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Impact of COVID-19 on water sector projects and practices

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ABSTRACT

The COVID-19 pandemic has negatively affected world economies. The water industry was adversely affected, with unprecedented slowdown and changes to ways of working. However, the pandemic also accelerated positive digital transformation. A qualitative research approach was adopted to analyze data collected from 12 interviewees representing six water sector organizations. The paper provides insight into the impact of COVID-19 on the delivery of water sector projects and how organizational practices have adapted from business as usual.

1. Introduction

The COVID-19 pandemic has slowed the UK economy and activity in the infrastructure sector. Some discretionary, non-time-critical projects and programmes have been put on hold with no certainty about whether and when they will resume (Horton and Laikin, 2020). The COVID-19 crisis has brought to light the urgency of recognizing water access is a basic human right and protecting human health during the COVID-19 pandemic. Recent water policies relate to equity and the environment. Ownership matters, as communities with municipally owned utilities appeared more inclined to protect residents from water service shutoffs and engage in water resource management. Sowby (2020) stated that water and wastewater utilities should reflect on their COVID-19 experience, learn from it, and apply their newfound perspective to strengthen future emergency preparedness. Furthermore, Poch et al. (2020) noted that safeguarding safe, reliable, and wholesome water whilst maintaining sanitation became critical at the onset of the pandemic.

WatEner (2020) reported that in the city of Karlsruhe in Germany during the COVID-19, Stadtwerke Karlsruhe, a municipal water utility in the state of Baden-Württemberg, used a platform to support the operation and management of its drinking water distribution system. The platform operated a Demand Forecast System (DFS) that applies Artificial Intelligence and Pattern Recognition Techniques, adapting dynamically not only to meteorological parameters (such as temperature, rainfall, and humidity) but also to changes in consumer behaviour. Sowby (2020) stated that water and wastewater utilities should reflect on their COVID-19 experience, learn from it, and apply their newfound perspective to strengthen future emergency preparedness. Furthermore, Poch et al. (2020) noted that safeguarding safe, reliable, and wholesome water whilst maintaining sanitation became critical at the onset of the pandemic.

The World Health Organization (WHO, 2020) further stated that providing safe water, sanitation, and waste management is vital for protecting human health during the COVID-19 pandemic. Recent water demand research by academics identified relocation of water consumption to homes from public places; this included intensive water use whilst maintaining sanitation became critical at the onset of the pandemic. The lifestyle of the population, climate, water scarcity, and water price influence drinking water demand. Bich-Ngoc and Teller (2020) used data from 23 municipalities in Liège, Belgium, to conduct statistical analysis to identify changes in outbound tourism on water demand. The results suggested that water demand was significantly lower in the months with a higher proportion of outbound travel activities. Though the projected risk of increased water needs due to fewer people traveling is moderate, the threat becomes much higher during long periods of dry and hot weather.

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The magnitude of the increase in domestic water use was quantified by Cook and Makin (2020) as between 15 and 20%, while business water use saw a reduction of between 30 and 50%.

As highlighted by Rachel Fletcher, Chief Executive of The Water Services Regulation Authority (Ofwat), water companies are facing unprecedented challenges that require extra effort to provide reliable water supply and wastewater services while protecting their staff. Thus, industry-wide research on the impact of COVID-19 pandemic is very limited. This study aims to assess the impact of COVID-19 on the delivery of water sector projects and how organizational practices have adapted from business as usual.

2. Literature review

2.1. Water sector regulatory advice on COVID-19 pandemic

The UK water sector was privatized in 1989 through the Water Act. Since then, water and wastewater services provision have been regulated by different organizations for different purposes, as shown in Table 1 below.

The advice from Ofwat to the water sector during the COVID-19 pandemic has been to prioritize meeting core service obligations, which are providing water and wastewater services, suggesting that no regulatory penalties would be applied to capital projects affected by reprioritization to meet core business and customer needs during the pandemic. However, assessments would be made in the reconciliation systems to take the pandemic’s effect on respective projects into account, which companies will have to demonstrate. Ofwat will also look at ways of lessening the burden of policy development among the other responsibilities water companies must manage during the pandemic (Fletcher, 2020).

The Drinking Water Inspectorate (DWI) and the Environment Agency’s (EA) advice in response to COVID-19 has been to follow guidelines set by the UK government (EA, 2020; DWI, 2020) as provided by the Health and Safety Executive (HSE), whose role is to prevent workplace death, injury, or ill health (HSEa, 2020). The HSE’s advice for UK businesses, including those in the water sector, was to prioritize becoming “COVID-secure” by adapting to current guidance and implementing measures to control the risk of COVID-19 to protect workers and others. The HSE proposed the following action steps:

- Carrying out COVID-19 risk assessments adhering to HSE guidance.
- Enhancing cleaning, hand washing, and hygiene procedures.
- Taking all reasonable steps to help people work from home.
- Maintaining 2 m social distancing where possible.
- Managing transmission risk where people cannot be 2 m apart.

Table 1

| Organization | Regulatory role |
|--------------|----------------|
| Defra and the Welsh Government | Set the overall water and sewerage policy framework in England and Wales, including setting standards, drafting legislation and creating special permits (for example, drought orders) |
| Ofwat (England and Wales) | Promotes competition, sets price limits, ensures that water companies can finance and carry out their functions, promotes economy and efficiency |
| Environment Agency (England) and Natural Resources Wales | Regulates water quality and waste water, work with partners to reduce flood risk and promote sustainable development |
| Drinking Water Inspectorate (England and Wales) | Checks that water companies supply water that is safe to drink and meets the standards set in the Water Quality Regulations by carrying out inspections and checking tests that water companies carry out on drinking water |

It is anticipated that being “COVID-secure” benefits the health of the UK nation, communities, businesses (water sector included) and the UK economy (HSEb, 2020).

2.2. Impacts on water sector operations and engineering projects

The water companies have had to adapt various measures, including regulatory inspections. The measures implemented include a combination of limited site visits, phone calls (remote working), and collection of visual evidence (photos and video footage). Companies have also been adopting and trialing new ways of working and new technologies, according to Frontier (2020). Solomon and Klyton (2020) noted transformative effect of Information and Communications Technology (ICT) on socio-economic development. The introduction of new ways of working, including new forms of communication, reconfiguration of office spaces, and working from home. This necessity has forced employees to adapt and accept these changes, with increased use of webinars and video conferencing (DTTG, 2020).

Adaptations from current to newer technology saw an increase, including digital meter reading (smart meters), virtual home visits, and digital channels for communication (Frontier, 2020; HSEb, 2020). Cotterill et al. (2020) observed that 84% of staff worked from home during the pandemic. Information and Communication Technology (ICT) was a significant issue, identified as a challenge, which was overcome by effective communication and collaboration. Other challenges related to working from home included differing internet speeds and standards and making data and information available in digital formats (for local authorities and utility firms), as not all of it was in the required digital format. This situation also caused increased costs due to inefficiencies in last-minute ICT upgrades (DTTG, 2020).

The DTTG (2020) pointed out that the value of digital transformation has become evident during the pandemic. Before the pandemic, behaviours rather than tools seemed to block implementation. Organizations that had previously invested in and implemented digital transformation experienced the benefits first-hand when the pandemic struck. The industry has gained understanding of interdependencies across the supply chain and the need to address digital adaptation and interoperability issues.

2.3. Impacts on water sector construction projects

The Institution of Civil Engineers (ICEa, 2020 and ICEc, 2020) highlighted that productivity growth was weak within the UK construction industry with significant regional differences. The pandemic has further disrupted the water sector’s demand and growth projections, with an increase in the demand for domestic water as business demand decreased. Hence there is a need for readjustment for the rest of the Asset Management Period (AMP) to reprioritize projects supported by Ofwat. It was also anticipated that 20–30% of operational staff might not have been available during the pandemic peak period (Horton and Laikin, 2020).

However, research by Cotterill et al. (2020) found that some water sector businesses already had resilient practices in place, which helped at the onset of the pandemic since they were preparing to mitigate the effects of the UK leaving the European Union. Kennedy (2020) stated that, together with the challenges brought about by COVID-19, these drivers could force the water sector to address some of its weaknesses and lead to lasting improvements; the current disruptions caused by the pandemic have single-handedly pushed digital technologies adoption and adaption to the top of the agenda. Project teams and contractors have been experiencing the benefits associated with the use of digital technologies, which include efficiency, coordination and remote working, despite the presence of ICT issues mentioned earlier.

The delivery of water sector construction projects hinges on individuals working together in the same physical space to complete certain project tasks (Smith, 2020). However, changes for all workplaces
3. Research methodology

This research investigates how water sector organizations have had to adapt to industry advice on being COVID-secure while implementing digital technologies to enable remote working to mitigate impacts on project delivery. Bryman and Bell (2015) noted that research design considers how best to carry out research to save time and cost. It involves the selection of methods, sampling, data collection, and interpretation procedures. Given the relatively new and unexplored nature of the research problem, a qualitative research method was adopted to collect and analyze data. Qualitative research methods focus on discovering and understanding the experiences, perspectives, and thoughts of participants. Qualitative research explores meaning, purpose, or reality (Creswell and Creswell, 2018). This approach corresponds with the research topic, which requires an understanding of the perceptions and experiences of water industry staff in becoming COVID-secure.

All 11 water and sewage organizations in the UK were invited to participate in this study, and six agreed. Conclusions from this approach are related to these six organizations and an in-depth analysis of the changes to their ways of working during the COVID-19 pandemic. Firstly, the organizations were sent an invitation letter that provided information about the research, the ethical aspects of conducting online interviews, and the benefits of participating.

The main interview questions asked were:

- How did the business continue with business as usual activities when the UK government implemented lockdown?
- What were the key changes made by the business (water company, consultant or contractor) to be COVID-secure?
- What was the key change for engineering (or construction) project delivery and the impacts?

The interviews lasted between 30 and 70 min. The interviews were conducted over the phone and through video conferences. The profiles of the organizations and interviewees for the study are shown in Table 2.

The 12 project subjects participated in semi-structured interviews, based on a purposive sampling technique, which involves identifying and selecting individuals or groups of individuals that are especially knowledgeable about or experienced with the phenomenon of interest (Creswell and Creswell, 2018). The interviews were analyzed through thematic analysis. The purpose of thematic analysis is to find the patterned meaning across a set of data essential to answer the research question specified (Guest, 2012). This type of analysis was practical as the semi-structured questions were used to record information about the impact of COVID-19. The themes were cross-checked in group discussions between the authors and two fellow researchers.

In a comprehensive assessment by Morison and Moir (1998) on the pros and cons of using software for coding, the limitations seemed to outweigh the benefits - more specifically, when the purported efficiency of data management and retrieval capabilities were weighed against the potential loss of ‘familiarity with the data engendered through repeated handling, reading, and re-reading that is part of the analytical process itself distancing researcher from the data through mediation of computer software’. Therefore, it was decided that a better approach was to use paper, pen, and word processing software. Threats to validity were minimised through triangulation of data collection methods and verification of the initial thematic codes by the participants (Tajeddini and Mueller, 2012), where they judged the accuracy of data collected, though not the findings and conclusions.

4. Research findings

4.1. Meeting regulatory needs and core services

Organizations A, B, D, and E highlighted the ongoing discussions with regulators (i.e., Ofwat and Environment Agency) on delayed projects while they focused on addressing the impact of the COVID-19 pandemic. The delays in the projects was echoed by 40% of the interviewees, identifying COVID-secure practices provided a chance to reflect on social changes and environmental benefits. Another 25% underlined the need to “deliver no-regret solutions, work to re-assess the balance of the programme”.

For organization B, the respective regulatory body was similarly affected by the COVID-19 pandemic. Their day-to-day operations were

| Organization | Size (no. of employees & approx. turnover in £) | Organizations’ operation nature | Operation scope | COVID-19 impacts on projects and BAU | Responsibility of interviewee in the organization |
|--------------|-----------------------------------------------|--------------------------------|----------------|------------------------------------|--------------------------------------------------|
| A            | 16,000 employees                              | Engineering consultancy        | International  | Low to Medium                      | Design Lead                                      |
|              | £1401 million                                 |                                 |                |                                    | Quantity Surveyor                               |
| B            | 1000 employees                                 | Utility company                | Regional       | Low to medium                      | Project Managers                                 |
|              | £240 million                                  |                                 |                |                                    | Team Leader                                     |
| C            | 6700 employees                                 | Construction Company           | Regional       | Medium                            | Project Manager                                 |
|              | £3 billion                                    |                                 |                |                                    |                                                  |
| D            | 16,000 employees                               | Engineering Consultancy        | International  | Medium/High                       | Project Managers                                 |
|              | £1.7 billion                                  |                                 |                |                                    | Technical Manager                                |
| E            | 2100 employees                                 | Utility company                | Regional       | Low                                | Project Manager                                 |
|              | £10.9 billion                                 |                                 |                |                                    | Senior Project Delivery Engineers               |
| F            | 1350 employees                                 | Engineering Consultancy        | International  | Low                                | Project Manager                                 |
|              | £100 million                                  |                                 |                |                                    | Senior Project Delivery Engineers               |

Table 2: Organizations’ profiles and a breakdown of professionals who were interviewed for the study.
affected, which led to office closures and staff working remotely. However, the expected outputs remained the same, while construction projects were delayed. An increase in domestic water demand meant that organization B had to prioritize and reallocate resources to ensure water supply, delaying delivery of engineering and construction projects, which was communicated to the regulator.

In organizations A, B, C, D, and E, construction project starts have been delayed within the current AMP7 cycle. However, the target is still to deliver all projects within the same five-year cycle to meet regulator commitments for AMP7. Year 1 (2020–2021) projects have been pushed back to year 2 (2021–2022), as stated by an Organization A interviewee during discussions with regulatory bodies.

4.2. Engineering projects phase changes

The COVID-19 pandemic has led to changes in how projects are delivered in the project initiation (design and development) and construction phases (ICEa, 2020; Kennedy 2020). The following changes to practice were implemented in organizations A, D, E, and F to mitigate the impacts of COVID-19:

- No changes to working hours, but location limited to homes (remote working).
- No site visits unless absolutely necessary during the design phase. These were restricted to site visits to assist in detailed design, which still had to be approved by higher management.
- Video live streaming and recording of site surveys to members of the design team (working remotely) so that there was no need to attend surveys physically. “Live” instructions would be sent to the survey team if extra data and information were needed.
- Revised site visit risk assessments to comply with the HSE COVID-secure approach to include social distancing and ensure proper health and safety practices relating to good hygiene at all times.
- Strongly discourage car sharing, which was previously encouraged for site visits.
- Mandatory weekly team meetings for catching up and progress reports.
- Acceleration of the implementation of digital technologies adaptation, with organization A migrating to Microsoft 365 SharePoint and Microsoft Teams for data, information, and knowledge sharing and management.
- Enhanced and reliant use of digital technologies for carrying out day-to-day activities. Technical support was made available remotely, with services in place to resolve any IT issues if needed.
- Sharing of digital drawings and other deliverables.

Remote working: All site visits stopped while risk assessments were revisited to implement the COVID-secure ways of working as laid out by the HSE. In organization B, one of the interviewees working from home last worked in the office in February 2020 and does not expect to return to the office till March 2021. Immediate changes were made within the six research organizations during the pandemic, the key one being a shift from office work to remote work (working from home) for the project development (design) teams. The research findings in organizations A, D, E, and F indicated they already had digital practices in place that were somewhat resilient to the impacts of COVID-19. However, meetings with clients and stakeholders were now carried out through video conferencing using Skype and Zoom facilities rather than in the office.

The interviewees stated that they received laptops from their organizations that allowed remote and agile working. Some interviewees stated that there were no changes to their productivity as it was a regular occurrence of flexible working. However, the CAD technicians could take their desktops home as they required high-performance computers with enhanced software for developing and handling design models and drawings development. Their respective organizations set up remote access to all necessary software and ensured authorizations were in place. At the same time, an interviewee from organization C highlighted their organization could do more, as the laptops were old and slow, which hindered their work progress. The internet connection to the organization’s servers was also not very reliable, as it was offline for a few minutes daily. The interviewee went on further, stating that:

“I am working from my computer local storage so that I don’t lose my work when the connection goes offline, which happened previously”.

According to the interviewee, there were also notable delays in issuing engineering deliverables, which attributed to the unavailability of key staff due to COVID-19 issues. After the first lockdown measures were lifted, the office attendance was 40% to ensure social distancing, coupled with office attendance rotation system was applied to all engineering project staff.

There were notable improvements in outputs and deliverables in organizations A and B, attributed to staff working outside and long hours, with an interviewee from organization A stating that emails were sent late at night and around midnight. However, the research found that staff had begun to see this as the “new normal”, with an increase of remote working hours per week, despite initial management concern that there would be a drop in productivity.

Use of ICT tools in project collaboration and delivery: Rezgui and Zarli (2006) highlighted that the construction industry was moving to ICT with intelligence. The research identified that ICT tools were being used extensively at various stages of project delivery, from the inception to the operation of assets, with the six organizations utilizing cloud-based technology for hosting and managing project data. For instance, organizations A, B, C, D, and E used and continue to use the Microsoft suite of cloud-based technology, including Bentley Project-Wise, Microsoft Teams, Zoom and Skype for Business. Organization B also used a Google cloud-based collaborative tool for sharing and management of project knowledge and information.

These ICT tools allowed utilizing workflows in developing and issuing documents and deliverables and supported collaboration of project participants at all levels while sharing and managing data and information. Furthermore, these tools allowed sharing and discussion of design and construction drawings generated in three dimensional and Building Information Modelling (BIM) platforms. Isolated project teams could comment in real time as design drawings were generated. Previous research identified the benefits of using BIM in project delivery (Kamunda et al., 2020), which became clearer during the COVID-19 period. These include a clear understanding of outcomes, quicker designs, enhanced collaboration, and cost and programme savings. For instance, this research identified that, in organizations A and D, the COVID-19 engineering phase project delays and cost impacts were mitigated in some cases by the use of BIM and digital technologies, ensuring quicker and more efficient designs and ensuring understanding of project deliverables by managers, clients, and stakeholders. The use of BIM processes was highly appreciated, especially for sharing three-dimensional drawings during video conferencing meetings.

4.3. Construction phase changes

Our research found that all water sector construction projects were paused when the pandemic measures were put in place, as well as during lockdown. The project managers who were interviewed stated the need for their sites to adhere to COVID-19 workplace-safe systems, according to the guidelines set out by the HSE.

Major changes occurred in the construction phase risk assessments and method statements to incorporate pandemic-related factors. Construction projects in both A and E that had not started were shelved, even though the detailed design was complete. Personal protective equipment (such as face masks) previously required only for specific tasks, are not required at all times. Various handwashing and sanitization points were installed on all the construction sites and offices, as well
as disposable gloves. Mandatory training sessions were held for all site operatives to ensure awareness of the revised working practices.

A construction slowdown was observed in site productivity due to social distancing measures on the projects that have resumed for organizations A and E, which supports the conclusions by Kennedy (2020). It is anticipated that the projects will also be delivered to new programme deadlines, with all stakeholders accepting the impacts of COVID-19. The construction phase progress meetings were carried out through video conferencing with the client, project managers, and other team members. This practice has also led to more photographs and videos being shared with team members to show construction progress on site.

Another change identified by the research was the phasing of some of the construction works to limit the number of site operatives to meet the social distancing requirement and limit the number of people on a site at any one time. The phasing of works required more planning to be carried out by the project managers to ensure productivity. However, it has been identified that site operatives have been working more efficiently, with less interference, even though they have been taking slightly longer.

There have been ongoing project contract discussions between clients and contractors due to programme changes, unprecedented pandemic impacts, reduced site operatives, cost implications, social distancing, and enhanced hygiene, health, and safety measures. Currently, the organizations are in the phase of data and information gathering while carrying out construction activities under COVID-19 safe systems of work. According to an interviewee from organization A, this information will be used for two purposes: (a) to identify lessons learnt and make continuous improvements, and (b) to provide a contractual obligation for substantiating programme delays and cost implications. A summary of how the six organizations have responded to the impacts of COVID-19 is shown in Table 3.

5. Conclusion

The COVID-19 pandemic has shown the importance of the water industry in public health during pandemics. There has been a change in water use associated with people staying at home and the need for regular handwashing and good hygiene practices, which has affected water company priorities and capital projects. It was imperative for Ofwat to notify the water companies that they would not face any penalties if they failed to meet deadlines for completing committed water company priorities and capital projects. It was imperative for water use associated with people staying at home and the need for social distancing, good hygiene through taking advantage of digital technologies. These new ways of remote working and enhanced health and safety systems at construction sites brought opportunities for the water sector to advance in engineering projects. All of the construction projects were put on hold while COVID-secure practices were put in place by revising risk assessments and method statements.

Our study identifies measures taken by the water sector to mitigate the impacts of COVID-19. There was adherence to advise by the HSE and the UK government on workplaces being COVID-secure. However, contractual discussions are still being held relating to cost implications, even though programme extensions were granted in some cases.

We found that the COVID-19 pandemic may be having positive effects on the delivery of projects within the water sector, as lessons are being learned. There has been an acceleration of ICT upgrades in the water sector, which matches the UK government’s push for “Digital Transformation”. Organizations have also taken positive steps to ensure that they are somewhat resilient to impacts requiring people to work remotely. Staff have been embracing the change to remote work, social distancing on sites, and good hygiene (wearing face masks and regular hand washing throughout the day).

### Table 3

| Impacts on Business as Usual | Organizations Affected | Organizations’ Countermeasures |
|-----------------------------|------------------------|--------------------------------|
| Office, Closures and Lockdowns | All | Working from home (WFH) for all organizations except the construction company. The organizations were already implementing flexible working with IT infrastructure readily available. |
| Isolated project delivery teams due to WFH | All | Mandatory weekly catch-up meetings were introduced using Microsoft Teams and Zoom. |
| Construction site closures | All | Construction risk assessments and method statements were revised to implement social distancing. Site works were phased to limit the number of people in close proximity and on site. |
| Change to Progress Meetings | All | Use of digital technologies, in particular Microsoft Teams and Zoom for progress meetings. Organization D accelerated the introduction of IT software to allow compatibility of stakeholder software for team meetings. |
| Change in Quality, Health and Safety Procedures for site visits | Organizations A, D, E, and F | Site visit risk assessments changed to include implementation of social distancing and appropriate hygiene practices. An extra layer of approval by senior management was introduced to challenge the need for the site visit. |
| None and limited attendance to site surveys by project delivery teams | All | Live streaming of surveys and video calling to direct survey teams on further requirements by the design team. |
| Ban on car and vehicle sharing to construction sites | All | Car sharing was heavily discouraged. Site staff were advised to drive by themselves to construction sites. |
| Delayed start to regulatory named projects | All | There are ongoing discussions with Ofwat and regulatory bodies who have understood and supported current measures and impacts on programmes. Water companies and their supply chains are gathering and documenting the extent of impacts on their initial commitments. Some site staff have moved to design teams to manage the trough in demand for site operatives. |

5.1. Recommendations

This research recommends following the sound practices set out for project delivery teams by the Institution of Civil Engineers (ICE, b, 2020) and the Construction Leadership Council (CLC, 2020), which stipulates a Roadmap to Recovery by Restarting, Resetting and Reinventing. Further comprehensive research must be carried out to gain insight into the full scale of COVID-19 impacts on the water sector. The assessment should be extended to the business management level to assess contractual issues relating to the new ways of working introduced by COVID-19. The full impact is not yet known, and it is not yet clear when the pandemic will end, allowing for life to return to normal. The water sector should build on these findings and apply the lessons learned and perspectives.
gained from their COVID-19 experience to strengthen their preparedness for the future.

Despite the novel insights provided by this study, it has some limitations. Given that the research reported in this paper was exploratory by nature, the results presented are only tentative and not generalizable. Furthermore, the findings of this paper are limited to the UK water sector only. Although generalizability outside of this context may be limited we suggest that the results are relevant to comparable developed countries. There is a need to explore the impact of the COVID-19 pandemic on the water sector worldwide to identify similarities and differences between responses in developed and developing countries. This research could generate benchmark data and identify effective practices in managing the COVID-19 outbreak.

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