups agreed). Introducing 4IR means individuals need to prepare themselves with high skill and have a high literacy. Lack of qualified personnel is frequently mentioned in 4IR related literature papers [29]. The most demanding skills are information and data literacy, communication and collaboration, digital content creation, safety and security, and problem-solving [40]. Therefore, attending training or any related 4IR courses is one of the best ways to upgrade talent skills.

Table 3. Challenges relating to talent in adopting 4IR in construction.

| Representative challenges quotes | Central challenges | Group Frequency | Agreement level |
|---------------------------------|-------------------|----------------|----------------|
| Lack of skilled labour          |                   | / 4/5          | 80%            |
| Insufficient talent pool supply |                   | /              |                |
| Talent availability             | Inadequate high skilled talent | /              |                |
| Skilled resources availability  |                   | /              |                |
| Education and training readiness|                   | / 3/5          | 60%            |
| Education readiness             | Lack of education and training to widen talent readiness | /              |                |
| Lack of skilled student skill   |                   | /              |                |
| Lack of demand (project)        |                   | / 3/5          | 60%            |
| Job security                    |                   | /              |                |
| Not enough jobs of the future to cater to industry | Talent job security | /              |                |
| Awareness on 4IR               |                   | / 3/5          | 60%            |
| No benchmarking of the status of 4IR | Lack of understanding or clarity of 4IR | /              |                |
| Lack of awareness               |                   | /              |                |
| Enforcement of foreign workers  |                   | / 2/5          | 40%            |
| Dependency on outside talent    | Dependency on outside talent | /              |                |
| Employer’s readiness            |                   | / 2/5          | 40%            |
| No clear vision, objective      | Employer’s readiness | /              |                |
| Wrong attitude of students      |                   | / 1/5          | 20%            |
| Emigration of highly trained or qualified people | The potential of emigration of highly trained or qualified talent | / 1/5          | 20%            |
| The existing workforce is in the comfort zone | Strong resistance towards new changes and technologies | / 1/5          | 20%            |

Next, digital transformation to Construction 4.0 will bring a challenge to job security. Three out of 5 groups agreed on the impact of job security, which contributed to 60% of the agreement level. The
advent of 4IR will increase the dominance of technology cause fears of individuals over future job security. Then, the challenges followed by lack of education and training to widen talent readiness with an agreement level of 60% (three out of five groups agreed). A financial problem can be noted as one of the main problems leading to a lack of education and training readiness. As mentioned early, the high cost of training, education, and consultant fees [27] demotivated construction employers towards transformation. In this context, the development of cost-benefit analysis costs can help estimate implementation costs and the profit obtained in the future [27]. Even though a high price is needed at the earlier implementation stage, significant benefits can be found later. Thus, appropriate education and training programmes must be included in the strategic development.

In this study, the lack of understanding or clarity of 4IR is highlighted as a barrier with an agreement level of 60% (three out of five groups agreed). It can be supported with a survey from Future of Jobs[10]; 51% of the construction players lack understanding of the disruptive changes. This result can be related to timid actions being taken by companies to adopt 4IR due to insufficient understanding and awareness. However, in few cases, the awareness of digitalisation is well understood, but the definition of construction revolution and industrial revolution are not well-defined. It causes another problem of unclear status either from people or from the organisation dimension. In this context, a guideline for successful implementation concerning the specific characteristics and requirements of the construction environment can be provided for companies to consider before implementing new technologies [27] to increase the level of understanding and clarity among individuals or organisations.

The other challenges that construction 4.0 faces are dependency on outside talent and employer’s readiness, which contributed to 60% of the agreement level. It is followed by the wrong attitude of students (20%), emigration of highly trained or qualified talent (20%) and the existing workforce is in the comfort zone (20%). Identifying this readiness is significantly needed as it will enable companies to measure shortages and future steps towards the digital transformation process [41]. Gürdür et al. [42] stated in their study that companies need a roadmap for organisational readiness assessment purposes. If this problem is not well addressed, this will eventually create a digital divide on the organisation and industry level. The organisations or industries with inadequate focus on digitalisation will be wiped out and left behind from the market. As mentioned in the table above, some construction players show a strong resistance towards the transformation. Most of the reason is due to their reposeful feeling with the conventional method. Changing to Construction 4.0 will force them to move from their comfort zone. In conclusion, moving forward to 4IR, the construction industry talents need to enhance and speed up their adaptability in technology advancement to avoid being left behind by other industries.

5. Concluding remarks
The construction industry is one of the least digitised industry in the country. Industry4WRD, initiated by the manufacturing industry, was introduced back in 2018, while Construction 4.0 strategic plan has just been announced earlier in 2021. Even though it is a bit late compared to the manufacturing industry, Malaysian construction's positive effort should be praised. The output of this research shows that he construction industry positively catching up on information digitalization, communication, and collaboration. At the end of the process, the adoption will pave the way for more advanced vital technologies and increase the efficiency and productivity of the industry.

This paper has shed light on the aspects of 4IR adoption and its talent gap. Therefore, a holistic shift of talent in the context of awareness, education, skill, and competencies should exhibit the era of 4IR, especially in the construction industry. The future talent needs to be highly adaptable, resourceful, resilient, and interdisciplinary for interaction and collaboration in the industrial market [40]. Whether this emerging technology will influence the job security in a company is also a question worth pondering. At this moment, it is important for talents to prepare themselves with training, and taking active role to improve their lifelong learning. In a nutshell, efforts to close the talent gaps among construction players need to be grounded based on future skill requirements due to rapid technological changes.
6. References

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