COVID-19: Main challenges during construction stage

ABSTRACT

Purpose
This document reviews the current literature on the major challenges faced by building contractors in the UK due to COVID-19 to create an evaluation framework

Design/methodology/approach
A PRISMA scoping review systematically maps the information published and establishes the potential challenges, as a precursor to a literature review that synthesises the data available to establish an initial COVID-19 evaluation framework to build a rationale for a future series of studies.

Findings
The research identified these seven challenges: health and safety on-site; economic cost; possible legal exposures; manpower availability; instability of the supply chain and subcontractors; and the uncertainty related to the constant and unpredictable evolution of the pandemic. The magnitude of each challenge was also found to differ depending on the size of the contractor, the rigor of local regulations, and the sector where the contractor works.

Research limitations/implications
This research contributes to increasing understanding on the subject and provides an initial assessment framework, based on these seven parameters, so that contractors can analyse their weaknesses and plan specific priorities so that their companies can remain competitive, minimising the impact of COVID -19 and possible future waves.

Originality/value
This research is timely and relevant as it produces the first academic review on how COVID-19 has affected contractors and the construction stage. This document gives a holistic view of the new scenario created by COVID-19 and creates a self-assessment system for contractors to test their resistance to COVID-19.

Keywords
COVID; Impact; Contractor; Construction; Assessment Framework; Health & Safety;

Declarations of interest: None

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1. Introduction

COVID-19 is an abbreviation that stands for Corona Virus Disease. The agent causing the disease is called SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2). The epidemic started in December 2019 in Wuhan (China) and is now viewed as a major global threat to human health. The World Health Organization (WHO) announced this outbreak as a pandemic on 11 March 2020. As of 28 June 2020, the virus has caused 502,772 deaths (Worldometer, 2020).

The disease can be transmitted by infectious respiratory droplets in direct contact with the mouth, nose, or eyes, by direct contact with infected people or indirect contact with infected surfaces (WHO, 2020). For that reason, most Governments around the world, including the UK, have imposed strict lockdowns, restricting the movement of people and gatherings, in order to reduce the virus transmission. Depending on the country, these lockdowns have been steadily lifted, but social distancing to prevent the spread of the disease will stay.

The need to implement these policies has caused a severe disruption to the world economy. Every industry has been affected. The UK construction industry shrunk by 5.9% in March and 40.1% during lockdown in April (ONS, 2020) and firms have already announced mass redundancies to cope with this economic slowdown, axing more than 5,000 jobs between March and May 2020 (Building, 2020a). The future is uncertain, and PricewaterhouseCoopers predicts a 14% reduction in the construction industry in 2020 for the UK if there is a "Smooth Exit", relative to a baseline without COVID, or a 25% reduction if the scenario is "irregular" (PwC, 2020).

The pandemic has completely disrupted any previous daily practice in the construction industry. Architects and designers quickly left the office and began completing the design stage remotely first in Italy, and then in the rest of the European countries, including the UK (B1M, 2020; Carlson, 2020). However, during the construction stage of a project, the physical presence of a large on-site workforce is required to meet deadlines. Therefore, COVID has had a severe impact on the ability of contractors to work on-site. Some sites were suspended, some employees got sick or quarantined (Levelset, 2020), there have been delays in payments (Skyline Construction, 2020a) and in the delivery of materials. All this has led to a lack of cash, manpower, and resources in general (Hulme, et al., 2020; Davis, 2020; BEIS, 2020a). All these factors are interconnected, and have created a chain of delays, loss of productivity, and contractual problems (BEIS, 2020a). Finally, and most importantly, contractors must provide by law a safe work environment (BEIS, 2020b), especially during a pandemic.
The main challenges for contractors tend to be the maintenance of the cash flow, completing projects on time, and the availability of skilled workers. The pandemic is disrupting all three. Therefore, contractors are under substantial pressure.

The construction industry represents an important factor within the economic and social welfare of most countries. In the UK, it represents 8% of GDP and 10% of employment (Mitchell, 2020). This study aims to scrutinise all existing information published in several different formats during the last four months to produce the first scoping review in this field, establishing the main challenges faced by contractors due to COVID, so that they can prepare to minimise them and continue to be competitive. The findings are expected to be beneficial to various stakeholders in the UK construction industry, especially contractors, but also to suppliers, subcontractors, consultants, owners, and policymakers. The conclusions of this paper can be useful for similar international scenarios, since in a globalised world some of the effects of the pandemic affect contractors in a similar way, with some local differences due to local policies and specific local characteristics.

In a constantly changing environment, contractors need a starting point to get through the current crisis and plan for the future. This research is relevant, in that it makes precise information about the new scenario created by COVID available to contractors. In addition, the result of this paper is an initial COVID evaluation framework, which will allow contractors and the construction industry in general, to better understand and assess the current situation and make better-informed decisions when planning strategies to minimise the existing risks that this pandemic entails.

The following section introduces the research approach. Section 3 covers a scoping review. Section 4 critically analyses and synthesizes the available information. Section 5 establishes an initial COVID evaluation framework to assess the resilience of contractors. The final section provides conclusions and proposes future studies.

2. Research design

In the last four months, a variety of guidelines, articles, webinars, videos, and news have been published trying to rationalise the events resulting from the pandemic, following different criteria, interests, legal and cultural frameworks depending on the country in which they were published. **This paper is thus timely and aims to analyse the existing information to establish the main challenges that contractors face under the COVID crisis, and, based on this, to develop an initial COVID evaluation framework for contractors.**

Firstly, a scoping review was conducted to systematically map the information published on how COVID is affecting contractors. A new body of knowledge, which has been documented heterogeneously. The scoping review examined the volume and nature/characteristics of the research activity in this topic area. Information was found to be disseminated in a wide range of formats. Given the mixed nature of the sources, a wide range of documents have been examined, such as webinars, videos, specialised magazine articles, and guidelines of governments and related bodies. For this purpose, Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) was used as the reference standard to synthesise evidence, due to its methodological rigour (Moher, et al., 2009). PRISMA involves a systematic search of a body of literature based on predefined eligibility criteria and performed according to a predefined methodological protocol (Moher, et al., 2009) as seen in Section three.

Secondly, and once the potential challenges were established, the scoping review was used as a helpful precursor to a brief literature review. The literature review synthesises the data extracted and draws overall conclusions from the body of literature on this novel topic. This review included in Section four answers the research question, and builds a rationale for future series of studies. Finally, based on the previous two reviews, an initial COVID evaluation framework for contractors is developed in Section five.

3. A scoping review

A total of 49 relevant documents, both video and written, were analysed. The eligibility criteria established to select the information sources that were included in the review focused on COVID and construction. Sources were excluded if they did not fit these criteria. Peer-reviewed journal papers, government guidelines, related bodies guidelines, specialised magazine articles, webinars, and videos were searched and included if they were published in English between the period of January 2020 to June 2020. The mixed nature of the sources was intended to allow for a consideration of information from different perspectives on the topic, which was necessary due to its novelty and continued evolution. This review is limited by the novelty and uncertainty of the subject, since the topic is constantly evolving and generating new information daily.

The method of identifying potentially relevant documents was an e-literature and e-video search. The same keywords were used for each source of information (COVID, Corona, Contractor, Construction). Following this strategy, a search generated 3,701 sources of information for the period from January 2020 to June 2020. The eligibility of the documents identified was evaluated based first on the title and abstract (excluding n= 3,376 documents) and then based on a full-text assessment (excluding n=276 documents).

Table 1 shows the search strategy of the scoping review, the keywords used, the limits of the search, and the number of documents per source of information before filtering.

Table 1. Search Strategy Template. Search performed from January 2020 to June 2020

Sources of information	Keywords	Limits
Journal papers: Construction Information Service [19]; Emerald [4]; Sage Journals [21]; Science Direct [27]; Scopus [47]; Springer [17]; Taylor & Francis [0]	COVID Corona Contractor Construction	**Language:** English **Time:** January 2020 **Topic:** Construction
Academic social networking: Academia [7]; ResearchGate [130];		
Specialised magazines: Building.co.uk [495]; ConstructingExcellence [2,025]		
Government and bodies guidelines: England [60], Scotland [40], Wales [15], Northern Ireland [10]**;** CLC [40]; BuildUK [30];		
Videos: Youtube [380]; Vimeo [334]		

3.1. Characteristics of sources of evidence

The sources of information include 49 written and visual documents. Figure 1 shows how most of the relevant material available on the topic has been published in web articles, specialised e-magazines, videos, and webinars, followed by several guides by specialised bodies and government regulatory documents. Only two peer-reviewed paper matched the predefined eligibility criteria at this time. The novelty of the topic explains this.

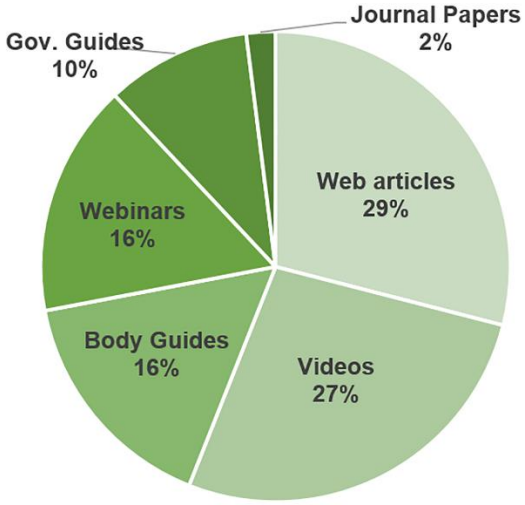

Fig. 1. Number of documents included in each different type of evidence source.

3.2. Analysis of the sources of evidence

An analysis of the titles and abstracts of the sources of evidence It was carried out to identify the most mentioned and important challenges. This analysis revealed that the challenges that contractors face due to COVID are diverse and classified into seven major themes: Health and Safety, Economics, Procurement, Manpower, Supply Chain, Subcontractors, Uncertainty.

Figure 2 shows a fragmented focus in different challenges and the interest that each challenge has in general. Different authors are interested in different aspects of the impact of COVID on contractors. We will see in Section four that according to the authors, two parameters primarily concern contractors: the health and safety of their employees and the economic impact that this crisis will have on their companies. This is confirmed by a survey conducted by Elliot Davis (2020). Health and safety standards have been clearly established in government guidelines. The economic impact is not yet clear, and although it is also important, the first reports are only just beginning to be published. The reason why the procurement topic has more documents is that it is open to interpretation, and more authors have reflected on the topic. The other four challenges are also important, but according to the interest shown, on a smaller scale than the previous three. In Figure 2, the size of the individual boxes is proportional to the number of documents available per challenge.

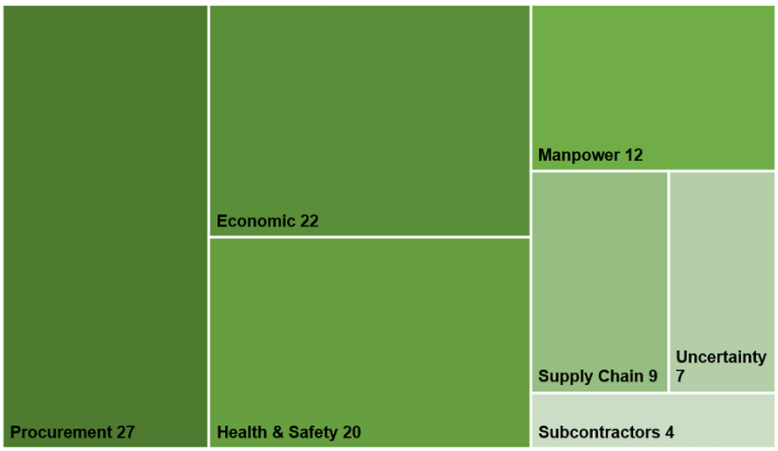

Fig. 2. Number of documents per challenge.

4. Review of the challenges that COVID has brought to contractors

In this chapter, a thematic review was carried out based on the data extracted from the 49 documents selected in the previous chapter. The data was thoroughly reviewed and organised around the seven major challenges established in the scoping review in order to generate an initial COVID evaluation framework for contractors in Section five.

4.1. New procedures to provide health and safety on-site

Working under optimal health and safety conditions on-site should be the number one aim for contractors (Berry, et al., 2020; The Builders' Association and AIA Kansas City, 2020). Contractors have a duty to reduce workplace risk to the lowest reasonably practicable level by taking preventative measures to protect the health and safety of workers and visitors (BEIS, 2020b). The first step is to carry out a "Health and Safety" risk assessment, taking into account the new risks presented by COVID. This is mandatory in the UK, according to the Health and Safety Executive (HSE). Once completed, the results must be explained to all employees (CPWR, 2020), and a set of site operating procedures must be established to mitigate the risks found.

The UK government, like most governments around the world, quickly released a guide for "Working safely during COVID in construction" (BEIS, 2020b). Therefore, the second step for the contractor is to adopt the new COVID site operating procedures to comply with the new regulatory framework so that they can continue working; otherwise, the site will be suspended. In the case of England, the contractor will take into consideration the documents prepared by the Department for Business, Energy and Industrial Strategy (BEIS) (2020b), and the Construction Leadership Council (CLC) (2020a). Extra restrictions and advice may apply in Scotland, Wales, and Northern Ireland. Before the pandemic, the focus was on on-site security, now attention to public health has increased. The complexity of this change requires an investment and had a clear impact on "time". Health & Safety site operating procedures are based upon the traditional industrial hygiene hierarchy of control measures to avoid the risk of contagion (CPWR, 2020), as the following paragraphs show.

A. Elimination of the hazard (CPWR, 2020)**:**

- The first measure is to eliminate the risk of exposure by making every reasonable effort to facilitate their employees working from home to reduce the number of people on-site (BEIS, 2020b; CLC, 2020a). Only essential workers should be permitted on-site, avoiding on-site meetings if possible or stopping all non-essential visitors to the site (Davis, 2020; CPWR, 2020; CLC, 2020a; Skyline Construction, 2020b).
- Ensuring everyone is aware of the symptoms and that both workers and visitors who feel unwell must stay at home and do not access the premise (BEIS, 2020b).
- Adopting pre-shift checking systems such as employee and visitor access temperature readings using non-contact thermometers (Davis, 2020; CPWR, 2020; Skyline Construction, 2020c and 2020d).
- Frequent handwashing and surface cleaning in every workplace (BEIS, 2020b).

The new regulatory document provides the norms to follow to maintain a safe workplace during the crisis. However, establishing new health and safety operating procedures is not enough on its own. In addition, everyone on-site must adopt these new norms as habits. A change of habits by every individual in the industry is necessary (Berry, et al., 2020). Therefore, the contractor must also establish an on-site COVID Task Force, responsible for ensuring that health and safety protocols are implemented immediately and being followed continuously, monitoring the performance of the individuals on-site (Hulme, et al., 2020; Davis, 2020). The same force will be responsible for one of the most important protocols. The protocol affecting workers experiencing COVID symptoms (Hulme, et al., 2020) to send them home (CLC, 2020a), carry out contact tracing, monitor the disinfection of the working areas affected (BEIS, 2020b), and inform local public health officials of the outbreak (CPWR, 2020). In the worst-case scenario, if there is an outbreak on-site, the contractor will need to partially or completely shut down the site (Skyline Construction, 2020c).

Hygiene, sanitation, and cleanliness need to be improved on-site to eliminate the hazard and prevent the spread of COVID (Skyline Construction, 2020d). Therefore, contractors have to invest time and money to develop and implement a selection of new practices, such as increased ventilation in enclosed spaces (CLC, 2020a), and extra on-site facilities, such as additional portable hygiene areas at multiple locations for hand washing, with non-contact soap dispensers or dryers (Hulme, et al., 2020; Davis, 2020; CPWR, 2020; Skyline Construction, 2020d). In addition, the contractor has to develop cleaning and decontamination procedures for frequently touched objects, such as vehicles, equipment, or door handles between uses (BEIS, 2020b; CPWR, 2020; Skyline Construction,

2020d), but also for common areas, such as lunchrooms, entrances, changing rooms, and bathroom areas, using disinfectant materials and perhaps disinfectant nebulisers (Skyline Construction, 2020d).

B. Administrative controls or changes to the way people work.
Where working from home is not possible, workplaces should comply with the social distancing guidelines set out by every local government (BEIS, 2020b). The distance varies depending on the country. Social distancing at work is the new protocol implemented by governments that has had the most impact (Hulme, et al., 2020; Berry, et al., 2020; Skyline Construction, 2020b and 2020e). Social distancing has two main effects: (i) the need to reduce the number of workers in the same place at the same time, and (ii) the increased time invested in the movement of labour and transportation of deliveries both horizontally and vertically (Skyline Construction, 2020b). Social distancing adds time to each stage, from accessing the site, reaching the task area, completing the task, preparing the area for the next task, and leaving the site. Social distancing delays tasks and has a severe impact on productivity (Berry, et al., 2020), schedules, and project flow (Skyline Construction, 2020b).

Scheduling is always important, but under these circumstance it becomes more important than ever, especially to reduce the number of workers in busy and confined areas, such as trailers, elevators, forklifts, access, toilets, or break areas (CPWR, 2020). Contractors should consider introducing a staggered start and finish to reduce congestion at Site Access and Egress Points (CLC, 2020a), and staggering break times to reduce congestions in common areas or use safe outdoor areas for breaks (BEIS, 2020b). In addition to a thoroughly planned schedule, contractors will need to consider investing in increasing the number or the capacity of canteens, rest areas, changing facilities, showers, and bathroom facilities (Davis, 2020; BEIS, 2020b; CLC, 2020a). Contractors will also need to set up new layouts to split sites into working zones to separate groups of workers (BEIS, 2020b).

Finally, contractors should also invest in additional parking facilities, including bike-racks, to facilitate travelling to the site in isolation (BEIS, 2020b; CLC, 2020a).

C. Mitigating actions where the social distancing cannot be fully followed
If the activity is unavoidable, the contractor should put in place all the possible mitigating actions to reduce the risk of transmission between staff. The frequency of handwashing and surface cleaning should be increased, the activity should be as short as possible, the use of screens to separate workers is advisable, whenever possible, face-to-face work should be avoided (working side to side or back to back should be encouraged), and the workforce should be split into fixed teams to reduce contact between a high number of people (BEIS, 2020b). It will also be necessary to revise pick-up and drop-off collection areas or transfer zones to avoid contact (BEIS, 2020b).

Sites were adapted to the required 2 meters of social distancing. However, from Saturday 04 July, the Prime Minister of the UK has established that where it is not possible to stay 2 metres apart, guidance will allow people to keep a social distance of 1 metre apart, plus mitigations which reduce the risk of transmission (Johnson, 2020). These mitigations include using protective screens and face coverings, closing non-essential social spaces, providing hand sanitiser, and changing shift patterns so that staff works in set teams (Rogers, et al., 2020).

D. Personal protective equipment (PPE) is at the bottom of the hierarchy (CPWR, 2020).
When managing the risk of COVID, additional PPE beyond what an employee usually wears is not beneficial (BEIS, 2020b). There is a debate around this topic, with some documents advising companies to provide additional PPE (CPWR, 2020; Davis, 2020). On the other hand, the Site Operating Procedures of the Scottish government does not recommend the wearing of face masks (Building, 2020b). Nevertheless, it is clear that COVID needs to be managed through social distancing, hygiene, and the hierarchy of control displayed in this section, and not through the use of PPE (BEIS, 2020b).

Finally, the contractor must invest time in training and communication with the employees on the new hazards and controls (CPWR, 2020; Davis, 2020). They need to be trained to take responsibility for maintaining social distance, washing their hands with disinfectant, and notifying supervisors if they experience symptoms (CPWR, 2020). This communication should be online but also done through the installation of visual signals and basic “Data Sheets” on-site to remind workers of the new rules of social distancing and hygiene (BEIS, 2020b; CPWR, 2020; Skyline Construction, 2020d; Glenigan, 2020a). Any information should be delivered using simple, clear language and images (BEIS, 2020b).

In conclusion, it is necessary to provide safe workplaces, which requires an investment of time and money. This also implies a severe impact on efficiency levels, which again adds time, and subsequently cost, to each project. Health and safety is the key driver to all the changes on-site and the reason behind most of the other challenges that we will see in this section (Section four). It should be the basis of all planning for the new way of working on-site. It is a must to stop the pandemic and preserve workers and the economy in the long term.

4.2. Economic challenges

Project cost and maintenance of the cash flow, or in other words, the money, is always one of the main challenges for contractors. Getting access to cash has been extremely important (Levelset, 2020) and for some authors like Skyline Construction (2020c), it has been the main challenge during the COVID crisis for contractors. For others, it is the second (Hulme, et al., 2020), after health and safety are provided on-site. Both are strongly interrelated and equally important. A project that does not follow health and safety requirements or does not have cash will have to close.

The economy of a project is affected by numerous factors, but time is the main driver of cost in any construction project, and COVID has disrupted project schedules in many areas (Skyline Construction, 2020c). COVID has increased the total time and cost of each project (Skyline Construction, 2020b). It has generated extra investments and delays due to the implementation of new health and safety procedures, and delays in the supply chain and the work of subcontractors (Hulme, et al., 2020; Skyline Construction, 2020b and 2020d). It has meant a sudden slowdown, producing an average reduction of 20% in the on-site productivity (Rogers, et al., 2020). COVID has also increased insolvency and reduction of cash-flow (CLC, 2020b), with general contractors and subcontractors facing an increased risk of not receiving payments (Skyline Construction, 2020a).

In the UK, the construction industry shrunk by 5.9% in March 2020 and 40.1% during the lockdown of April 2020 (ONS, 2020). Therefore, it is clear that COVID has had an economic impact on contractors, but not in a uniform way. England, Scotland, Wales and Northern Ireland are responsible for their own policies in relation to public health matters. Therefore, there is a disparity of COVID policies in relation to construction (Institute for government, 2020). They have approved different dates and regulations to return to work. There are also differences in the advice given (Door & Hardware Federation, 2020), including social distancing (Rogers, et al., 2020). The four nations introduced lockdown restrictions at the end of March. Although the lockdown restrictions were very similar, it is clear that the exit strategy is different. On 27 March, the UK government stated that the “construction sites have not been asked to close, so work can continue if it is done safely” (MHCLG, 2020). On the other hand, on 06 April 2020, the Scottish government advised all non-essential construction sites to close (Scottish Government, 2020). The result was that the majority of contractors operating in Scotland suspended their Scottish sites (Goddard, 2020). Meanwhile, in England, although some contractors shut during April to prepare the sites, a good part of non-essential sites were able to remain open if they were complying with social distancing requirements. At the end of April, 40% of ongoing projects were still suspended (Glenigan, 2020a), but most of those were located in Scotland (80%) and Northern Ireland (79%) (CPWR, 2020). At the end of June, in England, only 9% of sites were suspended, 12% in Wales, 49% in Northern Ireland, while in Scotland, 71% remained closed (Skyline Construction, 2020d). England and Wales started reopening its construction sites in the middle of May. Meanwhile, the Scottish and Northern Ireland governments imposed tighter health and safety restrictions and did not start to reopen sites until June 2020 (Glenigan, 2020b). For instance, in Scotland, the Restart Plan commenced on 22 June, with a “soft start” to site works from 28 May for preparation (Scottish Government, 2020).

The different health and safety measures applied in each territory could be the reason behind the results of the survey conducted by Build UK (Building, 2020b). This survey revealed that 29% of contractors in England and 32% in Wales, think that they would have significant financial difficulties this year due to COVID, while the percentage increases to 42% in Scotland, and 45% in Northern Ireland.

Additionally, on Saturday 04 July 2020, the Prime Minister announced a relaxation of the main rule in health and safety, the 'one-metre plus' social distancing rule, where it is not possible to stay two metres apart (Johnson, 2020). In principle, this could have a positive economic and productivity impact for the housing sector, and smaller building works in England (Rogers, et al., 2020). Again Wales, Scotland, and Northern Ireland will adjust social distancing rules “at their own pace” (Rogers, et al., 2020).

Contractors have been affected differently not only depending on the territory in which they work. The economic resilience also depends on the size of the company. Small and medium-sized enterprises (SMEs) are the backbone

of the construction industry, but these types of companies do not usually have large reserves of money (Berry, et al., 2020). Therefore, economically, SMEs are the most vulnerable. Finally, contractors dedicated only to the private sector will be at greater economic risk, especially if they are engaged in sectors such as retail, hotels, and leisure (Glenigan, 2020c). These sectors seem to be the most affected by the pandemic. On the other hand, the public sector, especially healthcare, education, and infrastructures, is healthy at the moment and heavy government investments are expected in these sectors to help reactivate the economy in the coming months (Glenigan, 2020c).

In this economic scenario, the contractor should invest time and resources in analysing the economic situation of current projects (Davis, 2020), maintain fluid and constant communication with every stakeholder to monitor delays and payments closely (Levelset, 2020), and compile documentation on any possible loss related to COVID (Hulme, et al., 2020) to present it in case of contractual exposure or to request government aid. Most governments have put sources of cash in place to provide liquidity to contractors (Levelset, 2020). The UK government has quickly implemented several economic measures, such as: the Coronavirus Job Retention Scheme (JRS) through which the government pays 80% of the wages of staff on furlough until 31 July 2020; the Statutory Sick Pay Rebate (SSPR) which pays back two weeks of SSP for staff affected by COVID; the Coronavirus Business Interruption Loan Scheme (CBILS) to help SMEs with loans of up to £5 million; the Bounce Back Loan Scheme (BBLS) for SMEs to borrow up to £50,000; the Coronavirus Large Business Interruption Loan Scheme (CLBILS) for large contractors to borrow up to £200 million; the COVID Corporate Financing Facility (CCFF) to facilitate with short-term debt the liquidity of large contractors; and the Trade Credit Insurance (TCI), through which the government will temporarily guarantee business-to-business transactions up to £10 billion of total insurer losses and some extra Tax and VAT deferral measures (Berry, et al., 2020; NFRC, 2020).

Finally, it is also important to invest time in studying the prospects for obtaining new projects and the financial risks involved (Davis, 2020). It is advisable for contractors to model worst-case, best-case, and guess scenarios before planning for the future (Wilkinson, 2020), taking into account the uncertainties and additional costs presented in this research. According to Elliot Davis (2020), in the coming months, there will be an increase in competition for available work, more pressure on operating margins, and aggressive cost control by construction companies. To end on a positive final note, it must also be said that the update of 12 June 2020 revealed that in the UK, planning applications have returned to pre-COVID figures (Glenigan, 2020d).

4.3. Procurement

Most contractors face contractual exposure due to delays or money shortages in their current projects because of COVID (Hulme, et al., 2020; Davis, 2020; Preston, 2020). Therefore, it is advisable for Contractors to review their contract portfolio to find possible exposures. There is a real concern that the construction industry will enter into costly and lengthy disputes (CLC, 2020c). Legal disputes are expensive disruptions in terms of time and money. The most typical construction disputes are about money, in particular, not being paid and failure to comply with the deadlines. COVID has exacerbated both issues (Levelset, 2020). For that reason, the UK government has called on all parties in the construction industry to act in a manner responsible and fair to protect jobs and economy and, where possible, ensure payments to every stakeholder and be flexible in respect of the time for delivery and completion (BEIS, 2020a).

Contractors should be careful with the application of force majeure. This clause allows a contracting party to be excused from fulfilling its obligations because events are beyond its control. This clause often does not cover COVID (Hansen, 2020). Extensions of time or additional costs as a result of COVID will depend upon the terms and conditions of the contract. There is no simple legal definition of what constitutes force majeure, as this always depends on the wording of the contract (Miller, 2020). Many contractors have cited “force majeure” as their reason for an extension of time on the completion date (Farrer, 2020). Stakeholders should be wary of assuming that simply pleading force majeure will exempt them from their contractual obligations (Harwood. 2020). In previous cases, the Courts interpreted the clause narrowly, and it was only accepted if an outbreak was explicitly named as force majeure in the contract. Most force majeure clauses do not include words epidemic or pandemic (Hulme, et al., 2020). Therefore, this is a grey area.

Contractors should also review their insurances**.** In general, they only cover standard risks, and epidemics are rarely included in the “business interruption” policies (Harwood. 2020). The contractor must also inform the insurer of any change in the circumstances of the site to prevent contractors from being uncovered in the event of fire, break-ins, or anything that affects the integrity of that site (Preston, 2020).

Contracts and insurance policies will change due to COVID (Hulme, et al., 2020; Berry, et al., 2020). COVID is no longer unforeseeable, and, as a result, it will not be a force majeure event in the future (HFW, 2020). The legal documentation and even the way of bidding for work will need to reflect the new reality and challenges (Berry, et al., 2020; Davis, 2020). It will be necessary to write appropriate provisions in contract preliminaries and general conditions, so that reasonable precautions are established to prevent the new risks (Watts, 2020). Finally, is worthy to remember that a contractor has a legal responsibility to protect workers and others from risk to their health and safety (BEIS, 2020b). In that regard, each local government has created mandatory on-site procedures to be followed.

4.4. Manpower

Before the lockdown, the UK government predicted that during the peak of the pandemic, 20% of the workforce would be in isolation (Glenigan, 2020c). The number of on-site qualified manpower has been reduced due to COVID-related sick leave (Hulme, et al., 2020), or workers who returned to their places of origin away from major projects (Skyline Construction, 2020a). In March, contractors were already experiencing staff shortages (B1M, 2020), and these shortages have affected every stakeholder in the construction industry, including contractors, subcontractors, supply chain, manufacturers etc.

Social distancing has reduced the number of individuals in confined areas to comply with the new health and safety regulations (CPWR, 2020). This is having a serious impact on the productivity levels on-site (Berry, et al., 2020). The solution could be to extend working hours and implement additional shifts to try to achieve the deadlines (Skyline Construction, 2020d). In this way, on 13 May 2020, the Housing Secretary of England (Jenrick, 2020) requested local planning authorities to take a positive approach when contractors request longer working hours to facilitate social distancing due to COVID. Construction sites can request an extension of working hours until 9 pm, Monday to Saturday, and in areas without residential properties, they can request a 24-hour work schedule. However, this should raise the question of whether this would be possible because there is already a shortage of labour, so it will be difficult to find new manpower.

Social distancing is also affecting, to a lesser extent how the labour force can get to work, as the government advises against sharing cars, and suggests travelling alone to the site using your own transportation (Davis, 2020; BEIS, 2020b; Berry, et al., 2020; CLC, 2020a).

4.5. Supply chain

The supply chain has been severely disrupted due to this global crisis (Skyline Construction, 2020f). In the first weeks of the pandemic, it was difficult to obtain not only some key construction materials but also some of the materials necessary to meet hygiene and safety requirements. There was little product available, all the industries needed it, and logistics were disrupted, which caused delays and prices to rise (The Builders' Association and AIA Kansas City, 2020). China represents about a third of global manufacturing, and the lockdown of China during the first months of 2020 started to have an impact on the availability of products for construction in early March (Levelset, 2020). Since March, several other countries have suffered severe lockdowns and not all parties involved in the supply chain, such as raw material suppliers, intermediate assemblers, manufacturers, or carriers, have returned to work at the same speed (Berry, et al., 2020). All this has created disruptions in the supply chain and the construction industry.

The contractor should analyse whether the suppliers have links at risk of disruption. The supply chain is being affected by the availability of materials and manpower (Skyline Construction, 2020e). It could be lockdowns in the area where items are manufactured or in the place where pieces are assembled (Skyline Construction, 2020f), or disruptions during the shipping process to the next point, where shipping by ground, air, or sea may involve different levels of risk (Skyline Construction, 2020e). The items with a significant impact on projects that presently pose a challenge to contractors are mainly mechanical-electrical products (Glenigan, 2020c), such as HVAC systems, LED lighting, lighting fixtures, fire safety devices, elevators, and some other products such as cast iron fixtures, millwork, and imported special timber, tiles, and stones (Davis, 2020, Skyline Construction, 2020f).

The impact that COVID is having on suppliers is transformed into delays in orders and the subsequent impact on tasks and deadlines on-site (Hulme, et al., 2020). Contractors have already been affected by a lack of certain materials (Skyline Construction, 2020e), and 40% of them admit that these delays will have a significant impact on the project schedule in the second half of 2020 (Davis, 2020). Therefore, contractors should dedicate more time to

communicate in both directions with their key vendors (Hulme, et al., 2020) and to put strategies in place, such as finding alternative, safer, local sources to mitigate this challenge (Levelset, 2020). Although local sources tend to be more expensive, in the current situation, they may be competitive.

Finally, the supply chain is under heavy economic stress. It is extremely important that the construction industry is saved as a whole. This is why the CLC (Mitchell, 2020) sent an open letter advising all construction companies to continue paying in accordance with agreed contractual conditions as a priority to keep the entire industry running. Public sector contractors have ensured to pay providers, until at least the end of June 2020, to facilitate them to restart normal contract delivery once the outbreak ends (BEIS, 2020c).

4.6. Subcontractors

Contractors need more than ever to schedule and organise different subcontractors very carefully to guarantee a safe site in which to work. “The days of stuffing a job with a lot of guys to finish it up in a hurry” are over (Skyline Construction, 2020b). In addition, subcontractors can put projects on hold or extend them due to the same problems than contractors are facing (Davis, 2020), including health and safety, lack of manpower, economic difficulties (Skyline Construction, 2020a) or supply chains issues (Davis, 2020). For instance, subcontractors can face labour problems due to outbreaks of COVID (Skyline Construction, 2020a), or if they are working on multiple projects with delays due to COVID. Therefore, contractors will need to dedicate more time to communicating in both directions with their key subcontractors to understand their current situation and vulnerabilities and plan accordingly (Hulme, et al., 2020).

4.7. Uncertainty about the evolution of COVID, markets and government decisions

The world drastically changed in just one month, nobody predicted in January 2020 the scenario that we are now seeing. The pandemic and its impact are constantly evolving (Hulme, et al., 2020; Skyline Construction, 2020c), and how governments and industry adapt to both. CLC recognises that the situation is continually evolving, and as such, the guidance that they provide will be revised if necessary (CLC, 2020b). England has changed its social distancing regulation within three months (Johnson, 2020). In the same period, some financial aids have appeared, and others terminated or renewed with slightly different terms and conditions. There is no consensus about the duration and the intensity of the impact, the cost of the impact, or if certain projects or markets will shut down or recover soon. A clear example is that, so far, the construction industry has not been uniformly affected. According to the survey carried out by Elliot Davis (2020) in May, 13% of the companies have already reduced their workforce, 15% reported significant impacts, but 20% reported that they had no impact or were still ahead of the plan for 2020. The reality is that each contractor is a unique case depending on its size, in which specific sectors of the industry it works (Davis, 2020), its location, the local government regulations and aids, and its proximity to sustainable sources of labour and materials.

This uncertainty about the evolution of the virus, the government decisions, and the local and global markets makes it difficult to predict the future of contractors in the short and long term and to plan accordingly. When everything is so highly unpredictable (Skyline Construction, 2020f), the risk of the unknown appears, and this has an impact on effective decision-making (Levelset, 2020; Davis, 2020).

Oey and Lim (2021) concluded that those who are resilient enough to adapt to this challenging business environment will survive. This review identified and critically reviewed the main challenges that contractors should assess when preparing their resilience plan.

4.8 Brief discussion

Section four has reviewed the seven main challenges that contractors face due to the COVID pandemic. The next paragraphs briefly discuss the implications of the findings and outline some recommendations.

Contractors have a legal responsibility to ensure health and safety of the workers, and to implement the new on-site procedures approved by their local government. The implication is that social distancing, the protocol with the greatest impact, is reducing on-site productivity by an average of 20%. The government has provided two remedies: an extension of the operating hours and, in England, the social distance has been reduced to “one meter plus mitigations” where it is not possible to stay two metres apart. It is still too early to anticipate the positive economic

impact of this change, but this could help SMEs working on small projects/buildings, including renovations. On the other hand, we all hope that this does not end in bad practices.

Insolvency has increased and cash flow has decreased. Therefore, money has become the biggest challenge for many contractors. However, the impact has not been the same for every company. Thus, the large contractors who work in locations with more relaxed health and safety regulations, as it happens in England, and for the public sector, may not have been affected as much by the crisis as those SMEs located in Northern Ireland and Scotland and working for the private retailing, hotel, or leisure sectors, since the regulations in these locations are stricter, and those sectors have been heavily affected by the crisis. This means that these contractors may have to start diversifying and looking for sources of business in the public sector and economic liquidity in the form of public aid.

This review has also revealed that most contractors face contractual exposures related to delays or money issues. Delays and shortage of money are the two most common problems that contractors and most stakeholders in the construction industry are facing right now. Therefore, contractors should try to avoid lengthy and costly legal disputes that aggravate the situation even more and negotiate every possible case with flexibility.

In addition, the authors advise that contractors should verify that the "force majeure" clause covers COVID before using it as a reason to extend the completion date of a project; otherwise, it will not be valid. They should also begin to assess the impact in time and costs that COVID is having in their projects to be able to draft appropriate contracts in the future, taking these issues into account to avoid future legal disputes.

COVID has also generated problems of access to manpower and disruptions in the supply chain and in the work of subcontractors. Both can delay or even put on hold a project. Therefore, the contractors should maintain close communication to assess the situation of suppliers and subcontractors at all times. At the same time, they should look for alternatives so that they can be prepared in the event of a cut in the traditional supply chain.

The last challenge is that the pandemic and its impact are continually evolving. This uncertainty, the number of factors and additional investments to consider, make it difficult for contractors to predict any scenario before planning for the future. That is why this research proposes a COVID assessment framework in the next chapter so that each contractor can analyse the resilience of their company against the main challenges that the pandemic created.

5. Initial COVID assessment framework for contractors

Each contractor is a unique case. Therefore, the impact of each of the challenges described in section four will have a different magnitude for each contractor. This research reveals that the magnitude depends on the size of the contractor, the specific sectors in which the contractor works, location, local government aids/regulations, and the proximity to sustainable sources of labour and materials. These factors will make the contractor more or less resilient to the pandemic.

The review included in section four gives a better understanding of what needs attention. This is a crucial starting point for planning solutions. Based on the previous review, an initial COVID evaluation framework is proposed and illustrated in Table 2. The table allows to evaluate the resilience of a contractor for each parameter included. In this way, the level of vulnerability of a company to each of them can be established. After analysis, they can model guess scenarios and plan to mitigate their vulnerabilities depending on possible future changes in the pandemic.

Table 2. Initial COVID evaluation framework for contractors

Health & Safety	Economics	Procurement & Regulations	Manpower	Supply chain	Subcontractors
Work from Home	Non-payments	H&S Legal Responsibility	Health & Safety	Non-payments	Non-payments
COVID Task Force	Extra Time	Different Regulations	Availability	Manpower	Manpower
Hygiene	Extra Cost	Revise Contract Portfolio	Logistics	Raw Material	Supply Chain
Social Distancing	Territory, Size & Sector	Revise Insurance Portfolio	Schedules	Assemblers	Contracts
Outbreak Protocol	Aid Funds	New Contracts & Insurance	Extra Hours	Manufacturers	Schedules/Time
Training & Communication	Future Projects	Check Force Majeure Clause	Travel to Work	Shipping	

6. Conclusions, recommendations and future research

This research study was set out to explore the major challenges that contractors are facing due to the COVID pandemic and has identified the following seven areas to assess: the health and safety on-site; the economic impact that COVID has on the company; the possible legal exposures; the manpower availability; the instability of the supply chain and subcontractors; and the uncertainty related to the constant and unpredictable evolution of the pandemic.

Due to the novelty of the topic, this study found little to no academic research that focused on the impact of the epidemic outbreak from a contractor perspective. Therefore, this research is timely and relevant, as it produces the first scoping review on how COVID has affected contractors and the construction stage. This new topic has been heterogeneously documented. This research mapped and thoroughly reviewed every challenge, allowing for a holistic vision of the current situation. This research makes available precise information on the new scenario created by COVID for contractors to understand the current situation better. Finally, it proposes an initial COVID assessment framework so that each contractor can analyse the resilience of a company concerning the seven main challenges previously outlined. By analysing these parameters, the contractor can identify vulnerabilities for each parameter and plan specific priorities to minimise them, so that companies can remain competitive and prepared in case of possible future epidemic waves.

The findings discussed in this research are expected to be beneficial to various stakeholders in the construction industry, especially contractors, but also suppliers, subcontractors, consultants, owners, and policymakers. Although the framework is based on the UK market, during the investigation, it was clear that, since COVID is a global pandemic, the challenges are common to all. Therefore, most of the recommendations in this document can be useful for similar international scenarios, always taking into account specific local characteristics.

Concluding thoughts

- Contractors have a legal responsibility to protect the health of their workers.
- COVID needs to be managed through social distancing, hygiene, and an on-site COVID Task Force to ensure that Health and Safety protocols are implemented and followed. This requires an investment of time and money.
- On average, the pandemic has reduced the productivity on-site by 20%. An extension of opening hours and a reduction in social distance to 1m “plus” could minimise this impact.
- COVID has meant a sudden slowdown or in other cases the interruption of on-site activity, lack of manpower, disruptions in the supply chain and in the work of subcontractors, an increase in insolvency, complex contractual exposures, and a reduction on cash-flow. Therefore, the construction industry is undergoing a period of shrinkage.
- This research concludes that the magnitude of the impact of each factor on each contractor mainly depends on the size of the company, the strictness of the local regulations, and the sector where the contractor works. SMEs working on retailer, hotel, and leisure private sectors are the most vulnerable and large contractors working in the healthcare, education, infrastructure, and utilities public sectors have the best prospects.
- COVID is a constantly evolving pandemic which has created an uncertain scenario with a lot of interconnected factors to consider. In these circumstances, it is difficult for contractors to predict and plan for the future, and planning is crucial to remain competitive.

Recommendations

- Governments and policymakers have a crucial duty to improve the resilience of contractors. It is clear that contractors still require financial support and a supportive structure for the coordination and mitigation of the always-evolving events during this pandemic with an effective combination of vision, feedback, and revision of the strategy to allow for necessary reorientations.
- All parties are deeply interconnected and must continue to work together, be as flexible as possible, and act responsibly to protect jobs and the construction industry as a whole, no one can be left behind.
- Contractors should maintain close communication to assess the situation of their employees, but also their suppliers and subcontractors, at all times to anticipate vulnerabilities and plan alternatives before problems arise.
- Contractors should model worst-case, best-case, and guess scenarios before planning the future. We recommend contractors use the proposed COVID assessment framework to evaluate the impact in time and costs of COVID on their projects so that they can create prediction models and be prepared in the event of possible future epidemic waves.

What is next?

To look to the future with hope in a crisis, it is essential to understand the current situation of each company and the main risks that exist. This study has built a rationale for a future series of studies on both topics. The study proposes an initial tentative framework to give contractors a starting point to assess the resilience of their companies against the main general challenges. In future research, these factors will be validated using case studies and further refined.

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Appendix A. Scoping Review

Table A1. PRISMA flow diagram for the selection of sources of evidence

Identification	**Total records identified after elimination of duplicates** n = 3,701	
Screening	**Level 1 Screen** Title & Abstract, Title & Description n = 3,701	**Records excluded after screening at Level 1** n= 3,376
Eligibility	**Level 2 Screen** Full document viewed or screened n = 325	**Records excluded after screening at Level 2** n=274
Full documents included n= 51		

Table A2 Characteristics of the sources of evidence. (Health & Safety: H&S; Economics: E; Procurement: P; Manpower: M; Uncertainty: U; Supply chain: S.C; Subcontractors: Sub; Challenges: All of them).

No	Time	Country	Nature of the source	Purpose - Topics	Stakeholders	Authors
1	10 March 2020	World	Web Article	H&S + P	Construction Industry	Watts, S.
2	19 March 2020	USA	Webinar	E + S.C + P + U	Construction Industry	Levelset
3	20 March 2020	UK	Government Doc.	P	Construction Industry	Department B&I
4	20 March 2020	UK	Video	E + S.C + M	Construction Industry	Glenigan
5	27 March 2020	Canada	Webinar	Challenges	Construction Industry	Hulme, et al.
6	27 March 2020	UK	Government Doc.	P	On-site Stakeholders	Ministry of H
7	29 March 2020	World	Web Article	H&S + P	Construction Industry	WHO
8	01 April 2020	World	Web Article	M	Architects	Carlson, C.
9	01 April 2020	UK	Webinar	P	On-site Stakeholders	Preston, M.
10	24 March 2020	UK	Video	H&S + M + P	On-site Stakeholders	B1M
11	06 April 2020	UK	Government Doc.	P	On-site Stakeholders	Scottish Gov.
12	06 April 2020	UK	Webinar	E	Construction Industry	Wilkinson, G.
13	08 April 2020	UK	Body Doc.	E + S.C + P	Construction Industry	Mitchell, A.
14	21 April 2020	USA	Video	H&S + E + M + U	On-site Stakeholders	Skyline
15	21 April 2020	USA	Video	H&S + S.C	On-site Stakeholders	Skyline
16	22 April 2020	USA	Video	E + Sub + M	On-site Stakeholders	Skyline
17	22 April 2020	USA	Video	S.C + U	On-site Stakeholders	Skyline
18	22 April 2020	USA	Webinar	H&S + M	On-site Stakeholders	CPWR
19	24 April 2020	UK	Video	H&S + E + P	Construction Industry	Glenigan
20	30 April 2020	UK	Web Article	P	On-site Stakeholders	Addleshaw G.
21	01 May 2020	World	Peer-reviewed Paper	P	Construction Industry	Hansen, S.
22	01 May 2020	UK	Body Doc.	H&S + U	On-site Stakeholders	DHF
23	04 May 2020	USA	Video	H&S + E + M	On-site Stakeholders	Skyline
24	04 May 2020	USA	Video	H&S + E + Sub + P	On-site Stakeholders	Skyline
25	04 May 2020	UK	Web Article	P	Construction Industry	HFW
26	06 May 2020	USA	Webinar	Challenges	On-site Stakeholders	Elliot Davis
27	07 May 2020	UK	Body Doc.	P	Construction Industry	CLC
28	07 May 2020	UK	Government Doc.	P	Construction Industry	Department B&I
29	13 May 2020	UK	Government Doc.	H&S + M + P	On-site Stakeholders	Jenrick, R.
30	15 May 2020	UK	Video	E	Construction Industry	Glenigan
31	15 May 2020	UK	Web Article	P	Construction Industry	Farrer
32	18 May 2020	UK	Body Doc.	H&S	On-site Stakeholders	CLC
33	19 May 2020	UK	Webinar	H&S + E + S.C + M + P	Construction Industry	Berry, et al.
34	22 May 2020	UK	Video	H&S + E + M + P	Construction Industry	Glenigan
35	26 May 2020	USA	Webinar	H&S + S.C	Construction Industry	AIA
36	01 June 2020	UK	Web Article	E	Construction Industry	NFRC
37	03 June 2020	UK	Web Article	P	Construction Industry	Harwood, B.
38	04 June 2020	UK	Web Article	E	Construction Industry	PwC
39	12 June 2020	UK	Web Article	E	Construction Industry	ONS
40	12 June 2020	UK	Body Doc.	E + U + P	Construction Industry	CLC
41	12 June 2020	UK	Video	E	Construction Industry	Glenigan
42	12 June 2020	UK	Web Article	P	Construction Industry	Miller, J.
43	14 June 2020	UK	Government Doc.	H&S + P	On-site Stakeholders	Ministry of H

44	19 June 2020	UK	Video	H&S + P	Construction Industry	Glenigan
45	19 June 2020	UK	Government Doc.	P	On-site Stakeholders	Institute for Gov.
46	23 June 2020	UK	Government Doc.	P	On-site Stakeholders	Johnson, B.
47	24 June 2020	UK	Web Article	H&S + E + P	On-site Stakeholders	Building
48	25 June 2020	UK	Web Article	E + P	On-site Stakeholders	Rogers, D.
49	25 June 2020	UK	Web Article	E	Construction Industry	Building