

Managing COVID-19 related knowledge in the UK Infrastructure sector

Haddy Jallow¹, Suresh Renukappa², Subashini Suresh² and Khaled Algahtani³

¹Costain Plc, London, UK

²Faculty of Science and Engineering, University of Wolverhampton, Wolverhampton, UK

³Ministry of Justice, Riyadh, Kingdom of Saudi Arabia

haddy.jallow@costain.com

Suresh.Renukappa@wlv.ac.uk

S.Subashini@wlv.ac.uk

khmghtani@moj.gov.sa

Abstract

COVID-19 has caused the most serious economic and health crisis globally that we have witnessed in decades. Millions of people across the world have lost jobs, while the healthcare systems are struggling to cope with the rapid increase in cases. Many sectors have been affected with this pandemic including the construction infrastructure sector which benefits from engineers and different staff members travelling to site and interacting/collaborating with peers. Infrastructure construction organisations have responded well during the pandemic in order to carry on works while minimising risks to their employees and their families, however management styles have had to be updated and the transferring/ storage and collection of knowledge has seen new processes and methods being adopted. The relationship between Knowledge and its management within the infrastructure sector during the COVID-19 Pandemic is a topic that has not been regularly researched. This paper aims to review both the impact that COVID-19 has had within the infrastructure sector and Knowledge Management during these times attempting to gain an output of how knowledge has been managed throughout the pandemic within the sector.

Methodology

Given the lack of research on this topic, this study adopted and implemented a case study methodology approach. Ten semi-structured interviews were conducted as well as observations with the organisations that took part on the research. A total of five organisations took part on this research and the patterns and connections were analysed during the data analysis stage to draw a conclusion from the study.

Findings

COVID-19 has turned our worlds upside down with everything coming to a halt and everyone's lives changing constantly. All sectors have had to change and adapt to this new way of life which also means working management styles are to accommodate for these new ways of working. Innovative technologies are at a rise and construction companies are aware of these advancements. However, the industry has been one of the slowest industries in adopting these advances in relation to Knowledge Management. Knowledge is a big influencer within the infrastructure sector, there is a lot of resistance in terms of adopting innovative techniques to boost KM practices positively as most companies are not fully aware of beneficial adoption practices and tend to overlook the potential benefits and instead investigate the challenges it may raise during adoption. During these difficult times, organisations within the infrastructure sector have had to become a lot more digital. Data storage environments are being heavily used as people are not travelling to work offices which gave employees the ability to use resources and data from the office itself whether it be through face-to-

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face communication or paper drawings and information. Some companies though have implemented some form of innovative KM processes, one which was highlighted as a trend was Big Data. The industry should enhance their awareness of these technological advances and explore more processes that could benefit the industry to explore the benefits that they can gain.

Value

This study provides contribution of the digitisation of knowledge within the construction sector. The paper highlights the challenges that the infrastructure sector has faced during COVID-19 and key innovative technologies that can provide benefits to the construction industry and enhance knowledge management processes within the construction sector. It has been concluded that awareness and training of these technologies can boost coordination within companies and enables organisations to have better practices achieving goals despite these current circumstances.

Key words: COVID-19, Industry 4.0, Knowledge Management, Big Data, Construction, Artificial Intelligence.

Introduction

The infrastructure sector is key to the global economy and in the UK, Infrastructure is worth over £483 billion in total considering both public and private sectors (HM Treasury and Cabinet Office , 2016). The construction infrastructure as a whole is divided in the ability to adapt to new changes and embrace new processes and ways of working especially in regards to technology (Deltek, 2021). During the year 2020 many new challenges have been introduced with the outbreak of Covid-19 forcing the world to turn digital to carry on. Covid-19 originated from Wuhan China back in late December 2019 which included symptoms of fever, dry cough and tiredness which led the initial cases to be characterised as pneumonia (Wu, Chen, & Chan, 2020). During the next few months after the first outbreak, it spread rapidly across the globe where it got identified as a novel beta-coronavirus which acted very similar to the SARS (severe acute respiratory syndrome) that was seen in 2003 (Wu, Chen, & Chan, 2020). This outbreak has affected the whole world and the way we work as social distancing to avoid the contamination of the virus was introduced in March 2020.

Many industries benefit from employees being present in the office, especially within the construction civil industry, operational staff members need to be present on site to complete works and construct and build assets. As all industries, the infrastructure sector also had to adapt to the changes in working practices and processes where these new ways of working do not put employees at risk. Management styles within the industry have seen a massive change where technologies are being used more to accommodate the work practices where employees cannot meet in person or travel to the sit offices. This has also impacted the ability to share and capture knowledge where within the industry, despite digital advances being available, most staff members are in the habit of view paper drawings and interacting with other people to gain knowledge on the project, with this not being possible as three quarters of staff members have been told to work from home, it is safe to say that there have been challenges of the collection and sharing of knowledge during this time.

There has been a lot of research conducted on Covid-19 and its disruption to businesses worldwide, however the studies have not considered Knowledge Management within the infrastructure sector and the impact Covid-19 has had on it. For example, Rogerson (2020), focussed on the new normal for infrastructure systems but fails to provide key practices that have been undertaken to accommodate for the restrictions we live with and how it is being managed to allow for best practices and work to carry on within the industry (Rogerson, 2020). This paper will highlight how the UK infrastructure sector are managing the Covid-19 outbreak and how daily practices and processes have been changed

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to adapt to the rules that were introduced due to the pandemic. There have been many challenges as there are still a lot of unknowns with Covid-19 which will also be investigated. This paper will be split into four sections to answer the research questions which are as follows:

Research question 1: What is Covid-19 and how are the guidelines fitting with practicalities of safe working?

Research question 2: How is the infrastructure sector changing to accommodate these new rules set and what new management practices are being adopted?

Research question 3: What is the current state of KM within the industry considering these new working and management practices? Are there benefits and challenges?

Research question 4: What are the future recommendation for enabling good Knowledge management practices during a pandemic?

Based on the research questions, the main objective for this paper is to conduct a literature review by providing an overview of the infrastructure sector within the UK and knowledge management practices along with Covid-19 and the impact it has had to day-to-day work practices. The paper is structured to demonstrate the literature review which answers research questions 1 and 2. Research question 3 is undertaken using the case study research methodology, which will contain the changes adopted by infrastructure organisations on their knowledge management practices during these times, and finally research question 4 will explore the results from the case study with the findings and challenges explored this will then lead to future recommendations on this research.

Literature review

The infrastructure sector and KM

Within the infrastructure sector, delivering complex assets safely is a normality (Woolley, Goode, Saon, & Read, 2020) as safety is quite critical within the industry and most work practices involve risks to health and safety for example manual handling, working around plant and working from heights. The infrastructure sector is one of the main industries that accounts for a number of injuries and deaths due to accidents on site where the fatality rate in the UK is 1.31 per 100,000 workers (Health and Safety Executive (HSE), 2019). The risks within the infrastructure sector go beyond on site operations as there are risks to people travelling to and from work or to and from communal lodging during the work period, within the industry risk and safety is usually measured as a production measure as safety can affect major aspects within the construction of these assets such as cost, efficiency and quality (Penaloza, Saurin, & Formoso, 2020).

The infrastructure sector has been one of the first to get affected by Covid-19 where a high rate of infections were noted and this is due to a few factors as the industry is mainly made up of male employees where over 40% of them are over 40 and significant numbers who are over 55 which puts them at a higher risk category as people older are being more affected by covid-19 (Koh, 2020). An infrastructure construction site also included many hazardous substances and materials where it is exposed to people it could increase the risk for health problems such as Covid-19. There however is limited data on understanding the implications of Covid-19 and these additional risks on and infrastructure project site.

In addition to these factors, infrastructure projects generally involve a lot of different organisations for medium and large projects with 100's of employees travelling from all over the UK to be present on site. The usually structure of a project organisation is demonstrated in Figure 1:

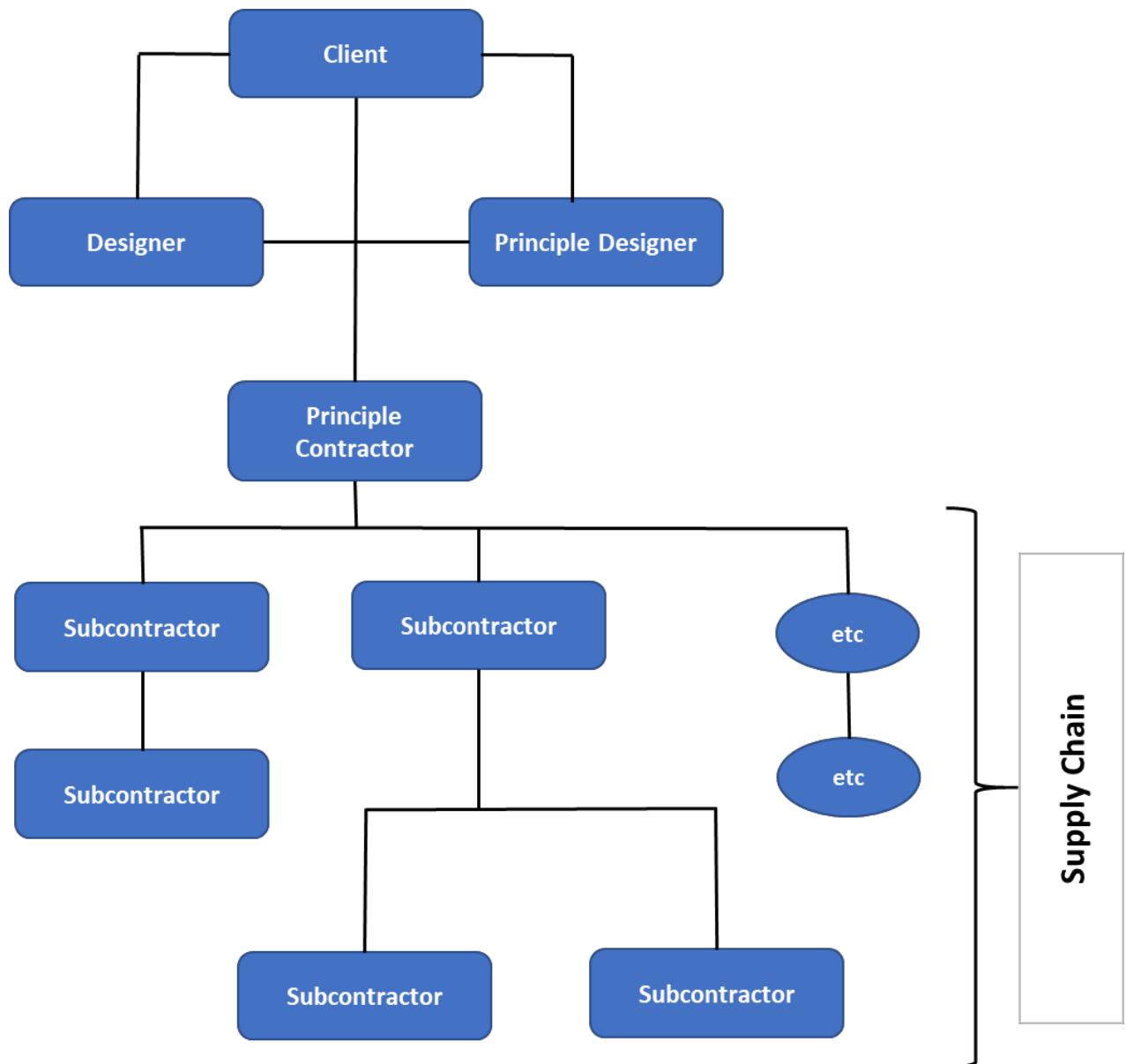


Figure 1 Typical Project Delivery Organisation Structure

As presented in Figure 1, it is clear that there are a lot of different parties involved within infrastructure projects which is more the reason why Knowledge is to be managed, collected, created and shared in order to collaborate between the multiples of parties involved. Prior to Covid-19, knowledge in the infrastructure sector was already in a fairly good position as the introduction and mandate of the use of the Building Information Model where common data environments (CDE) are mandatory allowing the storage, collection and sharing of knowledge within a project.

As briefly touched on above, Knowledge management is a key factor within the infrastructure sector as it is in most other industries. The infrastructure sector contains complex business environments and a lot of competition. Organisations benefit heavily on intellectual capital and it provides new innovative ideas and new solutions to problems that would differentiate organisations competitive advantages.

Technology has become an increasingly important factor globally and so has the role of knowledge allows more creativity capabilities and encouraging individual knowledge to be generated where the

generated knowledge provides greater opportunities to increase value, skills and influence the management processes within an organisation. In addition to this, knowledge is viewed as a strategic resource within an organisation where their performance can depend on the organisations ability to meet the stakeholder's requirements, this motivates most organisations explore new strategies to allow new opportunities. The performance of an organisation does not only depend on the resources available to be it also intangible resources such as efficient knowledge management and the intellect developed through this.

The outbreak of the pandemic happened during the National infrastructure development plan that the UK have produced in 2016 to invest billions of pounds in infrastructure during the years of 2016-2021 (HM Treasury and Cabinet Office , 2016). This mean that there are many projects still in construction while covid-19 spread. It was aimed that by the end of 2021, over £100 billion will be invested into infrastructure to drive economic benefits which include boosting competitiveness internationally and raising the productive capacity of the economy, many jobs are also created whether it be short term or long term (HM Treasury and Cabinet Office , 2016). With this huge investment and the many projects on infrastructure going on in the UK, Covid-19 has disrupted the construction and collaboration of these projects massively leading to new ways of working to achieve the goal from the UK government.

Covid-19 and guidance

The Covid-19 pandemic has impacted economic risks globally. As briefly mentioned, Covid-19 originated in Wuhan China back in early December 2019 and has spread across the globe. As of February 2021, it has been reported that 106 million have been infected and there have been over 58.9 million deaths globally (Ritchie, et al., 2021). It is extremely important to consider the way in which Coviid-19 is transmitted. Transmission is found to occur airborne in forms of droplets from human to human through face-to-face interactions (for example coughing) (Fennelly, 2020). It is also noted that transmission is specifically increased within enclosed environments and the virus can also exist on surfaces from the carrier where it could live for different lengths of time depending on the material surface (Suman, et al., 2020).

Due to the transmission and the way in which Covid-19 is transmitted, a global strategy was introduced to minimise person to person contact through either reducing social contact in the form of lockdowns, the closing of workplaces, public spaces, school etc. or through the introduction of social distancing. All over the world the distance varies, however in the UK, the guidance has specified a minimum of 2m distance at the time of writing. It is also suggested by public health to focus on hygiene particularly hand washing and the use of hand sanitiser (Gov.uk, 2021). HM government provided construction-specific advice for organisation in the industry, three other sets of guidance were released which were Outdoor working, Health and Safety Executive return to work advice and Construction Leadership Council COVID-19 guidance. A summary of these guidelines are provided in Table 1 below with provided examples of the guidance. These documents have had numerous updates as Covid-19 has changed since its first case with new variants now being noted. The summary refers to the latest versions published 5th of November 2020 (HM Government, 2020). A summary of the Covid-19 guidance is shown in Table 1 below:

Table 1 UK Governments guidelines for construction during Covid-19 summary

Guidance No	HM Government Construction-specific guidance (HM Government, 2020)
1	Thinking about risk (all need to engage in a risk assessment; consult with staff; failure to conduct COVID-19 risk assessment, or to act on it, is a breach of health and safety law)
2	Who should go to work (consider whether needed on site; plan for minimum people; keep in-touch with off-site workers)
3	Social distancing (wherever possible, handwashing, different locations, different roles)
4	Customers, visitor, and contractors (managing contacts, providing/explaining guidance)
5	Cleaning the workplace (before opening, keeping the workplace clean, hygiene, changing rooms and showers, handling equipment, materials, waste) (cleaning procedures for shared equipment; handwashing)
6	Personal protective equipment (PPE) (should not encourage precautionary use)
7	Workforce management (shifts and breaks work travel, communications, and training)
8	Inbound and outbound goods (pick-up and drop-off; frequency; driver behavior)
	Health and Safety Executive (HSE, 2021)
1	Talking with your workers (guide to communicating with staff, also consider if English is not first language)
2	Who should go to work (changing tasks to reduce risk; work from home if possible; if cannot work at home, protection, handwashing, minimum number of people)
3	Protect people at risk (plan for the vulnerable or with vulnerable family)
4	Getting into and leaving work (travel alone if possible, staggering arrival and departure times, handwashing)
5	Work area (social distancing, where you cannot distance, keeping work area clean)
6	Moving around work environment (only essential trips, restrict job rotation, temporary walkways)
7	Common areas (toilets, canteens, shower areas)
8	Good hygiene (handwashing, promoting hygiene, guidance for cleaning of hygiene areas)
9	Information and guidance (share information with workers, with visitors, hold conversations, listen and act)
10	PPE (personal protective equipment) (continue normal use)
	Construction Leadership Council (England)
1	When to travel to work (not when symptomatic; at higher risk; living in vulnerable group)
2	Travel to work (share with similar groups; good ventilation; pairing arrangements; if must use public transport avoid the peak)
3	Driving at work (travel between sites; share with same individuals; cleaning vehicle)
4	Site access and egress (one-way systems; minimize congestion; hygiene; site inductions)
5	Handwashing (regular breaks; additional facilities; clean facilities)
6	Toilet facilities (restrict number at one time; clean)
7	Canteens and rest areas— (increase size of facilities; staggered break times)
8	Changing facilities (increase size; restrict number of people at one time)
9	Work planning to avoid close contact (with a hazard control approach)
10	Emergency service and first aid (plan; anticipate delays)
11	Cleaning (toilets; handrails; lift and hoist controls)

These guidance's provided man factors to be considered, though most points in the three different guidance's are similar they all represent the approach in reducing the transmission rate and mitigations through social distancing, ventilation and adopting good hygiene practices. Though the guidance provides safe working practices it is clear that knowledge management within organisations will be affected through social distancing and the minimising of human interactions which is where KM benefits the most with the sharing and collection of knowledge.

Methodology

This study adopts a case study approach identifying any changes in management within the infrastructure sector that has been adopted due to Covid-19. This will include knowledge related management within the sector. Case studies were observed, and semi structured interviews were also conducted. Semi-structured interviews are a qualitative method that presents a pre-determined set of questions to the participants of the study, providing them with the opportunity to explore a wide range of responses.

Qualitative research

Qualitative research involves the collection and analysis of data which is non-numerical such as language (Flick, 2018). The aim of the collection of this data is to understand the reasoning behind the knowledge obtains, gain insight in opinions of the participants and or experiences, this can enable the researcher to generate new ideas for the research study in question (Flick, 2018). This method of research is usually undertaken through unstructured or semi-structured interviews which are conducted mainly through focus groups, case studies, individual interviews, documents, just to name a few, where the participants within the research are selected to achieve the provided part of the research (McLeod, 2019).

The aim of a qualitative research is to gain an understanding of social reality on individuals or groups that has physically experienced or taken part in some element within the research. Qualitative research seeks to explain the "why" and how of a phenomenon where the data collected can be interpreted with various different methods to make sense to the data collected, due to the close involvement of the interviewer, this method allows the researcher to gain a wider view of the field and allows issues to be noted which are normally missed (DeFranzo, 2020).

Prior to the semi-structured interviews, preparation for the research was conducted, this was done through steps:

Literature review

A critical Literature Review was conducted to understand the changes and impact that Covid-19 has made globally. Government rules were also discussed as understanding the changes in the way we work from normal practices was key for this research. Upon completion of the critical literature review, the research question for this research became clear.

Research Questions

Following the literature review, the research questions were finalised which are as follows (also described more in detail within the introduction section:

- What is Covid-19 and how are the guidelines fitting with practicalities of safe working?
- How is the infrastructure sector changing to accommodate these new rules set and what new management practices are being adopted?

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- What is the current state of KM within the industry considering these new working and management practices? Are there benefits and challenges?
- What are the future recommendation for enabling good Knowledge management practices during a pandemic?

Interviews

Upon the completion of the literature review and the finalisation of the research questions, an idea of the interview questions were clearer. An interview guide was produced based on the literature findings in the form of semi-structured interviews and the interviews targeted the Senior Management Team (SMT) within the UK infrastructure sector that have been in the industry prior to the Pandemic and are still in the industry during the pandemic as that targeted audience will understand the changes that have happened during this time within the industry in terms of managing Knowledge.

The interviews were undertaken through phone interviews and online tools such as Microsoft Teams due to the Covid-19 restrictions as face-to-face interviews were impossible.

Results

Case studies

Organisations throughout the world have had to adapt to new management styles and adopt new strategies to enable them to carry on working. Case studies selected for this study are organisations within the infrastructure sector in the UK whom can assist in answering the research questions for the study. Table 2 summarises the organisations profiles and breakdown the interviewees:

Table 2: Organisations breakdown

Organization	Size (no. of employees & approx. turnover in £)	Organization s' Operation Nature	Operation Scope	KM impact due to Covid-19	Responsibility of interviewee in the organization	No. of Interviews
A	• 3,400 employees	Engineering Contractor	Regional	Low	• BIM Lead	1
	• £1.162 million				• BIM Manager	1
B	• 38,000 employees	Construction and Development	Regional	Low	• Commercial Manager	1
	• £14.98 million				• Surveying Manager	1
C	• 71,839 employees	Construction	Regional	Low	• Design Manager	1
	• £386.06 million				• BIM Manager	2
Total						7

How is the infrastructure sector changing to accommodate these new rules set and what new management practices are being adopted?

A lot of changes within the sector has been made in order to accommodate for the changes to life that Covid-19 has introduced. The organisations that took part in this study has highlighted that most of their ongoing projects are joint ventures where two or more organisations come together to complete a project. This means that there is more collaboration to be expected and the different organisations should share knowledge and collaborate in order to accomplish construction in a productive and efficient way. One of the interviewees elaborated on the management process currently:

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“we have had to change many processes in terms of management, for one we have had many new starters which became a challenge for managers as new starters require inductions and training to gain knowledge about the project and job. Covid-19 has led us to use digital means for this as we have pre-recorded training and inductions for all new starters providing them induction packages of videos to watch during their initial days of starting on a project.”

Within the internal Microsoft SharePoint of all the organisations that took part within this study, training material, induction videos and useful information and knowledge is stored allowing all members of the organisation access to this knowledge. First the organisations analysed and understood the crisis in order to produce a fitting response to the pandemic. As the guidelines were set and clearly represented by the UK Government, this allowed the organisations to then initiate a response phase where though there were and still are a lot of uncertainties, the recover phase was introduced to account for the chaos in the form of turning to digital means to manage projects and staff.

What is the current state of KM within the industry considering these new working and management practices? Are there benefits and challenges?

Knowledge management has been on a rise in the UK infrastructure sector, especially with the Governments mandate of the Building Information model which has boosted the sectors ability to collect, store and share knowledge as the adoption of BIM requires a Common Data Environment (CDE) where all project information is to be stored with the government standards PAS 1192-2 which emphasises Information management. Since its mandate in 2016, BIM has pushed all public sector projects over £50,000 to adhere to BIM standards, this has meant that management process were to change for KM, however there were a lot of challenges in terms of resistance to change, however with Covid19, this has seen a massive increase. One of the interviewees states:

“with Covid-19, we have been more focused on changing business processes from traditional methods to more digital and efficient methods, the advantage we have found is that with the adoption of digital methods, we can all work from home and still share knowledge which is proving more efficient than when life was normal as we have found when people have the opportunity to speak to people and gain information face-to-face in offices that knowledge being shared in that conversation tends to not be stored and shared.”

The interviewees have specified that there have been benefits and many challenges due to the management changes introduced by Covid-19 which are as follows:

Benefits summary

- Industry becoming more digital and innovative.
- Storage of knowledge has picked up as that is the only means of information projects have to work from home.
- Teams are more collaborative as there are more virtual meetings held within the teams and parties.
- Knowledge is being captured in order to allow the sharing of knowledge within teams and stakeholder.

Challenges summary

- Communication as that lack of being able to know people within the office was limited: mainly new starters mainly collaborate with people they already know mainly within their teams.

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- Capturing of knowledge as with a construction project, the lack of going on site and seeing progress is limited with lockdowns and working from home.
- Stakeholder engagement, usually in construction there are a lot of stakeholder events and site visits to share project knowledge with stakeholders, with the limitation of office working and restrictions stakeholder events have been on hold or limited to virtually which does not have the same impact in terms of sharing knowledge with the stakeholders.

How is Covid-19 related knowledge being managed across the industry?

In addition to management styles being changed to accommodate for Covid-19 guidelines, Covid-19 related knowledge was also introducing which is a big topic and must be shared amongst the team to communicate new rules and safety aspects within the organisations.

With Covid-19 being a new virus, there is not a lot of knowledge available readily for people to gain knowledge it, especially during its prime. To accommodate for this, the case study organisations have adopted new ways in keeping their organisation and staff members updated on covid-19 and what they must do as staff members. There have been various of introduced ways and methods in which this knowledge can be shared, which are as follows;

- Monthly briefings held updating all staff members on the status of Covid and how the following month would be affected based on situation at the time.
- All companies' intranets home pages included a dedicated place for Covid information and guidelines which staff can easily access to gain knowledge.
- Forums are held every two weeks with the Senior management teams to discuss the situation and this discussion is fed down the chain by the managers.
- Toolbox talks held ever week, these were not compulsory but were held and any staff member is free to attend if they require knowledge or have questions on the topic.
- Mental health and wellbeing is being taken very seriously as surveys are held every two months allowing the Health, Safety and wellbeing team to act if necessary, to support staff members struggling.

In terms of covid related knowledge, the majority interviewees that took part in the research agree that their organisations have adopted techniques which prove to be effective in terms of keeping staff members updated and aware of what the covid-19 situation is at the time and how it will be affecting their working situation.

Discussion

One of the major changes that have been at a rise in implementation has been the use of Databases. Within infrastructure construction there is a lot of data in terms of assets being constructed, this data and knowledge must be managed and presented to the wider team in an understandable way. The Building Information Model (BIM) has been mandated in the UK which consists of a 3D virtual representation of assets within a project with data attached. This model data is a form of knowledge which assists the wider team during pre-construction, construction, and post construction. All the organisations that took part in this study have implemented BIM however one of the organisations has taken it a step further where they have produced a number of Power BI systems to filter this data providing easier access to the data for the wider team.

This has enhanced the sharing of project data and knowledge as the wider team have filtered data to analyse. With the databases being available, all site team and staff working from home can understand

the project quantities in a simpler way. Within this project being undertaken by the organisation, there are over 20 assets to construct with over hundreds and thousands of elements, this can be very tedious for all staff members whether working from home or on construction project site to analyse. The production and implementation of these Power BI databases has allowed all these elements to be filtered and produced in a way where analysis is simpler which was not implemented prior to Covid-19. These data bases have proved more efficient and productive for the wider team especially the commercial team who must quantify assets and costs. The use of Power BI Databases is known and common especially in technology heavy industries however due to the lack of knowledge in this profession, not many industries and sectors have implemented its use for data and knowledge where it could improve both efficiency and productivity for most industries.

During the Pandemic, Organisation B along with software developers developed a new connect communications and visual platform. As mentioned, BIM is implemented within all the organisations that took part in this study, however having one platform centralised for communications and visualisations of knowledge and data has not been implemented widely throughout the industry. Covid-19 has encouraged Organisation B to assist in the production of this software. This was developed during the summer of 2020 and has now been deployed on one of their projects where it is being used. This software was developed along with the developers of their common data environment, it allows for visualising the most up-to-date project models and data, in addition it is also used to raise communications such as Requests For Information (RFI's) and raise Non Conformance Reports (NCR's) within the same platform allowing the knowledge to be all available in one single platform. In a normal BIM project models are detached with construction documents where knowledge can be lost and missed as they do not share the same platform, with this new software developed, managing construction knowledge and sharing with the wider team has improved massively while the knowledge is also being stored for future use.

This newly developed software could enhance knowledge within the industry, as it has been developed during Covid-19, Organisation B are essentially the tester of the software where they are the first project to have access to this ability. This could create potential future use within the industry as a whole as with the software being tested on a live project obtaining finding of its use would enable organisations to determine if this would be a good investment for their projects.

Conclusion

Covid-19 has impacted all sectors around the globe and the way in which we work. With the restrictions being introduced in the form of social distancing and working from home, the construction sector which is considered essential still has to carry on works. The UK government introduced a few guidelines for the construction sector to adhere to so that works can carry on while minimising risks to employees on catching or transmitting Covid-19.

With the introduction of new work practices, management within all sectors had to change their management practices and with knowledge management being a key part of the infrastructure sector, new ways of managing, capturing, storing, and sharing of knowledge were to be analysed and implemented. The infrastructure sector has mainly opted for the use of digital means to promote the knowledge sharing and capture during this time. With the infrastructure sector becoming more digital and innovative over the past couple of years, Covid-19 has motivated the drive to become more digital as it is one of the only ways in which to manage knowledge within this time and to work during these times with the restrictions in place.

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There have been many challenges in terms of training requirements and adapting to the new ways of managing staff for the SMT team and storing and the sharing of knowledge within the teams. As their minimal office face-to-face interactions, most staff members feel that they do not always know who to contact and where to gain the knowledge they require for some of their tasks and this restriction of knowledge gaining delays some tasks that were given to them.

This research study has highlighted that with digital means, knowledge is being managed better in terms of capturing, storing and sharing has increased as it is the only way projects are carrying on works during restrictions introduced by Covid-19, for future studies it would be recommended that a framework for management within the infrastructure sector in terms of knowledge management for situation like the Covid-19 pandemic should be developed. There are newly developed software's specifically for infrastructure construction which are not widely available to the industry, providing results and analysis on this new software once testing is completed can be very useful for the industry as a whole as it would be beneficial to evaluate if the software provides a positive influence on knowledge management practices within organisation.

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