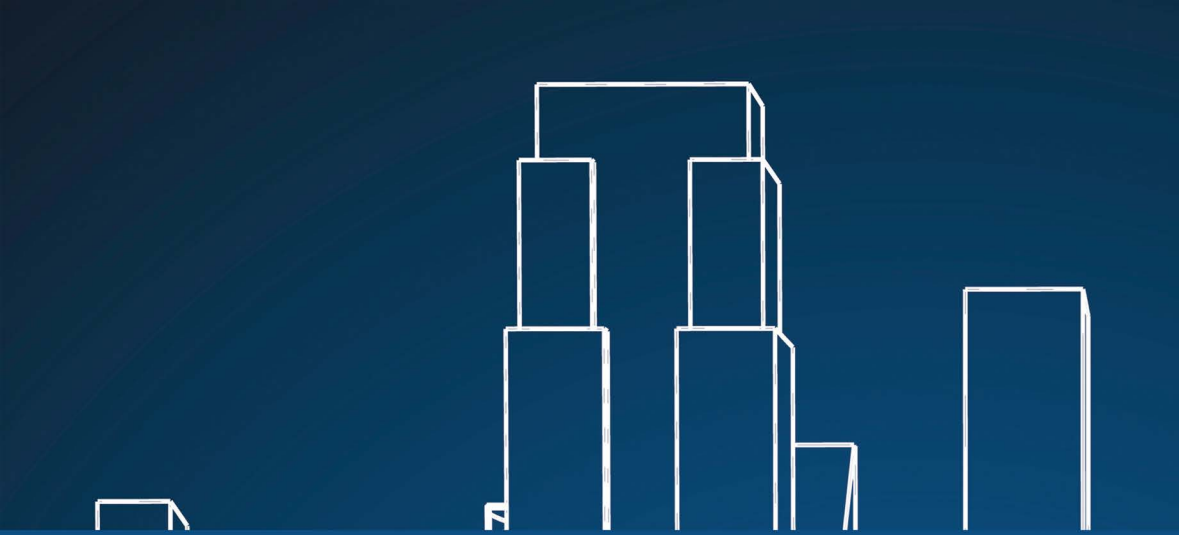

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CONSTRUCTION SAFETY, HEALTH AND WELL-BEING IN THE COVID-19 ERA

Edited by
Patrick Manu, Clara Cheung,
Akilu Yunusa-Kaltungo, Fidelis Emuze,
Tarcisio Abreu Saurin and Bonaventura Hadikusumo

Construction Safety, Health and Well-being in the COVID-19 Era

This edited book presents a significant and timely contribution to our understanding of a broad range of issues pertaining to COVID-19 and its relationship to occupational safety, health and well-being (OSHW) in the global construction industry.

The editors first introduce the industry and its poor OSHW history before highlighting some of the broader impacts of the pandemic on the sector. The book is then divided into two sections. Section One focuses on the management of COVID-19 transmission risk. It captures insights, practices, technologies and lessons learned in relation to what has and is being done to prevent or mitigate the risk of COVID-19 transmission among the construction workforce. *Construction Safety, Health and Well-being in the COVID-19 Era* also details case studies, lessons and best practices for managing sites and workforces when infections inevitably do occur. Section Two brings together international chapters discussing the impacts of COVID-19 on the OSHW of the construction workforce both on and off-site, as well as the management of those impacts. Furthermore, this presents implications of the pandemic (at the short-, medium- and long-term) for other performance measures of construction projects such as cost, schedule, quality and, most importantly, how the pursuit/non-pursuit of such performance measures have impacted/will impact the OSHW of construction workers and professionals in the industry.

This book addresses the gap in literature by offering global perspectives on the OSHW impacts and implications of COVID-19 in the construction industry and will help its wide readership (including construction industry organisations, professionals, researchers, government bodies/policy makers and students) to understand a broad suite of issues pertaining to COVID-19 and its relationship to OSHW in construction.

Patrick Manu is a professor of innovative construction and project management at the School of Architecture and Environment, University of the West of England. He is a research-active academic with an international reputation for construction safety and health research, which has underpinned exceptional contribution to knowledge transfer and external engagement in the construction industry, both in the United Kingdom and internationally. He has been involved as principal investigator (PI) and co-investigator in research projects (valued at over GBP £1.9 million) funded by several organisations. He led (as PI) an international consortium

in an EPSRC-funded research to develop the first web-based application for assessing design for safety organisational capability, which won an innovation award from HS2 Ltd. He has over 120 publications.

Clara Cheung is a reader in the Department of Mechanical, Aerospace and Civil Engineering (MACE) at The University of Manchester (UoM). She specialises in occupational health, safety and well-being (OSHW) management in high-risk industries in the United Kingdom (UK) and internationally. Since joining UoM in 2017, Clara has secured over GBP £2.3 million external funding as PI and Co-I to improve OSHW performance in the construction industry. During the COVID period, she led a work package in the Keeping the UK Building Safely project funded by Health and Safety Executive, the UK occupational health and safety regulator, to model transmission risks of different protective measures on construction sites. Her publications, including book chapters, industry reports, conference papers and articles in leading Q1 journals, have contributed to practice and theory development in OSHW management.

Akilu Yunusa-Kaltungo is a reader in reliability and maintenance engineering, as well as the Head of Mechanical Engineering Education at the Department of Mechanical, Aerospace and Civil Engineering (MACE), The University of Manchester. He has a diverse range of research specialties, owing to his blend of academic and industrial experience. Some of the areas in which Akilu has developed notable international reputation include improving OSH performance across high-risk sectors, decarbonisation of high-energy industrial operations, building energy consumption prediction and optimisation, vibration-based condition monitoring of industrial machines, machine learning-based faults detection and diagnosis, construction projects risk classification, etc. Through collaborations with reputable research-focused institutions such as Health & Safety Executive (HSE-UK), Lloyd's Register Foundation (LRF), InnovateUK, EPSRC, etc. He has supported the realisation of over GBP £1.6 million external research funding, either as Principal Investigator (PI) or Co-Investigator (Co-I). He has also generated over 130 technical publications in the form of high-impact journal articles, peer-reviewed conference articles, textbooks, book chapters, government commissioned reports and professional articles.

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Contents

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Foreword

The COVID-19 pandemic changed the world, and the built environment sector was no exception. The global construction sector was forced to consider worker health, safety, and well-being and placed these human rights at the forefront at their business. Unfortunately, across the globe, construction remains one of the most dangerous and fatal occupations. The sector struggles with higher-than-average divorce and suicide rates. Mental health must remain a central focus and emerge as a deep-rooted value within the construction sector in the post-COVID era.

This book places the pandemic in context along with the key safety, health, and well-being challenges facing the global construction sector. What will we learn from this book? Well, certainly it is hoped another pandemic does not occur for this book to be directly utilised. But the pandemic forced change and was something new to manage. The construction sector became more adaptable, nimble, and innovative. The authors of these excellent chapters also bring out that adaptability and innovation through coping with the pandemic. The global perspectives included in this book provide the reader with a diverse understanding of best practices that emerged during the pandemic. The same adaptability shown throughout the pandemic and evidenced by this book should be viewed as parallel to the ever-evolving and changing technologies in the construction sector such as wearables, artificial intelligence, monitoring devices, and other rapid changes in equipment and technology. This book highlights case studies and best practices to understand and better manage change; the pandemic simply happened to be that change agent. The key learning points contained within are generalisable to future technological change, and thus I have no doubt this textbook will be impactful far into the future.

The International Council for Research and Innovation in Building and Construction (CIB) has active Working Commissions on Health, Safety and Well-being in Construction (W099) and People in Construction (W123). W099 and W123 remained quite active during the pandemic, hosting two very well-attended and interactive online international conferences. The group and its leadership were adaptive to change and disruption, setting an example for other Working Commissions within CIB. This book also sets a wonderful example of forward thinking, innovation, and creativity while sharing case studies, research, and best practices from across the globe.

I am very keen to support this publication and hope that it makes an important contribution to improving the lives of construction workers and their families across the world.

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Past Coordinator, CIB W099 (2012–2019)

1 Construction safety, health and well-being in the COVID-19 era

An introduction

Patrick Manu, Clara Cheung, Akilu Yunusa-Kaltungo, Fidelis Emuze, Tarcisio Abreu Saurin, Bonaventura Hadikusumo and Saeed Reza Mohandes

Introduction

Globally, the construction sector accounts for a high and disproportionate number of occupational fatalities, injuries, and illnesses (International Labour Organisation, 2015; Health and Safety Executive, 2021; Eurostats, 2022). Workers in the construction industry are three to six times more likely than other workers to die from work-related accidents (International Labour Organisation, 2015). Furthermore, construction workers are more likely to suffer from an occupational illness than other workers (Health and Safety Executive, 2021). The industry is also notorious for poor workforce well-being, as evidenced by the prevalence of anxiety, stress, depression, and fatigue (Rees-Evans, 2020; RSM UK Consulting LLP, 2021). The nature of work at construction sites is physically more demanding than most other industries. The existence of a large number of workers on the work site coupled with the prevalence of hazards causes the likelihood of incident occurrence to surge. The incidents and work conditions in construction (e.g. time pressure, high level of subcontracting, job insecurity, long hours of work, long commutes, and dynamic work environment) commonly result in injuries, illnesses, deaths, and poor well-being outcomes for the workforce (Haslam, 2005; Manu et al., 2014; Rees-Evans, 2020; Tijani et al., 2021). Poor occupational safety, health, and well-being (OSHW) is a concerning issue for the workers, their families, companies, and government bodies since it has adverse impacts on the overall economic and social status of these stakeholders. Moreover, these impacts dampen the morale of the worker, which results in performing tasks inefficiently (De Prins et al., 2020). Between 2020 and 2030, globally, the construction sector's output is forecasted to increase by about USD $4.5 trillion to reach circa USD $15 trillion (Oxford Economics, 2021). This growth could adversely affect the OSHW of construction workers if adequate safeguards are not implemented. The gloomy outlook for construction OSHW has recently been exacerbated by the global COVID-19 pandemic.

The construction sector is highly labour-intensive and works are much more difficult to control due to the rapidly changing nature of construction sites, the multiplicity of site hazards, activities, and trades, and the transience of construction projects. Moreover, construction site operations are often undertaken by teams

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of tradespeople/workers who work in close proximity to each other. There is also less mechanisation of construction activities in some countries, which implies a greater physical presence of workers on construction sites and by extension implies greater exposure of the workforce to occupational health and safety hazards. The construction workforce is thus highly susceptible to COVID-19 transmission, infection, and related deaths. For instance, in England and Wales, construction occupations were reported to be among the occupations with the highest rates of death involving COVID-19 (Office for National Statistics, 2021a). Aside from the COVID-19-related deaths associated with the construction industry, the pandemic seriously impacted the industry in several ways. For instance, the number of employment opportunities dropped seriously, which was partially because of the work interruptions induced by the limitations imposed to prevent the spread of the coronavirus. In addition, there was a lack of personal protective equipment because healthcare employees placed high demand on such equipment. The interruption of supply chains and lack of employees/workers because of quarantines caused numerous construction projects to be stopped or suspended (Rouhanizadeh et al., 2019). The Associated General Contractors of America reported that 28% of their members had to stop or postpone construction projects due to the spread of COVID-19 (Pamidimukkala and Kermanshachi, 2021). Therefore, construction is highly impacted by COVID-19 (Koh, 2020).

Despite the significant toll of the COVID-19 pandemic, there is generally a dearth of published studies relating to the OSHW impacts and implications arising from the pandemic within construction. However, there is a growing interest in this area, as shown by calls for journal special issues on COVID-19 in the construction industry. Given that the COVID-19 pandemic has impacted nations on all continents in both similar and different manners/scales, a compendium of studies that offers comprehensive global coverage of the OSHW situation induced by the pandemic in the construction industry would be very useful to multiple stakeholders. This book addresses this gap by offering global perspectives on the OSHW implications of COVID-19 in the construction industry. In this introductory chapter, the status of OSHW in the construction industry is first highlighted. Following this, the impacts of COVID-19 are elaborated on. This is followed by a discussion regarding the OSHW opportunities and challenges induced by the pandemic in the construction industry. Finally, a summary of the chapters presented in the book is provided.

COVID-19 impacts on industry

COVID-19 can be transmitted among people, causing symptoms such as fever, fatigue, dry cough, and breath shortness (Shi et al., 2020). As of January 2023, it had spread to more than 200 countries and territories, with over 750 million cases and resulting in over six million COVID-19-related deaths (World Health Organisation, 2023).

The COVID-19 pandemic seriously affected not only the people's health status but also the global economy (International Monetary Fund, 2021). For instance,

a period of recession started in the United States in February 2020, which was termed the 'Recession of COVID-19' (Chodorow-Reich and Coglianese, 2021). In April 2020, a high unemployment rate of 14.7% was recorded in the United States because of the economic downturn, which was much worse than the 3.8% rate of February 2020 (Pamidimukkala and Kermanshachi, 2021).

Like other industrial sectors, the COVID-19 pandemic significantly affected the construction industry (Alsharef et al., 2021). Apart from the risks induced by the nature of construction work, construction workers and professionals are at high risk of being infected by aerosol and droplet contamination (Zheng et al., 2021). The restrictions imposed on construction projects as a result of the pandemic negatively affected economic growth, augmented the unemployment rate, interrupted supply chains of construction materials, and interrupted many investments (Bsisu, 2020; Ogunnusi et al., 2020). For instance, in the UK the value of new construction work in 2020 recorded an over-15% drop from £119.087 billion in 2019 (Office for National Statistics, 2021b). Several stakeholders of the construction sector were impacted by the crisis of COVID-19 at a global level (Ogunnusi et al., 2020).

Opportunities and challenges for OSHW in construction

Apart from the economic concerns induced by the COVID-19 pandemic, the OSHW of construction workers was also affected (Bourne et al., 2022). A number of reasons resulted in this situation, including the occurrence of health hazards to workers on remote construction sites while commuting because of overcrowding on transport and the nonexistence of risk control measures, and adverse impacts on workers' mental health because of the augmented anxiety amongst them (Iqbal et al., 2021). The emergence of COVID-19 offers a number of both opportunities and challenges regarding the OSHW of construction workers. As regards the opportunities, the pandemic has brought about the following upsides (Dobrucali et al., 2022; Bourne et al., 2022).

(1) The respective firms have been tilted towards the adoption of the latest technologies (e.g., sensors) to be brought into practice. The use of said technologies can benefit the concerned decision-makers by providing them with constant monitoring of the OSHW status of the ongoing projects, such as checking whether the workers have worn the required personal protective equipment (PPE) or when the respective workers come into contact with dangers, to name but a few.
(2) The respective firms have been adopting more flexible working conditions (e.g., working from home) for the workers compared to the pre-pandemic era, thereby improving the OSHW of all the groups involved in the projects.
(3) The respective companies have introduced more health practices for cleaning up and improving the related conditions of sites, which has made the work environment safer for the workers.
(4) Another point is related to the new communication channels among the stakeholders involved in a project, which has been accelerated by the increased adoption of information and communication technologies during the pandemic.

Challenges to the OSHW of construction personnel arising from the pandemic include the following (Amoah and Simpeh, 2020; Sierra, 2021; Stiles et al., 2021; Yang et al., 2021):

(1) The supply of appropriate and sufficient PPEs by contractors is one of the major impediments to achieving a safe working environment for the involved workers.
(2) There is always a threat of adherence to compliance from the side of the concerned regulators and policymakers; during the pandemic, it was observed that some construction projects did not implement a social distancing strategy on the respective sites, thereby posing dangers to the health of all the involved crew members. This was more apparent at the beginning of the pandemic when very few rules and regulations existed, if any.
(3) Another challenge is related to the proper sanitisation of the materials used on construction sites; if a frequent and appropriate sanitation strategy is in place, there are fewer infections spreading across the sites.
(4) Last but not least, superstition is another stumbling block to improving the OSHW of construction projects during the pandemic. Some crew members were of the opinion that COVID-19 was for a particular group of people, and that they could not contract it if they boosted their immune systems.

Further information regarding the challenges and opportunities is covered in the subsequent chapters of this book.

Overview of chapters

There are 25 chapters in the book, which have been grouped into three thematic sections. Collectively, the chapters provide insights from over 10 countries across six world regions – Africa, Asia, Australia, Europe, North America, and South America. A brief description of the chapters is presented here.

Chapter 1 is 'Construction safety, health and well-being in the COVID-19 era: an introduction.' In this introductory chapter, Manu et al. highlight the gap in the literature regarding the lack of a comprehensive compendium of studies about the OSHW impacts and implications arising from the COVID-19 pandemic within the construction domain. The chapter gives a high-level view of the OSHW status of the construction industry, the impacts of COVID-19 on industries, and the OSHW opportunities and challenges arising from the pandemic within the construction industry.

Section 1: management of COVID-19 transmission risk

Chapter 2 is 'The transmission of COVID-19 in construction: a systematic review of findings from statistical and modelling techniques.' In this chapter, Cao et al. used the PRISMA way of compiling a systematic literature review to beam the searchlight on modelling techniques related to the need to limit exposure to COVID-19. The chapter outlined and explained five modelling techniques with

their corresponding features. Knowing the characteristics and strength of each technique is vital to making informed decisions that will save lives on construction sites.

Chapter 3 is 'Health and safety measures for managing the COVID-19 pandemic in the construction industry: a comparison study.' This chapter by Chan et al. used semi-structured interviews conducted with the management staff of construction projects from Nigeria and China. The study outcomes revealed that both countries had construction site health and safety control measures, including body temperature monitoring, face mask-wearing, disinfection of offices, and sanitisation of employees. However, unlike Nigeria, China complemented the aforementioned measures with sophisticated technology-based approaches like big data analysis, onsite tracer apps, and health QR codes, which aided real-time management of COVID-19 transmission on construction sites.

Chapter 4 is 'Towards improving health management of construction projects during the COVID-19 pandemic.' In this chapter, Mahdiyar et al. frame the need to limit exposure to COVID-19 on construction sites. The chapter examined COVID-19 in Hong Kong to highlight how the effects of preventative measures were handled on-site. The chapter reinforced the benefits of health measures and ranked the importance of identified measures. The implication of the shared results is that decision- or policymakers should brainstorm about the effects of preventive measures before deployment.

Chapter 5 is 'An overview on the measures taken to tackle COVID-19 impacts on Nigerian construction sites: a case study of South-South Geo-Political Zone.' In this chapter, Okorie and Anugwo investigate the measures taken to mitigate the spread of COVID-19 among construction companies in Nigeria. They conducted interviews with 24 small, medium, and large companies. While they found the implementation of measures such as wearing face masks, social distancing, and temperature reading, they also reported that workers' attitude towards the measures as well as the implementation of the measures is relatively better among the large companies than the small and medium-sized companies. This echoes the challenges faced by small and medium-sized companies in effectively managing the safety, health, and well-being of workers.

Chapter 6 is 'COVID-19 pandemic: challenges in practising new norms for construction workers.' In this chapter, Mohamed @ Arifin et al. identify the new norms and practices for construction workers in the COVID-19 pandemic, examine the challenges of using those new norms and practices, and depict ways to practise them in the Klang Valley area in Malaysia. This study concludes that following the MOH (Ministry of Health) Malaysia's SOP (Standard Operating Procedure) at construction sites enabled construction employees to normalise new norms and practices more effectively during the pandemic.

Chapter 7 is 'Health and safety in the construction industry during the COVID-19 pandemic: case study of Vietnam.' In this chapter, Pham et al. investigate measures to prevent COVID-19 infection at construction sites in Vietnam, highlighting twelve solutions such as the reduction of the number of workers during safety training and the elimination of night work shifts. Three high-level lessons learned are

also discussed: strict compliance with government policies, flexible approach in policy implementation, and strong commitments of project stakeholders. Finally, based on an industry-wide survey, the authors found that government regulations were perceived as effective in curbing the spread of COVID-19 in construction sites.

Chapter 8 is 'Construction safety culture management during the COVID-19 pandemic.' This chapter addresses the role of safety culture in construction sites in order to reduce infection rates. Based on interviews with experts from small, medium, and large construction sites, Chinda proposed recommendations for the management of safety culture in a pandemic context. The recommendations account for five types of safety culture enablers: leadership, policy and strategy, people, resources, and processes. Several examples related to each enabler are discussed in the chapter.

Chapter 9 is 'Policy assessment framework to measure the efficacy of mask-wearing arrangements during the COVID-19 outbreak: case studies from Jakarta, Indonesia.' In this chapter, Hansen et al. explore the effectiveness of mask-wearing policy implementation on two construction projects in Jakarta, Indonesia. To do so, a qualitative approach together with semi-structured interviews are adopted. From the results obtained, differences in policy implementation between the two observed case studies are noted. It is also observed that the enforcement control and strategies undertaken by contractors have an unavoidable impact on workers' perception about the effectiveness of mask-wearing policy implementation. The findings also reveal the need to update the mask-wearing policy in both projects for future improvements.

Chapter 10 is 'Construction sector in Indonesia: occupational health and safety during the outbreak of COVID-19.' Setiawan et al. investigate the OHS of construction projects during the outbreak of COVID-19 in Indonesia using a qualitative approach. To this end, the existing regulations related to OHS during the pandemic are explored, followed by an exploration of the health protocols implemented in construction projects. It is seen that Indonesian contractors commit to implementing the guidance that regulates the implementation of health protocols in every workplace; thus, they established a procedure enabling the organisation of all the activities on construction project sites.

Section 2: impact of COVID-19 on occupational safety, health and well-being (OSHW)

Chapter 11 is 'Individual and organisational support mechanisms to foster career resilience during the COVID-19 pandemic.' In this chapter, Borg et al. explore the impacts of the pandemic on the well-being of project managers in the construction industry. Based on a survey with 148 project managers, the authors concluded that 61% of them reported high levels of personal resilience during the pandemic. Many attributed their personal resilience to organisational support mechanisms, such as an intensified focus on health and well-being, maintaining connections with work teams, training and development opportunities, and job security. The chapter also presents recommendations to foster personal and career resilience in construction companies.

Chapter 12 is 'Assessing how pandemic lockdown upended construction work creed in Free State and Limpopo, South Africa.' In this chapter, Matete and Emuze report on a qualitative inquiry into the impact of the COVID-19 pandemic lockdowns on workplace rules about the health, safety, and well-being of construction workers in South Africa. Based on interviews with 25 participants, they discuss several impacts, including: the impact on hazard identification and risk assessment; the impact on the implementation of the safety and health plan; the impact on the bi-weekly toolbox talks; the impact on safety and health induction of workers; impact on the provision and use of PPE; and impact on the provision and use of welfare facilities on site.

Chapter 13 is 'COVID-19 pandemic: a case study of mental health of migrant construction workers at Ttdi Sentralis, Selangor, Malaysia.' Migrant construction workers can be more prone to adverse safety, health, and well-being outcomes. Against this backdrop, in this chapter, Mohamed @ Arifin et al. investigate the effect of the COVID-19 pandemic on the mental health of migrant construction workers in Malaysia. They also investigated ways to mitigate this effect. Among the top factors that affected the mental health of migrant workers are: worrying about their financial difficulties; fear of losing job; and feeling helpless about the inability to help family during the lockdown. Suggestions to mitigate the effects of the pandemic on the mental health of migrant workers include: a good work environment that boosts work morale; provision of leaves of absence for sickness; recognition/praise by the work boss.

Chapter 14 is 'COVID-19 and the Ghanaian construction industry: current state of impact and mitigation measures.' In this chapter, Agyekum et al. examine the impact of the COVID-19 pandemic on Ghanaian construction with specific attention to control measures. A major impact identified in the chapter is anxiety, which underscores the importance of psychological safety in construction. The control measures deployed in Ghanaian construction helped limit the disease's spread. Some of the measures include mandatory screening and strict hygiene protocol on site.

Chapter 15 is 'Developing resilient construction professionals in the COVID-19 era: examining architecture students' personality perspective.' In this chapter, Sanh and Cakmak investigate the relationship between the personality types and resilience skills, stress factors experienced by architecture students during the pandemic, and provide recommendations on how to cope with stress and develop resilience. They found there are significant relationships between Enneagram personality types and resilience skills and stress factors experienced during the pandemic. The study also suggests the Enneagram as a practical guide to enhance and build resilience at the university level and beyond.

Chapter 16 is 'Safety, health and wellbeing of construction workers in Nigeria – opportunities and challenges associated with the COVID-19 pandemic.' In this chapter, Moda et al. show that the pandemic negatively affected project delivery on multiple fronts. The chapter turns readers' attention to coping mechanisms used in Nigerian construction during the pandemic. Some of the mechanisms are useful in similar context in developing countries.

Chapter 17 is 'Construction site management during COVID-19 in Myanmar.' In this chapter, Paing and Hadikusumo examine the effect of COVID-19 and its regulations imposed by Myanmar government on construction project management. Based on the four case studies, they identified the different and common construction safety management approaches that could be useful for construction projects to implement in the pandemic period and beyond.

Section 3: implications of the COVID-19 pandemic for construction project performance

Chapter 18 is 'Intricacies and lifeline for the construction industry amidst the Coronavirus pandemic.' In this chapter, Adekunle et al. conduct an investigation into the impact of the COVID-19 pandemic on the construction industry in the developing country. Based on a bibliometric analysis undertaken, four cardinal perspectives are obtained, including economic, safety, labour availability, and legal impacts. Moreover, an outlook for the construction industry in developing countries post-COVID-19 is provided via data from two African countries. The essence of information management for improving the OHSW of construction projects during the pandemic is also discussed.

Chapter 19 is 'Assessment of COVID-19 control and prevention measures: lessons learned at construction sites.' In this chapter, Costa and Santos develop the lessons learned at construction sites through the evaluation of COVID-19 control and prevention measures in Brazil. Based the analysis of the seven categories of COVID-19 control measures, they highlight the organisation and hygiene category as having the highest degree of implementation. Meanwhile, personal care responsibilities, creating awareness, and changing the work regime were partially implemented.

Chapter 20 is 'COVID-19 and shock events in the AEC Sector: perspectives on mitigating measures.' In this chapter, Musonda et al. initially examine the impacts of shock-wave events such as COVID-19 on construction projects, as well as generate lessons that could improve the resilience of construction projects against future shock-wave events. Following consultations with experts in built environment within the sub-Saharan Africa region via focus group discussions, it was identified that measures such as digital transformation, policy, standards/contract guidelines, capacity development, improved information management/awareness, health and safety, training/upskilling, employee-worker relationship, and risk identification are immensely critical.

Chapter 21 is 'Implication of COVID-19 SOP compliance to project-based construction workers in Malaysia.' In this chapter, Nasir and Che Ibrahim study the impact of construction workers' compliance with health and safety (H&S) standard operating procedures (SOP) on project performance. Following conducting 25 semi-structured interviews with construction professionals from Peninsular Malaysia, Sabah, and Sarawak, it was revealed that factors such as shortage of workers, workers' utilities and test kits, poor management, working hours restrictions

at sites, vaccination and quarantine, safety awareness, and SOP compliance were the dominant factors responsible for heightened H&S incidents during COVID-19 pandemic.

Chapter 22 is 'Facing the impacts of COVID-19 in construction: the case of Chile.' This chapter describes how the Chilean construction industry coped with the pandemic, both at the institutional level and at each company's level. Based on the lessons learned, Serpell recommends the following key measures of control: industrialisation in construction to reduce the exposition of workers at the site; use of technology to supervise workers and help protect them; dissemination of good practices for handling the pandemic and application of new business models to maintain the operation; teleworking; collaboration with suppliers; and contracts with clarity regarding the consequences from a pandemic like COVID-19.

Chapter 23 is 'Factors that led to an increase of building collapses during the COVID-19 lockdown period in the Greater Kampala Metropolitan Area, Uganda.' In this chapter, Alinaitwe and Irumba sought to understand the influence of a 16-month COVID-19 related lockdown on increased cases of building collapses in the Greater Kampala Metropolitan Area of Uganda. The examination of five case studies revealed a multi-causal relationship whereby the majority of causes were inherent, but exacerbated by the lockdown. The most dominant factors identified include poor supervision of building works, poor monitoring of works by local authorities, lack of approved building plans, poor construction methods, and failure to conduct site investigations.

Chapter 24 is 'A digital approach to health and safety management on-site: a silver lining of the COVID-19 pandemic.' In this chapter, Ghadiminia and Saeidlou pursued the following three main objectives via semi-structured interviews with construction professionals in the United Kingdom: (1) investigate the limitations brought by the COVID-19 pandemic to construction site; (2) explore the digital technologies introduced to overcome the limitations; and (3) investigate the feasibility of the digital technologies in tackling health and safety on-site. While presenting findings addressing these objectives, Ghadiminia also recommended further research to identify missing links between the anticipated potentials of the technologies and the real benefits derived from a mature digitalisation of health and safety management on site.

Chapter 25 is 'Digitalisation differently: an inclusive digital twin model for climate risk management in major projects in the post-COVID era.' Local weather conditions such as heat can make construction workers susceptible to heat stress during work on site. Construction projects in locations with a high risk of heat stress thus need to have systems for managing heat-related weather information. In this chapter, Jia et al. draw on pre-COVID-19 site observations and literature pertaining to industry 4 technologies to propose a digital twin model for managing weather information in major projects in the post-COVID-19 era. They suggest that the model can assist contractors and frontline workers to prepare for health risks resulting from extreme or changing weather conditions.

References

Alsharef, A., Banerjee, S., Uddin, S.M.J., Albert, A., & Jaselskis, E. (2021). Early impacts of the COVID-19 pandemic on the United States construction industry. *International Journal of Environmental Research and Public Health*, 18, 1559.

Amoah, C., & Simpeh, F. (2020). Implementation challenges of COVID-19 safety measures at construction sites in South Africa. *Journal of Facilities Management*, 19(1), 111–128.

Bourne, N., Cao, R., Cheung, C., Clarke, S., Collinge, W., Hartwig, A., Howells, A., Johnson, S., Kirkham, R., Ling, D., Mann, C., Manu, P., Qiao, Q., Saba, S., van Tongeren, M., & Yunusa-Kaltungo, A. (2022). Keeping the UK building safely phase 2. *PROTECT COVID-19 National Core Study: Buxton*. Available at https://sites.manchester.ac.uk/covid19-national-project/2023/01/17/3726/ (Accessed 24 January 2023).

Bsisu, K.A.D. (2020). The impact of COVID-19 pandemic on Jordanian civil engineers and construction industry. *International Journal of Engineering Research and Technology*, 13(5), 828–830.

Chodorow-Reich, G., & Coglianese, J. (2021). Projecting unemployment durations: A factor-flows simulation approach with application to the COVID-19 recession. *Journal of Public Economics*, 197, 104398.

De Prins, P., Stuer, D., & Gielens, T. (2020). Revitalizing social dialogue in the workplace: The impact of a cooperative industrial relations climate and sustainable HR practices on reducing employee harm. *The International Journal of Human Resource Management*, 31, 1684–1704.

Dobrucali, E., Sadikoglu, E., Demirkesen, S., Zhang, C., & Tezel, A. (2022). Exploring the impact of COVID-19 on the United States construction industry: Challenges and opportunities. IEEE Transactions on Engineering Management.

Eurostats. (2022). Accidents at work: Statistics by economic activity. *Eurostats*. Available at https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Accidents_at_work_-_statistics_by_economic_activity (Accessed 9 August 2022).

Haslam, R.A., Hide, S.A., Gibb, A.G.F., Gyi, D.E., Pavitt, T., Atkinson, S., & Duff, A.R. (2005). Contributing factors in construction accidents. *Applied Ergonomics*, 36(4), 401–415.

Health and Safety Executive. (2021). Construction statistics in Great Britain, 2021. *Health and Safety Executive*. Available at www.hse.gov.uk/statistics/industry/construction.pdf (Accessed 9 August 2022).

International Labour Organisation. (2015). *Construction: A hazardous work*. Available at www.ilo.org/safework/areasofwork/hazardous-work/WCMS_356576/lang-en/index.htm (Accessed 22 July 2020).

International Monetary Fund. (2021). *World economic outlook*. Available at www.imf.org/en/Publications/WEO/Issues/2021/10/12/world-economic-outlook-october-2021 (Accessed 24 January 2023).

Iqbal, M., Ahmad, N., Waqas, M., & Abrar, M. (2021). COVID-19 pandemic and construction industry: Impacts, emerging construction safety practices, and proposed crisis management. *Brazilian Journal of Operations & Production Management*, 18, 1–17.

Koh, D. (2020). Migrant workers and COVID-19. *Occupational and Environmental Medicine*, 77, 634–636.

Manu, P., Ankrah, N., Proverbs, D., & Suresh, S. (2014). The health and safety impact of construction project features. *Engineering Construction and Architectural Management*, 21(1), 65–93.

Office for National Statistics. (2021a). *Coronavirus (COVID-19) related deaths by occupation, England and Wales: Deaths registered between 9 March and 28 December 2020*. Available at www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/causesofdeath/bulletins/coronaviruscovid19relateddeathsbyoccupationenglandandwales/deathsregisteredbetween9marchand28december2020 (Accessed 23 January 2023).

Office for National Statistics. (2021b). *Construction statistics, Great Britain: 2020*. Available at www.ons.gov.uk/businessindustryandtrade/constructionindustry/articles/constructionstatistics/2020/pdf (Accessed 24 January 2023).

Ogunnusi, M., Hamma-Adama, M., Salman, H., & Kouider, T. (2020). COVID-19 pandemic: The effects and prospects in the construction industry. *International Journal of Real Estate Studies*, 14.

Oxford Economics. (2021). Future of construction. *Oxford Economics*. Available at www.oxfordeconomics.com/resource/future-of-construction/#:~:text=Global%20construction%20output%20in%202020,growth%20and%20recovery%20from%20COVID (Accessed 9 August 2022).

Pamidimukkala, A., & Kermanshachi, S. (2021). Impact of Covid-19 on field and office workforce in construction industry. *Project Leadership and Society*, 2, 100018.

Rees-Evans. (2020). Understanding mental health in the built environment. *CIOB*. Available at www.ciob.org/industry/research/Understanding-Mental-Health-Built-Environment?gclid=CjwKCAjwi8iXBhBeEiwAKbUofQX6exbnl9vfDzkkfgltgQQGhQTBoMERU4jPJfTmVRz1AjRYwEku6RoCbn8QAvD_BwE (Accessed 9 August 2022).

Rouhanizadeh, B., Kermanshachi, S., & Nipa, T.J. (2019). Identification, categorization, and weighting of barriers to timely post-disaster recovery process. In *Computing in civil engineering 2019: Smart cities, sustainability, and resilience* (pp. 41–49). Reston, VA: American Society of Civil Engineers.

RSM UK Consulting LLP. (2021). Mental health and wellbeing research: Final report. *CITB*. Available at www.citb.co.uk/media/ffwjadqn/citb_mental_health_and_wellbeing_research_report.pdf (Accessed 9 August 2022).

Shi, Y., Wang, G., Cai, X.P., Deng, J.W., Zheng, L., Zhu, H.H., Zheng, M., Yang, B., & Chen, Z. (2020). An overview of COVID-19. *Journal of Zhejiang University-SCIENCE B*, 21(5), 343–360.

Sierra, F. (2021). COVID-19: Main challenges during construction stage. *Engineering, Construction and Architectural Management*, 29, 1817–1834.

Stiles, S., Golightly, D., & Ryan, B. (2021). Impact of COVID-19 on health and safety in the construction sector. *Human Factors and Ergonomics in Manufacturing & Service Industries*, 31, 425–437.

Tijani, B., Nwaeze, J.F., Jin, X., & Osei-Kyei, R. (2021). Suicide in the construction industry: Literature review. *International Journal of Construction Management*. doi: 10.1080/15623599.2021.2005897.

World Health Organisation. (2023). *WHO coronavirus (COVID-19) dashboard*. Available at https://covid19.who.int/ (Accessed 30 January 2023).

Yang, Y., Chan, A.P.C., Shan, M., Gao, R., Bao, F., Lyu, S., Zhang, Q., & Guan, J. (2021). Opportunities and challenges for construction health and safety technologies under the COVID-19 pandemic in Chinese construction projects. *International Journal of Environmental Research and Public Health*, 18, 13038.

Zheng, L., Chen, K., & Ma, L. (2021). Knowledge, attitudes, and practices toward COVID-19 among construction industry practitioners in China. *Frontiers in Public Health*, 8, 599769.

Construction safety, health and well-being in the COVID-19 era

Alsharef, A. , Banerjee, S. , Uddin, S.M.J. , Albert, A. , & Jaselskis, E. (2021). Early impacts of the COVID-19 pandemic on the United States construction industry. International Journal of Environmental Research and Public Health, 18, 1559.

Amoah, C. , & Simpeh, F. (2020). Implementation challenges of COVID-19 safety measures at construction sites in South Africa. Journal of Facilities Management, 19(1), 111–128.

Bourne, N. , Cao, R. , Cheung, C. , Clarke, S. , Collinge, W. , Hartwig, A. , Howells, A. , Johnson, S. , Kirkham, R. , Ling, D. , Mann, C. , Manu, P. , Qiao, Q. , Saba, S. , van Tongeren, M. , & Yunusa-Kaltungo, A. (2022). Keeping the UK building safely phase 2. PROTECT COVID-19 National Core Study: Buxton. Available at https://sites.manchester.ac.uk/covid19-national-project/2023/01/17/3726/ (Accessed 24 January 2023).

Bsisu, K.A.D. (2020). The impact of COVID-19 pandemic on Jordanian civil engineers and construction industry. International Journal of Engineering Research and Technology, 13(5), 828–830.

Chodorow-Reich, G. , & Coglianese, J. (2021). Projecting unemployment durations: A factor-flows simulation approach with application to the COVID-19 recession. Journal of Public Economics, 197, 104398.

De Prins, P. , Stuer, D. , & Gielens, T. (2020). Revitalizing social dialogue in the workplace: The impact of a cooperative industrial relations climate and sustainable HR practices on reducing employee harm. The International Journal of Human Resource Management, 31, 1684–1704.

Dobrucali, E. , Sadikoglu, E. , Demirkesen, S. , Zhang, C. , & Tezel, A. (2022). Exploring the impact of COVID-19 on the United States construction industry: Challenges and opportunities. IEEE Transactions on Engineering Management.

Eurostats . (2022). Accidents at work: Statistics by economic activity. Eurostats. Available at https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Accidents_at_work_-_statistics_by_economic_activity (Accessed 9 August 2022).

Haslam, R.A. , Hide, S.A. , Gibb, A.G.F. , Gyi, D.E. , Pavitt, T. , Atkinson, S. , & Duff, A.R. (2005). Contributing factors in construction accidents. Applied Ergonomics, 36(4), 401–415.

Health and Safety Executive . (2021). Construction statistics in Great Britain, 2021. Health and Safety Executive. Available at www.hse.gov.uk/statistics/industry/construction.pdf (Accessed 9 August 2022).

International Labour Organisation . (2015). Construction: A hazardous work. Available at www.ilo.org/safework/areasofwork/hazardous-work/WCMS_356576/lang-en/index.htm (Accessed 22 July 2020).

International Monetary Fund . (2021). World economic outlook. Available at www.imf.org/en/Publications/WEO/Issues/2021/10/12/world-economic-outlook-october-2021(Accessed 24 January 2023).

Iqbal, M. , Ahmad, N. , Waqas, M. , & Abrar, M. (2021). COVID-19 pandemic and construction industry: Impacts, emerging construction safety practices, and proposed crisis management. Brazilian Journal of Operations & Production Management, 18, 1–17.

Koh, D. (2020). Migrant workers and COVID-19. Occupational and Environmental Medicine, 77, 634–636.

Manu, P. , Ankrah, N. , Proverbs, D. , & Suresh, S. (2014). The health and safety impact of construction project features. Engineering Construction and Architectural Management, 21(1), 65–93.

Office for National Statistics . (2021a). Coronavirus (COVID-19) related deaths by occupation, England and Wales: Deaths registered between 9 March and 28 December 2020. Available at www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/causesofdeath/bulletins/coronaviruscovid19relateddeathsbyoccupationenglandandwales/deathsregisteredbetween9marchand28december2020 (Accessed 23 January 2023).

Office for National Statistics . (2021b). Construction statistics, Great Britain: 2020. Available at www.ons.gov.uk/businessindustryandtrade/constructionindustry/articles/constructionstatistics/2020/pdf (Accessed 24 January 2023).

Ogunnusi, M. , Hamma-Adama, M. , Salman, H. , & Kouider, T. (2020). COVID-19 pandemic: The effects and prospects in the construction industry. International Journal of Real Estate Studies, 14.

Oxford Economics. (2021). Future of construction. Oxford Economics. Available at www.oxfordeconomics.com/resource/future-of-

construction/#:~:text=Global%20construction%20output%20in%202020,growth%20and%20recovery%20from%20COVID (Accessed 9 August 2022).
Pamidimukkala, A. , & Kermanshachi, S. (2021). Impact of Covid-19 on field and office workforce in construction industry. Project Leadership and Society, 2, 100018.
Rees-Evans . (2020). Understanding mental health in the built environment. CIOB. Available at www.ciob.org/industry/research/Understanding-Mental-Health-Built-Environment?gclid=CjwKCAjwi8iXBhBeEiwAKbUofQX6exbnl9vfDzkkfgltgQQGhQTBoMERU4jPJfTmVRz1AjRYwEku6RoCbn8QAvD_BwE (Accessed 9 August 2022).
Rouhanizadeh, B. , Kermanshachi, S. , & Nipa, T.J. (2019). Identification, categorization, and weighting of barriers to timely post-disaster recovery process. In Computing in civil engineering 2019: Smart cities, sustainability, and resilience (pp. 41–49). Reston, VA: American Society of Civil Engineers.
RSM UK Consulting LLP . (2021). Mental health and wellbeing research: Final report. CITB. Available at www.citb.co.uk/media/ffwjadqn/citb_mental_health_and_wellbeing_research_report.pdf (Accessed 9 August 2022).
Shi, Y. , Wang, G. , Cai, X.P. , Deng, J.W. , Zheng, L. , Zhu, H.H. , Zheng, M. , Yang, B. , & Chen, Z. (2020). An overview of COVID-19. Journal of Zhejiang University-SCIENCE B, 21(5), 343–360.
Sierra, F. (2021). COVID-19: Main challenges during construction stage. Engineering, Construction and Architectural Management, 29, 1817–1834.
Stiles, S. , Golightly, D. , & Ryan, B. (2021). Impact of COVID19 on health and safety in the construction sector. Human Factors and Ergonomics in Manufacturing & Service Industries, 31, 425–437.
Tijani, B. , Nwaeze, J.F. , Jin, X. , & Osei-Kyei, R. (2021). Suicide in the construction industry: Literature review. International Journal of Construction Management. doi: 10.1080/15623599.2021.2005897.
World Health Organisation. (2023). WHO coronavirus (COVID-19) dashboard. Available at https://covid19.who.int/ (Accessed 30 January 2023).
Yang, Y. , Chan, A.P.C. , Shan, M. , Gao, R. , Bao, F. , Lyu, S. , Zhang, Q. , & Guan, J. (2021). Opportunities and challenges for construction health and safety technologies under the COVID-19 pandemic in Chinese construction projects. International Journal of Environmental Research and Public Health, 18, 13038.
Zheng, L. , Chen, K. , & Ma, L. (2021). Knowledge, attitudes, and practices toward COVID-19 among construction industry practitioners in China. Frontiers in Public Health, 8, 599769.

The transmission of COVID-19 in construction

Adiga, A. , Chen, J. , Marathe, M. , Mortveit, H. , Venkatramanan, S. , & Vullikanti, A. (2020a). Data-driven modeling for different stages of pandemic response. Journal of the Indian Institute of Science, 100, 901–915.
Adiga, A. , Dubhashi, D. , Lewis, B. , Marathe, M. , Venkatramanan, S. , & Vullikanti, A. (2020b). Mathematical models for COVID-19 pandemic: A comparative analysis. Journal of the Indian Institute of Science, 100, 793–807.
Adriaanse, L.S. , & Rensleigh, C. (2011). Comparing web of science, scopus and Google scholar from an environmental sciences perspective. South African Journal of Libraries and Information Science, 77, 169–178.
Afkhamiaghda, M. , & Elwakil, E. (2020). Preliminary modeling of Coronavirus (COVID-19) spread in construction industry. Journal of Emergency Management, 18, 9–17.
Afzal, A. , Saleel, C.A. , Bhattacharyya, S. , Satish, N. , Samuel, O.D. , & Badruddin, I.A. (2022). Merits and limitations of mathematical modeling and computational simulations in mitigation of COVID-19 pandemic: A comprehensive review. Archives of Computational Methods in Engineering, 29, 1311–1337.
Aghaei Chadegani, A. , Salehi, H. , Yunus, M. , Farhadi, H. , Fooladi, M. , Farhadi, M. , & Ale Ebrahim, N. (2013). A comparison between two main academic literature collections: Web of science and scopus databases. Asian Social Science, 9, 18–26.

Allan-Blitz, L.-T. , Turner, I. , Hertlein, F. , & Klausner, J.D. (2020). High frequency and prevalence of community-based asymptomatic SARS-CoV-2 infection. MedRxiv.
Araya, F. (2021a). Modeling the spread of COVID-19 on construction workers: An agent-based approach. Safety Science, 133.
Araya, F. (2021b). Modeling working shifts in construction projects using an agent-based approach to minimize the spread of COVID-19. Journal of Building Engineering, 41.
Araya, F. (2022). Modeling the influence of multiskilled construction workers in the context of the covid-19 pandemic using an agent-based approach. Revista de la Construccion, 21, 105–117.
Aslan, S. , & Türkakın, O.H. (2022). A construction project scheduling methodology considering COVID-19 pandemic measures. Journal of Safety Research, 80, 54–66.
Becker, A.D. , Grantz, K.H. , Hegde, S.T. , Bérubé, S. , Cummings, D.A.T. , & Wesolowski, A. (2021). Development and dissemination of infectious disease dynamic transmission models during the COVID-19 pandemic: What can we learn from other pathogens and how can we move forward? The Lancet Digital Health, 3, e41–e50.
Cédric Cabral, F.Y. , Patrick Joël, M.M. , Ursula Joyce Merveilles, P.N. , Marcelline Blanche, M. , Georges Edouard, K. , & Chrispin, P. (2022). Using AI as a support tool for bridging construction informal sector mechanisms to sustainable development requirements. Journal of Decision Systems, 31(S1), 226–240.
Chen, J. , Vullikanti, A. , Santos, J. , Venkatramanan, S. , Hoops, S. , Mortveit, H. , Lewis, B. , You, W. , Eubank, S. , Marathe, M. , Barrett, C. , & Marathe, A. (2021). Epidemiological and economic impact of COVID-19 in the US. Scientific Reports, 11.
Cox, D.R. (2006). Principles of statistical inference. Cambridge: Cambridge University Press.
Cuevas, E. (2020). An agent-based model to evaluate the COVID-19 transmission risks in facilities. Computers in Biology and Medicine, 121, 103827.
De Bruin, Y.B. , Lequarre, A.-S. , Mccourt, J. , Clevestig, P. , Pigazzani, F. , Jeddi, M.Z. , Colosio, C. , & Goulart, M. (2020). Initial impacts of global risk mitigation measures taken during the combatting of the COVID-19 pandemic. Safety Science, 128, 104773.
Fargnoli, M. , & Lombardi, M. (2020). Building Information Modelling (BIM) to enhance occupational safety in construction activities: Research trends emerging from one decade of studies. Buildings, 10, 98.
Gerami Seresht, N. (2022). Enhancing resilience in construction against infectious diseases using stochastic multi-agent approach. Automation in Construction, 140.
Hosny, A. , Nik-Bakht, M. , & Moselhi, O. (2022). Physical distancing analytics for construction planning using 4D BIM. Journal of Computing in Civil Engineering, 36.
Ji, T. , Wei, H.-H. , & Chen, J. (2019). Understanding the effect of co-worker support on construction safety performance from the perspective of risk theory: An agent-based modeling approach. Journal of Civil Engineering and Management, 25, 132–144.
Jones, W. , Chow, V. , & Gibb, A. (2020). COVID-19 and construction: Early lessons for a new normal. Loughborough University, (August), 1–18.
Liberati, A. , Altman, D.G. , Tetzlaff, J. , Mulrow, C. , Gøtzsche, P.C. , Ioannidis, J.P. , Clarke, M. , Devereaux, P.J. , Kleijnen, J. , & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. Journal of Clinical Epidemiology, 62, e1–e34.
Lu, M. , Cheung, C.M. , Li, H. , & Hsu, S.-C. (2016). Understanding the relationship between safety investment and safety performance of construction projects through agent-based modeling. Accident Analysis & Prevention, 94, 8–17.
Macal, C.M. , & North, M.J. (2005). Tutorial on agent-based modeling and simulation. Proceedings of the Winter Simulation Conference, p. 14.
Mitchell, T.M. (1997). Machine learning. New Delhi: McGraw Hill Education India.
Moher, D. , Liberati, A. , Tetzlaff, J. , & Altman, D.G. (2010). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. International Journal of Surgery, 8, 336–341.
Neisani Samani, Z. , Karimi, M. , & Alesheikh, A. (2020). Environmental and infrastructural effects on respiratory disease exacerbation: A LBSN and ANN-based spatio-temporal modelling. Environmental Monitoring and Assessment, 192.
Olanrewaju, A. , Abdulaziz, A. , Preece, C.N. , & Shobowale, K. (2021). Evaluation of measures to prevent the spread of COVID-19 on the construction sites. Cleaner Engineering and

Technology, 5.
Onubi, H.O. , Yusof, N.A. , & Hassan, A.S. (2021). Perceived COVID-19 safety risk and safety behavior on construction sites: Role of safety climate and firm size. Journal of Construction Engineering and Management, 147, 04021153.
Pasco, R.F. , Fox, S.J. , Johnston, S.C. , Pignone, M. , & Meyers, L.A. (2020). Estimated association of construction work with risks of COVID-19 infection and hospitalization in Texas. JAMA Network Open, 3.
Radzi, A.R. , Rahman, R.A. , & Almutairi, S. (2022). Modeling COVID-19 impacts and response strategies in the construction industry: PLS-SEM approach. International Journal of Environmental Research and Public Health, 19.
Rice, L. (2021). Healthy BIM: The feasibility of integrating architecture health indicators using a Building Information Model (BIM) computer system. Archnet-IJAR, 15, 252–265.
Ronchi, E. , & Lovreglio, R. (2020). EXPOSED: An occupant exposure model for confined spaces to retrofit crowd models during a pandemic. Safety Science, 130.
Sadeh, H. , Mirarchi, C. , Shahbodaghlou, F. , & Pavan, A. (2022). Predicting the trends and cost impact of COVID-19 OSHA citations on US construction contractors using machine learning and simulation. Engineering, Construction and Architectural Management.
Saldaña, F. , & Velasco-Hernández, J.X. (2022). Modeling the COVID-19 pandemic: A primer and overview of mathematical epidemiology. SeMA Journal, 79, 225–251.
Vieira, E. , & Gomes, J. (2009). A comparison of Scopus and Web of Science for a typical university. Scientometrics, 81, 587–600.
Wilensky, U. , & Rang, W. (2015). An introduction to agent-based modeling: Modeling natural, social, and engineered complex systems with NetLogo. Cambridge, MA: MIT Press.
Yang, Y. , Chan, A.P.C. , Shan, M. , Gao, R. , Bao, F. , Lyu, S. , Zhang, Q. , & Guan, J. (2021). Opportunities and challenges for construction health and safety technologies under the COVID-19 pandemic in Chinese construction projects. International Journal of Environmental Research and Public Health, 18.
Yuan, Z. , Hsu, S.C. , Cheung, C.M. , & Asghari, V. (2022). Effectiveness of interventions for controlling COVID-19 transmission between construction workers and their close contacts. Journal of Management in Engineering, 38.

Health and safety measures for managing the COVID-19 pandemic in the construction industry

Agyekum, K. , Kukah, A.S. , & Amudjie, J. (2022). The impact of COVID-19 on the construction industry in Ghana: The case of some selected firms. Journal of Engineering, Design and Technology, 20, 222–244. doi: 10.1108/JEDT-11-2020-0476.
Alsharef, A. , Banerjee, S. , Uddin, S.M. , Albert, A. , & Jaselskis, E. (2021). Early impacts of the COVID-19 pandemic on the United States construction industry. International Journal of Environmental Research and Public Health, 18. doi: 10.3390/ijerph18041559.
Babatunde, O.K. , & Low, S.P. (2013). Chinese construction firms in the Nigerian construction industry. Habitat International, 40, 18–24. https://doi.org/10.1016/j.habitatint.2013.01.002.
Boadu, E.F. , Sunindijo, R.Y. , & Wang, C.C. (2021). Health and safety consideration in the procurement of public construction projects in Ghana. Buildings, 11, 128.
Ebekozien, A. , & Aigbavboa, C. (2021). COVID-19 recovery for the Nigerian construction sites: The role of the fourth industrial revolution technologies. Sustainable Cities and Society, 69, 102803. https://doi.org/10.1016/j.scs.2021.102803.
Ghondaghsaz, N. , Chokparova, Z. , Engesser, S. , & Urbas, L. (2022). Managing the tension between trust and confidentiality in mobile supply chains. Sustainability, 14, 2347.
Ito, A. (2019). Digital China: A fourth industrial revolution with Chinese characteristics? Asia-Pacific Review, 26, 50–75. doi: 10.1080/13439006.2019.1691836.
Jallow, H. , Renukappa, S. , & Suresh, S. (2021). The impact of COVID-19 outbreak on United Kingdom infrastructure sector. Smart and Sustainable Built Environment, 10, 581–593. doi: 10.1108/SASBE-05-2020-0068.
NCDC . (2020). Guidelines for employers and businesses in Nigeria. Available at https://covid19.ncdc.gov.ng/media/files/COVID19GuideforBusinessesAugust2020_V3.pdf(Acce

ssed 21 June 2022).
Nwaogu, J.M. , & Chan, A.P.C. (2021). Evaluation of multi-level intervention strategies for a psychologically healthy construction workplace in Nigeria. Journal of Engineering, Design and Technology, 19, 509–536. doi: 10.1108/JEDT-05-2020-0159.
Nwaogu, J.M. , Chan, A.P.C. , Naslund, J.A. , Hon, C.K. , Belonwu, C. , & Yang, J. (2021). Exploring the barriers to and motivators for using digital mental health interventions among construction personnel in Nigeria: Qualitative study. JMIR Formative Research, 5, e18969.
Olanrewaju, A. , Abdulaziz, A. , Preece, C.N. , & Shobowale, K. (2021). Evaluation of measures to prevent the spread of COVID-19 on the construction sites. Clean Eng Technol, 5, 100277. doi: 10.1016/j.clet.2021.100277.
Omatule Onubi, H. , Yusof, N.A. , & Sanusi Hassan, A. (2021). Perceived COVID-19 safety risk and safety behavior on construction sites: Role of safety climate and firm size. Journal of Construction Engineering and Management, 147, 04021153. doi: 10.1061/(ASCE)CO.1943-7862.0002201.
Sami Ur Rehman, M. , Shafiq, M.T. , & Afzal, M. (2022). Impact of COVID-19 on project performance in the UAE construction industry. Journal of Engineering, Design and Technology, 20, 245–266. doi: 10.1108/JEDT-12-2020-0481.
Sharara, S. , & Radia, S. (2022). Quick Response (QR) codes for patient information delivery: A digital innovation during the coronavirus pandemic. Journal of Orthodontics, 49, 89–97.
Simpeh, F. , & Amoah, C. (2021). Assessment of measures instituted to curb the spread of COVID-19 on construction site. International Journal of Construction Management, 1–19. doi: 10.1080/15623599.2021.1874678.
Sumner, S. , & Farrell, P. (2003). The influence of clients on health and safety standards in construction. Proceedings of the 19th Annual Association of Researchers in Construction Management (ARCOM) Conference, University of Brighton, pp. 193–202.
Vaismoradi, M. , Turunen, H. , & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. Nursing & Health Sciences, 15, 398–405.
Wu, J. , Wang, J. , Nicholas, S. , Maitland, E. , & Fan, Q. (2020). Application of big data technology for COVID-19 prevention and control in China: Lessons and recommendations. Journal of Medical Internet Research, 22, e21980–e21980. doi: 10.2196/21980.
Yang, Y. , Chan, A.P. , Shan, M. , Gao, R. , Bao, F. , Lyu, S. , Zhang, Q. , & Guan, J. (2021). Opportunities and challenges for construction health and safety technologies under the COVID-19 pandemic in Chinese construction projects. International Journal of Environmental Research and Public Health, 18, 13038.

Towards improving health management of construction projects during the COVID-19 pandemic

Agyekum, K. , Kukah, A.S. , & Amudjie, J. (2022). The impact of COVID-19 on the construction industry in Ghana: The case of some selected firms. Journal of Engineering, Design and Technology, 20, 222–244.
Ahmadi, H.B. , Kusi-Sarpong, S. , & Rezaei, J. (2017). Assessing the social sustainability of supply chains using Best Worst Method. Resources, Conservation and Recycling, 126, 99–106.
Ahmed, S. , Haq, I. , & Anam, S.M.A. (2022). Impacts of COVID-19 on the construction sector in the least developed countries. International Journal of Building Pathology and Adaptation, ahead-of-print. https://doi.org/10.1108/IJBPA-04-2022-0059.
Alsharef, A. , Banerjee, S. , Uddin, S.M.J. , Albert, A. , & Jaselskis, E. (2021). Early impacts of the COVID-19 pandemic on the United States construction industry. International Journal of Environmental Research and Public Health, 18, 1559.
Araya, F. (2021). Modeling the spread of COVID-19 on construction workers: An agent-based approach. Safety Science, 133, 105022.
Aslan, S. , & Türkakın, O.H. (2022). A construction project scheduling methodology considering COVID-19 pandemic measures. Journal of Safety Research, 80, 54–66.
Assaad, R. , & El-Adaway, I.H. (2021). Guidelines for responding to COVID-19 pandemic: Best practices, impacts, and future research directions. Journal of Management in Engineering, 37,

06021001.
Bavafa, A. , Mahdiyar, A. , & Marsono, A.K. (2018). Identifying and assessing the critical factors for effective implementation of safety programs in construction projects. Safety Science, 106, 47–56.
Briggs, B. , Friedland, C.J. , Nahmens, I. , Berryman, C. , & Zhu, Y. (2022). Industrial construction safety policies and practices with cost impacts in a COVID-19 pandemic environment: A Louisiana DOW case study. Journal of Loss Prevention in the Process Industries, 76, 104723.
Burton, E. , Edwards, D.J. , Roberts, C. , Chileshe, N. , & Lai, J.H.K. (2021). Delineating the implications of dispersing teams and teleworking in an Agile UK construction sector. Sustainability, 13, 9981.
CCOHS . (2021). Coronavirus (COVID-19)-tips: Construction sector [WWW Document]. Available at www.ccohs.ca. www.ccohs.ca/covid19/construction/ (Accessed 17 April 2022).
Construction Industry Council . (2021, January). Good practice on preventive measures against COVID-19 for construction site (English Version) [WWW Document]. Available at www.cic.hk/eng/main/safety-corner/referencematerials/. www.cic.hk/files/page/51/20210121_Good%20Practice%20on%20Preventive%20Measures%20Against%20COVID-19%20for%20Construction%20Sites.pdf (Accessed 17 April 2022).
del Rio-Chanona, R.M. , Mealy, P. , Pichler, A. , Lafond, F. , & Farmer, J.D. (2020). Supply and demand shocks in the COVID-19 pandemic: An industry and occupation perspective. Oxford Review of Economic Policy, 36, S94–S137.
Durdyev, S. , Mohandes, S.R. , Tokbolat, S. , Sadeghi, H. , & Zayed, T. (2022). Examining the OHS of green building construction projects: A hybrid fuzzy-based approach. Journal of Cleaner Production, 130590.
Gan, W.H. , & Koh, D. (2021). COVID-19 and return-to-work for the construction sector: Lessons from Singapore. Safety and Health at Work, 12, 277–281.
Gupta, H. (2018). Evaluating service quality of airline industry using hybrid best worst method and VIKOR. Journal of Air Transport Management, 68, 35–47.
Law, R.C.K. , Lai, J.H.K. , Edwards, D.J. , & Hou, H. (2021). COVID-19: Research directions for non-clinical aerosol-generating facilities in the built environment. Buildings, 11, 282.
Mahdiyar, A. , Mohandes, S.R. , Durdyev, S. , Tabatabaee, S. , & Ismail, S. (2020). Barriers to green roof installation: An integrated fuzzy-based MCDM approach. Journal of Cleaner Production, 122365.
Mohandes, S.R. , Durdyev, S. , Sadeghi, H. , Mahdiyar, A. , Hosseini, M.R. , Banihashemi, S. , & Martek, I. (2022a). Towards enhancement in reliability and safety of construction projects: Developing a hybrid multi-dimensional fuzzy-based approach. Engineering, Construction and Architectural Management, ahead-of-print.
Mohandes, S.R. , Karasan, A. , Erdoğan, M. , Ghasemi Poor Sabet, P. , Mahdiyar, A. , & Zayed, T. (2022b). A comprehensive analysis of the causal factors in repair, maintenance, alteration, and addition works: A novel hybrid fuzzy-based approach. Expert Systems with Applications, 208, 118112.
Mohandes, S.R. , Sadeghi, H. , Fazeli, A. , Mahdiyar, A. , Hosseini, M.R. , Arashpour, M. , & Zayed, T. (2022c). Causal analysis of accidents on construction sites: A hybrid fuzzy Delphi and DEMATEL approach. Safety Science, 151, 105730.
Mohandes, S.R. , & Zhang, X. (2021). Developing a holistic occupational health and safety risk assessment model: An application to a case of sustainable construction project. Journal of Cleaner Production, 291, 125934.
Nnaji, C. , Jin, Z. , & Karakhan, A. (2022). Safety and health management response to COVID-19 in the construction industry: A perspective of fieldworkers. Process Safety and Environmental Protection, 159, 477–488.
Olanrewaju, A. , AbdulAziz, A. , Preece, C.N. , & Shobowale, K. (2021). Evaluation of measures to prevent the spread of COVID-19 on the construction sites. Cleaner Engineering and Technology, 5, 100277.
OSHA . (2021). Protecting workers: Guidance on mitigating and preventing the spread of COVID-19 in the workplace [WWW Document]. Available at www.osha.gov. www.osha.gov/coronavirus/safework (Accessed 17 April 2022).
Owolabi, T.A. , Mohandes, S.R. , & Zayed, T. (2022). Investigating the impact of sewer overflow on the environment: A comprehensive literature review paper. Journal of Environmental Management, 301, 113810.

Pamidimukkala, A. , & Kermanshachi, S. (2021). Impact of Covid-19 on field and office workforce in construction industry. Project Leadership and Society, 2, 100018.
Safe Work Australia . (2022). COVID-19 for workplaces pack [WWW Document]. Available at covid19.swa.gov.au. https://covid19.swa.gov.au/covid-19-print-pack/737/733 (Accessed 17 April 2022).
Salihu, C. , Hussein, M. , Mohandes, S.R. , & Zayed, T. (2022). Towards a comprehensive review of the deterioration factors and modeling for sewer pipelines: A hybrid of biblio-metric, scientometric, and meta-analysis approach. Journal of Cleaner Production, 351, 131460.
Salimi, N. , & Rezaei, J. (2018). Evaluating firms' R&D performance using best worst method. Evaluation and Program Planning, 66, 147–155.
Stiles, S. , Golightly, D. , & Ryan, B. (2021). Impact of COVID19 on health and safety in the construction sector. Human Factors and Ergonomics in Manufacturing & Service Industries, 31, 425–437.
Tabatabaei, M.H. , Amiri, M. , Ghahremanloo, M. , Keshavarz-Ghorabaee, M. , Zavadskas, E.K. , & Antucheviciene, J. (2020). Hierarchical decision-making using a new mathematical model based on the best-worst method. International Journal of Computers Communications & Control, 14, 710–725.
Tetteh, M.O. , Chan, A.P.C. , Mohandes, S.R. , & Agyemang, D.Y. (2022). Diagnosing critical barriers to international construction joint ventures success in the developing country of Ghana. Construction Innovation, ahead-of-print.
Zhang, X. , & Mohandes, S.R. (2020). Occupational health and safety in green building construction projects: A holistic Z-numbers-based risk management framework. Journal of Cleaner Production, 275, 122788.

An overview on the measures taken to tackle COVID-19 impacts on Nigerian construction sites

Alara, S.A. (2021). Organisational characteristics and COVID-19 safety practices among small and medium construction enterprises in Nigeria. Frontiers in Engineering and Built Environment, 1(1), 4154.
Alozie, C.E. , Ideh, A.O. , & Ifelunini, I . (2020, September 21). Coronavirus COVID-19 pandemic economic consequences and strategies for ameliorating macroeconomic shocks in Nigeria. Economy.
Esmaeilzadeh, P. (2022). Public concerns and burdens associated with face mask-wearing: Lessons learned from the COVID-19 pandemic. Progress in Disaster Science, 13, 100215, 1–11.
Federal Republic of Nigeria . (2021). Coronavirus disease (COVID-19) health protection regulations 2021. Nigeria Centre for Disease Control, Federal Republic of Nigeria. Available at https://covid19.ncdc.gov.ng/media/files/Coronavirus_Disease_COVID19_Health_ProtectionRegulations_2021.pdf (Accessed 21 April 2022).
Flick, U. (2014). An introduction to qualitative research (5th ed.). London: Sage.
Hinze, J.W. (2006). Construction safety. Hoboken: Prentice-Hall Inc.
International Labour Organisation. (2020). Monitor COVID-19 and world of work. Geneva: ILO.
International Labour Organisation. (2021). Impact of COVID-19 on construction sector: ILO Sectorial Brief. Geneva: ILO.
International Monetary Fund . (2021). Policy responses to COVID-19 pandemic (Accessed 12 April 2922).
Kukoyi, P.O. , Simpeh, F. , Adebowale, O.J. , & Agumba, J.N. (2021). Managing the risk and challenges of COVID-19 on construction sites in Lagos, Nigeria. Journal of Engineering Design and Technology, 20 (1), 99–144.
Luo, H. , Liu, J. , Li, C. , Chen, K. , & Zhang, M. (2020). Ultra-rapid delivery of specialty field hospitals to combat COVID-19: Lessons learned from the Leishenshan Hospital project in Wuhan. Automation in Construction (Elsevier Ltd), 119(103345), 1–10.
Okorie, V.N. , Emuze, F.A. , Smallwood, J.J. , & van Wyk, J.J. (2014). A qualitative view of the health and safety: Leadership roles of managers in South African construction firms. Journal of Construction Project Management and Innovation, 4(2), 950–965.

Okorie, V.N. , & Musonda, I. (2020). An investigation on supervisor's ability and competency to conduct construction site health and safety induction training in Nigeria. International Journal of Construction Management. doi: 10.1080/15623599.2018.1531808.
Okorie, V.N. , & Smallwood, J.J. (2011). Impact of rural migrant workers on construction health and safety. In Proceedings of ASOCSA 6th built environment conference (pp. 128–140). Johannesburg: Association of Schools of Construction of Southern Africa.
Onubi, H.O. , Yusof, N. , Hassan, A.S. , & Bahdad, A.A.S. (2021). Forecasting the schedule performance resulting from the adoption of social distancing in construction projects. Engineering, Construction and Architectural Management. doi: 10.1108/ECAM-07-2021-0632.
World Health Organization (WHO) . (2020a). Coronavirus disease COVID-19 health and safety in workplace. Available at www.who.int/newsroom/q-a-detail/coronavirus-diseascovid19health-safety-intheworkplace (Accessed April 2022).
World Health Organization . (2020b). WHO COVID-19 dashboard. Geneva: World Health Organization. Available at https://covid19.who.int/ (Accessed April 2022).
WHO Health Organization (WHO) . (2020c). Coronavirus disease COVID-19 dashboard, world health organization. Available at www.who.int.newsroom/q-a-detail/coronavirus.disease-covid19health (Accessed April 2022).
Zakaria, S.A. , & Singh, A.M. (2021). Impact of COVID-19 outbreak on civil engineering activities in the Malaysia construction industry: A review. Journal of Social Sciences and Humanities Open Access, (1), 1000074.

COVID-19 pandemic

Abdullah, J.M. , Wan Ismail, W.F.N. , Mohamad, I. , Ab Razak, A. , Harun, A. , Musa, K.I. , Lee, Y. , & Sharma, Y. (2020). A critical appraisal of COVID-19 in Malaysia and beyond. The Malaysian Journal of Medical Sciences, 27(2), 1–9.
Alsharef, A. , Banerjee, S. , Uddin, S.J. , Albert, A. , & Jaselskis, E. (2021). Early impacts of the COVID-19 pandemic on the United States construction industry. International Journal of Environmental Research and Public Health, 18(4), 1559.
Assaad, R. , & El-Adaway, I.H. (2021). Guidelines for responding to COVID-19 pandemic: Best practices, impacts, and future research directions. Journal of Management in Engineering, 37(3), 06021001.
Hashim, J.H. , Adman, M.A. , Hashim, Z. , Mohd Radi, M.F. , & Kwan, S.C. (2021, May 7). COVID-19 epidemic in Malaysia: Epidemic progression, challenges, and response. Frontiers in Public Health. Frontiers Media S.A. https://doi.org/10.3389/fpubh.2021.560592.
Hermesauto . (2021, August 15). Malaysia relaxes COVID-19 curbs further for fully vaccinated individuals. The Straits Times. Available at www.straitstimes.com/asia/se-asia/malaysia-relaxes-COVID-19-curbs-further-for-fully-vaccinated-individuals (Accessed 28 October 2021).
Marzo, R.R. , Ahmad, A. , Abid, K. , Khatiwada, A.P. , Ahmed, A. , Kyaw, T.M. , … Shrestha, S. (2021). Factors influencing the acceptability of COVID-19 vaccination: A cross-sectional study from Malaysia. Vacunas. https://doi.org/10.1016/j.vacun.2021.07.007.
Ogunnusi, M. , Hamma-Adama, M. , Salman, H. , & Kouider, T. (2020). COVID-19 pandemic: The effects and prospects in the construction industry. International Journal of Real Estate Studies, 14(Special Issue 2).
Sharma, A.K. (2020). Novel coronavirus disease (COVID-19). Resonance, 25(5), 647–668. https://doi.org/10.1007/s12045-020-0981-3.
Zhang, J. , Xiang, P. , Zhang, R. , Chen, D. , & Ren, Y. (2020). Mediating effect of risk propensity between personality traits and unsafe behavioral intention of construction workers. Journal of Construction Engineering and Management, 146(4), 04020023.

Health and safety in the construction industry during the Covid-19 pandemic

Aczel, A. , & Sounderpandian, J. (2008). Complete business statistics (7th ed.). Irvine: McGraw-Hill.

Assaad, R. , & El-Adaway, I.H. (2021). Guidelines for responding to COVID-19 pandemic: Best practices, impacts, and future research directions. Journal of Management in Engineering, 37(3), 06021001.

Bao, L. , Tran, S.V.T. , Nguyen, T.L. , Pham, H.C. , Lee, D. , & Park, C. (2022). Cross-platform virtual reality for real-time construction safety training using immersive web and industry foundation classes. Automation in Construction, 143, 104565.

Choudhari, R. (2020). COVID 19 pandemic: Mental health challenges of internal migrant workers of India. Asian Journal of Psychiatry, 54, 102254.

Dennerlein, J.T. , Burke, L. , Sabbath, E.L. , Williams, J.A. , Peters, S.E. , Wallace, L. , … Sorensen, G. (2020). An integrative total worker health framework for keeping workers safe and healthy during the COVID-19 pandemic. Human Factors, 62(5), 689–696.

Ding, Z. , Xie, L. , Guan, A. , Huang, D. , Mao, Z. , & Liang, X. (2020). Global COVID-19: Warnings and suggestions based on experience of China. Journal of Global Health, 10(1).

Ebekozien, A. , Aigbavboa, C. , & Aigbedion, M. (2021). Construction industry post-COVID-19 recovery: Stakeholders perspective on achieving sustainable development goals. International Journal of Construction Management, 1–11.

Ezeokoli, F.O. , Okongwu, M.I. , & Fadumo, D.O. (2020). Adaptability of COVID-19 safety guidelines in building construction sites in Anambra state, Nigeria. Archives of Current Research International, 69–77.

Fruhen, L.S. , Griffin, M.A. , & Andrei, D.M. (2019). What does safety commitment mean to leaders? A multi-method investigation. Journal of Safety Research, 68, 203–214.

Gan, W.H. , & Koh, D. (2021). COVID-19 and return-to-work for the construction sector: Lessons from Singapore. Safety and Health at Work, 12(2), 277–281.

Gashahun, A.D. (2020). Assessmenton impact of Covid-19 on Ethiopian construction industry. International Journal of Engineering Science and Computing, 10(7), 26891–26894.

Hollingsworth, J. (2020). Construction safety practices for covid-19. Professional Safety, 65(6), 32–34.

Hussain, R. , Lee, D.Y. , Pham, H.C. , & Park, C.S. (2017). Safety regulation classification system to support BIM based safety management: In ISARC. Proceedings of the International Symposium on Automation and Robotics in Construction (Vol. 34). IAARC Publications.

Hussain, R. , Pedro, A. , Lee, D.Y. , Pham, H.C. , & Park, C.S. (2018). Impact of safety training and interventions on training-transfer: Targeting migrant construction workers. International Journal of Occupational Safety and Ergonomics, 26(2), 272–284.

Huynh, V.H. , Nguyen, T.H. , Pham, H.C. , Huynh, T.M.D. , Nguyen, T.C. , & Tran, D.H. (2021). Multiple objective social group optimization for time-cost-quality-carbon dioxide in generalized construction projects. International Journal of Civil Engineering, 19(7), 805–822.

Kabiru, J.M. , & Yahaya, B.H. (2020). Can Covid-19 considered as force majeure event in the Nigeria construction industry. International Journal of Scientific Engineering and Science, 4(6), 34–39.

La, V.P. , Pham, T.H. , Ho, M.T. , Nguyen, M.H.P. , Nguyen, K.L. , Vuong, T.T. ,… Vuong, Q.H. (2020). Policy response, social media and science journalism for the sustainability of the public health system amid the COVID-19 outbreak: The Vietnam lessons. Sustainability, 12(7), 2931.

Le, Q.T. , Pedro, A. , Pham, H.C. , & Park, C.S. (2016). A virtual world based construction defect game for interactive and experiential learning. International Journal of Engineering Educcation, 32, 457–467.

Le, T.A.T. , Vodden, K. , Wu, J. , & Atiwesh, G. (2021). Policy responses to the COVID-19 pandemic in Vietnam. International Journal of Environmental Research and Public Health, 18(2), 559.

Nguyen, N.H. , & Chinda, T. (2018). Interrelationship among key profit factors of Vietnamese residential projects using structural equation modeling. Sonklanakarin Journal of Science and Technology, 40(2), 467–474.

Pedro, A. , Chien, P.H. , & Park, C.S. (2018, April). Towards a competency-based vision for construction safety education. IOP Conference Series: Earth and Environmental Science (Vol. 143, No. 1, p. 012051). IOP Publishing.

Pedro, A. , Hussain, R. , Pham-Hang, A.T. , & Pham, H.C. (2022). Visualization technologies in construction education: A comprehensive review of recent advances. Engineering Education for Sustainability, 67–101.
Pedro, A. , Pham, H.C. , Kim, J.U. , & Park, C. (2020). Development and evaluation of context-based assessment system for visualization-enhanced construction safety education. International Journal of Occupational Safety and Ergonomics, 26(4), 811–823.
Pham, H.C. , Dao, N.N. , Kim, J.U. , Cho, S. , & Park, C.S. (2018). Energy-efficient learning system using web-based panoramic virtual photoreality for interactive construction safety education. Sustainability, 10(7), 2262.
Pham, H.C. , Le, Q.T. , Pedro, A. , & Park, C.S. (2015, October). Visualization based building anatomy model for construction safety education. Proceedings of the 6th International Conference on Construction Engineering and Project Management (ICCEPM), Busan, Korea (pp. 11–14).
Pham, H.C. , Pedro, A. , Le, Q.T. , Lee, D.Y. , & Park, C.S. (2019). Interactive safety education using building anatomy modelling. Universal Access in the Information Society, 18(2), 269–285.
Pham, H.C. , & Pham-Hang, A.T. (2020). Virtual photoreality for safety education. In New perspectives on virtual and augmented reality (pp. 211–223). Abingdon, UK: Routledge.
Pham, Q.D. , Dao, N.N. , Nguyen-Thanh, T. , Cho, S. , & Pham, H.C. (2021). Detachable web-based learning framework to overcome immature ICT infrastructure toward smart education. IEEE Access, 9, 34951–34961.
Pham, Q.V. , Pham-Hang, A.T. , & Pham, H.C. (2022). A legal framework and compliance with construction safety laws and regulations in Vietnam. In Engineering education for sustainability (pp. 103–140). New York: River Publishers.
Reinaldo, L.D.S.P. , Neto, J.V. , Caiado, R.G.G. , & Quelhas, O.L.G. (2021). Critical factors for total quality management implementation in the Brazilian construction industry. The TQM Journal, 33(5), 1001–1019. https://doi.org/10.1108/TQM-05-2020-0108.
Simpeh, F. , & Amoah, C. (2021). Assessment of measures instituted to curb the spread of COVID-19 on construction site. International Journal of Construction Management, 1–19.
Stiles, S. , Golightly, D. , & Ryan, B. (2021). Impact of COVID19 on health and safety in the construction sector. Human Factors and Ergonomics in Manufacturing & Service Industries.
Van Nguyen, Q. , Cao, D.A. , & Nghiem, S.H. (2021). Spread of COVID-19 and policy responses in Vietnam: An overview. International Journal of Infectious Diseases, 103, 157–161.
Vu, V.T. (2021). Public trust in government and compliance with policy during COVID-19 pandemic: Empirical evidence from Vietnam. Public Organization Review, 21(4), 779–796.
Wu, P. , Zhao, X. , Baller, J.H. , & Wang, X. (2018). Developing a conceptual framework to improve the implementation of 3D printing technology in the construction industry. Architectural Science Review, 61(3), 133–142.
Zhang, R.P. , Lingard, H. , & Nevin, S. (2015). Development and validation of a multilevel safety climate measurement tool in the construction industry. Construction Management and Economics, 33(10), 818–883.

Construction safety culture management during the COVID-19 pandemic

Abosede, A.O. , Opawole, A. , Olubola, B. , Ojo, G.K. , & Kajimo-Shakantu, K. (2019). Performance analysis of small and medium-sized construction firms in Oyo State, Nigeria. Acta Structilia, 26(1), 66–96.
Aksorn, T. , & Hadikusumo, B.H.W. (2007). Critical success factors influencing safety program performance in Thai construction projects. Safety Science, 46(4), 709–727.
Al-Bayati, S.J. (2021). Impact of construction safety culture and construction safety climate on safety behaviour and safety motivation. Safety, 7(41), 1–13.
Bank of Thailand . (2022). Criteria for company sizes from ministry of industrial, Thailand [in Thai]. Available at www.bot.or.th/Thai/ConsumerInfo/List_InfoImage/SMEs.jpg.
Celoch, A. , & Smolag, K. (2021). The impact of the COVID-19 pandemic on managing the work safety culture in the construction industry companies in Poland. Quality Production Improvement, 3, 105–119.

Chaisaard, N. , Ngowtanasuwan, G. , & Doungpan, S. (2020, August 28). A review of construction project management guidelines under the impact of COVID-19 epidemic dispersal: A case study of Thai construction projects. SUT International Virtual Conference on Science and Technology, Nakorn-Ratchasima, Thailand, IVCST-2020-0073.

Chinda, T. (2020). Factors affecting cost in pre-construction and construction phases: Structural equation modelling. International Journal of Construction Supply Chain Management, 10(3), 21, 115–140.

Chinda, T. , & Mohamed, S. (2008). Structural equation model of construction safety culture. Engineering, Construction and Architectural Management, 15(2), 114–131.

Choudhry, R.M. , Fang, D. , & Mohamed, S. (2007). Developing a model of construction safety culture. Journal of Management in Engineering, 23(4), 207–212.

Dakota Software . (2020). Keeping your safety culture healthy during COVID-19. Available at https://ehsdailyadvisor.blr.com/2020/08/keeping-your-safety-culture-healthy-during-covid-19/.

Grytnes, R. , Tutt, D.E. , & Anderson, L.P.S. (2020). Developing safety cooperation in construction: Between facilitating independence and tightening the grip. Construction Management and Economics, 38(11), 977–992.

Hansen, A.C.S. , & Kolokotronis, I. (2020). Managing health and safety on the building site: A study on communication issues between the involved actors. Student Report. Denmark: Aalborg University.

Jackson, S.L. (2003). Research methods and statistics: A critical thinking approach. Boston: Thomson Wadsworth.

Kim, S. , Lee, H. , Hwang, S. , Yi, J.S. , & Son, J.W. (2021). Construction workers' awareness of safety information depending on physical and mental load. Journal of Asian Architecture and Building Engineering, 21(3), 1067–1077.

Lingard, H. , & Blismas, N. (2006). Building a safety culture: The importance of shared mental models in the Australian construction industry. In D. Fang , R.M. Choudhry , & J.W. Hinze (eds.), Proceedings of the CIB W99 2006 international conference on global unity for safety and health in construction, 28–30 June 2006, Beijing, China (pp. 201–208). Beijing: Tsinghua University Press.

Novell, L.S. , Norris, J.M. , White, D.E. , & Moules, N.J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. International Journal of Qualitative Methods, 16(1), 1–13.

Othman, I. , Kamil, M. , Sunindijo, R.Y. , Alnsour, M. , & Kineber, A.F. (2020). Critical success factors influencing construction safety program implementation in developing countries. Journal of Physics: Conference Series, 1529(042079), 1–8.

SCG . (2020). Building resilience for sustainability leadership. Sustainability Report 2020. The Siam Cement Public Company Limited, Bangkok, Thailand. https://www.scg.com/pdf/en/SD2020.pdf.

Stiles, S. , Golightly, D. , & Ryan, B. (2020). Impact of COVID-19 in health and safety in the construction sector. Human Factor Management, 1–13. doi: 10.1002/hfm.20882.

Tam, C.M. , Zeng, S.X. , & Deng, Z.M. (2004). Identifying elements of poor construction safety management in China. Safety Science, 42(7), 569–586.

Tei Expert . (2021). Why building safety culture during the coronavirus pandemic is more important than ever? Available at www.triumvirate.com/blog/why-building-safety-culture-during-the-coronavirus-pandemic-is-more-important-than-ever.

Teo, A.L. , & Fang, D. (2006). Measurement of safety climate in construction industry: Studies in Singapore and Hong Kong. In D. Fang , R.M. Choudhry , & J.W. Hinze (eds.), Proceedings of the CIB W99 2006 international conference on global unity for safety and health in construction, 28–30 June 2006, Beijing, China (pp. 157–164). Beijing: Tsinghua University Press.

Vitharana, V.H.P. , & Chinda, T. (2017). Policy analysis of the budget used in training program for reducing lower back pain among heavy equipment operators in the construction industry: System dynamics approach. IOP Conference Series: Earth and Environmental Science, 140(012114), 1–9.

Vongvitayapirom, B. , Sachakamol, P. , Kropsu-Vehkapera, H. , & Kess, P. (2013). Lessons learned from applying safety culture maturity model in Thailand. International Journal of Synergy and Research, 2(1), 5–21.

Policy assessment framework to measure the efficacy of mask-wearing arrangements during the COVID-19 outbreak

Australian Welding Supplies (AWS) . (2021). A practical guide to welding fume control. Artarmon, NSW: Australian Welding Supplies Pty Ltd.

Chen, H. , Wang, J. , & Huang, J. (2014). Policy support, social capital, and farmers' adaptation to drought in China. Global Environmental Change, 24, 193–202.

Cheng, Y. , Ma, N. , Witt, C. , Rapp, S. , Wild, P.S. , Andreae, M.O. , Poschl, U. , & Su, H. (2021). Face masks effectively limit the probability of SARS-CoV-2 transmission. Science, 372(6549), 1439–1443.

Chua, M.H. , Cheng, W. , Goh, S.S. , Kong, J. , Li, B. , Lim, J.Y.C. , Mao, L. , Wang, S. , Xue, K. , Yang, L. , Ye, E. , Zhang, K. , Cheong, W.C.D. , Tan, B.H. , Li, Z. , Tan, B.H. , & Loh, X.J. (2020). Face masks in the new COVID-19 normal: Materials, testing, and perspectives. Research, 2020(6), 1–40.

Cohen, H.J. , & Birkner, J.S. (2012). Respiratory protection. Clinics in Chest Medicine, 33(4), 783–793.

Decree of the Minister of Health of the Republic of Indonesia No. HK.01.07/MENKES/328/2020 concerning Guidelines for the Prevention and Control of Corona Virus Disease 2019 on 20 May 2020.

Egardy, M.D. (2022). Identifikasi Masker sebagai Alat Pelindung Diri (APD) dan Alat Pencegah Virus COVID-19 pada Proyek Konstruksi di Jakarta. Bachelor Thesis, Construction Engineering & Management Program, Universitas Agung Podomoro, Jakarta.

Farihin, W.A. , Alamsyah, D.F. , & Pudjihardjo, H.S. (2021). Analisis Resiko Pelaksanaan Pembangunan Proyek Konstruksi Bangunan Gedung IGD RSUD Ajibarang pada Saat Pandemi COVID-19. Bachelor Thesis, Civil Engineering Program, Universitas Semarang, Semarang.

Fauziyah, S. , Susanti, R. , & Lukman . (2022). The mitigation of Covid-19 in the perspective of contractor for sustainable construction in Indonesia. IOP Conference Series: Earth and Environmental Science, 969, 012071.

Fitriani, R. (2020). Mengintip Panduan Pengendalian COVID-19 Sektor Konstruksi oleh OSHA. Buletin Konstruksi, 4, 4–6.

Hansen, S. (2020a). Does the COVID-19 outbreak constitute a force majeure event? A pandemic impact on construction contracts. Journal of the Civil Engineering Forum, 6(2), 201–214.

Hansen, S. (2020b). Investigasi Teknik Wawancara dalam Penelitian Kualitatif Manajemen Konstruksi. Jurnal Teknik Sipil, 27(3), 283–294.

Irfan, M. , Akhtar, N. , Ahmad, M. , Shahzad, F. , Elavarasan, R.M. , Wu, H. , & Yang, C. (2021). Assessing public willingness to wear face masks during the COVID-19 pandemic: Fresh insights from the theory of planned behavior. International Journal of Environmental Research and Public Health, 18(9), 4577, 1–22.

Kim, Y.J. , Choi, S. , & Nam, B.H. (2021). Developing advanced data-driven models to understand the complex patterns of mask wearing amid the COVID-19 pandemic: Efforts to accelerate collective cognition of shared risk. Natural Hazards Review, 22(2), 02521001.

Koebele, E.A. , Albright, E.A. , Dickinson, K.L. , Blanch-Hartigan, D. , Neuberger, L. , DeLeo, R.A. , Shanahan, E.A. , & Roberts, J.D. (2021). Perceptions of efficacy are key determinants of mask-wearing behavior during the COVID-19 pandemic. Natural Hazards Review, 22(3), 06021002.

Krismantoro, & Susilo, W.H. (2021). Study of customer demand for cloth masks during the COVID-19 pandemic and an affecting the performance: Insight the industrial organization theory in management research. International Journal of Research in Commerce and Management Studies, 3(5), 1–12.

Lima, M.M.Ds ., Cavalcante, F.M.L. , Macedo, T.S. , Galindo-Neto, N.M. , Caetano, J.A. , & Barros, L.M. (2020). Cloth face masks to prevent Covid-19 and other respiratory infections. Revista Latino-Americana de Enfermagen, 28, 1–8.

Ministry of Health Circular Letter No. HK.02.02/I/385/2020 concerning the Use of Masks and the Provision of Handwashing Facilities with Soap to Prevent Transmission of Corona Virus

Disease 2019.
Ministry of Public Works and Housing Instruction No. 02/In/M/2020 concerning the Protocol for Preventing the Spread of COVID-19 in the Execution of Construction Services.
Oerther, D.B. , & Shattell, M. (2020). Environmental hygiene for COVID-19: It's all about the mask. Journal of Environmental Engineering, 146(12), 01820004.
O'Kelly, E. , Arora, A. , Pirog, S. , Ward, J. , & Clarkson, P.J. (2021). Comparing the fit of N95, KN95, surgical, and cloth masks and assessing the accuracy of fit checking. PLoS One, 16(1), e0245688.
Pattisinai, A.R. , Widayanti, F.R. , Nusantara, D.A.D. , & Nadiar, F. (2020). The importance of occupational safety and health in the construction project site in the era pandemic COVID-19. PROTEKSI, 2(2), 84–89.
Pradhan, N.S. , Su, Y. , Fu, Y. , Zhang, L. , & Yang, Y. (2017). Analyzing the effectiveness of policy implementation at the local level: A case study of management of the 2009–2010 drought in Yunnan Province, China. International Journal of Disaster Risk Science, 8, 64–77.
Pranata, Y.H. (2019). Kajian terhadap Semen Portland sebagai Material Berbahaya bagi Pekerja Proyek Konstruksi. Bachelor Thesis, Construction Engineering & Management Program, Universitas Agung Podomoro, Jakarta.
Presidential Decree No. 12 of 2020 concerning the Determination of Non-Natural Disasters for the Spread of COVID-19 as a National Disaster.
Purnomo, M.R.A. , Shinta, R.C. , Ramadhani, R. , Yassaruddin, A.R. , & Sabit, M.I. (2016). Automatic polarizing filter system for welding mask. Proceeding of 9th International Seminar on Industrial Engineering and Management, September 20–22, Padang, West Sumatera, Indonesia, pp. 1–7.
Sari, H.M. (2021). Penerapan Protokol Pencegahan Penyebaran Corona Virus Disease 2019 (COVID-19) Pada Penyelenggaraan Proyek Konstruksi. Mecha Jurnal Teknik Mesin, 3(2), 16–22.
Sickbert-Bennett, E.E. , Samet, J.M. , Prince, S.E. , Chen, H. , Zeman, K.L. , Tong, H. , & Bennett, W.D. (2021). Fitted filtration efficiency of double masking during the COVID-19 pandemic. JAMA Internal Medicine, 181(8), 1126–1128.
Siswanto, A.B. , Salim, M.A. , & Ramawati, D. (2022). Analisis Penerapan K3 Masa Pandemi COVID-19 pada Proyek Dermaga Samudera Semarang. Teras Jurnal: Jurnal Teknik Sipil, 12(1), 229–244.
Suraji, A. (2021). Dampak, Adaptasi dan Mitigasi Pandemi COVID-19 di Sektor Konstruksi Indonesia. In Buku 3 Konstruksi Indonesia 2021 (pp. 574–592). Jakarta: Kementerian Pekerjaan Umum dan Perumahan Rakyat.
Susila, H. , & Arbianto, R. (2021). Penerapan Protokol Pencegahan COVID-19 dalam Pelaksanaan Proyek Konstruksi. Jurnal Teknik Sipil dan Arsitektur, 26(2), 10–17.
Waluyo, P. (2020). Penerapan Pekerjaan Proyek Konstruksi pada Masa Pandemi COVID-19 Menggunakan Pendekatan OHSAS 18001. Jurnal Konstruksia, 12(1), 69–80.
Wati, E.T. , Muda, C.A.K. , Rusdy, M.D.R. , & Handayani, P. (2021). Factors related to the behaviour of the use of mask in workers in the era of covid-19 pandemic in project. Majalah Ilmu Keperawatan dan Kesehatan Indonesia, 10(2), 185–195.

Construction sector in Indonesia

Alenezi, T.A.N. (2020). The impact of Covid-19 on construction projects in Kuwait. International Journal of Engineering Research and General Science, 8(4), 6–9.
Asih, R. , & Latief, Y. (2021). Evaluation of implementation within occupational health and safety management system based on Indonesia government regulation number 50 of 2012 and ISO 45001:2018 (Case Study: Company X). In: 2021.
Buranatrevedh, S. (2015). Occupational safety and health management among five ASEAN countries: Thailand, Indonesia, Malaysia, Philippines, and Singapore. Journal of the Medical Association of Thailand, 98(2), S64–S69.
Gamil, Y. , & Alhagar, A. (2020). The impact of pandemic crisis on the survival of construction industry: A case of COVID-19. Mediterranean Journal of Social Sciences, 11(4), 122.

Larasati, D. , (2021). Impact of the pandemic COVID-19 on the implementation of construction contracts. IOP Conference Series: Earth and Environmental Science, 738(1), 12075.
Ling, F.Y. , (2022). Impact of COVID-19 pandemic on demand, output, and outcomes of construction projects in Singapore. Journal of Management in Engineering, 38(2), 04021097.
Lingard, H. , & Rowlinson, S. (2004). Occupational health and safety in construction project management. Abingdon, UK: Routledge.
Ministry of Health of the Republic of Indonesia . (2020). Decree of Minister of Health of the Republic of Indonesia Number HK.01.07/MENKES/328/2020 of 2020 about Guidelines for Prevention and Control of Corona Virus Disease 2019 (Covid-19) in the Office and Industry Workplace to Support Business Continuity in Pandemic Situations.
Ministry of Public Works and Public Housing of the Republic of Indonesia . (2014). Regulation of the Minister of Public Works and Public Housing Number 05/PRT/M/2014 of 2014 concerning Guidelines for Construction OHSMS in the Public Work Sector.
Ministry of Public Works and Public Housing of the Republic of Indonesia . (2020). Instruction of the Minister of Public Works and Public Housing Number 02/IN/M/2020 of 2020 concerning the Protocol to Prevent the Spread of Corona Virus Disease 2019 (COVID-19) in the Implementation of Construction Services.
Ministry of Public Works and Public Housing of the Republic of Indonesia . (2021). Regulation of the Minister of Public Works and Public Housing Number 10 of 2021 concerning Guidelines for Construction Safety Management Systems.
Ogunnusi, M. , (2020). COVID-19 pandemic: The effects and prospects in the construction industry. International Journal of Real Estate Studies, 14(2), 120–128.
Parinduri, L. , & Parinduri, T. (2020). Implementasi Manajemen Keselamatan Konstruksi dalam Pandemi Covid 19. Buletin Utama Teknik, 15(3), 222–228.
Phuspa, S. , (2019). Implications of Indonesian occupational safety and health management system award to the safety culture. In Z. Rusnalasari, (eds.).
Republic of Indonesia . (1970). Law of the Republic of Indonesia Number 1 of 1970 on Occupational Safety.
Republic of Indonesia . (2003). Law of the Republic of Indonesia Number 13 of 2003 concerning Manpower.
Republic of Indonesia . (2012). Government Regulation of the Republic of Indonesia Number 50 of 2012 concerning Implementation of OHS Management System (OHSMS).
Republic of Indonesia . (2017). Laws of the Republic of Indonesia Number 2 of 2017 about Construction Services.
Stiles, S. , Golightly, D. , & Ryan, B. (2021). Impact of COVID-19 on health and safety in the construction sector. Human Factors and Ergonomics in Manufacturing, 31(4), 425–437.

Individual and organisational support mechanisms to foster career resilience during the COVID-19 pandemic

AIPM (Australian Institute of Project Management) . (2021). The diversity challenge: AIPM gender equity report 2021. AIPM Website. Available at https://f.hubspotusercontent10.net/hubfs/7399164/AIPM%20Gender%20Equity%20in%20the%20Workplace%202021%20V5.pdf?hsCtaTracking=c5a5b998-1393-4da8-9ad4-0d79667ab3df%7C64c970b7-d3df-4335-949d-a135c063595d (Accessed 30 July 2022).
Akkermans, J. , & Kubasch, S. (2017). Trending topics in careers: A review and future research agenda. Career Development International, 22(6), 586–627.
Akkermans, J. , Richardson, J. , & Kraimer, M.L. (2020). The COVID-19 crisis as a career shock: Implications for careers and vocational behaviour. Journal of Vocational Behaviour, 119, 103–134.
Akkermans, J. , Seibert, S.E. , & Mol, S.T. (2018). Tales of the unexpected: Integrating career shocks in the contemporary career's literature. SA Journal of Industrial Psychology, 44, 1503.
Bakker, A.B. , & Demerouti, E. (2014). Job demands: Resources theory in wellbeing. Hoboken, NJ: John Wiley & Sons Ltd.
Bengtsson, M. (2016). How to plan and perform a qualitative study using content analysis. NursingPlus Open, 2, 8–14.

Bezuidenhout, M. (2011). The development and evaluation of a measure of graduate employability in the context of the new world of work. Unpublished master's dissertation, University of Pretoria, Pretoria.
Bowen, P. , Govender, G. , Edwards, E. , & Cattell, K. (2017). Work-related contact, work: Family conflict, psychological distress and sleep problems experienced by construction professionals: An integrated explanatory model. Construction Management and Economics, 36(3), 153–174.
Bright, J.E.H. , Pryor, R.G.L. , & Harpham, L. (2005). The role of chance events in career decision making. Journal of Vocational Behavior, 66, 561–576.
Brundage, H. , & Koziel, M. (2010). Retaining top talent. Journal of Accountancy, 38–44.
Bushuyev, S. , Bushuiev, D. , & Bushuieva, V. (2020). Project management during infodemic of the COVID-19 pandemic. Innovative Technologies and Scientific Solutions for Industries, 2(12), 13–21.
Career Action Centre . (2019). Career action centre. Available at www.careeractioncentre.com.au/.
Cascio, W. (2007). Trends, paradoxes, and some directions for research in career studies. In Handbook of career studies (pp. 549–557). Los Angeles: SAGE Publications.
Cavanagh, S. (1997). Content analysis: Concepts, methods and applications. Nurse Researcher, 4(3), 5–16.
Chiaburu, D.S. , Baker, V.L. , & Pitariu, A.H. (2006). Beyond being proactive: What (else) matters for career self-management behaviors? Career Development International, 11(7), 619–632.
Daniels, C. , & Radel, K. (2018). Career resilience in 21st century Australian labour markets, [conference presentation]. 29th Annual Conference of the Australian and New Zealand Academy of Management, New Zealand. Available at https://www.anzam.org/wp-content/uploads/pdf-manager/2639_205.PDF (Accessed 17 June 2020).
Darling, E.J. , & Whitty, S.J. (2019). A model of projects as a source of stress at work: A case for scenario-based education and training. International Journal of Managing Projects in Business, 1753–8378.
De Vos, A. , & Van der Heijden, B.I.J.M. (2015). Handbook of research on sustainable careers. Cheltenham: Edward Elgar Publishing.
Evans, J.R. , & Mathur, A. (2005). The value of online surveys. Internet Research, 15(2), 195–219.
Foddy, M. , & Crundall, I. (1993). A field study of social comparison processes in ability evaluation. British Journal of Social Psychology, 32, 287–305.
Greenhaus, J.H. , Callanan, G.A. , & Godshalk, V.M. (2010). Career management (4th ed.). London: Sage.
Harari, O. (1995). The new job security. Your Management Review, 84(9), 29–31.
Hite, L.M. , & McDonald, K.S. (2020). Careers after COVID-19: Challenges and changes. Human Resource Development International, 23(4), 427–437.
Hsieh, H.F. , & Shannon, S.E. (2005). Three approaches to qualitative content analysis. Qualitative Health Research, 15(9), 1277–1288.
Isaac, S. , & Michael, W.B. (1997). Handbook in research and evaluation: A collection of principles, methods, and strategies useful in the planning, design, and evaluation of studies in education and the behavioral sciences. (3rd ed.). San Diego: Educational and Industrial Testing Services.
Lazarus, R. , & Folkman, S. (1984). Stress, appraisal and coping. New York: Springer.
London, M. (1993). Relationships between career motivation, empowerment and support for career development. Journal of Occupational and Organizational Psychology, 66, 55–69.
London, M. (1997). Overcoming career barriers: A model of cognitive and emotional processes for realistic appraisal and constructive coping. Journal of Career Development, 24(1), 25–38.
Luthans, F. (2002). The need for and meaning of positive organisational behavior. Journal of Organisational Behavior: The International Journal of Industrial, Occupational and Organisational Psychology and Behavior, 23(6), 695–706.
Lynn, B.E. (2000). Intellectual capital. Ivey Business Journal, 64(13), 48–51.
Mack, O. , Khare, A. , Kramer, A. , & Burgartz, T. (2016). Managing in a VUCA world. Switzerland: Springer International Publishing.

Miles, M.B. , & Huberman, A.M. (1994). Qualitative data analysis: An expanded source-book. Thousand Oaks, CA: Sage Publications Inc.
Pallant, J. , & Manual, S.S. (2020). A step-by-step guide to data analysis using SPSS. Berkshire, UK: McGraw-Hill Education.
Patil, G.V. (2016). Project management challenges. Journal of Multidisciplinary Engineering Science and Technology, 3(11), 6019–6024.
Peterson, B.D. , Pirritano, M. , Block, J.M. , & Schmidt, L. (2011). Marital benefit and coping strategies in men and women undergoing unsuccessful fertility treatments over a 5-year period. Fertility and Sterility, 95(5), 1759–1763.
Project Management Institute (PMI) . (2019). The future of work leading the way with PMTQ. Project Management Institute Website. Available at https://www.pmi.org/-/media/pmi/documents/public/pdf/learning/thought-leadership/pulse/pulse-of-the-profession-2019.pdf?sc_lang_temp=en (Accessed 11 December 2021).
Rossier, J. , Ginevra, M.C. , Bollmann, G. , & Nota, L. (2017). The importance of career adaptability, career resilience, and employability in designing a successful life. In K. Maree (ed.), Psychology of career adaptability, employability and resilience (pp. 65–82). Champagne: Springer.
Ruize-Martin, C. , Lopez-Paredes, A. , & Wainer, G. (2018). What we know and do not know about organizational resilience. International Journal of Production Management and Engineering, 6(1), 11–28.
Saunders, M.N.K. , Lewis, P. , Thornhill, A. , & Bristow, A. (2015). Understanding research philosophy and approaches to theory development. In M.N.K. Saunders , P. Lewis , & A. Thornhill (eds.), Research methods for business students (8th ed.). Harlow: Pearson Education.
Savickas, M.L. (2005). The theory and practice of career construction. In S.D. Brown & R.W. Lent (eds.), Career development and counselling: Putting theory and research to work. Hoboken, NJ: Wiley.
Seibert, S.E. , Kraimer, M.L. , & Heslin, P.A. (2016). Developing career resilience and adaptability. Organizational Dynamics, 45, 245–257.
Seibert, S.E. , Kraimer, M.L. , Holton, B.C. , & Pierotti, A.J. (2013). Even the best laid plans sometimes go askew: Career self-management processes, career shocks, and the decision to pursue graduate education. Journal of Applied Psychology, 98(1), 169–182.
Super, D.E. (1975). Career education and career guidance for the life span and for life roles. Journal of Career Education, 2(2), 27–42.
Waterman, R.H. , Waterman, J.A. , & Betsy, C.A. (1994). Towards a career resilient work-force. Harvard Business Review, 87–95.
Zull, C. (2016). Open-ended questions (version 2.0). Mannheim: GESIS-Leibniz-Institut für Sozialwissenschaften.

Assessing how pandemic lockdown upended construction work creed in Free State and Limpopo, South Africa

Aigbavboa, C.O. , Aghimien, D.O. , Thwala, W.D. , & Ngozwana, M.N. (2021). Unprepared industry meet pandemic: COVID-19 and the South Africa construction industry. Journal of Engineering, Design and Technology, 20(1), 183–200.
Alsharef, A. , Banerjee, S. , Uddin, S.M.J. , Albert, A. , & Jaselskis, E. (2021). Early impacts of the COVID-19 pandemic on the United States construction industry. International Journal of Environmental Research and Public Health, 18(4), 1559–1579.
Assaad, R. , & El-Adaway, I.H. (2021). Guidelines for responding to COVID-19 pandemic: Best practices, impacts, and future research directions. Journal of Management in Engineering, 37(3), 1–17.
Ataei, H. , Becker, D. , Hellenbrand, J.R. , Mehany, M.S.H.M. , Mitchell, T.E. , & Ponte, D.M. (2021). COVID-19 pandemic impacts on construction projects. Reston, VA: ASCE.
Bou Hatoum, M. , Faisal, A. , Nassereddine, H. , & Sarvari, H. (2021). Analysis of COVID-19 concerns raised by the construction workforce and development of mitigation practices. Frontiers in Built Environment, 7(688495), 1–15. doi: 10.3389/fbuil.2021.688495.

Creswell, J.W. (2014). Research design: Qualitative, quantitative, and mixed methods approach (4th ed.). Thousand Oaks, CA: SAGE Publications, Inc.
Kumar, R. (2014). Research methodology: A step by step guide for beginners (4th ed.). Los Angeles: SAGE Publications Ltd.
Raliile, M.T. , Haupt, T.C. , & Akinlolu, M. (2021). Rethinking construction health and safety legislation compliance: Lessons learnt from COVID-19. Proceedings of the Joint CIB W099 & W123 Annual International Conference 2021: Good Health, Changes & Innovations for Improved Wellbeing in Construction, 9th–10th September, Glasgow (on-line), UK, pp. 337–346.
Stiles, S. , Golightly, D. , & Ryan, B. (2020). Impact of COVID-19 on health and safety in the construction sector. Human Factors and Ergonomics in Manufacturing & Service Industries, 31(4), 425–437.
Republic of South Africa (RSA) . (2020). The South African economic reconstruction and recovery plan. Pretoria: South African Government.

COVID-19 pandemic

Alsharef, A. , Banerjee, S. , Uddin, S.M.J. , Albert, A. , & Jaselskis, E. (2021). Early impacts of the COVID-19 pandemic on the United States construction industry. International Journal of Environmental Research and Public Health, 18(4), 1–21. https://doi.org/10.3390/ijerph18041559.
Anselmi, F. , Cavigli, L. , Pagliaro, A. , Valente, S. , Valentini, F. , Cameli, M. , Focardi, M. , Mochi, N. , Dendale, P. , Hansen, D. , Bonifazi, M. , Halle, M. , & D'Ascenzi, F. (2021). The importance of ventilatory thresholds to define aerobic exercise intensity in cardiac patients and healthy subjects. Scandinavian Journal of Medicine and Science in Sports, 31(9), 1796–1808. https://doi.org/10.1111/sms.14007.
Araya, F. (2021). Modelling the spread of COVID-19 on construction workers: An agent-based approach. Safety Science, 133(September 2020), 105022. https://doi.org/10.1016/j.ssci.2020.105022.
Bavel, J.J.V. , Baicker, K. , Boggio, P.S. , Capraro, V. , Cichocka, A. , Cikara, M. , Crockett, M.J. , Crum, A.J. , Douglas, K.M. , Druckman, J.N. , Drury, J. , Dube, O. , Ellemers, N. , Finkel, E.J. , Fowler, J.H. , Gelfand, M ., Han, S. , Haslam, S.A. , Jetten, J. ,… Willer, R. (2020). Using social and behavioural science to support COVID-19 pandemic response. Nature Human Behaviour, 4(5), 460–471. https://doi.org/10.1038/s41562-020-0884-z.
Burton, W.N. , Schultz, A.B. , Chen, C.Y. , & Edington, D.W. (2008). The association of worker productivity and mental health: A literature review. International Journal of Work-place Health Management, 1(2), 78–94. https://doi.org/10.1108/17538350810893883.
Chan, Y.H. (2005). Biostatistics 304: Cluster analysis. Singapore Medical Journal, 46(4), 153–160.
Choudhari, R. (2020). COVID-19 pandemic: Mental health challenges of internal migrant workers of India. Asian Journal of Psychiatry, 54(May), 102254. https://doi.org/10.1016/j.ajp.2020.102254.
Christodoulou, N.G. , & Christodoulou, G.N. (2013). Financial crises: Impact on mental health and suggested responses. Psychotherapy and Psychosomatics, 82(5), 279–284. https://doi.org/10.1159/000351268.
Cui, X. , Rockett, I.R.H. , Yang, T. , & Cao, R. (2012). Work stress, life stress, and smoking among rural-urban migrant workers in China. BMC Public Health, 12(1), 1. https://doi.org/10.1186/1471-2458-12-979.
Esa, M.B. , Ibrahim, F.S.B. , & Kamal, E.B.M. (2020). Covid-19 pandemic lockdown: The consequences towards project success in the Malaysian construction industry. Advances in Science, Technology and Engineering Systems, 5(5), 973–983. https://doi.org/10.25046/aj0505119.
Ettman, C.K. , Abdalla, S.M. , Cohen, G.H. , Sampson, L. , Vivier, P.M. , & Galea, S. (2020). Prevalence of depression symptoms in US adults before and during the COVID-19 pandemic. JAMA Network Open, 3(9). https://doi.org/10.1001/jamanetworkopen.2020.19686.
Hossain, M.M. , Sultana, A. , & Purohit, N. (2020, July). Mental health outcomes of quarantine and isolation for infection prevention: A systematic umbrella review of the global evidence.

SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3561265.
Hossain, M.M. , Tasnim, S. , Sultana, A. , Faizah, F. , Mazumder, H. , Zou, L. , McKyer, E.L.J. , Ahmed, H.U. , & Ma, P. (2020). Epidemiology of mental health problems in COVID-19: A review. F1000Research [revista en Internet] 2018 [acceso 10 de diciembre de 2020], 9, 1–16.
Htay, M.N.N. , Latt, S.S. , Maung, K.S. , Myint, W.W. , & Moe, S. (2020). Mental well-being and its associated factors among Myanmar migrant workers in penang, Malaysia. Asia-Pacific Journal of Public Health, 32(6–7), 320–327. https://doi.org/10.1177/1010539520940199.
ILO . (2020). Managing work-related psychosocial risks during the COVID-19. Available at www.ilo.org/wcmsp5/groups/public/-ed_protect/-protrav/-safework/documents/instructionalmaterial/wcms_748638.pdf.
Johari, S. , & Jha, K.N. (2020). Impact of work motivation on construction labor productivity. Journal of Management in Engineering, 36(5), 04020052. https://doi.org/10.1061/(ASCE)me.1943-5479.0000824.
Karim, M.R. , Islam, M.T. , & Talukder, B. (2020). COVID-19's impacts on migrant workers from Bangladesh: In search of policy intervention. World Development, 136, 105123. https://doi.org/10.1016/j.worlddev.2020.105123.
Leitão, J. , Pereira, D. , & Gonçalves, Â. (2021). Quality of work life and contribution to productivity: Assessing the moderator effects of burnout syndrome. International Journal of Environmental Research and Public Health, 18(5), 1–20. https://doi.org/10.3390/ijerph18052425.
Li, Q. , Chi, P. , Hall, B.J. , Wu, Q. , & Du, H. (2019). Job stress and depressive symptoms among migrant workers in Macau: A moderated mediation model of self-esteem and perceived social support. Psych Journal, 8(3), 307–317. https://doi.org/10.1002/pchj.298.
Mucci, N. , Traversini, V. , Giorgi, G. , Tommasi, E. , De Sio, S. , & Arcangeli, G. (2020). Migrant workers and psychological health: A systematic review. Sustainability (Switzerland), 12(1), 1–28. https://doi.org/10.3390/SU12010120.
Nwaogu, J.M. , Chan, A.P.C. , Hon, C.K.H. , & Darko, A. (2020). Review of global mental health research in the construction industry: A science mapping approach. Engineering, Construction and Architectural Management, 27(2), 385–410. https://doi.org/10.1108/ECAM-02-2019-0114.
Pamidimukkala, A. , & Kermanshachi, S. (2021). Impact of Covid-19 on field and office workforce in the construction industry. Project Leadership and Society, 2, 100018. https://doi.org/10.1016/j.plas.2021.100018.
Pandey, K. , Thurman, M. , Johnson, S.D. , Acharya, A. , Johnston, M. , Klug, E.A. , Olwenyi, O.A. , Rajaiah, R. , & Byrareddy, S.N. (2021). Mental health issues during and after COVID-19 vaccine era. Brain Research Bulletin, 176(May), 161–173. https://doi.org/10.1016/j.brainresbull.2021.08.012.
Peng, L. , & Chan, A.H. (2020). Adjusting work conditions to meet the declined health and functional capacity of older construction workers in Hong Kong. Safety Science, 127, 104711.
Relojo-Howell, D. (2020). Mental health and the everyday construction worker _ Free Malaysia Today (FMT). Free Malaysia Today. Available at www.freemalaysiatoday.com/category/leisure/2020/02/04/mental-health-and-the-everyday-construction-worker/.
Sato, K. , Kuroda, S. , & Owan, H. (2020). Mental health effects of long work hours, night and weekend work, and short rest periods. Social Science and Medicine, 246(December 2019), 112774. https://doi.org/10.1016/j.socscimed.2019.112774.
Shah, K. , Kamrai, D. , Mekala, H. , Mann, B. , Desai, K. , & Patel, R.S. (2020). Focus on mental health during the coronavirus (COVID-19) pandemic: Applying learnings from the past outbreaks. Cureus, 12(3).
Shen, Q. , Lu, Y.W. , Hu, C.Y. , Deng, X.M. , Gao, H. , Huang, X.Q. , & Niu, E.H. (1998). A preliminary study of the mental health of young migrant workers in Shenzhen. Psychiatry and Clinical Neurosciences, 52(SUPPL.). https://doi.org/10.1111/j.1440-1819.1998.tb03272.x.
The Star . (2020). The unnoticed, unsung heroes during this time of the pandemic. The Star. Available at www.thestar.com.my/opinion/letters/2020/12/19/the-unnoticed-unsung-heroes-during-this-time-of-pandemic.
The Star . (2021). The construction sector could fully reopen by October. The Star. Available at www.thestar.com.my/business/business-news/2021/09/09/construction-sector-could-fully-reopen-by-october.
The Straits Times . (2020). Malaysia's construction industry records $6b losses in the first three lockdown phases, SE Asia news and top stories: The Straits Times. The Straits Times.

Available at www.straitstimes.com/asia/se-asia/malaysias-construction-industry-records-s6-bil-losses-in-first-three-lockdown-phases.
Tan, T.T. , Noor, N.M. , & Khalidi, J.R. (2020, June). Covid-19: We must protect foreign workers. Khazanah Research Institute, 1–36. Available at www.KRInstitute.org.
Turner, M. , & Lingard, H. (2020). Examining the interaction between bodily pain and mental health of construction workers. Construction Management and Economics, (11), 1009–1023. https://doi.org/10.1080/01446193.2020.1791920.
Wahab, A. (2020). The outbreak of Covid-19 in Malaysia: Pushing migrant workers at the margin. Social Sciences and Humanities Open, 2(1), 100073. https://doi.org/10.1016/j.ssaho.2020.100073.
Zakaria, S.A.S. , & Singh, A.K.M. (2021). Impacts of Covid-19 outbreak on civil engineering activities in the Malaysian construction industry: A review. Jurnal Kejuruteraan, 33(3), 477–485.
Zhou, X. , Snoswell, C.L. , Harding, L.E. , Bambling, M. , Edirippulige, S. , Bai, X. , and Smith, A.C. (2020). The role of telehealth in reducing the mental health burden from COVID-19. Telemedicine and E-Health, 26(4), 377–379. https://doi.org/10.1089/tmj.2020.0068.

COVID-19 and the Ghanaian construction industry

Adinyira, E. , Manu, P. , Agyekum, K. , Mahamadu, A.-M. , & Olomolaiye, P.O. (2020). Violent behavior on construction sites: Structural Equation Modelling of its impact on unsafe behavior using partial least squares. Engineering, Construction and Architectural Management, 27(10), 3363–3393.
Agyekum, K. , Kukah, A.S. , & Amudjie, J. (2022). The impact of COVID-19 on the construction industry in Ghana. Journal of Engineering, Design and Technology, 20(1), 222–244.
Agyekum, K. , Simons, B. , & Botchway, S.Y. (2018). Factors influencing the performance of safety programmes in the Ghanaian construction industry. Acta Structilia, 25(2), 39–68.
Alhusban, A.A. , Alhusban, S.A. , & Alhusban, M.A. (2022). How the COVID-19 pandemic would change the future of architectural design. Journal of Engineering, Design and Technology, 20(1), 339–357.
Amoah, C. , Bamfo-Agyei, E. , & Simpeh, F. (2021). The COVID-19 pandemic: The woes of small construction firms in Ghana. Smart and Sustainable Built Environment. doi: 10.1108/SASBE-02-2021-0025.
Annan, J.S. , Addai, E.K. , & Tulashie, S.K. (2015). A call for action to improve occupational health and safety in Ghana and a critical look at the existing legal requirement and legislation. Safety and Health at Work, 6(2), 146–150.
Boadu, E.F. , Wang, C.C. , & Sunindijo, R.Y. (2021). Challenges for occupational health and safety enforcement in the construction industry in Ghana. Construction Economics and Building, 21(1), 1–21.
Bourne, N.K. , Balmforth, H. , Beers, H. , Cao, R. , Cheung, C. , Clarke, S. , Collinge, W. , Cooper, G. , Corbett, E. , Hartwig, A. , Johnson, S. , Kirkham, R. , Li, L. , Ling, D. , Liu, C. , Manu, P. , Van Tongeren, M. , Weightman, A. , Yuan, P. , & Yunusa-Kaltungo, A. (2021). Keeping the UK building safely: A scoping study: Prepared for the PROTECT COVID-19 National Core Study on transmission and environment. University of Manchester. Available at https://documents.manchester.ac.uk/display.aspx?DocID=56698.
Brown, S. (2022). Construction worker mental health during the COVID-19 pandemic. Data Bulletin. Available at www.cpwr.com/wp-content/uploads/DataBulletin-January2022.pdf (Accessed 16 March 22).
Chigara, B. , & Moyo, T. (2022). Factors affecting the delivery of optimum health and safety on construction projects during the COVID-19 pandemic in Zimbabwe. Journal of Engineering, Design and Technology, 20(1), 24–46.
Creswell, J.W. (2009). Research design: Qualitative, quantitative, and mixed method s approaches (3rd ed.). Thousand Oaks, CA: Sage Publications, Inc.
Critelli, J. , Jbara, K. , & Sahota, R. (2020). Impacts of COVID-19 on construction projects. Available at www.protiviti.com/US-en/insights/covid-19-impact-construction-projects(Accessed 5 April 2022).

Danso, F.O. , Adinyira, E. , Manu, P. , Agyekum, K. , Ahadzie, D.K. , & Badu, E. (2022). The mediating influence of local cultures on the relationship between factors of safety risk perception and risk-taking behavioural intention of construction site workers. Safety Science, 145(2022), 105490.

Eze, E. , Ugulu, R.A. , Egwunatum, S.I. , & Awodele, I.A. (2021). Green building materials products and service market in the construction industry. Journal of Engineering, Project and Production Management, 11(2), 89–101.

Gamil, Y. , & Alhagar, A. (2020). The impact of pandemic crises on the survival of construction industry: A case of COVID-19. Mediterranean Journal of Social Sciences, 11(4), 122–128.

Ghasemi, A. , & Zahediasl, S. (2012). Normality test for statistical analysis: A guide for non-statisticians. International Journal of Endocrinol Metabolism, 10(2), 486–489.

Hatoum, M.B. , Faisal, A. , Nassereddine, H. , & Sarvari, H. (2021). Analysis of COVID-19 concerns raised by the construction workforce and development of mitigation practices. Frontiers in Built Environment, 11, 1–17.

Hui, D.S.I. , Azhar, E. , Madani, T.A. , Ntoumi, F. , Kock, R. , Dar, O. , & Zumla, A. (2020). The continuing 2019-nCoV epidemic threat of novel coronaviruses to global health: The latest 2019 novel coronavirus outbreak in Wuhan, China. International Journal of Infectious Diseases, 91, 264–266.

Husien, I.A. , Borisovich, Z. , & Naji, A.A. (2021). COVID-19: Key global impacts on the construction industry and proposed coping strategies. E3S Web of Conferences, 263, 05056.

International Labour Organisation . (2019). Extending social security to construction workers [L'extension de la Sécurité Sociale aux Ouvriers du Bâtiment]. Available at www.social-protection.org/gimi/Emodule.action?id=64 (Accessed 31 January 2021).

Jain, N. (2021). Coping with COVID-19: Part II, impacts on schedule. Available at www.mgac.com/blog/coping-with-covid-19-part-ii-impacts-on-schedule/ (Accessed 16 March 2021).

Jones, W. , Gibb, A.G.F. , & Chow, V. (2022). Adapting to COVID-19 on construction sites: What are the lessons for long term improvements in safety and worker effectiveness?. Journal of Engineering, Design and Technology, 20(1), 66–85.

King, S.S. , Rahman, R.A. , Fauzi, M.A. , & Haron, A.T. (2022). Critical analysis of pandemic impact on AEC organisations: The COVID-19 case. Journal of Engineering, Design and Technology, 20(1), 358–383.

King, T. , & Lamontagne, A.D. (2022). COVID-19 and suicide risk in the construction sector: Preparing for a perfect storm. Scandinavian Journal of Public Health, 49, 774–778.

Ogunnusi, M. , Hamma-Adama, M. , Salman, H. , & Kouider, T. (2020). COVID-19 pandemic: The effects and prospects in the construction industry. International Journal of Real Estate Studies, 14(2), 120–128.

Oladimeji, O. (2022). Influence of COVID-19 pandemic on local construction firms' viability. Journal of Engineering, Design and Technology, 20(1), 201–221.

Olatunde, N.A. , Awodele, I.A. , & Adebayo, B.O. (2022). Impact of COVID-19 on indigenous contractors in a developing economy. Journal of Engineering, Design and Technology, 20(1), 267–280.

Peterson, C. , Sussell, A. , Li, J. , Schumacher, P.K. , Yeoman, K. , & Stone, D.M. (2020). Suicide rates by industry and occupation: National violent death reporting system, 32 States, 2016. MMWR Morb Mortal Wkly Rep, 69, 57–62. http://dx.doi.org/10.15585/mmwr.mm6903a1.

PricewaterhouseCoopers Limited . (2020). Impact of COVID-19 on the supply chain industry. Available at www.pwc.com/ng/en/assets/pdf/impact-of-covid19-the-supply-chain-industry.pdf (Accessed 05 April 2022).

Rehman, M.S.U. , Shafiq, M.T. , & Afzal, M. (2022). Impact of CIVID-19 on project performance in the UAE construction industry. Journal of Engineering, Design and Technology, 20(1), 246–266.

Salami, B.A. , Ajayi, S.O. , & Oyegoke, A.S. (2022). Coping with the Covid-19 pandemic: An exploration of the strategies adopted by construction firms. Journal of Engineering, Design and Technology, 20(1), 159–182.

Simpeh, F. , & Amoah, C. (2020). Assessment of measures instituted to curb the spread of COVID-19 on construction site. International Journal of Construction Management. doi: 10.1080/15623599.2021.1874678.

Simpeh, F. , & Amoah, C. (2022). COVID-19 guidelines incorporated in the health and safety management polices of construction firms Journal of Engineering, Design and Technology, 20(1), 6–23.
Stride, M. , Suresh, R. , Suresh, S. , & Egbu, C. (2021). The effects of COVID-19 pandemic on the UK construction industry and the process of future-proofing business. Construction Innovation. doi: 10.1108/CI-03-2021-0045.
Umeokafor, N. , Evangelinos, K. , & Windapo, A. (2020). Strategies for improving complex construction health and safety regulatory environments. International Journal of Construction Management. doi: 10.1080/15623599.2019.1707853. Advance online publication.
World Health Organization (WHO) . (2020). Q&A on coronaviruses (COVID-19). Available at www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/q-acoronaviruses (Accessed 24 March 2022).

Developing resilient construction professionals in the COVID-19 era

AlDabbagh, Z.S. (2020). The role of decisionmaker in crisis management: A qualitative study using grounded theory (COVID19 pandemic crisis as a model). Journal of Public Affairs, 20(4), e2186.
Allu-Kangkum, E.L. (2021). Covid-19 and sustainable architectural education: Challenges and perceptions on online learning. Journal of Educational Research, 6(2), 7–13.
APA (American Psychological Association). Dictionary of psychology [Online]. Available at https://dictionary.apa.org/ (Accessed 17 July 2020).
Bland, A.M. (2010). The Enneagram: A review of the empirical and transformational literature. The Journal of Humanistic Counseling, Education and Development, 49(1), 16–31.
Chih, Y.Y. , Hsiao, C.Y.L. , Zolghadr, A. , & Naderpajouh, N. (2022). Resilience of organizations in the construction industry in the face of COVID-19 disturbances: Dynamic capabilities perspective. Journal of Management in Engineering, 38(2), 04022002.
Cronbach, L.J. , & Shavelson, R.J. (2004). My current thoughts on coefficient alpha and successor procedures. Educational and Psychological Measurement, 64(3), 391–418.
Dahiru, T. (2008). P-value, a true test of statistical significance? A cautionary note. Annals of Ibadan Postgraduate Medicine, 6(1), 21–26.
Daniel, S.J. (2020). Education and the COVID-19 pandemic. Prospects, 49(1), 91–96.
Daniels, D.N. , & Price, V.A. (2004). Enneagram Kendini Bilme Sanatı. Turkey: Kaknüs Yayınları.
Dumitru, V.M. , & Cozman, D. (2012). The relationship between stress and personality factors. Human and Veterinary Medicine, 4(1), 34–39.
The Enneagram Institute . [Online]. Available at www.enneagraminstitute.com/ (Accessed 27 April 2020).
Gamil, Y. , & Alhagar, A. (2020). The impact of pandemic crisis on the survival of construction industry: A case of COVID-19. Mediterranean Journal of Social Sciences, 11(4), 122–122.
Groen, C. , Simmons, D.R. , & Turner, M. (2019). Developing resilience: Experiencing and managing stress in a US undergraduate construction program. Journal of Professional Issues in Engineering Education and Practice, 145(2), 04019002.
Holdsworth, S. , Turner, M. , & Scott-Young, C.M. (2019). Developing the resilient learner: A resilience framework for universities. In Transformations in tertiary education (pp. 27–42). Singapore: Springer.
Knight, C. (2007). A resilience framework: Perspectives for educators. Health Education, 107(6), 543–555.
Manz, C.C. , & Sims Jr, H.P. (1980). Self-management as a substitute for leadership: A social learning theory perspective. Academy of Management Review, 5(3), 361–367.
McKight, P.E. , & Najab, J. (2010). Kruskalwallis test. In The corsini encyclopedia of psychology (pp. 1–1). Wiley Online Library. Available at https://onlinelibrary.wiley.com/(Accessed 20 July 2020).
Milovanović, A. , Kostić, M. , Zorić, A. , Đorđević, A. , Pešić, M. , Bugarski, J. , Todorović, D. , Sokolović, N. , & Josifovski, A. (2020). Transferring COVID-19 challenges into learning potentials: Online workshops in architectural education. Sustainability, 12(17), 7024.

Ogunnusi, M. , Hamma-Adama, M. , Salman, H. , & Kouider, T. (2020). COVID-19 pandemic: The effects and prospects in the construction industry. International Journal of Real Estate Studies, 14(Special Issue 2).
Oraz, G. , Günaydın, H.M. , Giritli, H. , & Tezel, E. (2016). Proje Yönetimi Performansı ve Kişilik Etkileşimleri. 4th International Project and Construction Management Conference, Eskişehir, Turkey (in Turkish).
Palmer, H. (2010). Ruhun Aynası Ennegram'a Yansıyan İnsan Manzaraları. İstanbul, Turkey: Kaknüs Yayınları (in Turkish).
Ramazani, J. , & Jergeas, G. (2015). Project managers and the journey from good to great: The benefits of investment in project management training and education. International Journal of Project Management, 33(1), 41–52.
Riso, D.R. , & Hudson, R. (1999). The wisdom of the Enneagram: The complete guide to psychological and spiritual growth for the nine personality types (Vol. 20). New York: Bantam Books.
Riso, D.R. , & Hudson, R. (2008). Enneagram ile Kişilik Analizi. Turkey: Butik Yayınevi (in Turkish).
Salama, A.M. , & Crosbie, M.J. (2020). Educating architects in a post-pandemic world. Common\Edge [Online]. Available at https://commonedge.org/educating-architects-in-apost-pandemic-world/ (Accessed 9 October 2020).
Sekaran, U. , & Bougie, R. (2016). Research methods for business: A skill building approach. New York: John Wiley & Sons.
Sirotiak, T. , & Sharma, A. (2019). Problem-based learning for adaptability and management skills. Journal of Professional Issues in Engineering Education and Practice, 145(4), 04019008.
Sutton, A. , Allinson, C. , & Williams, H. (2013). Personality type and work-related outcomes: An exploratory application of the Enneagram model. European Management Journal, 31(3), 234–249.
Turner, M. , Scott-Young, C.M. , & Holdsworth, S. (2016). Bouncing back to move forward: Resilience of students in the built environment. Association of Researchers in Construction Management, 1, 589–598.
Turner, M. , Scott-Young, C. , & Holdsworth, S. (2019). Developing the resilient project professional: Examining the student experience. International Journal of Managing Projects in Business, 12(3), 716–729.
Turner, M. , & Simmons, D.R. (2020). Taking a partnered approach to managing academic stress: An undergraduate study. International Journal of Construction Education and Research, 16(4), 251–269.
Varma, A. , & Jafri, M.S. (2020). COVID-19 responsive teaching of undergraduate architecture programs in India: Learnings for post-pandemic education. Archnet-IJAR: International Journal of Architectural Research, 15(1), 189–202.
Vollrath, M. (2001). Personality and stress. Scandinavian Journal of Psychology, 42(4), 335–347.
Williams, K.C. , Petrosky, A.R. , & Hernandez, E.H. (2008). The Enneagram and its possibilities for student learning. Journal of Business and Change Management, 3, 63–93.
World Health Organization. (2020). Director-General's opening remarks at the mission briefing on COVID-19. Geneva, Switzerland: Tedros Adhanom Ghebreyesus.

Safety, health and wellbeing of construction workers in Nigeria – opportunities and challenges associated with the COVID-19 pandemic

Abubakar, M. , Zailani, B.M. , Abdullahi, M. , & Auwal, A.M. (2021). Potential of adopting a resilient safety culture toward improving the safety performance of construction organizations in Nigeria. Journal of Engineering, Design and Technology, 20(5), 1236–1256.
Adeyemo, O. , & Smallwood, J. (2017). Impact of occupational health and safety legislation on performance improvement in the Nigerian construction industry. Procedia Engineering, 196, 785–791.
Agyekum, K. , Kukah, A.S. , & Amudjie, J. (2021). The impact of COVID-19 on the construction industry in Ghana: The case of some selected firms. Journal of Engineering, Design and

Technology, 20(1), 222–244.
Akinade, O.O. (2017). BIM-based software for construction waste analytics using artificial intelligence hybrid models. Doctoral dissertation, University of the West of England.
Akinlolu, M. , Haupt, T.C. , Edwards, D.J. , & Simpeh, F. (2020). A bibliometric review of the status and emerging research trends in construction safety management technologies. International Journal of Construction Management, 1–13.
Alsharef, A. , Banerjee, S. , Uddin, S.J. , Albert, A. , & Jaselskis, E. (2021). Early impacts of the COVID-19 pandemic on the United States construction industry. International Journal of Environmental Research and Public Health, 18(4), 1559.
Arayici, Y. , & Aouad, G. (2010). Building information modelling (BIM) for construction lifecycle management. In Construction and building: Design, materials, and techniques, 2010 (pp. 99–118). Hauppauge, New York, USA: Nova Science Publishers.
Awolusi, I. , Marks, E. , & Hallowell, M. (2018). Wearable technology for personalized construction safety monitoring and trending: Review of applicable devices. Automation in Construction, 85, 96–106.
Baldwin, R. , & Tomiura, E. (2020). Thinking ahead about the trade impact of COVID-19. Economics in the Time of COVID-19, 59, 59–71.
Bartlett, K. , Blanco, J.L. , Johnson, J. , Fitzgerald, B. , Mullin, M. , & Ribeirinho, M.J. (2020). Rise of the platform era: The next chapter in construction technology. Available at www.mckinsey.com/industries/private-equity-and-principal-investors/ourinsights/rise-of-the-platform-era-the-next-chapter-in-construction-technology (Accessed 14 March 2022).
Bevan, S. , & Cooper, C.L. (2021). Workplace health interventions to improve productivity. In The healthy workforce. Bingley, United Kingdom: Emerald Publishing Limited.
Bowen, P. , Edwards, P. , Lingard, H. , & Cattell, K. (2014). Occupational stress and job demand, control and support factors among construction project consultants. International Journal of Project Management, 32(7), 1273–1284.
Choi, M. , Ahn, S. , & Seo, J. (2020). VR-Based investigation of forklift operator situation awareness for preventing collision accidents. Accident Analysis & Prevention, 136, 105404.
Dallasega, P. , Rauch, E. , & Linder, C. (2018). Industry 4.0 as an enabler of proximity for construction supply chains: A systematic literature review. Computers in Industry, 99, 205–225.
Ebekozien, A. , & Aigbavboa, C. (2021). COVID-19 recovery for the Nigerian construction sites: The role of the fourth industrial revolution technologies. Sustainable Cities and Society, 69, 102803.
El Jazzar, M. , Schranz, C. , Urban, H. , & Nassereddine, H. (2021). Integrating construction 4.0 technologies: A four-layer implementation plan.
Fernandes, N. (2020). Economic effects of coronavirus outbreak (COVID-19) on the world economy. IESE Business School Working Paper No. WP-1240-E. Available at SSRN: https://ssrn.com/abstract=3557504 or http://dx.doi.org/10.2139/ssrn.3557504.
Fernandez Galarreta , J., Kerle, N., & Gerke, M. (2015). UAV-based urban structural damage assessment using object-based image analysis and semantic reasoning. Natural Hazards and Earth System Sciences, 15(6), 1087–1101.
Fleming, K.L. , Hashash, Y.M. , McLandrich, S. , O'Riordan, N. , & Riemer, M. (2016). Novel technologies for deep-excavation digital construction records. Practice Periodical on Structural Design and Construction, 21(4), 05016002.
Frimpong, S., Antwi, A.B. , Sunindijo, R.Y. , Wang, C.C. , Ampratwum, G. , Dansoh, A. , Boateng, E.S. , Hagan, J.A. , & Mensah, P.A. (2022). Health status of young construction workers in the Global South: The case of Ghana. Safety Science, 148, 105673.
Gamil, Y. , & Alhagar, A. (2020). The impact of pandemic crisis on the survival of construction industry: A case of COVID-19. Mediterranean Journal of Social Sciences, 11(4), 122–122.
ILO . (1992). Safety and health in construction. An ILO Code of Practice. Available at www.ilo.org/global/topics/safety-and-health-at-work/normative-instruments/code-of-practice/WCMS_107826/lang-en/index.htm (Accessed 2 March 2022).
ILO . (2015). Good practices and challenges in promoting decent work in construction and infrastructure projects. Issues paper for discussion at the Global Dialogue Forum on Good Practices and Challenges in Promoting Decent Work in Construction and Infrastructure Projects. Available at www.ilo.org/sector/Resources/publications/WCMS_416378/lang-en/index.htm (Accessed 2 March 2022).

ILO . (2018). Improving the safety and health of young workers. Available at Improving the Safety and Health of Young Workers (ilo.org) (Accessed 1 March 2022).
King, S.S. , Rahman, R.A. , Fauzi, M.A. , & Haron, A.T. (2021). Critical analysis of pandemic impact on AEC organizations: The COVID-19 case. Journal of Engineering, Design and Technology, 20(1), 383–388.
Koh, D. (2020). Occupational risks for COVID-19 infection. Occupational Medicine, 70(1), 3–5.
Kola, L. , Kohrt, B.A. , Hanlon, C. , Naslund, J.A. , Sikander, S. , Balaji, M. , Benjet, C. , Cheung, E.Y.L. , Eaton, J. , Gonsalves, P. , & Hailemariam, M. (2021). COVID-19 mental health impact and responses in low-income and middle-income countries: Reimagining global mental health. The Lancet Psychiatry, 8(6), 535–550.
Malomane, R. , Musonda, I. , & Okoro, C.S. (2022). The opportunities and challenges associated with the implementation of fourth industrial revolution technologies to manage health and safety. International Journal of Environmental Research and Public Health, 19(2), 846.
McGraw, H. (2014). The business value of BIM for construction in major global markets: How contractors around the world are driving innovation with building information modeling. SmartMarket Reports. Available at www.construction.com/toolkit/reports/bim-business-value-construction-global-markets (Accessed 3 January 2015).
Moda, H.M. , Ofodile, N. , Zailani, B.M. , Abubakar, M.A. , & Ibrahim, Y.M. (2022). Management support as a critical success factor (CSF) for changing worker's safety attitude: A case of the Nigerian construction industry. International Journal of Construction Management, 1–7.
Nath, N.D. , Behzadan, A.H. , & Paal, S.G. (2020). Deep learning for site safety: Real-time detection of personal protective equipment. Automation in Construction, 112, 103085.
National Bureau of Statistics (NBS) . (2021). Annual abstract on statistics, summary of survey findings, 87–94.
Ogunnusi, M. , Omotayo, T. , Hamma-Adama, M. , Awuzie, B.O. , & Egbelakin, T. (2021). Lessons learned from the impact of COVID-19 on the global construction industry. Journal of Engineering, Design and Technology, 20(1), 299–320.
Omar, T. , & Nehdi, M.L. (2016). Data acquisition technologies for construction progress tracking. Automation in Construction, 70, 143–155.
Osei-Asibey, D. , Ayarkwa, J. , Acheampong, A. , Adinyira, E. , & Amoah, P. (2021). Framework for improving construction health and safety on Ghanaian construction sites. Journal of Building Construction and Planning Research, 9(2), 115–137.
Osuizugbo, I.C. (2021). Disruptions and responses within Nigeria construction industry amid COVID-19 threat. Covenant Journal of Research in the Built Environment, 8(2).
Osunsanmi, T.O. , Aigbavboa, C. , & Oke, A. (2018). Construction 4.0: The future of the construction industry in South Africa. International Journal of Civil and Environmental Engineering, 12(3), 206–212.
Pollock, A. , Campbell, P. , Cheyne, J. , Cowie, J. , Davis, B. , McCallum, J. , McGill, K. , Elders, A. , Hagen, S. , McClurg, D. , & Torrens, C. (2020). Interventions to support the resilience and mental health of frontline health and social care professionals during and after a disease outbreak, epidemic or pandemic: A mixed methods systematic review. Cochrane Database of Systematic Reviews, (11).
Rastogi, S. (2017). Construction 4.0: The 4th generation revolution. Indian Lean Construction Conference, ILCC.
Simpeh, F. , Bamfo-Agyei, E. , and Amoah, C. (2021). Barriers to the implementation of COVID-19 safety regulations: Insight from Ghanaian construction sites. Journal of Engineering, Design and Technology, 20(1), 47–65.
Stiles, S. , Golightly, D. , & Ryan, B. (2021). Impact of COVID19 on health and safety in the construction sector. Human Factors and Ergonomics in Manufacturing & Service Industries, 31(4), 425–437.
Taher, G. (2021). Industrial revolution 4.0 in the construction industry: Challenges and opportunities. Management Studies and Economic Systems, 6(3/4), 109–127.
Umeokafor, N. , Isaac, D. , Jones, K. , & Umeadi, B. (2014). Enforcement of occupational safety and health regulations in Nigeria: An exploration. European Scientific Journal, 3, 93–104.
United Nations . (2015). The 17 goals | sustainable development. Available at https://sdgs.un.org/goals (Accessed 30 May 2022).
Wang, X. , Truijens, M. , Hou, L. , Wang, Y. , & Zhou, Y. (2014). Integrating augmented reality with building information modeling: Onsite construction process controlling for liquefied natural

gas industry. Automation in Construction, 40, 96–105.
Yang, Y. , Chan, A.P. , Shan, M. , Gao, R. , Bao, F. , Lyu, S. , Zhang, Q. , & Guan, J. (2021). Opportunities and challenges for construction health and safety technologies under the COVID-19 pandemic in Chinese construction projects. International Journal of Environmental Research and Public Health, 18(24), 13038.
Yusuf, S.O. , Adindu, C.C. , Badmus, A. , & Muhammed, H. (2021, March). Curbing the effect of Covid-19 pandemic in the Nigeria construction industry through digitalization of operations and processes. Proceedings of the 5th CU Construction Conference 2021, School of Energy, Construction and Environment, Coventry University, UK.

Construction site management during COVID-19 in Myanmar

Abinraj, R.S. (2020). India: Impact of Covid-19 on construction and engineering sector. [Online]. ResearchGate. Available at www.researchgate.net/publication/340966338_ INDIA_IMPACT_OF_COVID-19_ON_CONSTRUCTION_AND_ENGINEERING_SECTOR.
Alenezi, T.A.N. (2020). COVID-19 causes of delays on construction projects in Kuwait. IJERGS, 8(1), 6–9.
Alsharef, A. , Banerjee, S. , Uddin, S. , Albert, A. , & Jaselskis, E. (2021). Early impacts of the COVID-19 pandemic on the United States construction industry. International Journal of Environmental Research and Public Health, 18(4), 1559.
Emmett, T. (2020). COVID-19 and the impact on Australian construction projects [Online]. Available at www.turnerandtownsend.com/en/perspectives/COVID-19-and-the-impact-on-australian-construction-projects/.
Fulcher, J. , & Abrams, M. (2020). Protecting workers from heat stress and COVID-19 [Online]. Public Citizen. Available at www.citizen.org/article/protecting-workers-from-heat-stress-and-COVID-19-recommendations-for-employers/.
JLL Research . (2020). COVID-19 construction industry impacts [Online]. Available at www.us.jll.com/en/coronavirus-resources/construction-industry-impacts-and- considerations (Accessed 31 May 2022).
Kerr, K. (2020, July 21). Alberta’s construction industry: Physical distancing on the girder? The Globe and Mail [Online]. Available at www.theglobeandmail.com/business/industry-news/property-report/article-albertas-construction-industry-physical-distancing-on-the-girder/ (Accessed 31 May 2022).
Ministry of Construction . (2020). Minister’s office/news [Online]. Available at https://construction.gov.mm/news-show/f87c94b0-d396-11ec-a8be-e9291a621227.
Ministry of Health and Sports . (2020). COVID-19 (coronavirus disease 2019) acute respiratory disease [Online]. Available at https://mohs.gov.mm/Main/content/publication/2019-ncov.
Nandan, A. (2020). COVID-19: Building again Brick by Brick [Online]. Available at www.savills.co.th. https://en.savills.co.th/research_articles/166413/181475-0 (Accessed 31 May 2022).
O'Sullivan, T. (2020). Avoiding heat illness risks due to facial coverings [Online]. LHSFNA. Available at www.lhsfna.org/avoiding-heat-illness-risks-due-to-facial-coverings/#:~:text=Using%20face%20coverings%20makes%20it (Accessed 31 May 2022).
Tekin, H. (2022). The impact of COVID-19 on construction labor productivity: The case of Turkey. Engineering, Construction and Architectural Management, (ahead-of-print).
Yin, R.K. (2018). Case study research and applications: Design and methods (6th ed.). Thousand Oaks, CA: Sage Publications, Inc.

Intricacies and lifeline for the construction industry amidst the coronavirus pandemic

Adekunle, S.A. , Ejohwomu, O. , & Aigbavboa, C.O. (2021a). Building information modelling diffusion research in developing countries: A user meta-model approach. Buildings, 11(7), 264. doi: 10.3390/buildings11070264.

Adekunle, S.A. , Aigbavboa, C.O. , Ejohwomu, O. , Adekunle, E.A. , & Thwala, W.D. (2021b). Digital transformation in the construction industry: A bibliometric review. Journal of Engineering, Design and Technology, (2013). doi: 10.1108/JEDT-08-2021-0442.

Aghimien, D. , Aigbavboa, C.O. , Oke, A.E. , Edwards, D. , & Roberts, C.J. (2021). Dynamic capabilities for digitalisation in the AECO sector-a scientometric review. Engineering, Construction and Architectural Management. doi: 10.1108/ECAM-12-2020-1012.

Andam, K. , Edeh, H. , Oboh, V. , Pauw, K. , & Thurlow, J. (2020). Estimating the economic costs of COVID-19 in Nigeria (No. 63; Strategy Support Program).

Aslam, F. , Mohmand, Y. T. , Ferreira, P. , Memon, B. A. , Khan, M. , & Khan, M. (2020). Network analysis of global stock markets at the beginning of the coronavirus disease (Covid-19) outbreak. Borsa Istanbul Review, 141926. doi: 10.1016/j.scitotenv.2020.141926.

Ataguba Ochega, A. , & Ataguba, J.E. (2020). Social determinants of health: The role of effective communication in the COVID-19 pandemic in developing countries. Global Health Action, 13(1), 1788263. doi: 10.1080/16549716.2020.1788263.

Bartik, A.W. , Bertrand, M. , Cullen, Z.B. , Glaeser, E.L. , Luca, M. , & Stanton, C.T. (2020). How are small businesses adjusting to COVID-19? Early evidence from a survey. Available at www.nber.org/papers/w26989 (Accessed 11 September 2020).

Benítez, M.A. , Velasco, C. , Sequeira, A.R. , Henríquez, J. , Menezes, F.M. , & Paolucci, F. (2020). Responses to COVID-19 in five Latin American countries. Health Policy and Technology, (xxxx), 449. doi: 10.1016/j.hlpt.2020.08.014.

CIOB . (2020). 60% of businesses struggle to obtain face masks: Construction manager. Available at www.constructionmanagermagazine.com/60-of-businesses-struggle-to-obtain-face-masks/ (Accessed 21 September 2020).

Constructionline . (2020). The impact of COVID-19 across the construction industry [Info-graphic]: Constructionline. Available at www.constructionline.co.uk/insights/news/covid-19-infographic/ (Accessed 25 September 2020).

Eck, N.J. Van , & Waltman, L. (2007). Bibliometric mapping of the computational intelligence field nees. International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems, 15(5), 625–645.

Huang, A. , Makridis, C. , Baker, M. , Medeiros, M. , & Guo, Z. (2020a). Understanding the impact of COVID-19 intervention policies on the hospitality labor market. International Journal of Hospitality Management, 91(July). doi: 10.1016/j.ijhm.2020.102660.

Huang, C. , Wang, Y. , Li, X. , Ren, L. , Zhao, J. , Hu, Y. , Zhang, L. , Fan, G. , Xu, J. , Gu, X. , Cheng, Z. , Yu, T. , Xia, J. , Wei, Y. , Wu, W. , Xie, X. , Yin, W. , Li, H. , Liu, M. ,… Cao, B. (2020b). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. www.thelancet.com , 395, 497. doi: 10.1016/S0140-6736(20)30183-5.

Inaba, M. , & Kakai, H. (2019). Grounded text mining approach: A synergy between grounded theory and text mining approaches. In A. Bryant & K. Charmaz (eds.), The SAGE handbook of current developments in grounded theory. Thousand Oaks, CA: SAGE Publications Ltd. doi: 10.4135/9781526485656.

Jan van Eck, N. , and Waltman, L. (2006, April). VOS: A new method for visualizing similarities between objects. Erim Report Series Research in Management, 11. Available at www.erim.eur.nl.

Lai, C.-C. , Shih, T.-P. , Ko, W.-C. , Tang, H.-J. , & Hsueh, P.-R. (2020). Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease-2019 (COVID-19): The epidemic and the challenges. International Journal of Antimicrobial Agents, 55, 105924. doi: 10.1016/j.ijantimicag.2020.105924.

Laing, T. (2020). The economic impact of the coronavirus 2019 (Covid-2019): Implications for the mining industry. The Extractive Industries and Society, 7(2), 580–582. doi: 10.1016/j.exis.2020.04.003.

Maria Del Rio-Chanona, R. , Mealy, P. , Pichler, A. , Lafond, F. , & Doyne Farmer, J. (2020). Supply and demand shocks in the COVID-19 pandemic: An industry and occupation perspective. Oxford Review of Economic Policy. Available at

www.insee.fr/en/statistiques/4473305?sommaire=4473307 (Accessed 11 September 2020).
Mora Cortez, R. , & Johnston, W.J. (2020). The coronavirus crisis in B2B settings: Crisis uniqueness and managerial implications based on social exchange theory. Industrial Marketing Management, 88(April), 125–135. doi: 10.1016/j.indmarman.2020.05.004.
National Bureau of Statistics . (2020). Nigerian gross domestic product report Q2 2020, national bureau of statistics quarterly report, 2016. Available at www.nigerianstat.gov.ng/nanapages/download/329.
Newman, C. , Edwards, D. , Martek, I. , Lai, J. , Thwala, W.D. , & Rillie, I. (2020). Industry 4.0 deployment in the construction industry: A bibliometric literature review and UK-based case study. Smart and Sustainable Built Environment, (June). doi: 10.1108/SASBE-02-2020-0016.
Nwannekanma, B. (2021). Construction sector slumps amid shrinking funds. The Guardian Nigeria News – Nigeria and World News – Property – The Guardian Nigeria News – Nigeria and World News, Guardian Property. Available at https://guardian.ng/property/construction-sector-slumps-amid-shrinking-funds/ (Accessed 10 August 2021).
OECD . (2020). Evaluating the initial impact of COVID-19 containment measures on economic activity Introduction and key messages. Tackling Coronavirus Contributing to a Global Effort.
Office for National Statistics . (2020). Coronavirus and homeworking in the UK labour market: 2019. In ONS (Issue April). Available at https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/articles/coronavirusandhomeworkingintheuklabourmarket/2019
Ogwueleka, A.C. , & Ikediashi, D.I. (2017). The future of BIM technologies in Africa: Prospects and challenges. In Integrated building information modelling (pp. 307–314). UAE: Bentham Science Publisher. doi: 10.2174/9781681084572117010016.
Schindler, S. , Jepson, N. , & Cui, W. (2020). Covid-19, China and the future of global development. Research in Globalization, 2, 100020. doi: 10.1016/j.resglo.2020.100020.
Sharma, H.B. , Vanapalli, K.R. , Cheela, V.S. , Ranjan, V.P. , Jaglan, A.K. , Dubey, B. , Goel, S. , & Bhattacharya, J. (2020). Challenges, opportunities, and innovations for effective solid waste management during and post COVID-19 pandemic. Resources, Conservation and Recycling, 162(July). doi: 10.1016/j.resconrec.2020.105052.
Sherif, M. (2020). The impact of Coronavirus (COVID-19) outbreak on faith-based investments: An original analysis. Journal of Behavioral and Experimental Finance, 126175. doi: 10.1016/j.knosys.2020.105893.
Siemens . (2017). African digitalization maturity report. Available at www.siemens.co.za/pool/about_us/Digitalization_Maturity_Report_2017.pdf (Accessed 5 June 2019).
Squire Patton Boggs . (2020). Termination notice requirements/obligations.
StatsSA . (2020). GDP falls by 2,0% | Statistics South Africa. Available at www.statssa.gov.za/?p=13401 (Accessed 25 September 2020).
StatsSA . (2020). Business impact survey of the COVID-19 pandemic in South Africa. Pretoria. Available at www.statssa.gov.za,info@statssa.gov.za,Tel+27123108911 (Accessed 10 August 2021).
Uğur, N.G. , and Akbiyik, A. (2020). Impacts of COVID-19 on global tourism industry: A cross-regional comparison. Tourism Management Perspectives, 36(April), 100744. doi: 10.1016/j.tmp.2020.100744.
Vanapalli, K.R. , Sharma, H.B. , Ranjan, V.P. , Samal, B. , Bhattacharya, J. , Dubey, B.K. , & Goel, S. (2020). Challenges and strategies for effective plastic waste management during and post COVID-19 pandemic. Science of the Total Environment, 750. doi: 10.1016/j.scitotenv.2020.141514.
van Eck, N.J. , & Waltman, L. (2019). Manual for VOS viewer version 1.6.10. Univeristeit Leiden. The Netherlands. Available at www.vosviewer.com/documentation/Manual_VOSviewer_1.6.1.pdf.
Verma, S. , & Gustafsson, A. (2020). Investigating the emerging COVID-19 research trends in the field of business and management: A bibliometric analysis approach. Journal of Business Research, 118(June), 253–261. doi: 10.1016/j.jbusres.2020.06.057.
Wang, J. , Pan, L. , Tang, S. , Ji, J. S. , & Shi, X. (2020). Mask use during COVID-19: A risk adjusted strategy. Environmental Pollution. Elsevier Ltd, 115099. doi: 10.1016/j.envpol.2020.115099.

WHO . (2020a). Coronavirus disease (COVID-19).
WHO . (2020b). COVID-19 and violence against women what the health sector/system can do. Available at www.womensaid.org.uk/the-impact-of-covid-19-on-women-and-children-experiencing-domestic-abuse-and-the- (Accessed 11 September 2020).
The World Bank . (2020). Nigeria development update: Rebuilding after COVID-19. Available at www.worldbank.org/en/country/nigeria/publication/nigeria-development-update-rebuilding-after-covid19 (Accessed 10 August 2021).
Yin, S. , Zhang, N. , & Dong, H. (2020). Preventing COVID-19 from the perspective of industrial information integration: Evaluation and continuous improvement of information networks for sustainable epidemic prevention. Journal of Industrial Information Integration, 19(June). doi: 10.1016/j.jii.2020.100157.
Zhou, Y. , Zhang, Z. , Wang, B. , Ren, G. , Qi, H. , & Wang, X. (2020). Construction time, cost and testing data of a prefabricated isolation medical unit for COVID-19. Data in Brief, 32. doi: 10.1016/j.dib.2020.106068.

Assessment of COVID-19 control and prevention measures

Albert, A. , (2020). Does the potential safety risk affect whether particular construction hazards are recognised or not? Journal of Safety Research, 75, 241–250.
Alsharef, A. , (2021). Early impacts of the COVID-19 pandemic on the United States construction industry. International Journal of Environmental Research and Public Health, 18, 1559.
Araya, F. (2021). Modeling the spread of COVID-19 on construction workers: An agent-based approach. Safety Science, 133, 105022.
Assaad, R. , & El-Adaway, I. (2021). Guidelines for responding to COVID-19 pandemic: Best practices, impacts, and future research directions. Journal of Management in Engineering, 37(3), 06021001.
Brazil Federal Ministry of Economics . (2020, March 27). Official letter SEI nº 1088/2020/ME. Brasília, DF: Ministério da economia. Available at www.sindusconpa.org.br/arquivos/File/1088-2020-ME.pdf (Accessed 3 July 2021).
Brazil Federal Ministry of Economics . (2020, April 14). Official letter SEI nº 1247/2020/ME. Brasília, DF: Ministério da economia. Available at www.gov.br/trabalho/pt-br/inspecao/covid-19-1/covid_19_construcao_civil_orientacoes_gerais.pdf (Accessed 3 July 2021).
Brazil Federal Ministry of Economics . (2020, June 18). Joint ordinance Nº 20. Brasília, DF: Ministério da economia. Available at www.in.gov.br/en/web/dou/-/portaria-conjunta-n-20-de-18-de-junho-de-2020-262408085 (Accessed 3 July 2021).
Bruin, Y. , (2020). Initial impacts of global risk mitigation measures taken during the combatting of the COVID-19 pandemic. Safety Science, 128, 1047773.
Geocovid. Available at https://covid.mapbiomas.org/cases/ (Accessed October 8 2022).
Hox, J.J. , & Boeije, H.R. (2005). Data collection, primary vs. secondary. In K. Kempf-Leonard (ed.), Encyclopedia of social measurement (pp. 593–599). Atlanta, GA: Elsevier Science.
Los Angeles . (2020, April 15). Los Angeles building & safety announcement no. 5. Available at www.ladbs.org/docs/default-source/publications/misc-publications/construction-site-guidance.pdf?sfvrsn=8f6ef753_18 (Accessed 1 April 2020).
Moreno-Sueskun, I. , (2020). Reincorporacioń al trabajo en el contexto de la pandemia de COVID-19 en sectores de industria y construccioń en Navarra (España). Archivos de prevención de riesgos laborales, 23(4), 443–457.
Occupational Safety and Health (OSHA) . Guidance on preparing workplaces for COVID-19. Available at www.osha.gov/Publications/OSHA3990.pdf. (Accessed 3 December 2020).
San Francisco . San Francisco order of the health officer no. C19–07c. Available at https://sf.gov/sites/default/files/2020-04/2020.04.29%20FINAL%20%28signed%29%20Health%20Officer%20Order%20C19-07c-%20Shelter%20in%20Place.pdf (Accessed 15 December 2020).
Simpeh, F. , & Amoah, C. (2021). Assessment of measures instituted to curb the spread of COVID-19 on construction site. International Journal of Construction Management, 1–19. doi: 10.1080/15623599.2021.1874678.

Supreme Federal Court of Brazil . (2020). STF recognises concurrent competence of states, DF, municipalities and the Union in combating COVID-19. Available at www.stf.jus.br/portal/cms/verNoticiaDetalhe.asp?idConteudo=441447 (Accessed 3 March 2021).
Zheng, L. , Chen, K. , & Ma, L. (2021). Knowledge, attitudes, and practices toward COVID-19 among construction industry practitioners in China. Front. Public Health, 8, 599769. doi: 10.3389/fpubh.2020.599769.

COVID-19 and shock events in the AEC sector

Abdullahi, S. (2019, July). Adoption of building information modelling in small and medium-sized adoption of building information modelling in small and medium-sized enterprises in developing countries: A system dynamics approach.
Agyekum, K. , Kukah, A.S. , & Amudjie, J. (2022). The impact of COVID-19 on the construction industry in Ghana: The case of some selected firms. Journal of Engineering, Design and Technology, 20(1), 222-244.
Al-Mhdawi, M.K.S. , Brito, M.P. , Abdul Nabi, M. , El-Adaway, I.H. , & Onggo, B.S. (2022). Capturing the impact of COVID-19 on construction projects in developing countries: A case study of Iraq. Journal of Management in Engineering, 38(1).
Alsharef, A. , Banerjee, S. , Uddin, S.M.J. , Albert, A. , & Jaselskis, E. (2021). Early impacts of the COVID-19 pandemic on the United States construction industry. International Journal of Environmental Research and Public Health, 18(4), 1559. https://doi.org/10.3390/ijerph18041559.
Amoah, C. , & Simpeh, F. (2021). Implementation challenges of COVID-19 safety measures at construction sites in South Africa. Journal of Facilities Management, 19(1), 111-128. https://doi.org/10.1108/JFM-08-2020-0061.
Assaad, R. , & El-Adaway, I.H. (2021). Guidelines for responding to COVID-19 pandemic: Best practices, impacts, and future research directions. Journal of Management in Engineering, 37(3), 06021001.
Badamasi, A.A. , Aryal, K.R. , Makarfi, U.U. , & Dodo, M. (2021). Drivers and barriers of virtual reality adoption in UK AEC industry. Engineering, Construction and Architectural Management, ahead-of-print (ahead-of-print).
Blake, H. , Knight, H. , Jia, R. , Corner, J. , Morling, J.R. , Denning, C. , Ball, J.K. , Bolton, K. , Figueredo, G. , Morris, D.E. , Tighe, P. , Villalon, A.M. , Ayling, K. , & Vedhara, K. (2021). Students' views towards sars-Cov-2 mass asymptomatic testing, social distancing and self-isolation in a university setting during the COVID-19 pandemic: A qualitative study. International Journal of Environmental Research and Public Health, 18(8), 4182.
Bou Hatoum, M. , Faisal, A. , Nassereddine, H. , & Sarvari, H. (2021). Analysis of COVID-19 concerns raised by the construction workforce and development of mitigation practices. Frontiers in Built Environment, 66.
Bushman, D. , Sekaran, J. , Jeffery, N. , Rath, C. , Ackelsberg, J. , Weiss, D. , Wu, W. , Van Oss, K. , Johnston, K. , Huang, J. , Khatun, U. , Sheikh, T. , Sutcliff, J. , & Tsoi, B. (2021). Coronavirus disease 2019 (COVID-19) outbreaks at 2 construction sites: New York city, October-November 2020. Clinical Infectious Diseases, 73(Supplement_1), S81-S83. https://doi.org/10.1093/cid/ciab312.
Dahab, M. , van Zandvoort, K. , Flasche, S. , Warsame, A. , Ratnayake, R. , Favas, C. , Spiegel, P.B. , Waldman, R.J. , & Checchi, F. (2020). COVID-19 control in low-income settings and displaced populations: What can realistically be done? Conflict and Health, 14(1), 1-54. https://doi.org/10.1186/s13031-020-00296-8.
Dobrucali, E. , Sadikoglu, E. , Demirkesen, S. , Zhang, C. , & Tezel, A. (2022). Exploring the impact of COVID-19 on the United States construction industry: Challenges and opportunities. IEEE Transactions on Engineering Management, 1-13. https://doi.org/10.1109/TEM.2022.3155055.
Friston, K.J. , Parr, T. , Zeidman, P. , Razi, A. , Flandin, G. , Daunizeau, J. , Hulme, O.J. , Billig, A.J. , Litvak, V. , Price, C.J. , Moran, R.J. , & Lambert, C. (2020). Second waves, social distancing, and the spread of COVID-19 across America. Welcome Open Research, 5, 103.

https://doi.org/10.12688/wellcomeopenres.15986.1.
Gambo, N. , & Musonda, I. (2022). Influences of social media learning environments on the learning process among AEC university students during COVID-19 pandemic: Moderating role of psychological capital. Cogent Education, 9(1). https://doi.org/10.1080/2331186X.2021.2023306.
Gbadamosi, A. , Oyedele, L. , Olawale, O. , & Abioye, S. (2020). Offsite construction for emergencies: A focus on isolation space creation (ISC) measures for the COVID-19 pandemic. Progress in Disaster Science, 8, 100130. https://doi.org/10.1016/j.pdisas.2020.100130.
Gill, N. , Musonda, I. , & Stafford, A. (2019). Duality by design: The global race to build Africa's infrastructure. Cambridge: Cambridge University Press.
Khan, M.N. , Ashraf, M.A. , Seinen, D. , Khan, K.U. , & Laar, R.A. (2021). Social media for knowledge acquisition and dissemination: The impact of the COVID-19 pandemic on collaborative learning driven social media adoption. Frontiers in Psychology, 12.
Kukoyi, P.O. , Simpeh, F. , Adebowale, O.J. , & Agumba, J.N. (2022). Managing the risk and challenges of COVID-19 on construction sites in Lagos, Nigeria. Journal of Engineering, Design and Technology, 20(1), 99-144. https://doi.org/10.1108/JEDT-01-2021-0058.
Kuldosheva, G. (2021). Challenges and opportunities of digital transformation in the public sector in transition economies: Examination of the case of Uzbekistan. In Adbi (Issue 1248).
Lidia Pinti, R.C. , & Bonelli, S. (2022). A review of building information modelling (BIM) for facility management (FM): Implementation in public organisations. Applied Sciences, 12(3), 1540. https://doi.org/10.3390/app12031540.
Maharaj, R. , Musonda, I. , Onososen, A. (2023). Construction Organisation's Planning and Implementation: The Case Between Conceptualization and Implementation Teams. In Haupt, T.C. , Akinlolu, M. , Simpeh, F. , Amoah, C. , Armoed, Z. (Eds.), Construction in 5D: Deconstruction, Digitalization, Disruption, Disaster, Development. Lecture Notes in Civil Engineering, vol 245. Springer, Cham. https://doi.org/10.1007/978-3-030-97748-1_22.
Makhathini, N. , Musonda, I. , & Onososen, A. (2023). Utilisation of remote monitoring systems in construction project management. In Z. Haupt , T.C. Akinlolu , M. Simpeh , R Amoah , & C. Armoed (Eds.), Construction in 5D: Deconstruction, digitalization, disruption, disaster, development. Springer. doi: 10.1007/978-3-030-97748-1_8.
Marco-Franco, J.E. , Pita-Barros, P. , Vivas-Orts, D. , González-de-Julián, S. , & Vivas-Consuelo, D. (2021). COVID-19, fake news, and vaccines: Should regulation be implemented? International Journal of Environmental Research and Public Health, 18(2), 744. https://doi.org/10.3390/ijerph18020744.
Ogunnusi, M. , Omotayo, T. , Hamma-Adama, M. , Awuzie, B.O. , & Egbelakin, T. (2022). Lessons learned from the impact of COVID-19 on the global construction industry. Journal of Engineering, Design and Technology, 20(1), 299-320. https://doi.org/10.1108/JEDT-05-2021-0286.
Olatunde, N.A. , Awodele, I.A. , & Adebayo, B.O. (2021). Impact of COVID-19 pandemic on indigenous contractors in a developing economy. Journal of Engineering, Design and Technology, 20(1), 267-280.
Onososen, A. , & Musonda, I. (2022). Barriers to BIM-based life cycle sustainability assessment for buildings: An interpretive structural modelling approach. Buildings, 12(3), 324. https://doi.org/10.3390/buildings12030324.
Onubi, H.O. , Hassan, A.S. , Yusof, N. , & Bahdad, A.A.S. (2022). Moderating effect of project size on the relationship between COVID-19 safety protocols and economic performance of construction projects. Engineering, Construction and Architectural Management, ahead-of-print (ahead-of-print).
Osman, I. , & Ataei, H. (2022). Studying construction claims due to COVID-19 for road and highway projects. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 14(1).
Pamidimukkala, A. , & Kermanshachi, S. (2021). Impact of Covid-19 on field and office workforce in construction industry. Project Leadership and Society, 2, 100018.
Ramírez-Montoya, M.S. , Loaiza-Aguirre, M.I. , Zúñiga-Ojeda, A. , & Portuguez-Castro, M. (2021). Characterization of the teaching profile within the framework of education 4.0. Future Internet, 13(4), 91.
Raoufi, M. , & Fayek, A.R. (2020). Identifying actions to control and mitigate the effects of the COVID-19 pandemic on construction organizations: Preliminary findings. Public Works Management & Policy, 26(1), 1087724X2096916.

Rokooei, S. , Alvanchi, A. , & Rahimi, M. (2022). Perception of COVID-19 impacts on the construction industry over time. Cogent Engineering, 9(1).
Roziqin, A. , Mas'udi, S.Y.F. , & Sihidi, I.T. (2021). An analysis of Indonesian government policies against COVID-19. Public Administration and Policy, 24(1), 92–107. https://doi.org/10.1108/PAP-08-2020-0039.
Sierra, F. (2022). COVID-19: Main challenges during construction stage. Engineering, Construction, and Architectural Management, 29(4), 1817–1834. https://doi.org/10.1108/ECAM-09-2020-0719.
Sy, M. , O'Leary, N. , Nagraj, S. , El-Awaisi, A. , O'Carroll, V. , & Xyrichis, A. (2020). Doing interprofessional research in the COVID-19 era: A discussion paper. Journal of Interprofessional Care, 34(5), 600–606.
Takashima, R. , Onishi, R. , Saeki, K. , & Hirano, M. (2020). Perception of COVID-19 restrictions on daily life among Japanese older adults: A qualitative focus group study. Health-care, 8(4), 450.
Wang, Z. , Liu, Z. , & Liu, J. (2020). Risk identification and responses of tunnel construction management during the COVID-19 pandemic. Advances in Civil Engineering. https://doi.org/10.1155/2020/6620539.
Yang, Y. , Chan, A.P. , Shan, M. , Gao, R. , Bao, F. , Lyu, S. ,… Guan, J. (2021). Opportunities and challenges for construction health and safety technologies under the COVID-19 pandemic in Chinese construction projects. International Journal of Environmental Research and Public Health, 18(24), 13038.
Zakar, R. , Yousaf, F. , Zakar, M.Z. , & Fischer, F. (2021). Socio-cultural challenges in the implementation of COVID-19 public health measures: Results from a qualitative study in Punjab, Pakistan. Frontiers in Public Health, 9.
Zamani, S.H. , Rahman, R.A. , Fauzi, M.A. , & Mohamed Yusof, L. (2022). Government pandemic response strategies for AEC enterprises: Lessons from COVID-19. Journal of Engineering, Design and Technology, Vol. ahead-of-print No. ahead-of-print. http://dx.doi.org/10.1108/JEDT-10-2021-0540.

Implication of COVID-19 SOP compliance to project-based construction workers in Malaysia

Abdussalam, S. , Dyaa, H. , & Nehal, S. (2020). The effects of pandemic on construction industry in the UK. Mediterranean Journal of Social Science, 11, 48–60.
Alenezi, N.A.T. (2020). The impact of COVID-19 on construction projects in Kuwait. International Journal of Engineering Research and General Science, 8(4), 6–9.
Alsharef, A. , Banerjee, S. , Uddin, S.M. , Albert, A. , & Jaselskis, E. (2021). Early impacts of the COVID-19 pandemic on the United States construction industry. International Journal of Environmental Research and Public Health, 18, 1559.
Assaad, R. , & El-Adaway, I.H. (2021). Guidelines for responding to COVID-19 pandemic: Best practices, impacts, and future research directions. Journal of Management in Engineering, 37(3).
Bodenstein, M. , Corsetti, G. , & Guerrieri, L. (2020). Social distancing and supply disruptions in a pandemic. Finance and Economics Discussion Series. doi: 10.17016/FEDS.2020.031.
Braun, V. , & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101. doi: 10.1191/1478088706qp063oa.
CIDB . (2022). NRP-permission to operate. Available at www.cidb.gov.my/en/mco-permission-operate.
Construction Industry Development Board . (2020a). Embracing construction revolution. CIDB Heights, 3, 8–12.
Construction Industry Development Board . (2020b). Leadership in the time of pandemic. CIDB Heights, 2, 9–17.
Department of Statistics Malaysia . (2020). Quarterly construction statistics: Second quarter 2020. Available at www.dosm.gov.my/v1/index.php?r=column/cthemeByCat&cat=77&bul_id=TWxzVlA3L2lkYksxOWpjS3d6c3hHQT09&menu_id=OEY5SWtFSVVFVUpmUXEyaHppMVhEdz09 (Accessed 15

June 2022).
Esa, M.B. , Ibrahim, F.S.B. , & Kamal, E.B.M. (2020). Covid-19 pandemic lockdown: The consequences towards project success in Malaysian construction industry. Advances in Science, Technology and Engineering Systems Journal, 5(5), 973–983.
Gamil, Y. , & Alhagar, A. (2020). The impact of pandemic crisis on the survival of construction industry: A case of COVID-19. Mediterranean Journal of Social Sciences, 11(4), 122–128. doi: 10.36941/mjss-2020–0047.
Gara, J.A. , Zakaria, R. , Aminudin, E. , Yahya, K. , Sam, A.R.M. , Loganathan, R. , Munikanan, V. , Yahya, M.A. , Wahi, N. , & Shamsuddin, S.M. (2022). Effects of the COVID-19 pandemic on construction work progress: An on-site analysis from the Sarawak Construction Project, Malaysia. Sustainability, 14, 6007.
Ghandour, A. (2020). The impact of COVID-19 on project delivery: A perspective from the construction sector in the United Arab Emirates. Humanities and Social Sciences Reviews, 8(5). doi: 10.18510/hssr.2020.8516.
International Labor Organization . (2021). Impact of COVID-19 on the construction sector. Available at www.ilo.org/sector/Resources/publications/WCMS_767303/lang-en/index.htm (Accessed 15 June 2022).
Jallow, H. , Renukappa, S. , & Suresh, S. (2020). The impact of Covid-19 outbreak on United Kingdom infrastructure sector. Smart and Sustainable Built Environment, 10(4). doi: 10.1108/SASBE-05–2020–0068.
Kim, S. , Chang, S. , & Castro-Lacouture, D. (2020). Dynamic modelling for analysing impacts of skilled labor shortage on construction project management. Journal of Management in Engineering, 36, 04019035. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000720.
Ling, F.Y.Y. , Zhang, Z. , & Yew, A.Y.R. (2022). Impact of COVID-19 pandemic on demand, output, and outcomes of construction projects in Singapore. J. Manag. Eng., 38(2), 04021097(1–12). https://doi.org/10.1061/(ASCE)ME.1943–5479.0001020.
Ministry of Health Malaysia . (2020). COVID-19: Social distancing guidelines for work-place, homes and individuals. Available at http://covid-19.moh.gov.my/garis-panduan/garis-panduan-kkm/Annex_26_COVID_guide_for_Social_Distancing_24032020.pdf(Accessed 15 March 2022).
Ogunnusi, M. , Omotayo, T. , Hamma-Adama, M. , Awuzie, B.O. , & Egbelakin, T. (2021). Lessons learned from the impact of COVID-19 on the global construction industry. Journal of Engineering, Design and Technology, 20(1), 299–320. https://doi.org/10.1108/JEDT-05-2021-0286.
Raoufi, M. , & Fayek, A.R. (2020). Identifying actions to control and mitigate the effects of the COVID-19 pandemic on construction organisations: Preliminary findings. Public Works Manage. Policy, 26(1), 1–9. https://doi.org/10.1177/1087724X20969164.
Simpeh, F. , & Amoah, C. (2021). Assessment of measures instituted to curb the spread of COVID-19 on construction site. International Journal of Construction Management, 1–9.
The Sun . (2020). COVID-19 pandemic leaves lasting scar on Malaysian construction sector. Available at www.thesundaily.my/business/covid-19-pandemic-leaves-lasting-scar-on-malaysian-construction-sector-FL5782315 (Accessed 15 June 2022).
Tan, C.K.L. , & Abdul-Samad, Z. (2022). A study of the impact of COVID-19 on construction workforce productivity in Malaysia. International Journal of Productivity and Performance Management. https://doi.org/10.1108/IJPPM-07-2021-0421.
Tan, S.Y. , & Zainon, N. (2022). Impact of COVID-19 pandemic on the quantity surveying practices in Malaysia. Engineering, Construction and Architectural Management. https://doi.org/10.1108/ECAM-11–2021–0988.
Wang, Z. , Liu, Z. , & Liu, J. (2020). Risk identification and responses of tunnel construction management during the COVID-19 pandemic. Advances in Civil Engineering. Article ID: 6620539. https://doi.org/10.1155/2020/6620539.
WHO (World Health Organization) . (2021). WHO coronavirus (COVID-19) dashboard. Available at https://covid19.who.int/ (Accessed 15 June 2022).
Zamani, S.H. , Rahman, R.A. , & Fauzi, M.A. , & Yusof, L.M. (2021). Effect of COVID-19 on building construction projects: Impact and response mechanisms. Proceedings of the 4th National Conference on Wind & Earthquake Engineering, Putrajaya, Malaysia, 16–17 October 2020; IOP Conference Series: Earth and Environmental Science Effect of COVID-19 on Building Construction Projects: Impact and Response Mechanisms (Vol. 682, pp. 012049).

Facing the impacts of COVID-19 in construction

Almohassen, A. , Alkhaldi, M. , & Essam, M. (2023). The effects of COVID-19 on safety practices in construction projects. Ain Shams Engineering Journal, 14(1), 101834. https://doi.org/10.1016/j.asej.2022.101834.

Alsharef, A. , Banerjee, S. , Uddin, S.M.J. , Albert, A. , & Jaselskis, E. (2021). Early impacts of the COVID-19 pandemic on the United States construction industry. Int. J. Environ. Res. Public Health, 18, 1559. https://doi.org/10.3390/ijerph18041559.

Assaad, R. , & El-Adaway, I.H. (2021). Guidelines for responding to COVID-19 pandemic: Best practices, impacts, and future research directions. Journal of Management in Engineering, 37, 06021001.

Bassoli, A. , & Probst, T. (2022). COVID-19 moral disengagement and prevention behaviors: The impact of perceived workplace COVID-19 safety climate and employee job insecurity. Safety Science, 150, 105703. https://doi.org/10.1016/j.ssci.2022.105703.

Caligiuri, P. , (2020). International HRM insights for navigating the COVID-19 pandemic: Implications for future research and practice. Journal of International Business Studies, 51, 697–713.

Cámara Chilena de la Construccioń (2020a). El sector construcción frente a la crisis sanitaria, septiembre, Temuco, Chile (The construction sector facing the health crisis, September, Temuco, Chile). Available at www.ccc.cl/wp-content/uploads/2021/03/Barometro_informe_Experiencia-internacional-del-sector-de-la-construcci%C3%B3n-frente-a-la-crisis-sanitaria.pdf.

Cámara Chilena de la Construccioń (2020b). Informe MACh 55 Macroeconomía y construcción, diciembre (MACh 55 macroeconomics and construction report, December), p. 13.

Centres for Disease Control and Prevention (CDC) . (2020). Construction COVID-19 checklists for employers and employees [Online]. Available at www.cdc.gov/coronavirus/2019-ncov/community/organizations/construction-worker-checklists.html.

Comisioń Nacional de Productividad . (2020). Efectos del COVID-19 en la actividad de las empresas en Chile (Effects of COVID-19 on the activity of companies in Chile). Santiago, Chile.

Direccioń de Presupuestos de Chile . (2022). COVID-19: evolución, efectos y políticas adoptadas en Chile y el mundo (COVID-19: Evolution, effects and policies adopted in Chile and the world). Available at www.dipres.gob.cl/598/articles-266625_doc_pdf.pdf.

El Mercurio . (2021). Construcción revela escasez de trabajadores por efecto de ayudas económicas por pandemia (Construction reveals shortage of workers due to economic aid due to pandemic), 12 March, section B.

Gobierno de Chile . (2020). Protocolo de manejo y prevención ante COVID-19 en sector construcción, Programa Paso a Paso, Chile (Management and prevention protocol against COVID-19 in the construction sector, Step by Step Program, Chile). Available at https://cdn.digital.gob.cl/public_files/Campa%C3%B1as/Corona-Virus/documentos/paso-a-paso/Protocolo-construccion.pdf.

ICR Chile . (2020). Industria inmobiliaria y construcción (Real estate and construction industry). Available at https://icrchile.cl/noticia/ante-la-actual-contingencia-sanitaria-pr2261/.

Instituto de la Construccioń . (2021). Costos en la construcción se triplican y presionan un alza de hasta un 15% en el precio de la vivienda para los próximos meses (Construction costs triple and push up to a 15% rise in housing prices for the coming months). Available at www.iconstruccion.cl/2021/08/19/costos-en-la-construccion-se-triplican-y-presionan-un-alza-de-hasta-un-15-en-el-precio-de-la-vivienda-para-los-proximos-meses/.

International Labor Organization ILO . (2021). The impact of COVID-19 in the construction sector, Informative sectorial note. Available at www.ilo.org/sector/Resources/publications/WCM_800244/lang--es/index.htm.

Ministerio de Economía, Fomento y Turismo . (2021). Boletín de análisis descriptivo del impacto de la pandemia sobre las empresas en Chile (Bulletin of descriptive analysis of the impact of the pandemic on companies in Chile). Santiago, Chile: Unidad de Estudios, Divisioń Política Comercial e Industrial.

MINVU . (2020). Ministerio de Vivienda y Urbanismo anticipa pagos (Ministry of Housing and Urbanism anticipates payments). Available at www.minvu.cl/noticia/noticias/minvu-anticipa-pagos-para-asegurar-continuidad-de-obras-sueldos-y-seguridad-de-trabajadores/.

Nnaji, C. , Jin, Z. , & Karakhan, A. (2022). Safety and health management response to COVID-19 in the construction industry: A perspective of fieldworkers. Process Safety and

Environmental Protection, 159, 477–488. https://doi.org/10.1016/j.psep.2022.01.002.
Ogunnusi, M. , Hamma-Adama, M. , Salman, H. , & Kouider, T. (2020). COVID-19 pandemic: The effects and prospects in the construction industry. International Journal of Real Estate Studies [online], 14 (Special Issue 2), 120–128. Available at www.utm.my/intrest/files/2020/11/2_Final_MS_CRES-Covid-025.pdf.
Pamidimukkala, A. , & Kermanshachi, S. (2021). Impact of COVID-19 on field and office workforce in construction industry. Project Leadership and Society, 2, 100018. https://doi.org/10.1016/j.plas.2021.100018.
PMG . (2020). Contingencia COVID-19 El modelo ganar: antecedentes y oportunidades en la construcción (COVID-19 contingency the win model: Background and opportunities in construction). Available at www.pmgchile.com/wp-content/uploads/2020/05/Modelo-GANAR-PMG-Constructoras.pdf.
PWC . (2020, mayo). COVID-19: Impacto en infraestructura y construcción (Impact on infrastructure and construction). Available at www.pwc.com.uy/es/covid-19/pdfs-covid-19/covid19-impacto-infraestructura-construccion.pdf.
Reeves, M. , Lang, N. , & Carlsson-Szlezak, P. (2020, February 27). Lead your business through the Coronavirus crisis. Harvard Business Review.
Rokooei, S. , Alvanchi, A. , & Rahimi, M. (2022). Perception of COVID-19 impacts on the construction industry over time. Cogent Engineering, 9(1), 2044575. doi: 10.1080/23311916.2022.2044575.
Saurin, T.A. (2020, September). A complexity thinking account of the COVID-19 pandemic. Saf Sci, 134, 105087. https://doi.org/10.1016/j.ssci.2020.105087.
Senado de Chile . (2021). Alza de materiales de la construcción: solicitan investigar razones y entregar información al SERNAC y la FNE (Rise in construction materials: Senators request to investigate reasons and deliver information to SERNAC and the FNE). Available at www.senado.cl/noticias/coronavirus/alza-de-materiales-de-la-construccion-solicitan-investigar-razones-y.
Tapia, M. (2020). ¿El COVID-19 es un caso fortuito? (Is COVID-19 a fortuitous event?). Available at www.derecho.uchile.cl/comunicaciones/columnas-de-opinion/el-covid-19-es-un-caso-fortuito---mauricio-tapia.

Factors that led to an increase of building collapses during the COVID-19 lockdown period in the Greater Kampala metropolitan area, Uganda

Alinaitwe, H. , & Ekolu, S. (2014). Structural failures in East Africa: A study of cases in Uganda. In S. Ekolu , M. Dundu , & X. Gao (eds.), Construction materials and structures (pp. 76–85). Johannesburg: IOS Press. ISBN: 978-1-61499-465-7.
Alinaitwe, H.M. , Mwakali, J.A. , & Hansson, B. (2007a). Factors affecting the productivity of building craftsmen: Studies of Uganda. Journal of Civil Engineering and Management, 13(3), 169–176.
Alinaitwe, H.M. , Mwakali, J.A. , & Hansson, B. (2007b). Analysis of accidents on building construction sites reported in Uganda during 2001–2005. In T.C. Haupt & R. Milford (eds.), Proceedings of the international council for research and innovation in building and construction (CIB) world building congress on construction for development, 14–18th May 2007 (pp 1208–1221). Cape Town, South Africa: CIB Publication. ISBN: 1-920-01704-6.
Alinaitwe, H.M. , Mwakali, J.A. , & Hanson, B. (2009). Organizational effectiveness of Ugandan building firms as viewed by craftsmen. Journal of Civil Engineering and Management, 15(3), 281–288.
Building Control Act . (2013). Government of Uganda. Entebbe: Government Publishing House.
Building Control Regulations . (2020). Government of Uganda. Entebbe: Government Publishing House.
CIDB . (2010). Report on construction health and safety in South Africa. In J. Smallwood , T. Haupt , & W. Shakantu (eds.). Cape Town: Construction Industry Development Board of South Africa Publication, pp. 1–48.
Coble, R. ; Hinze, J. , & Haupt, T.C. (2000). The management of construction safety and health. Brookfield: CRC Press.

Fellows, R. , & Liu, A. (2003). Research methods for construction (2nd ed.). Oxford: Blackwell Science.
Haslam, R.A. , Hide, S.A. , Gibb, A.G.F. , Gyi, D.E. , Pavitt, T. , Atkinson, S. , & Duff, A.R. (2005). Contributing factors in construction accidents. Applied Ergonomics, 36, 401–415.
Husrul, H. , Hamminah, A. , & Kamaruzaman, J. (2008). Management of safety for quality construction. Journal of Sustainable Development, 1(3), 41–48.
Irumba, R. (2014). Spatial analysis of construction accidents in Kampala, Uganda. Safety Science, 64(April), 109–120.
Irumba, R. , & Mwakali, J. (2007). Ethics in construction: Examples from Uganda. In T.C. Haupt & R. Milford (eds.), Proceedings of the international council for research and innovation in building and construction (CIB) world building congress on construction for development, 14–18th May 2007 (pp. 2094–2105). Cape Town: CIB Publication. ISBN: 1-920-01704-6.
Irumba, R. , Wilhelmsson, M. , & Kerali, A.G. (2010). Modelling the dynamics of safety on construction projects: An undiscovered rework perspective. In Proceedings of the 18th international council for research and innovation in building and construction (CIB) world congress on building a better world, 10–13th May 2010 (pp. 227–240). Salford Quays, UK: CIB Publication 357. ISBN: 978-1-905732-91-3.
Kagioglou, M. , Cooper, R. , Aouad, G. , & Sexton, M. (2000). Rethinking construction: The generic design and construction process protocol. Engineering, Construction and Architectural Management, 7(2), 141–153.
Kakitahi, J. , Aliaitwe, H. , Landin, A. , & Mudaaki, S. (2015). A study of non-compliance with quality requirements in Uganda. Management, Procurement and Law, 168(1), 22–42.
Kampala Capital City Act . (2010). The Kampala Capital City Act of 2010 as amended. Kampala: Government of Uganda Publication.
Lo, A. (1997). A talk of safety experience. A Hong Kong Journal of Safety Bulletin, Occupational Safety and Health Association, 15(4), 6–7.
Lubega, H.A. , Kiggundu, B.M. , & Tindiwensi, D. (2000). An investigation of the causes of accidents in the construction industry in Uganda. In Proceedings of the 2nd international conference on construction in developing countries: Challenges facing the construction industry in developing countries, 15–17 November 2000, Gaborone, Botswana.
Mbachu, J. , & Nkado, R. (2006). Conceptual framework for assessment of client needs and satisfaction in the building development process. Construction Management and Economics, 24(1), 31–44.
McKibbin, W. , & Fernando, R. (2021). The global macroeconomic impacts of COVID-19: Seven scenarios. Asian Economic Papers, 20(2), 1–30. https://doi.org/10.1162.
Nigel, S. (2018). Engineering management: Project cost estimating. London: Thomas Telford.
Perttula, P. , Merjama, J. , Kiurula, M. , & Laitinen, H. (2003). Accidents in materials handling at construction sites. Construction Management and Economics, 21, 729–736.
Physical Planning Act . (2010) Government of Uganda. Entebbe: Government Publishing House.
Simpeh, F. , & Amoah, C. (2021). Assessment of measures instituted to curb the spread of COVID-19 on construction site. International Journal of Construction Management. doi: 10.1080/15623599.2021.187467.
Yin, R.K. (2003). Applications of case study research (2nd ed.). Thousand Oaks, CA: Sage.

A digital approach to health and safety management on-site

Busetto, L. , Wick, W. , & Gumbinger, C. (2020). How to use and assess qualitative research methods. Neurological Research and Practice 2020 2:1, BioMed Central, 2(1), 1–10.
Dai, F. , Olorunfemi, A. , Peng, W. , Cao, D. , & Luo, X. (2021). Can mixed reality enhance safety communication on construction sites? An industry perspective. Safety Science, Elsevier, 133, 105009.
Li, Z. , Jin, Y. , Li, W. , Meng, Q. , & Hu, X. (2022). Impacts of COVID-19 on construction project management: A life cycle perspective. Engineering, Construction and Architectural Management, Emerald Group Holdings Ltd. https://doi.org/10.1108/ECAM-10-2021-0873/FULL/HTML.

Lv, Z. , Chen, D. , & Lv, H. (2022). Smart city construction and management by digital twins and BIM big data in COVID-19 scenario. ACM Transactions on Multimedia Computing, Communications, and Applications. Association for Computing Machinery (ACM). https://doi.org/10.1145/3529395.

Majumder, S. , & Biswas, D. (2021). COVID-19 impacts construction industry: Now, then and future. Lecture Notes on Data Engineering and Communications Technologies, Springer Science and Business Media Deutschland GmbH, 60, 115–125.

Moser, A. , & Korstjens, I. (2018). Series: Practical guidance to qualitative research. Part 3: Sampling, data collection and analysis. European Journal of General Practice, Taylor and Francis Ltd., 24(1), 9–18.

Nnaji, C. , Jin, Z. , & Karakhan, A. (2022). Safety and health management response to COVID-19 in the construction industry: A perspective of fieldworkers. Process Safety and Environmental Protection, Elsevier, 159, 477.

Okorie, V.N. , & Musonda, I. (2020). An investigation on supervisor's ability and competency to conduct construction site health and safety induction training in Nigeria. International Journal of Construction Management, Taylor and Francis Ltd., 20(5), 357–366.

Olukolajo, M.A. , Oyetunji, A.K. , & Oluleye, I.B. (2022). Covid-19 protocols: Assessing construction site workers compliance. Journal of Engineering, Design and Technology, Emerald Group Holdings Ltd., 20(1), 115–131.

Pamidimukkala, A. , & Kermanshachi, S. (2021). Impact of Covid-19 on field and office workforce in construction industry. Project Leadership and Society, Elsevier, 2, 100018.

Sami Ur Rehman, M. , Shafiq, M.T. , & Afzal, M. (2022). Impact of COVID-19 on project performance in the UAE construction industry. Journal of Engineering, Design and Technology, Emerald Group Holdings Ltd., 20(1), 245–266.

Seagers, J. , Liu, Y. , & Jebelli, H. (2022). Smart robotic system to fight the spread of COVID-19 at construction sites. In Construction Research Congress 2022: Health and safety, workforce, and education: Selected papers from Construction Research Congress 2022 (Vol. 4-D, pp. 452–461). American Society of Civil Engineers (ASCE).

Silao, J.F. , Guerrero, R.L. , Pantalunan, C. , Renomeron, C. , & Jr., S.L. (2021). Pandemic risk management in construction projects. International Journal of Recent Technology and Engineering (IJRTE), Blue Eyes Intelligence Engineering and Sciences Engineering and Sciences Publication – BEIESP, 10(2), 1–4.

Simpeh, F. , & Amoah, C. (2022). COVID-19 guidelines incorporated in the health and safety management policies of construction firms. Journal of Engineering, Design and Technology, Emerald Group Holdings Ltd., 20(1), 6–23.

Tan, C.K.L. , & Abdul-Samad, Z. (2022). A study of the impact of COVID-19 on construction workforce productivity in Malaysia. International Journal of Productivity and Performance Management, Emerald Group Holdings Ltd. https://doi.org/10.1108/IJPPM-07-2021-0421/FULL/24924/IJABM/2017.11/V5.ISS2/53.67.

Umeokafor, N. , Evangelinos, K. , & Windapo, A. (2022). Strategies for improving complex construction health and safety regulatory environments. International Journal of Construction Management, Taylor and Francis Ltd., 22(7), 1333–1344.

Yang, Y. , Chan, A.P.C. , Shan, M. , Gao, R. , Bao, F. , Lyu, S. , Zhang, Q. , (2021). Opportunities and challenges for construction health and safety technologies under the COVID-19 pandemic in Chinese construction projects. International Journal of Environmental Research and Public Health, Multidisciplinary Digital Publishing Institute (MDPI), 18(24), 13038.

Digitalisation differently

Aghimien, D. , Matabane, K. , Aigbavboa, C. , & Oke, A. (2019). Industry 4.0 diffusion in the South African construction industry: Construction professionals' perspective. In Haupt, T. & Akinlolu, M. (eds.), Proceedings of the 13th Built Environment Conference, 2–3 September 2019. Durban, South Africa: Association of Schools of Construction of South Africa.

Alashwal, A. , & Moustafa, A.A. (2022). Weather and suicide of construction workers in Australia. Proceedings of World Building Congress: Building our future, 27–30 June 2022. Melbourne: RMIT.

Alrashed, S. , Min-Allah, N. , Ali, I. , (2022). COVID-19 outbreak and the role of digital twin. Multimedia Tools and Applications, 81, 26857–26871. https://doi.org/10.1007/s11042-021-11664-8.

Assaf, S.A. , & Al-Hejji, S. (2006). Causes of delay in large construction projects. International Journal of Project Management, 24, 349–357.

Ballesteros-Pérez, P. , Rojas-Céspedes, Y.A. , Hughes, W. , Kabiri, S. , Pellicer, E. , Mora-Melià, D. , & Campo-Hitschfeld, M.L.D. (2017). Weather-wise: A weather-aware planning tool for improving construction productivity and dealing with claims. Automation in Construction, 84, 81–95.

Ballesteros-Pérez, P. , Smith, S.T. , Lloyd-Papworth, J.G. , & Cooke, P. (2018). Incorporating the effect of weather in construction scheduling and management with sine wave curves: Application in the United Kingdom. Construction Management and Economics, 36, 666–682.

Buildingsmart . (2012). National building information modelling initiative volume 1: Strategy, buildingSMART Australiasia. Available at https://buildingsmart.org.au/wp-content/uploads/2014/03/NationalBIMIniativeReport_6June2012.pdf (Accessed 24 March 2019).

Byrne, J. , Ludington-Hoe, S.M. , & Voss, J.G. (2020). Occupational heat stress, thermal comfort, and cognitive performance in the OR: An integrative review. AORN Journal, 111, 536–545.

CDBB . (2022). Gemini paper: What are connected digital twins? Cambridge, United Kingdom: University of Cambridge, Centre for Digital Built Britain.

Chigara, B. , & Smallwood, J. (2016). The impact of environmental thermal changes on construction health and safety in Zimbabwe. In E.M. Mwanaumo , I. Musonda , F. Muleya , M. Muya , J.N. Agumba , & C.S. Okoro (eds.), Proceedings of the DII-2016 Conference on infrastructure development and investment strategies for Africa: Achieving solutions for renewable energy and sustainable development, 31 August–2 September 2016, Livingstone, Zambia. Johannesburg: The Development and Investment in Infrastructure (DII) Conference Series.

Deng, Y. , Gan, V.J.L. , Das, M. , Cheng, J.C.P. , & Anumba, C. (2019). Integrating 4D BIM and GIS for construction supply chain management. Journal of Construction Engineering and Management, 145.

Dunne, J.P. , Stouffer, R.J. , & John, J.G. (2013). Reductions in labour capacity from heat stress under climate warming. Nature Climate Change, 3, 563–566.

Emuze, F. (2022). Guest editorial. Journal of Engineering, Design and Technology, 20(1), 1–5.

Fellows, R. , & Liu, A. (2008). Research methods for construction (3rd ed.). Oxford: Wiley-Blackwell.

Hattab, M.A. , & Hamzeh, F. (2018). Simulating the dynamics of social agents and information flows in BIM-based design. Automation in Construction, 92, 1–22.

Jones, W. , Gibb, A.G.F. , & Chow, V. (2022). Adapting to COVID-19 on construction sites: What are the lessons for long-term improvements in safety and worker effectiveness? Journal of Engineering, Design and Technology, 20(1), 66–85.

Jung, M. , Park, M. , Lee, H.-S. , & Kim, H. (2016). Weather-delay simulation model based on vertical weather profile for high-rise building construction. Journal of Construction Engineering and Management, 142(6), 4016007. https://doi.org/10.1061/(ASCE)CO.1943-7862.0001109.

Locatelli, G. , Greco, M. , Invernizzi, D.C. , Grimaldi, M. , & Malizia, S. (2021). What about the people? Micro-foundations of open innovation in megaprojects. International Journal of Project Management, 39, 115–127.

Mahmood, A.F. , & Rafaa, M.M. (2022). Designing a collection of two IoT-Systems for real time health telemonitoring. Journal of Engineering, Design and Technology, 20(1), 86–98.

Matthews, J. , Love, P.E.D. , Heinemann, S. , Chandler, R. , Rumsey, C. , & Olatunj, O. (2015). Real time progress management: Re-engineering processes for cloud-based BIM in construction. Automation in Construction, 58(October 2015), 38–47.

Mazlomi, A. , Golbabaei, F. , Dehghan, S.F. , Abbasinia, M. , Khani, S.M. , Ansari, M. , & Hosseini, M. (2017). The influence of occupational heat exposure on cognitive performance and blood level of stress hormones: A field study report. International Journal of Occupational Safety and Ergonomics, 23, 431–439.

Microsoft . (2017). The process digital twin: A step towards operational excellence. Redmond, Washington, United States of America: Microsoft Corporation.

Narayanan, V.K. , & Huemann, M. (2021). Engaging the organizational field: The case of project practices in a construction firm to contribute to an emerging economy. International Journal of Project Management, 39, 449–462.
NECA . (2004). The effect of temperature on productivity. Washington, DC: National Electrical Contractors Association.
Nguyen, L.D. , Kneppers, J. , de Soto, B.G. , & Ibbs, W. (2010). Analysis of adverse weather for excusable delays. Journal of Construction Engineering and Management, 136(12), 1258–1267. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000242.
NIOSH . (2021). OSHA-NIOSH heat safety tool app. Cincinnati, Ohio, United States of America: National Institute of Occupational Safety and Health.
Noti, P.-A. , Spirig, C. , Casanueva, A. , Bhend, J. , & Liniger, M. (2017). Operational setup and skill analysis of a seb-seasonal forecasting system for detecting heat stress. Zurich, Switzerland: Federal Office of Meteorology and Climatology MeteoSwiss.
Ohor, K.A. , Diakité, A. , Krijnen, T. , Ledoux, H. , & Stoter, J. (2018). Processing BIM and GIS models in practice: Experiences and recommendations from a GeoBIM project in the Netherlands. ISPRS International Journal of Geo-Information, 7.
Osunsanmi, T.O. , Aigbavboa, C. , & Oke, A. (2018). Construction 4.0: The future of the construction industry in South Africa. International Journal of Civil and Environmental Engineering, 12, 206–212.
Ponjavic, M. , & Karabegovic, A. (2019). Location intelligence systems and data integration for airport capacities planning. Computers, 8.
Rajagopalan, P. , Andamon, M. M. , Paolini, R. , & Santamouris, M. (2018). Developing experimental protocol for collecting large scale urban microclimate data through community participation. In P. Rajagopalan & M.M. Andamon (eds.), Engaging architectural science: Meeting the challenges of higher density: 52nd international conference of the architectural science association 2018 (pp. 561–568). Melbourne, Australia: The Architectural Science Association and RMIT University.
Rowlinson, S. (1997). Hong Kong construction site safety management. Hong Kong: Sweet & Maxwell Limited.
Rowlinson, S. , Jia, A.Y. , Li, B. , & Ju, C.C. (2014). Management of climatic heat stress risk in construction: A review of practices, methodologies, and future research. Accident Analysis and Prevention, 66, 187–198.
Sacks, R. , Brilakis, I. , Pikas, E. , Xie, H.S. , & Girolami, M. (2020). Construction with digital twin information systems. Data-Centric Engineering, 1, 1–26.
Sawhney, A. , Riley, M. , Irizarry, J. , & Pérez, C.T. (2020). A proposed framework for Construction 4.0 based on a review of literature. ASC 2020 (EPiC Series in Built Environment Vol. 1), 1, 301–309.
Smuts, D. (2022). The use of virtual reality technology in health and safety training solution for construction sites. BSc Hon dissertation, Port Elizabeth, South Africa, Faculty of Engineering, the Built Environment, and Technology, Nelson Mandela University.
Tawatsupa, B. , Lim, L.L.-Y. , Kjellstrom, T. , Seubsman, S.-A. , & Sleigh, A. (2012). Association between occupational heat stress and kidney disease among 37,816 workers in the Thai Cohort Study (TCS). Journal of Epidemiology, 22, 251–260.
Thorpe, D. , & Karan, E.P. (2008). Method for calculating schedule delay considering weather conditions. In A. Dainty (ed.), Procs 24th annual ARCOM conference, 1–3 September 2008 (pp. 809–818). Reading, United Kingdom: Association of Researchers in Construction Management.
Tian, W. , & de Wilde, P. (2011). Uncertainty and sensitivity analysis of building performance using probabilistic climate projections: A UK case study. Automation in Construction, 20, 1096–1109.
Trivedi, A. , & Rao, S. (2018). Agent-based modelling of emergency evacuations considering human panic behaviour. IEEE Transactions on Computational Social Systems, 5, 277–289.
WEF . (2022). Regional action group for Africa: Attracting investment and accelerating fourth industrial revolution adoption in Africa. White Paper, World Economic Forum.