

Scientific and Technological Approaches to Mitigating the impact of COVID-19 Pandemic and its Socio-Economic Challenges-the Built Environment in Perspective: A systematic reviews and meta-analysis

Olalusi O C, Fagbohun J O and Fashubaa T O

Department of Building Technology Federal Polytechnic, Ado Ekiti, Nigeria

Submitted: 30-09-2021

Revised: 05-10-2021

Accepted: 08-10-2021

ABSTRACT

COVID-19 has changed the way we live and work, as various health and safety restrictions keep more of us at home more often. The resulting changes to our behaviour are already impacting the environment around us in myriad ways and the containment of the spread of the pandemic and limitations on commercial activities, mobility, manufacturing, educational and construction sectors have significantly been affected. Since we are in technological age, it is the responsibility of the professionals in the Built Environment to find the best approach to mitigate the socio-economic challenges the pandemic introduced to our environment. This research focuses on the impact of the pandemic on the environment and the expected response of its professionals to rebuild the system from its recovering process in the Post COVID-19 period.

Keyword COVID-19, Environmental Science, Architectural Design, Urban Planning, Facility Management, Waste Management, Construction value chain, Surveying

I. INTRODUCTION

Pandemic and traumatic experiences have always had an impact on our environment. Further, they have long reshaped our built environment, forcing us to respond and learn from our failure and as a result adapt new ways to mitigate. As a concept, Science encompasses the systematic study of the structure and behaviour of the physical and natural world through observation and technology

is the application of scientific knowledge for practical purposes. (Harshin, 2020).

During these strange and difficult circumstances, it is hard not to pay attention to physical surrounding and rethink our daily habits in the built environment. To successfully mitigate the impact of COVID-19 which caught everyone unawares and less prepared, there is need for environmental science professionals to step up their contributions leveraging the availability of scientific and technological advancement to help redesign, rebuild, maintain, sustain and manage our environment from post COVID-19 pandemic and its socio-Economic Challenges it introduces.

“Urban Planning, architecture and public health were partners in the historic efforts to prevent epidemics.” (Vittori, G & Guenther, R 2008)

Architectural Design Responses in Meeting Post COVID-19 Pandemic

Architects are most times referred to as “master planners” because of their efficient production of conceptual design models and this possess a heavy responsibility of knowing the impact of COVID-19 pandemic on the economies and societies worldwide to predict the future of cities and design from the present situations.

According to Norman Robert Foster, a British architect and designer, “As an architect, you design for the present, with an awareness of the past, for a future which is essentially unknown”.

After Coronavirus Pandemic, architectural design will be in stage of design for an independent building in case of emergencies. People are more

aware about environmental and health issues and client's requirements are changing under house quarantine influence, they are reducing the number of guest rooms and add office, hobby room or a garden instead. Hence we will see wider spread of Human-centred design concept to fulfil inhabitants needs and enhance life quality (Ateek, 2020).

Green open spaces (courtyard, garden, green roofs) will be the new luxury. Interaction with living plants and using natural materials within the building would give a cosier touch and help improve mental health during house quarantine; since green spaces protect against mood disorders and depression that people could feel during pandemics (Engemann,k;Pedersen, C;Arge, L;.....,& Svenning,J.c, 2019).

Since architectural spaces are conceptualized and designed with a clear goal, such space can promote or aid the inhibition of infectious disease (Olalusi and Ayeni 2010). This was first experimented with by Florence Nightingale, when she launched the hospital ward model, stated that the daylight and cross ventilation are significant components to disinfect and lessen the infection occurrences in hospitals. Some appropriate design strategies are to be employed in adapting our domestic, commercial, residential and hospital spaces for infection, prevention and control. (Udomiaye E; Eze Desu O and Kalu C 2020)

These design strategies include;

- Design for social distancing
- Design to enhance natural ventilation
- Design to enhance Daylight or Sunlight.
- Design with adaptive finishing materials and construction methods
- Flexible design with sustainable features, (Olalusi and Ayeni 2010)

Facilities Management and Maintenance of Public Infrastructure in Post COVID-19 Pandemic

Facilities management are an expert administration discipline, devoted to offering environmental friendly and nice guide to the maintenance of upcoming and existing infrastructure. The responsibility of the facility managers is the obligation to take measures to implement the correct preventive and control strategies in the workplace.(Ali, 2020)

Being in charge of the maintenance of buildings, organisations and most importantly, people, it is the responsibility of facility managers to take actions towards implanting the right prevention and containment strategies both in the

workplace and in public infrastructures.(Infraspeak, 2020)

Nigeria, as a nation has been tagged the Giant of Africa' owing to the fact that some of its public infrastructural development of high standards but unfortunately, lacks the maintenance and sustainability to stand the test of time. The outbreak of the COVID-19 pandemic has resuscitated some development in hospitals, health care centres, public gatherings, market squares etc. These infrastructures needs to be maintained so that it can last it purpose and serve its existence. Infrastructures like emergency clinics, water dispensers for public location (schools, market complex, offices and religious centres), General sanitizer stands etc., needs the effective monitoring and maintenance by professional facility Managers in post COVID-19 pandemic Era.

Facility management companies can also provide more incentives to co-workers who clean and disinfect commercial buildings and residential areas. The company does this to ensure employee engagement and some customers are willing to pay for it. It could also provide workers with food, temporary housing and sanitation support and pay attention to their safety and wellbeing to facilitate a balanced pandemic free ecosystem.

Facilities management in a bid to manage public infrastructures in post COVID-19 pandemic period should be ready to take the under listed approach in Mitigation;

- Notify everyone by placing posters with rules and guidelines for hand hygiene, coughing and sneezing, and instructional guide to proper usage of public infrastructures
- Cleaning and Disinfecting Sitting/Living Area and public places like parks, museums, garage etc.
- Enforcing the physical distancing by workers.(Ali, 2020)

Sustainable Waste Management as Triggered by Post COVID-19 Pandemic

Before the COVID-19 pandemic, the world was already facing challenges in the waste management sector, where over two billion people lack access to waste collection whereas over three billion people lack access to waste disposal (UN-Habitat 2020).

The COVID-19 pandemic has imposed a global emergency and also has raised issues with waste management practices. A huge increase in the amount of used personal protective equipment (facemasks, gloves and other protective stuffs) and wide distribution of infectious waste from hospitals, health care facilities and quarantined

household has been injected into the environment (Hantoko D, Manage J. E, 2021). The amount of food and plastic waste also increased during the pandemic and all these factors caused waste treatment facilities to be overwhelmed, forcing emergency treatment and disposals to ramp up processing capacity. Hence, there is a need for proper waste disposal as triggered by the pandemic.

For example, the COVID-19 pandemic has triggered a zero-waste approach that requires members of the EU to recycle waste between 70–80% while declining green house gas (GHG) emissions attributed to toxic waste disposal and incineration techniques (Zero Waste 2020). The zero-waste approach encompasses “the conservation of all resources by means of responsible production, consumption, reuse and recovery of products, packaging and materials without burning, and with no discharges to land, water or air that threaten the environment or human” (ZWIA 2018). In Nigeria, the post-crisis offers lessons that waste management before the COVID-19 pandemic cannot be continued as business as usual but requires structural adjustments, hence accentuating the importance of transitioning from linear to a circular economy. This in effect navigates towards achieving zero-waste and zero-carbon-based economic development that has low waste management expenditure.

It is the responsibility of waste management agencies as Environmentalist to ensure disinfection of treatment wastewater as per prevailing practices to inactivate corona viruses, this can be achieved by following the national regulations WHO / WASH guidance on infectious waste treatment as stated below;

- Treat corona virus waste as any infectious waste.
- Segregate waste at source.
- Dispose in an infectious waste in foot operated bin, with a suitably colour code.
- Cut masks and other PPE (mask, face shield, heavy duty gloves, long sleeve gown, and boots): un confirmed reports says that they are being illicitly resold.
- Follow routine disinfection and cleaning protocols for waste bins.(Capoor, 2020)

Urban Planning, Tourism and Recreation in Post COVID-19 Pandemic

“Design has an important social role. It has the role of interpreting societal needs by translating them in an empathetic and innovative way”- Valentina Zanoni

The discomfort generated by the lockdown and social distancing situation -avoiding large crowds-might be further fuelled by various stressors like social isolation, loss of income, confinement, boredom, and activity restriction. Hence, it is crucial to identify factors that might deplete the adverse impact of the pandemic lockdown and social distancing on mental health. To this respect and from urban design perspective, it is argued that public open spaces such as parks and gardens should be brought to the forefront in terms of mitigating the adverse effects of pandemic lockdown and social distancing on the population’s mental health. In the first place, it might seem against common sense to bring together two antagonist concepts such as “pandemic lockdown” and “public parks”. Urban parks are crucial public open spaces that provide inhabitants with opportunities for social interaction, sharing experiences, physical activities, enjoyment of nature, for tourism and an escape from the stress of cities. It allows citizens to fulfil their needs for passive and active engagement, relaxation, and comfort. Hence, it is extremely difficult to ignore the importance of recreational outdoors areas and the seeking of pleasure and wellbeing from residents, especially during prolonged social lockdown periods. (Amine M and Chebab D, 2020).

The crisis may provide citizens and planners with an opportunity to rethink drastically, from the ground up, the way we live, consume, produce and travel. Cities are where everything and everyone connects, which makes cities thrilling and vibrant, but also vulnerable. People living in cities are more dependent on public and private services for transportation, food, and enjoying open spaces. COVID-19 has shown that the urban interconnectedness can be vulnerability, where inadequate access or interruptions of services leave them vulnerable. At the same time, neighbourhood initiatives that sprung up around the world have also shown that there is also another way to live together in cities (UNESCO, 2020).

The following socio-economic recommendations were given as activities that provide a wake-up call to adopt environmentally friendly development pathways;

- Greening the transportation and industry sectors can provide major air quality, reduce traffic-related pollution and as measures designed for reducing some pollutants may increase secondary pollutants, holistic approaches to pollution mitigation are needed.
- More inclusive actions towards reducing inequalities and addressing the needs of

vulnerable groups should be prioritized and Slum upgrading should be prioritized.

- Enhancing sense of community is critical for improving response and recovery capacities.
- Considering other multiple benefits of compact urban developments, planners should continue promoting them- More space should be allocated to pedestrian areas and open spaces.
- Designing regulations to minimize negative agricultural, industrial and traffic impacts on water resources should be prioritize.(Ayyoob S, Amir R K, Garmsird, 2020)

Construction value Chain in Post COVID-19 Pandemic

Construction industry members including owners, developers, contractors, subcontractors and supply chain vendors have experienced varying degrees of impacts as a result of the COVID-19 pandemic based upon the various responses at the state and local levels.

It is important for construction firms and project owners to understand how COVID-19 has impacted and continues to affect the availability and prices of construction materials and supplies. Virus outbreaks and lockdowns have inhibited the manufacturing and transportation of supplies, while a booming residential construction market has increased their demand, leading to a supply squeeze and increasing costs (Schnippert, 2021)

The construction sector, characterized by long and fragmented low margin supply chains, was a part of the economy likely to be quickly and heavily impacted by the pandemic outbreak. This proved to be the case, with construction activities hastily suspended and many sites closing voluntarily to meet social distancing requirements. The sector is widely known for having systemic weaknesses including fragmentation, a multi-tiered structure, low net profit margins, poor cash flow and generally weak balance sheet strength. The high level of intellectual property often locked in lower levels of the supply chain, together with a slow adoption of digital technologies and other factors, has left the sector poorly equipped to handle the pandemic and any future significant downside events.

Despite all the obvious negative consequences of the pandemic, the seismic nature of its impact perhaps offers the opportunity for the construction sector to do more than revert to former ways of working.

For the public sector, there are suggestions that practical measures need to be set in place to encourage a determination in the private sector to continue with new innovations that will enable real

productivity improvements (e.g. through **modular construction**) and sustainable technologies to be brought to bear.

Early collaborative engagement of suppliers and clients, though not new, could be espoused more broadly. This could promote the development of component parts using sustainable techniques earlier into the project development lifecycle. With designs confirmed for standard components, to be delivered by a larger pool of suppliers, this would potentially help increase consistency of quality and would assist with achieving higher volume off-site manufacturing. By turn, this could flow through to on-site assembly and be part of assisting driving productivity gains and bringing projects to completion on time and to budget.

A specific issue associated with COVID-19 in performing supplier financial checks is that pre-COVID-19 financial accounts are likely to paint a very different picture of a company's financial health to that during the pandemic. Thus, it is suggested that such analysis may need to be enhanced by appraisal of the current and forward looking factors which provide indicators of financial health including instances where the market is looking to short the shares of a given company in the supply chain, any proposed changes to supplier payment terms, indicating fragility of cash flow, reduced credit ratings etc.

An acceptance of mistakes and learning between projects will potentially help create sufficient consensus drive to adoption of new ways of working in what remains a fragmented market. Ultimately, this will need clear leadership to drive change from all parts of the supply chain, where the client acknowledges itself as an integral component part of the supply chain.

Document All Impacts. While it is always advisable to document events that occur over the course of any construction project, the COVID-19 outbreak has placed an even greater emphasis on the need to maintain contemporaneous and thorough records. Project records comprised of generic descriptions of site activities and impacts will not be sufficient to establish a clear record. Instead, all interested parties should track and document any COVID-19 impacts and related mitigation efforts (James P. C, Gina A. F and Gregory H.K, 2020)

Surveying Practices during and after COVID-19 Pandemic

"For years, the common belief has been that experiential surveying labs cannot be offered remotely online. Well, during the early 2020, all schools were forced to make a sudden change from

traditional in-person classes to remote delivery if possible. This sudden transition, affected surveying labs that were in session in mid-March. Many programs were in the middle of their semester breaks and had perhaps one week to readjust and decide how to conduct the rest of the semester online"(ASCE, 2020).

Like so many other industries over the past year, Surveyors which includes (Land, Quantity and Estate) took an initial hit as a result of the COVID-19 pandemic. Being an industry that has been categorically esteemed with their professional techniques that involves a high number of rigorous working hours on field and physical site inspection at different geographical location in varying characteristics and attribute. There's a need for more scientific-technological approach to mitigate the restrictions presented by the pandemic outbreak as surveying professionals build the bedrock for meaningful development. One of the major approaches that came through during the pandemic for Surveyors is the leverage on spatial technologies that involves little or no Field work and still gives relatively accurate results when compared to the traditional method before COVID-19. The working principles of these technologies are fully operational on the ability of space satellite, unmanned vessels (e.g drones) and computers to give the characteristics of a landed property by data processing, manipulation, analysis and modeling techniques. Hence, we have "Remote Surveying".

Remote Surveying is the way forward as scientific approach to mitigate the socio-economical effect of COVID-19 through the use of spatial technologies. These technologies have provided the future to the surveying professionals in the Post pandemic era; it also offers a number of these technologies with various functions, capability and operations based on the need by its users. The available technologies include (but not limited to) Geographic information system (GIS), Remote Sensing, Digital cartography, photogrammetry, Aerial Surveys etc. Majority of these technologies have been in existence before the COVID-19 pandemic, but were less deployed due to financial incapability, lack of expertise, poor education/awareness. Now that the pandemic has befallen us, the narrative has changed and an enormous attention has to be shifted on spatial technologies to make it more available than it was for surveyors to use and contribute their quota in reclaiming the lost territories by the pandemic.

The technical know-how (knowledge and expertise) is a secondary setback to combining these technologies to surveying practice as a

"hybrid", aside from the relative high cost. To tackle this, several bodies in the professions have to make use of available and effective methods to teach its members starting from schools (students) to practicing members (veterans) on the importance of the adoption of the technologies to ensure professional continuity and mitigating the socio economic challenges of COVID-19 at large.

"We are in a unique position to move forward in our use of blended learning. We have seen rapid development in the online platforms and technologies available and, more importantly, our ability to use them to achieve effective learning. We have also learned that there are a range of learners who all learn differently. Not everyone is suited to online learning, while some are more comfortable learning only using online materials. A key challenge we face is to develop approaches and pathways that cater for these different learning needs"(Mitchell, 2020).

II. CONCLUSION

The separation of health and environmental Science is a dangerous delusion. Our health entirely depends on the climate and the other Environmental elements we share the planet with. We need to bring these communities together. But largely we still view the environment and life on earth as separate. We can and must do better if we want to prevent the next infectious pandemic. That means we must combat Environmental changes with the right tools by with its professionals far more to safeguard the diversity of life on earth and the infrastructures it relies on to survive. Scientific and technological approach are most suitable in mitigating the socio-economic challenges possessed by COVID-19 only when Environmental Science Professionals stand up to the challenge of accepting the 'new normal' of the Post pandemic realities as it melts out on their professional ethics and required responsibilities.

REFERENCE

- [1]. Ali, B. (2020). The Impact of COVID-19 in Facility Managment Sectors/Industries. Research Gate.
- [2]. Amine Moulay and Chebab Daouia. (2020). The Post COVID-19 Aspect of Public Open spaces - An Economic and Urban Design Perspective. Research gate: The future of Earth.
- [3]. ASCE, A. S. (2020). Teching Surveying Classes in the Era of COVID 19. American Society of Civil Engineers.

- [4]. Ateek, G. (2020). Future of Sustainable Architecture: Rethinking COVID-19 a Pandemic or turning point? ResearchGate.
- [5]. Ayyoob Sharifia, Amir Reza Khavarian,Garmsird. (2020). The COVID-19 pandemic: Impacts on cities and major lessons for urban planning, design, and management. *Science of the Total Environment* journal homepage:www.elsevier.com/locate/scitotenv.
- [6]. Bernstein, D. A. (2021). Coronavirus, Climate Change and the Environment. Harvard T.H Chan; School of Public Health; Center for Climate,Health and the Global Environment.
- [7]. Capoor, D. M. (2020). Health-CareWaste Management in COVID-19 context: Best and Sustainable Practices. CPCB BMWM guidelines for COVID, 2020.
- [8]. Center, N. S. (2020). Environmental Impact of the COVID-19 pandemic, as observed from space. *ScienceDaily*.
- [9]. Engemann,k;Pedersen, C;Arge, L;.....,& Svenning,J.c. (2019). Residential green space in childhood is associated with lower risk of psychiatric disorder from adolescence into adulthood. Retrieved from *Proceedings of the National Academy of Science*:<https://www.pnas.org/content/116/11/5188>.
- [10]. Hantoko DwI, Manage J. *Environ.* (2021). Challenges and practices on waste management and disposal during COVID-19 Pandemic. NIH National Center for Biotechnology information Library.
- [11]. Harry Colledge; David Moss; Gary Forde. (2020). How will the UK construction Supply chain reset and reinvent itself as it emerges from the ravages of COVID-19.
- [12]. Harshin, J. (2020, April). what is meant by science and technology? Retrieved from Brianly: <https://brainly.in/question/16375191>
- [13]. Infraspak. (2020). What is the role of facility management in dealing with COVID-19. Retrieved from Infraspak: blog.infraspak.com/covid19-facility-management
- [14]. James P. Chivilo, Gina A. Fonte, Gregory H.Koger. (2020). A look at COVID-19 impacts on the construction industry. Retrieved from Holland & Knight Alert: <https://www.hklaw.com/en/insights/publications/2020/05/a-look-at-covid19-impacts-on-the-construction-industry>
- [15]. Mitchell, D. (2020). COVID-19 responses and FIG2020:Lessons for Surveying Education. FIG Working Week ,Amsterdam. Amsterdam: FIG Publications.
- [16]. Olalusi & Ayeni (2010) *The Built Environment and the Reduction of Facility Related Infection Towards vision 20:2020* Environ-Link, A journal of Environmental Issues ISSN 2006-0009 vol. 3 No 1 pp 105-112
- [17]. Samuel Asumadu Sarkodie ; Phebe Asantewaa Owusu. (2021). Impact of COVID-19 pandemic on waste managemen. Springer; Environment, Development and Sustainability .
- [18]. Schnippert, D. (2021). COVID-19's Impact on the Construction Supply Chain. Retrieved from Construction Citizen: <https://constructioncitizen.com/blog/covid-19s-impact-construction-supply-chain/21031771>
- [19]. Stantec. (2020). A Global view of design and Urban planning post-COVID-19 (Part 1): Pandemic Prevention. Retrieved from Stantec: <https://www.stantec.com/en/ideas/topic/cities/a-global-view-of-design-and-urban-planning-post-covid-19-part-1-pandemic-prevention>
- [20]. Udomiaye Emmanuel; Eze Desu Osondu; Kalu Cheche Kalu . (2020). Architectural design strategies for infection prevention and control (IPC) in health-care facilities: towards curbing the spread of COVID+19. *Journal of Environmental Health Science and Engineering*.
- [21]. UNESCO. (2020). URBAN SOLUTIONS: LEARNING FROM CITIES' RESPONSES TO COVID-19 . UNESCO CITIES PLATFORM.
- [22]. Vittori,G., & Guenther, R. (2008). *Sustainable Healthcare Architecture*.