

## Digital Transformation is the New Norms in Construction Industry

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**Abstract** – Covid-19 pandemic has had severe consequences for the country's economy especially in the construction industry. The Movement Control Order (MCO) period has restricted the non-critical construction industry to be temporarily suspended and under-interest to be closed. This restricts direct interaction between the parties involved in the construction phase of the project. Therefore, various digital technologies are now capable of increasing collaboration virtually, increasing employee motivation and new ways of working on new norms. The objective of this study is to identify the types of technologies used in construction projects management during the pandemic. Also, to identify the problems faced by project management in adapting digital technology and its solutions. The study method used for these objectives is through the e-questionnaire medium. It has been analysed using nominal and ordinal analysis. This study was conducted on small-medium class construction firms, G1-G5 and the large class, G6-G7 in the field of contractor and project manager during the construction phase covering the entire state of Johor, Malaysia. The results of the study found that the technology that is often used is connectivity element which is text message, email, 5<sup>th</sup> generation broadband network, cloud storage and teleconferencing. The problem is that it requires digital knowledge, skills and requires rapid access to the internet. Then, initiative that can be taken by provide skills training in technology control and the implementation of new technology transformation.

*Keywords – Digital Transformation, Project Management, Covid-19*

### I. INTRODUCTION

Covid-19 pandemic has forced all construction companies through a difficult situation in carrying out their duties and commitments as a result of the closure and blocking phase of movement in each state [1]. It requires the contractor's commitment to maintain social distancing to reduce the rate of infection to other individuals. The Movement Control Order (MCO) has temporarily blocked non-critical construction and all less interested construction-related industries had to be closed during MCO [2], [3].

According to [4], contractor and project manager face problems of non-compliance with contract terms due to the suspension of projects, the fluctuation of the price of building materials in the middle of the Covid-19 pandemic, job losses and

shortages of labor workers have a great impact on a project to continue and maintain the flow of project progress and cash flow at new norms. Some foreign workers may also choose to return to their respective countries due to fears and risks of Covid-19. All of these implications demand drastic changes in the construction industry to adjust the new working procedures following the MCO guidelines in Malaysia country which became the new norm [2].

The emergence of the latest technology through practical construction is able to produce faster, safer and effective decision-making. Current technological trends such as 3D BIM, cost modeling and construction schedule with 5D Macro-BIM, pre-fabrication or modular construction, power saving building systems, smart buildings, robotic automation and 3D printing help contractor and

project manager in all phases of construction management such as logistics, pre-construction work, acquisition, project design, project construction, marketing, and nexus interaction between all project parties [5]–[7].

Therefore, digital technology is able to make the construction process on the project development more secure and efficient, resulting in an increase in productivity among contractor, project manager and other parties involved in the project even less interaction in order to be able to achieve the main goal in a project [8]. It also allows construction firms to handle more complex projects during the Covid-19 pandemic with the help of construction digital technology that can assist in the process of analysis, managing, documenting, video and call conferencing the project information deliver through virtual [9], [10].

The purpose of this study is to identify the digital technologies used in the construction of projects management, problems in adapting to digital technologies and initiative needs from construction firm during the pandemic.

## II. MATERIALS AND METHOD

The studies were conducted as deductive approach which is from literature review analysis convert the knowledge to variables for this study. The needs and interests of digital technology during the pandemic [11], the advantages and disadvantages of digital technology [12],[13] challenges and steps that need to be taken by construction industry in the use of digital technology in the construction project management [14] is variables being considered in this study.

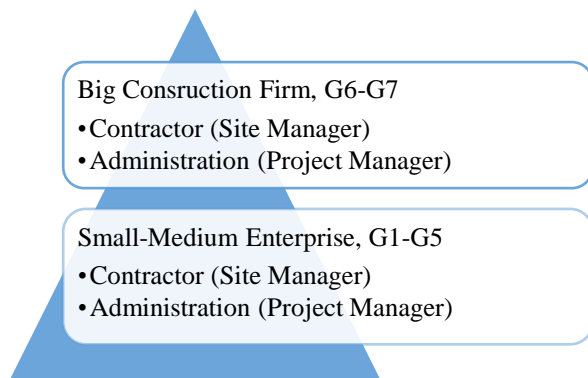


Fig. 1 Research Scope

The study scope is focused on construction firm from Grade 1 to Grade 7 as ‘G’ represent the CIDB

grading system, the highest level at which the contractor is allowed to complete projects and the category of works for which they have been certified to complete projects. This indicates the technology being used by particular construction firm need according to their specialization.

The study method used for these objectives is through questionnaires through the medium of e-questionnaire. It was analyzed using nominal and ordinal analysis. The list of respondents of contractor firm G1-G5 represent small-medium enterprise (SME) and G6, G7 represent Big firms in the field of contractor and project manager in the construction phase covering the entire state of Johor, Malaysia. The number of contractor and project manager representing each party is derived from the Construction Industry Board (CIDB) website. The following table shows the sample sizes obtained.

Table 1. Number of Construction Contractor Firms in Johor

Contractor Grade	District: Johor	Construction Firm Size	Total
G1	5271	SME	11397
G2	2893		
G3	2166		
G4	536		
G5	531		
G6	130	Big	855
G7	725		
<b>Total</b>	<b>12252</b>		<b>12252</b>

Table 2. Krejcie & Morgan; Determining Sample Size Based on Population

Population	Samples
9000	368
10000	370
15000	375
20000	377

Therefore, for the determination of the required number of samples, the Krejcie Morgan sampling method is used to represent the entire population where maximum 370 respondents required. The size of this sample is enough to represent the entire population. As a result of the study methods used, the quantitative primary data was obtained for analysis. Therefore, 250 respondents who were willing to give feedback and cooperation to make this study success.

### III. RESULT

#### A. Digital technology used in project management during the pandemic.

There are twenty-one digital technologies that have been identified and classified into four elements as shown table below.

Table 3. Ranking of digital technology used

Rank	Element	Digital Technology	Freq.
1	Connectivity	Text message, Emails	98%
2	Connectivity	Internet and Wi-Fi	96%
3	Connectivity	Cloud Storage	95%
4	Connectivity	Conference Calls	91%
5	Connectivity	Teleconferencing	84%
6	Emerging Technology	Internet of Things	77%
7	Digital Access	Scheduling Software	50%
8	Digital Access	Estimation Software	50%
9	Digital Access	SaaS Construction Software	50%
10	Digital Access	Construction Productivity Software	43%
11	Digital Access	Collision Detection Software	34%
12	Emerging Technology	BIM technology for 3D modelling	27%
13	Automation	Cognitive Technology/ Artificial Intelligence	27%
14	Emerging Technology	Pre-Fabrication/ Modular Construction	23%
15	Automation	3D Printing/ Additive Manufacturing	20%
16	Emerging Technology	Virtual Reality/ Augmented Reality/ Mixed Reality	18%
17	Emerging Technology	Big Data (E-contract, E-procurement)	17%
18	Automation	Manufacturing/ Warehouse Robot	14%
19	Emerging Technology	Drone Technology	11%
20	Automation	Automation Robotic Process	14%
21	Emerging Technology	Light Detection and Ranging (LIDAR)	9%

Text messages, e-mail (98%) is seen as a type of digital technology that is often used in the construction project management. The second and third higher is 5G internet, Wi-Fi (96%) and cloud storage (95%) with unlimited speed internet connection makes it easier for contractor and project manager to access project information in the daily project with the help of cloud storage.

Digital technology that is underused is drone (11%) because it is likely to be used only for large-scale projects and requires large capital. Automation processing robots (14%) is likely not suitable for use in the construction firm, especially in limited work space in construction site as it requires a large processing space to operate and high cost maintenance. Moreover, this technology has always been used in the manufacturing industry [15]. The lowest use of digital technology is Light Detection and Ranging (9%) due to the high cost of technical equipment and limited labour expertise proficiency in using LIDAR technology on the construction site to read and process data from this technology.

#### B. Problems in adapting digital technology at the new norm

Table below shows the rankings for problems identified by the mean range method.

Table 4. Ranking the problem in using digital technology from social aspect

Rank	Problems encountered	Mean range
1	Requires digital skill knowledge and proficiency.	4.02
2	Digital skill labour shortage proficiency.	3.75
3	Firm's perceptions, thinking and ideology are low about digitalization that driving force of digital innovation.	3.66
4	Build and form the necessary skills.	3.55
5	Create and form digital competencies.	3.55
6	Coordinate resources and team management in the implementation and execution digital technology.	3.52
7	New practice the workings of new digital technologies.	3.48
8	Acquire the digital knowledge and skills required by subordinate.	3.45
9	Attract new talent to the workforce.	3.25
10	Redesigning the organization.	2.84

In social aspects, requiring knowledge and skills in using digital technology in the project shows that the mean rate is 4.02 which is in the first rank that many of the contractor and project manager agree on this problem while reorganising the organization has the least agreement with 2.84 because need a lot of internal changes in terms of specialization in organization structure.

Table 5. Ranking the problem in using digital technology from technology aspect

Rank	Problems encountered	Mean range
1	Fast and efficient internet access.	4.24
2	Adjusting the workforce in the use of new technologies.	3.61
3	Combination of technology and humans in a new way of performing work tasks.	3.59
4	Motivate construction firm in adopting new technologies.	3.57
5	Broadband connections are less common in all regions.	3.48
6	High cost of training and courses.	3.34
7	Capital investment for labour replacement	3.32
8	High cost of execution.	3.20
9	Invasion and abuse of privacy.	3.20
10	High cost of technical equipment.	3.11

In technology aspects, the highest mean rate identified was 4.24, where contractor and project manager thought that the main problem in using digital technology in terms of technology is the need for fast and efficient internet access while the least agreement with 3.11 mean range shows that cost of technological equipment is expensive which need a huge capital by construction firm.

### C. Initiative in adapting digital technology at the new norm

Table below shows the rankings for initiative being identified by the mean range method.

Table 6. Ranking the initiative in using digital technology from social aspect

Rank	Steps taken	Mean range
1	Improvement of the quality of the work culture.	4.15
2	Subordinate knowledge based on innovative and creative thinking.	3.95
3	Proficiency training in controlling new technologies to local workers.	3.84
4	Provide the necessary skill positions.	3.80
5	Coordination of resources and management in stages and in batches for the implementation of new SOPs.	3.77
6	Worker motivation in the use and implementation of digital technology through rewards.	3.75
7	Sharing of digital knowledge and skills from leaders	3.73
8	Provide skills training in producing multiskilled workers.	3.61

9	Joint ventures from government initiatives in producing workforce skills in the future.	3.48
10	Support from the organisational structure in providing a digital construction program platform.	3.39

In social aspects, the highest initiative that can be taken by a construction firm with mean range 4.15 is the improvement of the quality of work by providing digital skills training in the handling of new technologies while the support from organization structure in digital program platform at the last rank with 3.39 mean range.

Table 7. Ranking the initiative in using digital technology from technology aspect

Rank	Steps taken	Mean range
1	Implementation of new technological transformations.	4.22
2	Getting government support in tax exemption incentives	3.86
3	Willingness to change skills and the gradual adoption of technology	3.84
4	Enhancing new technologies and new equipment.	3.77
5	Willingness in making capital investments in new technologies.	3.74
6	Government support in the provision of funds to employers in promoting the use of technology.	3.73
7	Capital investment in skills training programmes to enhance work skills.	3.70
8	Obtain government support in the provision of grants/funds.	3.68
9	Safety of data storage through the privacy of the company's storage	3.55
10	Designing a new organization that implements democratic approach	3.35

In technology aspects, the highest mean range is 4.22 which is initiative construction firm to adapt fundamental digital technology in project management as implement digital skill and knowledge among workers while the lowest mean range is 3.35 where creating a new organisation with a democratic management style [16].

## IV. DISCUSSION

### A. Digital technology used in project management during the pandemic.

The majority of contractor have awareness the use of digital technology in construction projects

management during the pandemic. Table 8 show the ranking of digital technology element.

Table 8. Ranking of digital technology element

Rank	Digital Technology Element
1	<i>Connectivity</i>
2	<i>Digital access</i>
3	<i>Emerging Technology</i>
4	<i>Automation</i>

Digital technology that often used is communication where to interact with operation on-site and off-site management. With 5G internet and Wi-Fi, digital medium such as e-mail and text message help contacting directly parties involved at the same time store informations in cloud storage such as one drive [17]. Teleconferencing is very helpful in terms of virtual communication with other parties involved especially client, sub-contractor, suppliers in managing construction projects [18]. Therefore, connectivity is an element that must be used by project management in virtual interacting with workers and parties involved.

Digital technology that less used is automation, because least demanding in terms of large capital and require high skill expertise. Robotic programmes, AI and 3D printing need a specific digital skill expertise to being applied in construction stage which helps contractor and project manager in strategies logistics, preliminary work, acquisition, project design, site supervision and marketing at the same time integrate and collaborate with others construction firm in accelerating the project management process [19] especially in big firms. In long terms benefits, construction firms should consider automation is needed in their project management [20] as a long-term productivity goal.

#### B. Problem in adapting digital technology at the new norm

Construction firms have reported difficulty adjusting to changing social and technology aspects while using digital technologies. Table 9 shows the issues that are considered critical according to every aspect.

Table 9. Problems in adapting digital technology

Aspects	Problems encountered
Social	Requires digital knowledge and skills in the use of digital technology.

Technology	Requires fast and efficient internet access for optimal use of digital technology
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The problem that is considered to be feared from social aspect is the need of digital knowledge and skills in the use of technology required in particular managing project requirement. It is important for construction firms to address the requirement technology need in particular project management. Digital knowledge and skills of contractor and project manager will be able to handle project management centralise with other parties virtually in doing a daily-task especially in handling technology that has never been used [21].

Main challenger in terms of technology is the need for fast and efficient internet access for optimal use of digital technology. Covid-19 pandemic indirectly cause employees to access project information through smartphones and other communication tools with the help of fast internet to make it easier for virtual communication to run smoothly. Contractor and project manager need to adapt a new working culture during work hours at home and outside the site area [21]. Therefore, technological advances need to keep pace with the efficiency and speed of the internet to avoid any disruptions faced during the construction project.

#### C. Initiative in adapting digital technology at the new norm

Construction firms' action in adapting digital technology in social and technology aspects have been identified from the analysis of the study. Table 10 shows the initiative that contractor firms can take according to each aspect.

Table 10. Initiative in adapting digital technology

Aspects	Steps taken
Social	Improvement of the quality of work culture by providing digital skills training in the handling of new technologies.
Technology	The implementation of new technological transformations is adapted among workers to changes in proficiency and use of technology.

The initiative from the social aspect is to improve the quality of work by providing digital skills training in the handling of new technologies. This can be attributed to the problem faced by the

contractor and project manager which requires knowledge and skills in the use of digital technology. With the provision construction firm initiative in digital strategy program and skill training, be able to produce a well-trained, skilled workforce in handling daily task which give positive impact to GDP in construction digital technology demanding [5], [21].

From the aspect of technology, implementation of new digital technology related to particular management project requirement can help workers adapt changes in proficiency and use of technology. For examples, smart contract can help project management to integrate with other parties in terms of claims, e-contracting and many more [18]. In line with CIDB IR 4.0 goals, it encourages the use of digital technology for all construction firms, no matter small firms or large construction firms as digital disruptive era where digital technology is one necessity in achieving productive construction projects [5], [22].

## V. CONCLUSION

This study found that more than 70% of contractor and project managers use connectivity element of digital technology which is used on-site and off-site for virtual interaction between parties involved in construction projects in data collection, discussion, documentation, analysing data to facilitate the delivery of information and access by all parties involved virtually [23], [24]. Internet access, teleconferencing for formal and informal meetings, cloud storage, text messages and emails are used by all project managers in all construction firms in coordinating the way they work online regardless of contractor and project manager in integrating centralize management [8]. Covid-19 pandemic indirectly helps connecting the parties involved especially client in managing construction projects [4].

The automation element is a technology that is underused by the contractor and project manager which is less than 30%, where automation technologies such as robotic automation, 3D printing, cognitive technology and manufacturing robots. Automation technology requires significant capital by construction firms in investments to help the construction process more dexterously [25]. This technology is actually very efficient especially during the Covid-19 pandemic phase as it helps in the construction process on-site as it does not

require many workers to operate automation technology meanwhile meet the requirements of the Malaysian government's SOP where less than 60% of the workers' capacity on-site and off-site for example Robolab Technology Private Limited, Malaysia [2], [26].

The problem that is considered to be feared from the social aspect is the need for digital skill and knowledge in the use of digital technology. Covid-19 pandemic cause the difficulty to have a face-to-face discussion. This requires the contractor and project manager in handling digital technology individually in performing a task especially in virtual meeting that has never been done before [4]. In technology aspect is that requires fast and efficient internet access for optimal use of digital technology. Covid-19 pandemic is urging employees to access smartphones and other communication tools with connection of 5<sup>th</sup> generation broadband network for virtual interaction run smoothly. Contractor and project manager need to adapt a new working environment to access centralise project management at home and outside site area virtually [5], [21].

Initiative that can be taken from the social aspect in enhance the quality of work by providing digital skills training in handling the specific digital technologies required in the project. This can be attributed to the problem faced by the contractor and project manager which requires digital competency in the use of digital technology [5]. With the provision of training and skills, it will be able to produce a well-trained, skilled workforce in handling daily task which give a positive impact to improve the quality of work with accurate decision making through technology processor [21]. In technology aspect, digital technology competency should be adapted among worker in the culture change of digital skills and the technology implementation. Current technology leads to disruptive of traditional way in managing projects. Thus, construction firm need for building an attribute of digital traits as digital technology is a necessity in achieving productive construction projects [5], [21], [27]. This implementation can increase digital traits indirectly the use of digital technology among construction firm as the new norms in digital age.

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