Critical Barriers to Prevention through Design in Construction in Nigeria: A Qualitative Inquiry

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ABSTRACT

Methdology:

Twenty-eight semi-structured interviews and e-interviews of architects, builders and civil engineers in Nigeria were analysed using the six-phase thematic analysis. To improve the trustworthiness of the research, triangulation, peer-debriefing, refining the interview protocol and thick detailed description were done.

Purpose:

Given the complexities in improving safety in the construction industry globally, which is exacerbated by the complex safety environment in developing countries (DCs), prevention through design (PtD) has been established to improve occupational safety and health (OSH) where applied. However, it has received very little attention in DCs and the extant literature with limitations. Using Nigeria as a case study, the current study advances the understanding of PtD in DCs by investigating the critical barriers to PtD and other potential OSH responsibilities of designers in the construction industry.

Findings:

The study's findings question the extant general knowledge and understanding of PtD among clients and designers and its technical aspect among designers where it is skewed to structural safety and omitted in universities' curricula. This explains the inconclusive findings of existing studies on why there is a high level of awareness of PtD but a low level of implementation. There is little client support for PtD, and designers have limited influence on clients in terms of it. The fear of liability from PtD is exacerbated by the limited legal system and lack of adequate legislation in the country. The demotivating attitudes of clients and contractors towards designers in terms of PtD are also reported, just as there are project delivery barriers such as traditional procurement not supporting PtD as design and build procurement does.

Social implication

For the sustainable growth in the practice of PtD, the increased and improved quality of education and awareness of PtD is needed but this must focus on instilling a robust understanding of it among designers based on the local context. This educational requirement can be supported by statute.

Originality/value

Through qualitative data, the findings explain and offer insight into the inconclusive findings in the extant studies on PtD in Nigeria. Also, it contributes to improving health and safety by advancing the understading of the critical barriers to PtD and other potential OSH responsibilities of designers in D Nigeria's construction using qualitative data.

Keywords: Architecture, engineering and construction industry, design for safety, safety in design, emerging and developing countries, risk control.

INTRODUCTION AND RATIONALE FOR THE RESEARCH

In meeting the United Nations Sustainable Development Goals 3 and 8 through occupational health and safety (OHS) (International Labour Organisation (ILO) 2019), the losses incurred through the direct and indirect cost of incidents and illness need to be addressed. This will have positive implications for OHS, business performance, the economies of countries and by extension these goals. Although prevention through design (PtD) (also known as design for safety (DFS), safety in design, safe design and design risk management) has limitations like other OSH improvement measures, it has been proven to contribute to a safer workplace and cost reduction. Studies (such as Haslam et al. 2005; Churcher and Alwani Starr 1996; Behm 2005) show correlation or links between PtD and accident causation. In particular, of the 100 accidents in the UK that Haslam et al. (2005) examine, nearly half of the associated risks could have been mitigated with PtD. Findings in an earlier study (Churcher and Alwani Starr 1996) in the UK show that two-third of the injuries and fatalities could have been mitigated or eliminated with adequate design decisions and adequate planning.

Additionally, there is extensive research such as Poghosyan et al. (2019), Toole and Erger (2018) and Smallwood and Haupt (2005) that support this and demonstrate the role of designers in designing out hazards based on the risk control hierarchy measures. This is where hazards or risks are eliminated or minimised by substitution, modification or isolation (NSW Workcover 2001). The designer is supposed to identify hazards or risks associated with the construction, operation, decommissioning of the product then consider and address them through design or the introduction of control measures to protect workers from the risks and inform the contractor of the residual hazards that requires consideration in the construction process (Churcher and Alwani Starr 1996).

However, despite the extensive research on PtD, there are still gaps in this area globally and in developing countries (DCs) (Poghosyan et al. 2018 (a systematic literature review on PtD); Manu et al. 2018). Manu et al. (2018) are instructive that there is very limited studies on the subject in sub-Saharan Africa. Umeokafor (2018) affirms this following an extensive systematic review of OSH studies in Nigeria over 36 years, 1983 to 2018. While the current study advances the understanding of critical barriers to PtD and other OSH responsibilities of designers in DCs through social constructivism, further and specific knowledge gaps are outlined in the following paragraph.

First, the limited research on PtD in DCs has not adopted interpretivism and constructivism perspective. For example, Ismail et al. (2021) profile designers' PtD competence in Malaysia using a statistical questionnaire survey. Manu et al. (2018) adopt a positivist paradigm to examine the awareness and practice of PtD among architects in Ghana using a survey. The same is applicable to Abueisheh et al. (2020) who examine the implementation of PtD among design professionals in Palestine using the questionnaire survey. Labo-Popoola et al. (2019) investigate the barriers to PtD in Nigeria. Through a questionnaire survey, Manu et al. (2019) sought Nigerian architects' perspectives in advancing the understanding of PtD awareness and practice in the construction industry. These studies are inconclusive in some regard. For example, Manu et al. (2019) found a high level of PtD awareness (89.4 per cent), and 60.9 per cent have received a lesson on PtD as part of formal education, however, when the practice of PtD was assessed, it was found to be low, showing a disconnect (Manu et al. 2019). Labo-

Popoola et al. (2019) also found a disconnect between the two with a high level of awareness of PtD and poor implementation among civil engineers. A similar finding is reported in Ghana by Manu et al. (2018), where there is a poor implementation of PtD but a high level of awareness of the concept of PtD, 98.5 per cent. Consequently, Manu et al. (2018, 2019) call for research that will advance the understanding of the critical success factors and barriers to the implementation of PtD in DCs. Subsequent studies from Labo-Popoola et al. (2019) and Abueisheh et al (2020) that address these factors provide valuable insight but from the positivist perspective.

Furthermore, while these studies have contributed toward advancing and establishing the understanding of the subject in the region, the missing interpretivism and constructivism perspective has implications for gaining an in-depth understanding of PtD in DCs. For example, the 'subjects' perceptions of the world around them, the meanings, understandings and opinions about the world are of significance and can be the subject of investigation' (Kheni, 2008: 91). Also, the ability of interpretivism and constructivism paradigm research to facilitate closer collaboration between academics and industry practitioners to practically solve construction management problems such as OHS, which will result in new models and systems will be missing in such research (AlSehaimi et al., 2013). A counter-argument is that research methods adopted in the research should be underpinned by the research problem (Umeokafor and Windapo, 2018) hence a justification. However, the underrepresentation of interpretivism and constructivism paradigm research in the built environment (Umeokafor and Windapo, 2018) and in OHS (Umeokafor, 2018b) suggest that recommendations and knowledge of the extant research are skewed to what quantitative research captures. Further, there is currently regulatory reform of OSH regulatory system in some sub-Saharan African countries such as Nigeria and OSH responsibilities for designer and PtD responsibilities at the design stage are expected. This would provide statutory backing for PtD for designers, OSH obligations for stakeholders in the project delivery and project team (including designers), and provision for the regulation of OSH throughout the phases of construction including the pre-contract stage. There are anticipated barriers that have not been examined; doing this should offer valuable insight into what may be encountered. The current study will provide insight into the current and anticipated barriers.

Second, while the current research contributes to the discourse from the qualitative research perspective, it will also adopt a multi-designer perspective as against the aforesaid studies in the area in Nigeria which mainly focused on one category of designer, Architects or Civil Engineers, with the exception of the study by Abueisheh et al. (2020) which surveyed both. A qualitative inquiry into PtD in the Nigerian construction context will provide more insight and explain a lot in the extant findings of previous PtD studies in the country and other DCs. For example, there is a relationship between geographic location OSH practices/interventions by communities and the likelihood of this in OSH in general (Umeokafor, 2018a). However, these are yet to be explored in relation to PtD.

Third, another motivation for this study is that the dearth in PtD literature in developing countries (Poghosyan et al. 2018; Manu et al. 2018, 2019; Labo-Popoola et al. (2019) warrants another study that will support, refute or expand the only study, Labo-Popoola et al. (2019) which examine the barriers to PtD implementation in West Africa with a focus on Nigeria. Also, the interpretation of the findings of Labo-Popoola et al. (2019) is limited by information

such as geographic location information of the participants of the project which is relevant given its implications the findings.

Following the background established so far, using Nigeria as a case study, this study examines the barriers to PtD and other OSH responsibilities for designers in DCs through social constructivism. In achieving this aim, the following questions guide the research.

- What are the critical barriers to PtD and other possible OSH responsibilities of designers?
- How can the critical barriers above be explained from the designers' perspective?
- How does the current study advance the findings of the extant studies on PtD that are of the positivism paradigm?

Following this is an overview of the context on which the research is based after which a detailed methodology is presented. The findings of the study are then presented and discussed in the section that follows. After that, the study implications that make way for the conclusions and recommendations in the last section are presented.

CONTEXT

Occupational safety and health in developing countries

Many papers in OSH acknowledge the poor record of the construction industry globally. Granted the improvements recorded (Health and Safety Executive (HSE) 2014), there is consensus among authors (for example, Nawaz et al. 2020; Hämäläinen et al. 2017; Umeokafor 2018b) that the case of DCs is worse. In particular, based on 2014 data, Asia has the higher number of fatalities among the five regions (Africa, Asia, Europe, America, Oceania) (70 per cent with a fatality rate of 12.7 per 100,000 people in the labour force) but Africa has the highest, 16.6 per 100,000 people in the labour force. Europe has the lowest, 3.61 per 100,000 people in the labour force (Hämäläinen et al. 2017). The lack of data and accident reporting, the poor attitudes of contractors towards safety, and inadequate governmental regulation, legislation and laws are among the main barriers to implementing OSH in many DCs [for example, Alkilani et al. (2013) for Jordan; Kheni (2008) for Ghana; Umeokafor et al. (2014) for Nigeria]. In particular, Alkilani et al. (2013) found that only about 10 per cent of the accident in Jordan's construction sites are reported.

Some fundamental questions confronting DCs include how to get the government involved in OSH, how to improve the regulation of OSH and its environment, and how to get OHS to the level at which it is in developed countries. However, attention has or is starting to shift to the subtle ways to improve OHS in DCs with or without governmental support in developed countries, but acknowledge the fundamental role of government and adequate regulation in the crusade.

Nigeria in Context

A country with a population of over 200 million people, Nigeria has six geopolitical zones, North East, North West, North Central, South South, South West and South East. Just like in many other countries, the Nigerian construction industry contributes to its economy. For example, in the third quarter of 2021, it has accounted for 9.26 per cent of the nominal Gross Domestic Product (GDP) (National Bureau of Statistics 2021). Its total real GDP in the same quarter for 2021 was 3.22 per cent and 3.21 per cent in the same quarter in 2020 (ibid).

Conversely, the industry has poor health and safety records, a lack of health and safety research and holistic national health and safety Act (ILO 2017). Despite the underreporting of injuries and fatalities in the country, between 2014 to 2016, the industry accounted for 1358 (39.29 per cent) of all accidents/injuries across all industries, the highest (ibid).

Prevention through Design

While regulation and compliance with OSH laws are fundamental and a pillar for improving safety including in PtD (Umeokafor et al. 2020), PtD still contributes to safety in the absence of regulation because some activities in the concept require no or little additional cost. Irrespective of the terms used, prevention through design (PtD) in the US, design for safety (DFS) in Singapore, safe design in Australia, and construction design and management in the UK, according to Che Ibrahim et al. (2020), all encourage designers to eliminate or reduce construction hazards in the early stage of the project, planning and design. The strategic position of designers in PtD provides a platform for this. They can reduce these hazards by selecting alternative methods of activities and designing barriers (Hollnagel 2008). Che Ibrahim's and Belayutham's (2020) conclude that generally, 40 to 70 per cent of construction site accidents have associations with permanent designs. By implication, this emphasises the extent to which designers can contribute to accident prevention through Ptd (ibid). This may explain the significant growth of the concept globally, for example in South Africa, Singapore and UK where it has supporting legislation, in Australia where there is a PtD guideline for owners, designers and contractors and even in Alabama US where there are no supporting laws yet adequately implemented (Toole and Erger 2018). The ability of PtD to improve OSH is evidenced in numerous studies (NSW Workcover 2001; Xiahou et al. 2018). For example, in the UK and US, studies have shown a link between design and the occurrence of accidents (Haslam et al. 2005, Behm, 2005; Manu et al., 2014). Analysis of 442 accident data from lifecycle subway projects in China also shows that 236 are linked to PtD (Xiahou et al. 2018). In Australia, Cooke et al. (2008) found a correlation between PtD and improved H&S.

<u>Barriers to prevention through design</u>

However, there are perils of PtD. For example, Toole and Erger (2018) demonstrate the risk of a successful lawsuit against designers for job site safety because if there is an injury because there is an assumption that design for safety is a duty to ensure safety on construction site, the injured would allege that the design firm has breached their duty. The implication of this is the risk of a lawsuit for design firms. Others include that owners may not support an increase in design fee and the PtD process; the risk of the regulator of safety citing the design firms; and the risk is any liabilities from post-construction activities. For example, if a designer identified locations for fall protection anchorage points and there is an injury during the operation of the building which is the fault of the client due to poor maintenance, Toole and Erger (2018) argue that the design firm will be named a defendant in the worker lawsuit. Also, there is a risk associated with the lack of designers expertise in PtD, which may be explained by the lack of skills and knowledge in it. The training that the designer receive in universities may account for it. According to Toole and Erger (2018: 10), 'Education on PtD is rarely offered and never required in undergraduate civil engineering curricula, rarely offered to graduate engineers through continuing education courses, and often not learned "on the job" outside of the process construction sector'.

Goh and Chua (2016) found that the lack of PtD knowledge and guidance were key barriers to designers (Civil and Structural Engineers) implementing PtD despite their support for it. They also noted barriers concerning contracts between clients and designers while adequate enforcement and legislation and client involvement are drivers of PtD. Extant literature such as Gambatese et al. (2015) support the points on the mindset of designers towards safety, increasing designer knowledge and the need to better harness designers knowledge of PtD modifications. They also noted the barriers concerning designers liability from PtD and the lack of tools and guidance that will be used as a reference. Further, Che Ibrahim's and Belayutham's (2020) findings show the limited knowledge of PtD (especially on its principles) among civil and structural Engineers in Malaysia.

METHODOLOGY

Reporting part of a larger study to advance the OSH understanding through social constructivism in DCs, the current paper focuses on the critical barriers to PtD and other potential OSH responsibilities of designers in Nigeria. The overall process of the study is captured in Figure 1. To answer the research questions and address the study's aim, a qualitative approach is deemed adequate because of its ability to offer a deep understanding of the complex phenomena from the participants' perspective (Saunders et al. 2009). Erikkson and Kovalainen (2008) instruct that qualitative methods such as semi-structured interviews excel in answering 'what', 'why' and 'how' questions. Specifically, semi-structured interviews (30 to 45 minutes) and e-interviews were conducted.

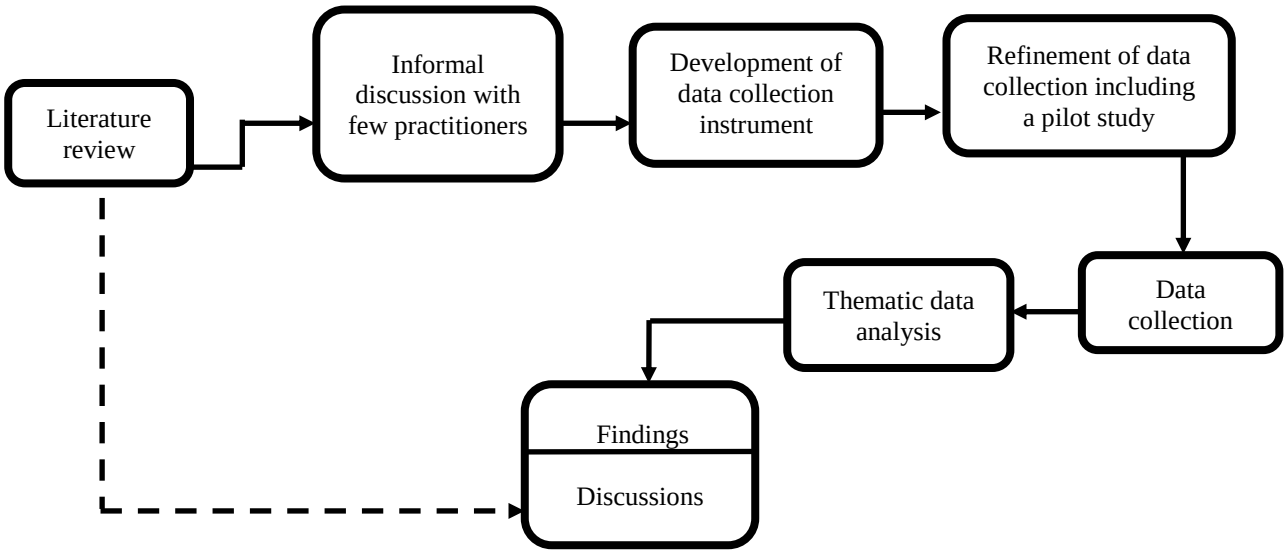


Figure 1: Overall research process

Data collection instruments

Literature review and informal discussion with industry practitioners informed the development of the interview protocol. It was refined to improve the use-ability and reliability [see trustworthiness in the research section for details]. The questions were open-ended, covering the interviewees' background, including their role in the construction industry and the scope. Interviewees awareness of the concept of PtD and usage was explored by asking them questions such as whether they have experience of using PtD and it principles. One of the sections focused on the implications of designers' roles and responsibilities for OSH.

Another section covered how their relationship with other stakeholders, clients, other designers, and contractors would hinder OSH's improvement, including through PtD and the efficiency of the anticipated OSH legislation that will back the designer's OSH responsibilities. The fourth section sought to understand barriers and challenges to PtD and other OSH responsibilities [including OSH promoters] that they have in the absence and or would have in the presence of the anticipated supportive OSH legislation. The questions in this section cover the social, economic and political challenges and barriers, legal-related barriers and challenges, barriers and challenges relating to other designers' interest, the fragmentation of the supply chain and procurement routes—some of the questions in section three were purposefully included to triangulate the few questions in section four.

Data collection

Purposeful and snowballing sampling was adopted in the research. Five hundred and sixty-two architects registered with the Architect Registration Council of Nigeria (ARCON) on the 2013 register were invited to participate in the study. Through personal contact, an additional 33 academics with industrial experience and 13 professionals were also invited. Also, 12 participants were recommended by the interviewees who were then invited to participate in the study. According to Suri (2011), snowballing sampling aims to recruit informants (based on the recommendations of other participants) that can provide credible information in research. Consequently, participants that can provide rich and relevant data can be easily recruited. In total, 620 people were invited to the study. The participants met the following criteria:

- Must have worked in the Nigerian construction industry as a consultant in one of these positions, an architect, an OSH consultant, a builder and a civil engineer.
- The above experience (part-time or full time) must be within the past 10 years from the date of invitation.
- If an academic must have held or had industrial experience alongside the academic experience.

Introductory and invitation letters were sent to participants, clearly stating the research aim, the researchers contact and the criteria above. They were also provided with two options for participation, telephone or face to face interview or where possible and e-interview. The process of the e-interview was explained to them, including the possibilitry of sequel emails or telephone calls to probe or clarify their responses. According to Bampton and Cowton (2002), e-interviews involve collecting qualitative data through the exchange of emails (containing interview questions) between the interviewer and the participants. These open-ended questions are just sent to participants electronically, just like questionnaires (Carter and Fortune 2004). Granted that the data collection method has its limitations like others, authors such as Carter and Fortune (2004) canvas for using the internet to collect qualitative data and even found that using the web and email platform to collect data provided more data than the traditional conference focus group interview. Studies such as Umeokafor and Windapo (2018) have combined both data collection methods in built environment research.

While permission to record the telephone interviews were sought, the introductory letter clearly stated that the information provided would be anonymised, kept confidential and only for research purposes. They were also given the option and timeline for withdrawing from

the study—withdrawal anytime within two weeks of the data collection or even during the data collection.

The study's number was determined by saturation; hence, 28 interviews and e-interviews were used. In establishing this, the saturation grid by Brod et al. (2009) was used. A preliminary saturation grid was designed during interviews and e-interviews, refined during the coding process, and continuously developed as the data collection progressed. Each time an interview or e-interview was conducted, a new column was created to house any new evidence missing in an existing previous subtheme or code in that group which would, in turn, inform a new theme. If a new theme is found, more data was collected. The process was continued until no new meaningful themes that will contribute to theory construction for that group thus the grid column for all the groups are empty. Throughout the coding process and constant comparison, the saturation grid was validated in line with the process that Bowen (2008) proposes. The steps are not limited to noting ideas, hunches and questions while comparing the categories; checking for gaps and new relationships; refining categories to identify areas of commonalities and divergence, and identifying major concepts and themes or categories that capture relationships.

During the interviews and e-interviews, the responses of the interviewees were probed where possible. There were some unclear responses to a few questions or questions that needed probing in the e-interview done via email or phone. The probing drew on the seven techniques for probing by Easterby-Smith et al. (1991) including expanding on some responses to ensure that the interviewer clearly understands; echoing the interviewee's responses and suggesting points following a response but not leading.

Trustworthiness in the research

The nature of qualitative research entails the need to demonstrate steps to ensure trustworthiness in the research (Lincoln and Guba 1985). In doing this, various things can be done including triangulation (Adami 2005), peer-debriefing (Creswell & Miller 2000), refining the interview protocol (Castillo-Montayo 2016) and thick, detailed description (Bowen 2008). In the current study, all of these were done.

For peer debriefing, the authors exchanged ideas on various parts of the research, including the interview questions and methodology. The lead author also discussed some of the questions with colleagues. As will be seen in the following sections, multiple triangulation (Adami 2005), person triangulation (using analysis groups Arch and Build Civil and within-group analysis), and analytical triangulation were adopted. For the analytical triangulation, the use of software, NVivo, and constant comparison were adopted (Humble 2009). Using the analysis groups (Arch and BuildCivil), the triangulation occurred in five ways: dissonant, complementary, convergence, illumination and providing unique information (Sand and Roerstrier 2006). As can be seen here, there is a thick description covering how and why all the activities and events occurred, to enable the readers to make an informed judgement. Lastly, the four-phase interview protocol refinement framework developed by Castillo-Montayo (2016) was adopted. The first phase entailed ensuring that the interview questions aligned with the research questions. In the current study, the interview and e-interview questions were mapped against a research question in a matrix to ensure that no research question was over, under or not addressed. Phase two — Constructing an inquiry-based

conversation to ensure that the rich and sincere information was elicited as much as possible, the interview questions were designed to be conversational. One example of this is avoiding judgemental questions, using day-to-day languages or terminologies in Nigeria, assuring them that the researcher understands the happenings in the country hence the need to relax and pass the information with no fear of condemnation. This would ensure that the interviewee was relaxed and the interview relatable. Following this, in Phase three, receiving feedback on the interview protocol was applied. The researchers read the questions aloud to see how answerable they are. This was revised, the last phase of piloting was conducted, and the data collection instrument was refined and used for the study. In the pilot, the indicative interview questions were tested on four designers (two Architects, a builders and a civil engineer) in Nigeria and their views considered in refining the data collection instrument before use. This resulted in rewording some questions in line with the local context. It indicated the possible responses to the questions, how to ask them and the possible duration of each interview.

Additionally, further steps to improve the research's trustworthiness were taken and mapped against the six phases of the thematic analysis [see data analysis for details]. Notably, the steps and examples therein are not exhaustive but show selected efforts to ensure trustworthiness in the research in every thematic analysis phase. In phase one, reading the data over and over helped ensure prolonged engagement and provided accuracy, showing credibility. For phase two, to ensure credibility where equal attention was given to all the data to ensure that the aim of qualitative research was achieved — capturing multiple realities— the data were organised in a hierarchy of nodes. Dependability and conformability were achieved by using a framework of analysis or coding against preconceived ideas or concepts. The diagramming to show connections of the themes and make sense of them, as shown in Figures 2 and 3 helped achieve dependability in phase three, where the elimination and combination of codes resulted in conformability. The defining and naming of themes, Phase five, helped capture multiple realities to ensure that the data has the same level of attention, ensuring credibility. The last phase of writing up where the methodology was detailed would help ensure transferability as readers will read as much as possible and make informed decisions and conclusions.

Data analysis

The analysis was conducted using NVivo for Mac. The six-phase thematic analysis in line with Braun and Clarke (2006) was adopted covering familiarisation with the data; initial codes; developing or searching for themes; reviewing themes; defining and naming themes, and writing up. Notably, the application is not linear but flexible (Braun and Clarke, 2006). Deductive and inductive approaches to analysis were adopted. This is consistent with studies such as Fereday and Muir-Cochrane (2006). The interviews were transcribed verbatim.

In phase one — familiarisation with the data, the analyst was immersed in the data (e-interviews and interview transcripts) by reading over and over, just as the notes were taken during the data collection.

For the second phase, the initial codes were developed. Here, using line-by-line coding questions not limited to these were asked: 'what is missing here?', What message is passed here? What are the implications? What are the common words? How can an identified pattern be explained? What is consistent within a group of analysis? The line-by-line coding

involves reading the interviews' e-interviews and transcripts word for word or line by line. By implication, this phase started in phase 1. To adequately manage the data, coding commenced by coding to broad parent codes, and coding and re-coding continued. Following this, they were organised into a hierarchy, child nodes and parent nodes. Importantly, latent and manifest meanings were explored just as deductive and inductive approaches were adopted. The coding around preconceived ideas and the analysis framework were first, then those that did not align or were not within the scope of the framework were coded inductively. While authors such as Harding and Whitehead (2013) and Elliot (2018) argue that coding by more than one person, preferably 2 or 3, is ideal, they agree that one person can code qualitative data yet ensure reliability to a reasonable extent. For example, when one person is coding, the coder can ensure consistency over time by 'coding a clean version of a document (transcript) which the coder have previously coded, before comparing' the outputs of the two or more coding processes to see the extent to which they agree or disagree and any newly formed codes (Elliott 2018: 2858). This was applicable in the current study. The coder acknowledges the risk of bias associated with this hence noted all personal bias and addressed it throughout the research. The coder is an expert in construction health and safety including PtD and has research it extensively. The coder also has extensive experience in qualitative research including publishing papers in qualitative methodology [further details has been withheld for review purposes and will be provided afterwards].

The third phase involved searching and developing themes from the existing codes. Here, the existing codes were examined, over and over, arranged, some were combined, and some deleted to form subthemes from where the theme was formed; the codes that do not align to the themes formed new themes. The main defining factor for this phase was how consistent or inconsistent the codes and data therein were. Also, text search query, word tree and Matrix coding were used in this phase. Diagrams were used to show the themes' connections and make sense of themes, for example, Figures 2 and 3.

Phase four— reviewing themes — involved two levels. For level 1, the aim here was to ensure that the extracts were consistent with the potential theme towards merging the theme, enriching themes or subthemes, creating new themes or subthemes and refining them. A key determinant was how sufficient or insufficient data and codes were in the candidate of potential themes and subthemes, and the meaning they presented therein. Hence, the content or extract of each theme was read to ensure consistency and coherency. For the second level, the aim was to ensure that the relationship between the potential themes was well defined, told a compelling story, and potential themes reflective of the entire data. Hence, the entire data was read against each theme.

The fifth — defining and naming themes —and sixth phases —writing up— wherein the former, the fitness for the themes were examined to assess how they address the research questions and objectives. The themes that were overburdened were addressed, and all themes sharpened and refined. The last phase, writing up, involves using diagrams, quotes, tables and narratives to tell the story.

FINDINGS

Overview of the profile of the participants

Twenty-eight interviewees and e-interviewees who participated in the research comprised 15 architects, 9 Civil Engineers and 4 Builders, of which 6 were academics who must have held industrial experience. The entire geopolitical zones [North East, North West, North Central, South-South, South West and South East] in Nigeria were covered. The participants were quite experienced, but some are yet to acquire the average number of years of experience. This is where the years of experience range from 3 to 20 years in the building and civil engineering and infrastructure projects. The industry practitioners work in public and private sectors (large, medium and small enterprises. To improve the research's analysis and trustworthiness, two groups of analysis were used, the 'Arch' group comprising 15 Architects and the 'BuildCivil' group comprising 4 Builders and 9 Civil Engineers. This includes the six academics whose industrial experience designation was used for the group categorisation.

Assessing the particpants' knowledge and awareness of PtD

All the participants were aware of the concept of PtD to a reasonable extent enough to participate in the study. All the participants have designed out hazards at the design stage of the project Lifecycle at some point in their careers, from a few times to very often. This does not mean expertise or adequate knowledge of the topic.

Knowledge and awareness

Limited technical knowledge and awareness of PtD

While the participants have vast experience in the building and civil engineering industry, evidence in the research shows varied level of experience in PtD when asked how their role as a designer contributes to improving OHS including through PtD (Table 1). While few Arch shows a good understanding and knowledge of the technical aspect of PtD, many have limited knowledge; the same is applicable from the BuildCivil. The finding also highlights possible misconception about PtD (also called DFS) and the aspect it covers or skewness of the knowledge towards structural safety to avoid collapse and that the building control departments of local councils were responsible for PtD (Table 1). However, few identified hazards in drawings to draw contractors or other designers' attention, removing the use of hazardous materials at the design stage, for instance, fire considerations such as places to include fire hydrants, steps and staircases in the building.

The quotation below support the lack of PtD technical skills and knowledge and highlights the lack of adequate sources of education detailed in the subtheme, Lack of clarity on PtD duty holder and competency requirements.

'Design for Safety (*DFS) as you call it requires some technical knowledge which is lacking in the industry. Health and safety in Nigeria is not as strong as it is in the UK ... Many of us learn DFS because we studied and worked abroad before coming back home. It is not a core subject here, and training is not commonplace. Many civil engineers and architects lack this knowledge as a result. And little is done by organisations to bridge this gap; that is if they see the gap. Clients, in many cases expect on big projects,* [are not aware of DFS]. *We design out the hazards where possible, don't get me wrong.'* [Civil Engineer and Architect, Abuja]

While the above response is triangulated to fullness later in this theme, when the above response was probed, the participant notes that the types of organisation and project might

mean that some have better knowledge than others but generally speaking there is the need for improvement of knowledge. The participant then asked:

'If people know how to prevent hazards through design that well in Nigeria, why is safety poor in Nigeria and buildings keep collapsing? People cannot be heartless just to leave people to die. If it is [PtD] *taught in schools'.* [Builder South South region]

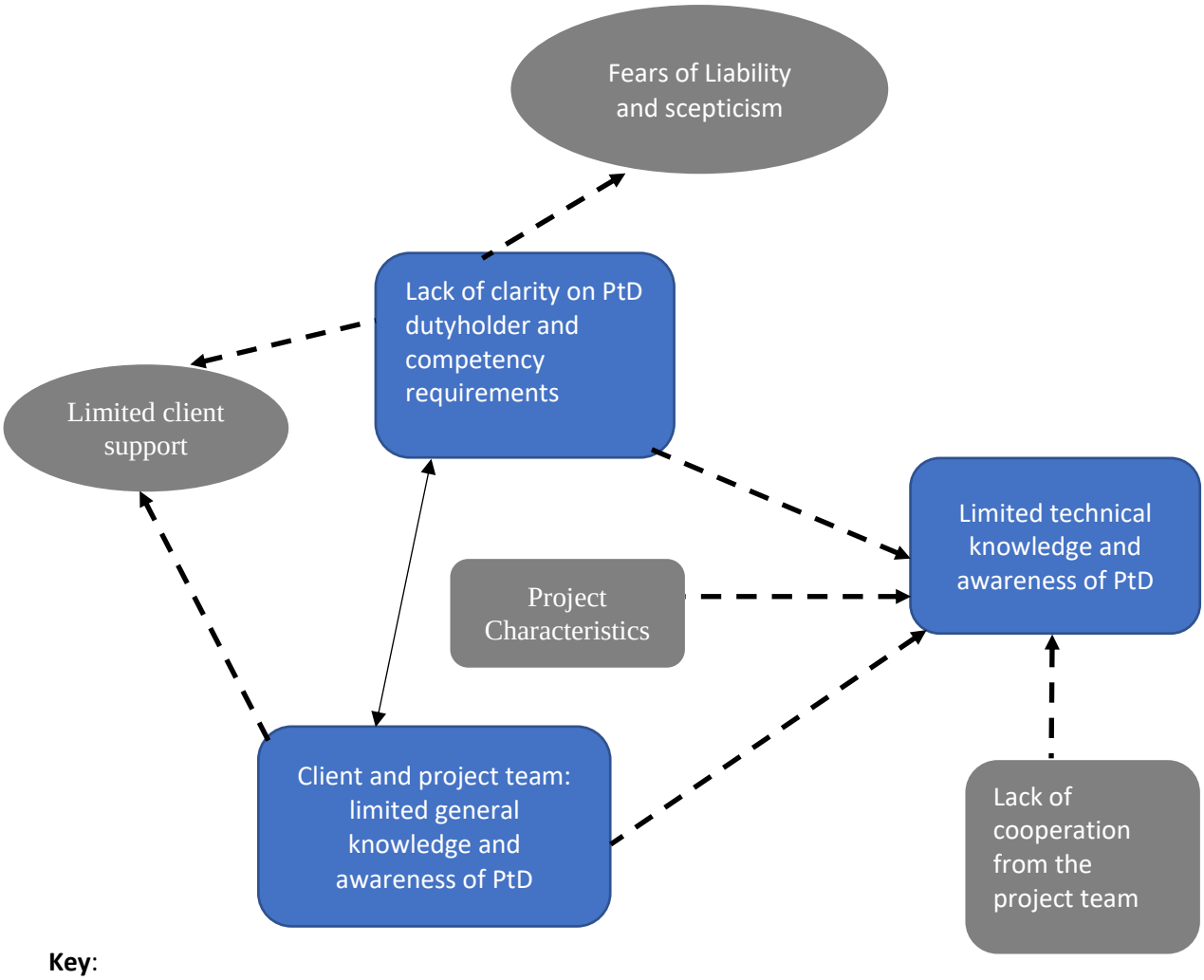
While most of the interviewees acknowledged their roles in OHS, a participant views that PtD was for the clients and designers, not the contractor. However, this participant's response was focused on the traditional procurement method, where the Bill of Quantity is used. Table 1 captures a summary of the findings and Figure 2 mirrors the interactions and causal interferences within the theme and with external themes.

Table 1: A Summary of the barriers to statutory backed legislation for PtD and other OSH management responsibilities for designers

Themes	Subthemes	Evidence
Knowledge and awareness	Client and project team: limited general knowledge and awareness of PtD	Lack of knowledge of PtD by other members of the project team. Limited knowledge of how architects relate or address OHS, including PtD in construction; views mainly the clients. The understanding that time, cost and risk from PtD is usually disproportionate to the benefits. Little understanding that PtD can reduce project cost in some cases. Lack of awareness of laws The client has limited knowledge of safety.
	Lack of clarity on PtD dutyholder and competency requirements	Because of limited knowledge and awareness of architects in OHS in the country, it should be run by safety experts. Lack of agreement on possible duty holder for PtD. Lack of PtD in education curricula. Many designers know little about how to design for safety.
	Limited technical knowledge and awareness of PtD	Limited knowledge of PtD and possible misconception, understanding in some cases mainly focus on stopping building collapse. Additional qualifications can be added to the designers qualification to provide more specialised knowledge. Lack of PtD training and education sources in the countries
Client interest	Limited Client support	Types of clients determine architects ability to drive OHS. Architects' inability to influence clients in terms of OHS. View and experience of some clients being difficult and unsupportive of the Architects' role how much more safety-related roles they will have. Risk of designed out hazard not being implemented on-site because of the client's counter request or other factors. Clients not open to PtD which is demotivating
	Incapacity	Limited 'say' by the Architect to the client and others because of lack of PtD responsibilities supported by law.
	Cost, a priority over PtD	Clients will not support PtD that the cost cannot be justified—money is their priority irrespective of your relationship with them; hence the relationship will not make any difference.

		Trading off safety for cost-saving because of lack of legislation. Increase in project time because of PtD hence increase in cost.
Liability and enforcement issues	Regional differences in standards and enforcement.	The difference in the enforcement of legislation due to location. Higher risk of bribery and corruption in some locations of the country more than the others in enforcement
	Lack of faith in the legal and regulatory process.	The perception that professional bodies are better enforcers than the state. Lengthy court cases hence people take laws into their hands; poor enforcement. Frustration by designers in the enforcement process.
	Fears of Liability and scepticism	Designers fears of what will happens if they get things wrong. Scepticism to innovate design for fear of disadvantages in tendering. Scepticism of risks from changing the existing designs to those that design out hazards in some places.
Lack of cooperation from the project team	Non-implementation of PtD	Procurement of excessive materials with limited storage hence PtD to ensure safe movement of people is not implemented. Procurement of poor-quality materials which are not easy to handle, against what is designed. Designed out hazard not being implemented on-site because of the client's counter request.
	Demotivating Contractor and client	Incompetent and inexperienced contractors with political support or background will not implement PtD; this is demotivating. Demotivating attitudes from the project team, including the client.
	Conflict in the project team	Non-acceptance of the Architects positions by other project team members because of rivalry. High risk of conflict between client and designer; high risk of conflict or clash between designer and contractors.
	Culture, attitude and value	Culture, attitude and value change because of the long absence of the laws hence the need for sensitisation which will take longer. Difficulty in culture change; the late awareness Little value for PtD which can be done with little cost in many cases. Designers give more attention to aesthetics than designing out the hazards; PtD is low on the priority list.
Project characteristics	Increase in duration.	Likely project and design duration because of PtD.
	Increase in cost.	Likely increase in project and design cost due to PtD.
	Project delivery arrangement.	Implications of the increase in cost due to PtD in the procurement of the project. PtD in traditional procurement may not favour designers in terms of cost when compared to other procurement arrangements.

	Not fit for purpose	Difficulty in fully PtD implementing in traditional procurement. Unimplementable design for safety by contractors Design lacks focus — more attention on aesthetics than on practicality that designs out the hazards.



Key:
Causal inference
Subtheme in the current theme
Subtheme from another theme
Another theme
Link

Figure 2: Graphic illustration of interaction and inferences between the subthemes (Lack of clarity on PtD dutyholder and competency requirements, Limited technical knowledge and awareness of PtD, and Client and project team: limited general knowledge and awareness of PtD) in the theme (Knowledge and awareness) and between themes (lack of cooperation from the project team; Project characteristics) and subtheme (culture, value and attitude; limited client support; fear of liabaility and scepticism).

<u>Client and project team: Limited general knowledge and awareness of PtD</u>

There is also evidence of a lack of knowledge in the project team, including the clients, according to the participants (Table 1). Hence, PtD receives limited support as the value and culture for safety needs regeneration and sensitisation. This attitude and lack of value are not limited to the clients and design team but the entire construction industry. This is supported

by the quote on value, culture and attitude [see the theme, lack of cooperation from project team], figure 2 and the ones below from an Architect.

'*The anticipated challenges are proper education of construction industry Professionals towards accepting the OHS promoter as a member of the Design Team to enhance effective project delivery and not a competitor in the present un-holy rivalry amongst Nigerian construction industry Professionals.*' [Architect, South South region]

<u>Lack of clarity on PtD dutyholder and competency requirements</u>

Interestingly, interviewees triangulate the first quotation in the subsection, limited technical knoweldge and awareness of PtD by a Civil Engineer and Architect in Abuja in terms of fullness.

'So, to effectively put in place safety in the construction industry. It should be run by a professional in the field; Architects should not do that. It is better to have specialists to do that, people who are experts in the area of safety or after qualifying as an Architect, studied another course to specialise in that area. In other words, there should be an additional safety qualification than giving the responsibilities to architects.' [Architect and Senior Lecturer, South East region]

While the Architect and academics argue for additional qualification for designers or that PtD becomes an area of specialisation in the existing undergraduate or post-graduate programmes, the interviewee also argues for safety expertise as an alternative and questions the existing knowledge of designers on the subject.

When the indicative questioning of the knowledge of designers on PtD and OHS was probed, the participant claimed that there is the need to strategically include OHS and PtD into the curricula and the need for more training for academics opportunities to do this. The participant then noted that given the content of some OHS courses, the emphasis and anticipated impact or implications for PtD is limited or non-existent. Some do not even cover OHS, how much more PtD.

Another participant expands: '*…the direction of the training is not reflective of the OHS needs of some designers. What is the content? Is it reflective of what it should be, ensuring that the designs are safe? I cannot claim that OHS and PtD are not taught in universities in Nigeria because I do not have the data but I cannot remember any person that said they were taught them at school apart from ensuring that buildings do not collapse. Many acquire the relevant training on their own.'* [Builder, South West region].

While the above questions the quality of training on PtD, it claims that it is not covered in universities based on experience, they indicate that the onus of quality PtD is also on education and training providers, including universities.

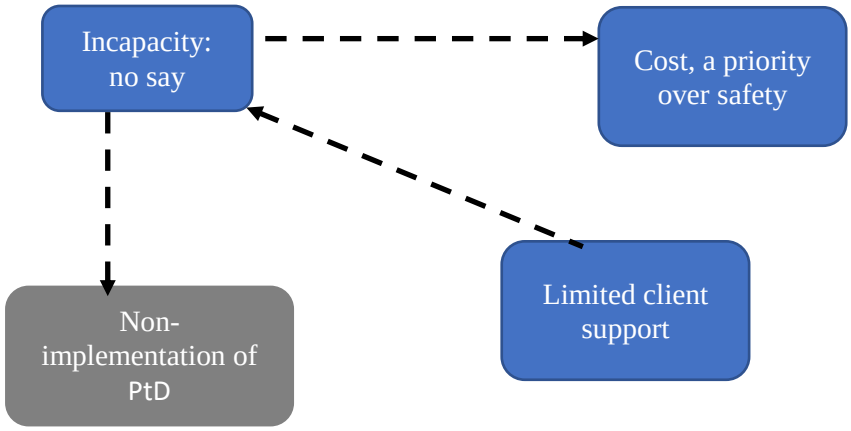
The causal inference between this subtheme and other subthemes is strong (Figure 2). For example, there is a causal inference between lack of clarity on PtD duty holder and competency requirements and external ones, fears of liability and scepticism, and limited client support.

Client interests

This manifests in three ways: lack of client support, incapacity, and clients prioritising cost over safety. These subthemes interact or show causal inference, as seen in Figure 3. For example, there is causal inference between 'incapacity' and 'limited client support' and subtheme in another theme 'non-implementation of PtD'. Many of the interviewees from both groups report limited client involvement or support in OHS and view that the same may be applicable if any OHS laws to be introduced is not adequately enforced. Many in the 'Arch' group in the industry triangulate this to completion in that a causal factor to this is that they have little grounds or 'say' to drive or convince the client because they lack the legal backing for the OHS responsibilities. The Arch group also report that these clients then prioritise cost over safety, especially when PtD will cost more or increase the project time because there is no legal backing.

There is some evidence that points to public clients inclining to designers' voice or requests; this is mirrored below.

'*For instance, in Abuja few government buildings [have] ramps being introduced. If such laws are in place, it will be a welcome development. ..If [Architects] introduce them to clients, some may not listen you. They feel that if a disabled person comes to the building, he/she should have someone to assist them to the next floor. But relevant laws and public awareness in place will influence the institution as a whole. I think it will be a welcome development. Clients do not buy into some things we want to introduce in design.'* [Architect, former company owner, Abuja]



Key:
Causal inference
Subtheme in the current theme
Another theme

Figure 3: Graphic illustration of interaction and inferences between the subthemes here (incapacity and limited client support) and between another theme (non-implementation of PtD).

While the quotation above also evidences inequality, which can present a risk of slip and fall when people carry the person with a disability on the wheelchair, it is likely to have implications for the mental health and well-being of the person with a disability on the wheelchair who needs to access buildings. It may also be against the Discrimination Against Persons with Disabilities (Prohibition) Act 2018 in Nigeria if it is a public building.

The points on lack of client support in terms of implementation of PtD on site because of the client counter request are covered by many in the BuildCivil group and a couple of 'Arch' but tends to be more emphasised in the South East, North East and North West of the country in the account of the Arch group. This point of lack of safety as a priority aligns with evidence in the subtheme, culture, value and attitude in that there is a causal inference from the latter to the former

Liability and Enforcement issues

This theme has three subthemes, regional difference in regulation, lack of faith in the legal and regulatory process, and the fear of liability and scepticism. They all have interactions and causal inferences (Figure 4). For example, fear of liability and scepticism has causal inference between the regional difference in regulation, project characteristics, and an external subtheme, Limited technical knowledge and awareness of PtD.

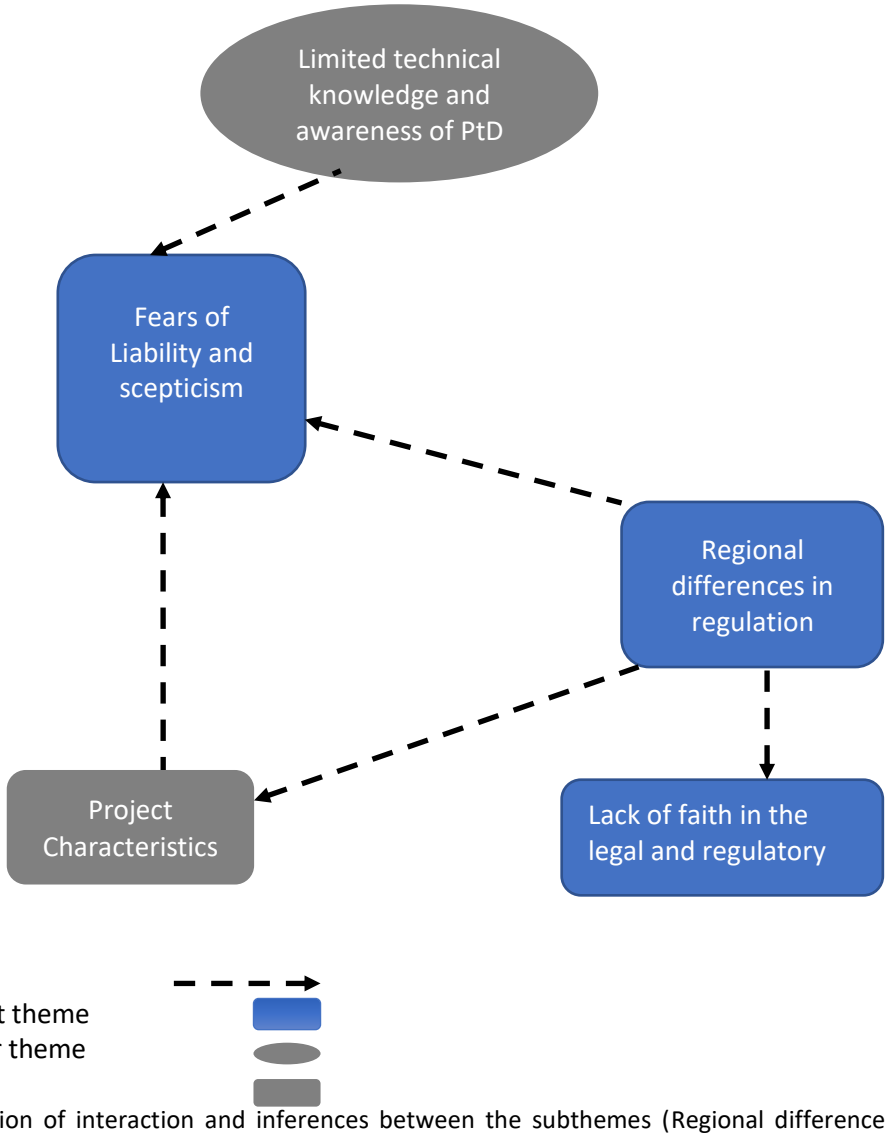


Figure 4: Graphic illustration of interaction and inferences between the subthemes (Regional difference in regulation; Fears of Liability and scepticism; Lack of faith in the legal and regulatory process), the theme (project characteristics) and another subtheme (Limited technical knowledge and awareness of PtD)

Quite a reasonable number of interviewees from both groups made the point on the regional difference in the enforcement of regulations in the construction industry and the level of

standards, but this tends to be emphasised by mainly those with many years of experience of working in more than one geopolitical zone. While this is applicable in Nigeria's complex OHS regulatory environment, it can also be seen in others in the construction industry. The interviewees view that the case may not be different on the introduction of legislation for PtD and other OHS management responsibilities for designers. The interviewees' accounts capture the difference in the effectiveness of enforcement of laws due to the difference in regions or locations.

'*…the standard in Abuja is different from the rest of the country. For instance, the Architects Registration Council of Nigeria, the regulatory body of architects in Nigeria, is more active in Abuja and maybe Lagos and Port Harcourt. They try to minimise quackery in the profession. In Abuja, before your drawing goes for approval, there are certain measures in place to ensure it is* [produced] *by registered architects [*with the potentials of getting to] *the development council.* [With the relevant laws, implementation is easier] *in Abuja. For instance, I have also* [worked] *in the east, … Enugu and Anambra. You find out that development authorities there do not follow up. The Architects Registration Council of Nigeria is [*less active there compared] *to Abuja.'* [Architect 1, North Central (Abuja)]

'*We, architects, work very hard to get approvals. .. The kind of jobs* [Most architects] *do in Enugu or Anambra cannot* [occur] *here. Once the drawing* [goes for] *approval, it is thrown out, and [*if approval is not secured, the client will see] *as incompetent. If you* [produce a] *design in Abuja and fail* [to secure] *approval from development control, your client will be unhappy with you. However, in the east or other places*, [architects] *design anything, give a little money to the development authority and secure approval to build. But in Abuja* [development authorities] *are very strict; If you do not get approval and you go ahead and construct, it is at your risk, because one day development authorities pull the house down.'* [Architect 2, North Central (Abuja)]

The account of Architect 2 shows inequality in the efforts that architects put into their works and disappointment in this regard. It also contributes to the second subtheme, Lack of faith in the legal and regulatory process.

Few interviewees in both groups of analysis also note the second subtheme in Lack of faith in the legal and regulatory process. The interviewees' account shows the need for a more trusted regulatory system to achieve a better result, including regulatees' cooperation.

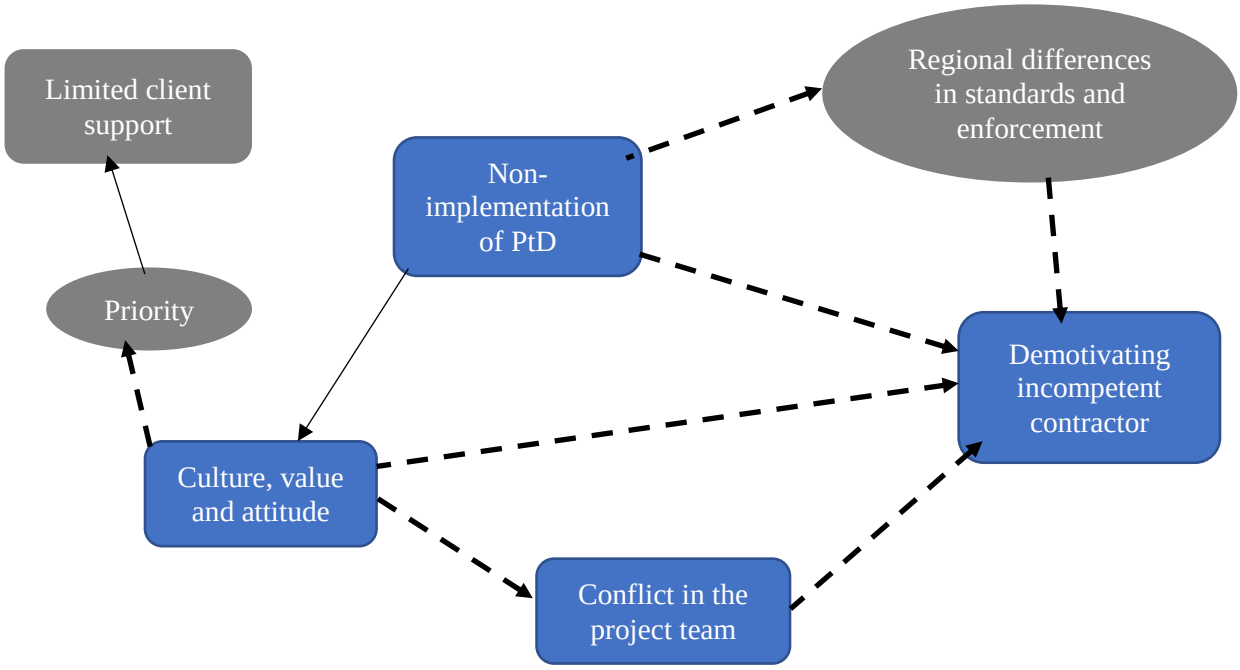
There is evidence to conclude that the fears of liability and scepticism to apply the PtD concept are due to the anticipated uncertainty in tendering, for example, if the client is not knowledgeable enough on the concept, they may view it as irrelevant. While few interviewees were sceptical because of associated risks from implementing PtD which they have limited knowledge, some don't want to deviate from the norm with some clients. The quote below mirrors this.

'*Nobody wants to be responsible for anything that goes wrong if you change how things are done in the name of PtD. I am not sure what difference a law will make here... What if you change the design of the structure and it does not gain approval? What if the cost and time of the project increase and you lose out to other designers* [in the tendering]? *If you are talking about changing things to make the site safe, yes, these are easier.'* [Civil Engineer, South East].

Lack of cooperation from the project team

This manifests in four subthemes: non-implementation of PtD; Demotivating incompetent contractors; Conflict in the project team; and culture, attitude and value. There are inferences or interactions with the subthemes in the themes but some interviewees did not show this. These interactions and inferences, including the causal ones, are captured in Figure 5. The Figure also shows the triangulation of the data in terms of completeness or fullness and inter-theme inferences and interactions.

The interviewees' accounts in both groups show the non-implementation of PtD, but the groups report their manifestation differently. Many in the BuildCivil suggest that the non-implementation of PtD is due to the procurement of materials that either the storage and quality counter the implementation of the outcomes of the PtD, but there is no evidence of this in the Arch group. They also contribute to the point, the request that some parts of PtD are not implemented. Some interviewees in the Arch group support this which has implications for the regional difference. Following on from the regional differences in standards and enforcement, inferences of demotivation, as a result are captured, reported in another theme (Lack of cooperation from the project team).



Key:
Causal inference
Subtheme in the current theme
Subtheme from another theme
Another theme
Link

Figure 5: Graphic illustration of interaction and inferences between the subthemes (priority, and regional difference in standards and enforcement) in the theme (Lack of cooperation from the project team) and between themes (non-implementation of PtD; culture, value and attitude; conflict in the project team; demotivating incompetent contractor)

Further points on demotivation can be seen in the culture, values, and attitudes, resulting in OHS being a low priority hence the need for regeneration of the mind, culture and values

(Figure 5). This subtheme seems to have attracted much attention from the interviewees with most of them, providing responses that relate to this subtheme. However, there is a difference in response based on groups with the Arch group focusing on little value for PtD which comes at little cost, and the timing of the change, attitude and awareness, the BuildCivil group does not focus on timing and value but culture, attitude and awareness. The quotations below show some of these points.

'The proposed health and safety laws in the construction industry are overdue. Unfortunately, it is the fact that such laws are just about rearing their heads now that appear to make their advent a strange phenomenon. Elsewhere, matters of safety and health assume priority in all facets of interaction not only in the construction industry but in all areas of interaction involving human presence. But because the awareness is coming late, our attitudes and values need first be rebased to entrench acceptability of what, at first glance, might appear to be an oddity with the erroneously accepted norms in the construction task that hardly consider health and safety considerations.' [Academic and Architect; North Central (Jos)]

'*Our attitude as a nation to safety is poor. …Designing out hazards can be done at no additional cost in some cases, but for some reasons [including] lack of awareness and knowledge of how this is done, they are not done. Sometimes, we (Architects) can easily do it but we don't, even when the clients don't interfere. This has industry culture undertone. I recall a project [name withheld] where I designed the windows to … be cleaned from the ground, but because making them bigger was more aesthetically appealing, the lead Architect went for this option. When I raised the issue, he said 'while the client does not mind, in Nigeria, aesthetics is more of the Architects interest'. This is* [despite] *my explanations that cleaning the window and the installation would meaning working from height. As a young architect, [this] demotivate us to apply the* [knoweldge gained] *abroad?'* [Architect; North Central and South South]

While the account above supports the discourse, it also shows strong reflection, demotivation, lack of appreciation, and attempts to lower the participant's esteem. Inference can then be made from a few other r interviewees that such differences in value and culture and attitude towards PtD can result in a conflict that is demotivating to designers especially when they find themselves also working as project managers (Figure 5).

Project characteristics

Figure 6 mirrors the interaction and inferences between the subthemes and evidence on how project characteristics hinder PtD. The lack of general knowledge and awareness of PtD by the project team and clients is fuelled by the increase in duration and the project's cost. However, this may not always be the case, as PtD can save direct or indirect costs from incidents because it can prevent them, but this positive aspect is overlooked in some cases, according to a few in the Arch group. Understandably, their experience indicates that the cost of design is likely to increase once the design is altered. The project delivery arrangement that is separated, such as traditional procurement would not support PtD as the collaborative ones. This unfavourable procurement arrangement does not favour designers. These would have an implication for the cost of the project.

There was also evidence from a few in both groups of analysis who have worked or work for contractors that they have experienced design that should remove or reduce hazards that are disconnected between the PtD paperwork and the construction process. Some in the

BuildCivil group claim that architects pay more attention to the product's aesthetics than safety; hence PtD is the least on the priority list.

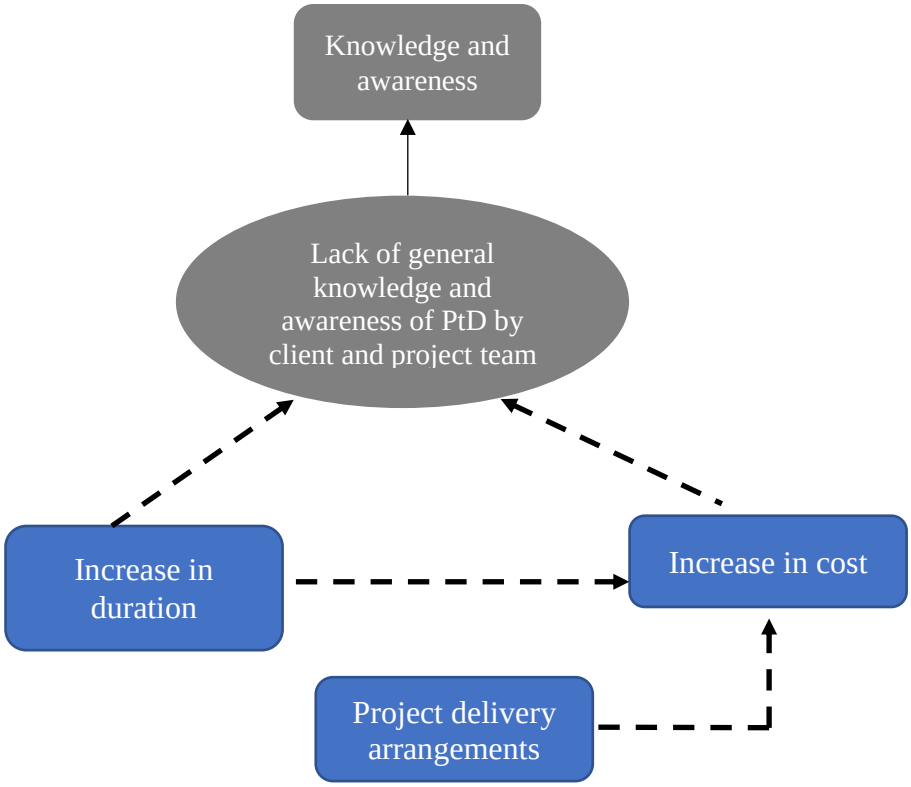


Figure 6: Graphic illustration of interaction and inferences between the subthemes (increase in duration, increase in cost, and project deleivery arranagements) in the theme (project characteristics) and between another theme (knowledge and awareness)

Summary of causal inferences among the critical barriers

The several causal inferences within the themes and between them in Figures 2 to 6 are synthesised from the findings resulting in an overall causal inference figure, 7. While the details of the causal inferences among the barriers are detailed in the aforementioned figures, Figure 7 offers several unique insights into the discourse. For example, it shows the bilateral-causal inference between the themes, client interest and lack of cooperation from the project team in that there are barriers in them inferred to cause each other. In particular, the limited client support for DFS (due to knowledge and awareness-related barriers (Figure 2)) accounts for the negative culture, value and attitude towards DFS in the industry (Figure 7). On the other hand, as a result of the said culture, value and attitude towards DFS, it is not a priority hence the limited client support (Figure 5). Further, the former causal inference suggests that client support is dependent on the level of knowledge and awareness which will determine the value, culture and attitude towards DFS hence their level of cooperation.

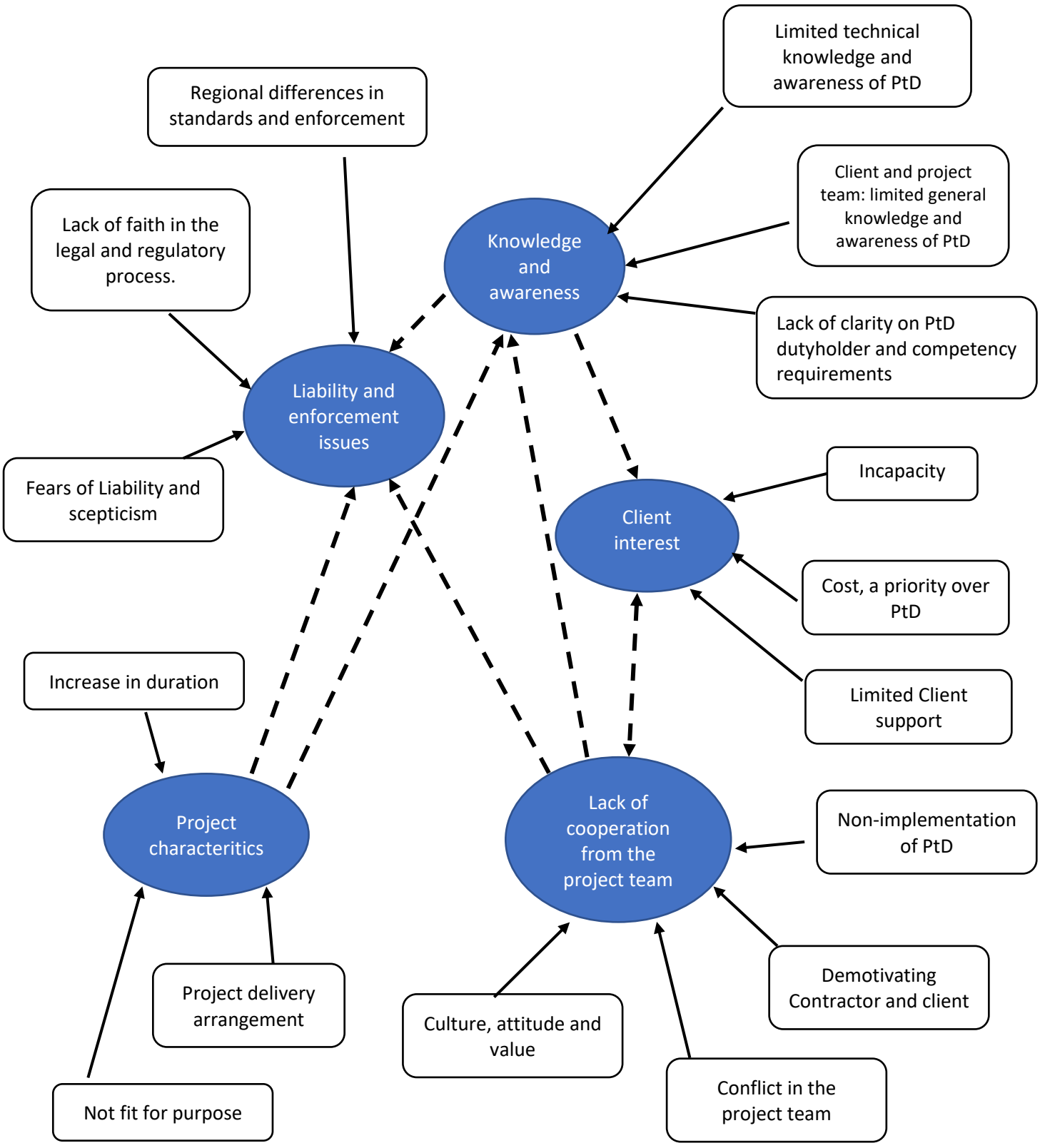


Figure 7: A summary of the overall causal inference: A synthesis of the critical barriers to PtD in Nigeria

Key:

Causal inference

Emerging subtheme

Emerging theme

Link or connection

Another insight from Figure 7 is the emphasised strategic position of knowledge and awareness of DFS in that it is the only theme with causal inference between each of the themes. The role of the need for cooperation from the project team is also highlighted in the figure. However, the figure also shows that no causal inference was identified between client interest and project characteristics, and the latter and lack of cooperation from the project team, and client interest and liability and enforcement issues.

DISCUSSION

The sample is made up of the variations of the population. For example, the country's six geopolitical zones are covered, the public and private sector, just as small, medium and large contractors and building and civil engineering are covered. Unlike in quantitative research where such contribute to the representation of the population or statistical generalisation, according to Adami (2005) the representation helps address the epistemological aspect of the study aim. The interviewees' diverse range of experiences enables them to offer what Patton (1990) describes as rich information. For example, academics who hold or have held industrial positions where they may have worked for various categories of employers with about 20 years of experience can draw on the diverse and many years of experience. The implications of this include that the trustworthiness of the research is improved. 'Design of multi-disciplinary and a social process' (Pirzadeh et al. 2020: 647), and, the sample, including their characteristics, share the same features.

The Literature review section of this paper shows the need to understand why there is a very high level of awareness of PtD and an above-average number of lessons on it among architects, but the engagement with PtD is low in Nigeria and Ghana respectively (Manu et al. 2018, 2019). The same is reported for civil engineers in Nigeria (Labo-Popoola et al. 2019). The findings of the current study explain this finding in these positivist studies in that while there is a very high awareness of PtD in the studies described above, just as there is relatively sufficient level of education, it does not necessarily translate to the required level of knowledge needed to implement PtD. The skewness of the knowledge of PtD towards the structural safety questions their knowledge of PtD. This is triangulated as per fullness by the report of lack of basic proper education of PtD, its absence in the curricula of many schools, and the inability of all training on PtD or OHS to meet designers' needs. This lack of PtD education in universities is also reported in the US by Toole and Erger (2018), and Goh and Chua (2016) found that lack of PtD knowledge and guidance are key barriers to PtD. The risk associated with lack of designer expertise in PtD is covered in Toole and Erger (2018). Academic qualifications and types of training are not covered by Manu et al. (2018) and Labo-Popoola et al. (2019) and used in the analysis; this may shed some light on the inconclusive results.

Nevertheless, the limited knowledge of PtD and the high awareness of PtD but low adoption of it may be explained by the interviewees ' geographic location as the study finds. Literature review supports this, showing the influence of geographic location on OHS in Nigeria. In Nigeria, the awareness of OHS is higher in Port Harcourt because of the oil sector which has a higher level of safety requirements than others. It is higher in Lagos because it is the

country's commercial capital, the wealthiest state in the country and has many big organisations there; Abuja is the administrative capital with large projects by multinational contractors who are influenced by the policy of their parent company. These also result in a difference in OHS regulation.

The limited knowledge of PtD in the current study, when compared the findings of Toole and Erger (2018) in the United States of America on PtD knowledge, there is no evidence of geographic location implications. Rather issues include the lack of PtD education in higher education which is also found in the current study and the Occupational Safety and Health Administration's and National Institute for Occupational Safety and Health's guidance documents and checklist on PtD are too generic given the unique nature of construction projects (Toole and Erger 2018). This does not mean that developing countries does not experience the latter, but this is to show just one unique possible challenge that developing countries encounter.

The finding of fear of liability as a barrier to PtD in the current study is consistent with the Risk of a lawsuit of liability also agrees with Gambatese et al. (2015), Toole and Erger (2018) and Labo-Popoola et al. (2019). Labo-Popoola et al. (2019) found that designers' exposure to liability was the highest barrier to PtD. This is followed by project time requirement and the third being cost requirement . While the interpretation of the findings of Labo-Popoola et al. (2019) is limited by the little information provided, there is little or no evidence to suggest or conclude that the fear of liability was experienced by most of the interviewees. However, the study suggests that the enforcement issues may exacerbate the country's fear of liability and limited knowledge and understanding of PtD.

Lack of cooperation from the project team is revealing in that it shows the key role of a group or team dynamics that will enable optimum synergy in PtD is emphasised. Given that the designers may not always be on site to ensure the implementation of the design for safety depending on the contractual or procurement arrangement, others' attitudes in the project team who will implement or approve it need to be supportive. Other findings such as an increase in project cost and duration align with Labo-Popoola et al. (2019) findings. However, the current study expands on the discourse by providing their implication of causal inference on the client and team's lack of general knowledge and awareness of PtD. This implies that the limited knowledge barrier is also fuelled by the designers' experiences, which may not always be correct.

Also revealing is the low value for PtD and the negative attitude toward this of which one of the possible explanations is the long absence OHS legislation and good regulatory environment. The regulatory challenges in DCs in terms of OSH are reported in studies such as Umeokafor et al. (2020) where the regulatory environment is complex and adequate regulation is non-existent. Such limitations can be seen in other non-safety legislation such as the Disability Act in Nigeria in that it is limited to access to public buildings. Of course, if the client is private, they are not breaking the laws. The need for adequate enforcement for optimum PtD cannot be overemphasised. The questionable knowledge of PtD among the designers is consistent with the unimplementable design for safety in the study (Table 1). The finding of a disconnect between the PtD paperwork and the supposed construction process is aligned with the findings of Larsen and Whyte (2013) who found a discrepancy between

information required and information available pre-construction. The finding that PtD should be left for the experts and not for Architects raises concern about whether there will be widespread acceptance of PtD responsibilities when supported by legislation in the country.

The limited client support for PtD remains a critical concern given their strategic position in the construction supply chain. The lack of adequate knowledge of PtD concerning the client and their limited understanding of the benefits may explain their limited support for PtD. Pirzadeh et al. (2020) suggest that such knowledge gap can be addressed by collaboration and effective interaction between project participants in design and construction decisions by being a catalyst to OSH knowledge and information sharing between the participants which in this case can be clients and designers and clients and contractors. Of course, their contribution would differ where the designer (e.g. design Engineer) would offer design knowledge, and the constructor would offer construction expertise (Pirzadeh et al. 2020). It is possible that the procurement arrangements would determine the level of interaction with the collaborative one supporting more than the traditional one.

Further, on procurement arrangement, the study found that separated project delivery arrangement has negative cost implications for the project. Procurement arrangement has implications for safety in design as was found in Pirzadeh et al. (2020) were a design and build project, amid clients emphasis on the end-use requirements, contractors still received the relevant support in the form of permission to decide on the design and construction process. The contractors took advantage of this to make decisions that improved constructability and OHS, including PtD.

Causal inferences among the critical barriers

There are several causal inferneces within the themes and between them (Figures 2 to 7). One of the strategic findings is the dependence of PtD in Nigeria on its knowledge and awareness, given the strong causal inference between the barriers therein and other themes. While Designers require the relevant skills, knowledge and attributes on which PtD implementation is depeendant on as Che Ibrahim et al. (2020) found, other stakeholders such as client also need some level of awareness and knowledge of it which will inform their attitude, values and culture towards it. The current study shows that this account for the level of support they provide to PtD. PtD is a collective responsbility encompassing ‘Cs (Cooperation, Communication and Coordination)’which is dependent on the skills, knowedege and experience, according to Che Ibrahim et al. (2020). The causal inference in Figure 7 agree with this findings of Che Ibrahim et al. (2020) and highlights another theme (lack of cooperation from the project team) in the figure with a core contribution to the discourse. The difference in culture, interest and values in the project team impact of group dynamics of which the absence of the relevant laws that support PtD in the country is blamed. In an industry where collaboration is a major challenge and confict and adversarialism is a norm, the challenging platform for PtD to thrive increases.

Equally important is the no observed causal inference between a few themes, for example, project characteristics and lack of lack of cooperation from the project team. Given that project characteristics such as the project delivery arranagements define the nature relationship, roles and responsibilities of clients, contractors and designers and even the

effectiveness and efficiency of PtD but has not causal inference with lack of cooperation from the project team is insightful. A possible explantion may be the nature of project delivery arranagement of other factors.

Nevertheless, the causal infernece and other findings can result in propositions or hypotheses that may require further testing from the quanatitaive perspective. One is that project characteristics has no moderating effect on the relationship between PtD implementation and cooperation from the project team. PtD knowledge and awareness is the most critical success factor for PtD implementation in Nigeria and some other developing countries. Project characteristics has no influence on client interest in PtD.

Study implications

The findings offer insight into inconclusive findings in the extant studies of which one is the disconnect between the high level of awareness of PtD and considerable education on it, and the poor implementation of PtD (Manu et al. 2018, 2019; Labo-Popoola et al. 2019). This is where the quality of education and training, including the content and its ability to meet designers' needs to design out hazards, is questioned, hence explaining or concluding the inconclusive finding above.

The implications here include the need for the quality of PtD education and training to meet the local needs of designers in OHS and PtD. The education and training could include introducing designers to digital tools for PtD (Farghaly et al., 2021). For example, PtD inculcation in the education curricula can result in a shift from a high awareness level of PtD to a high level of knowledge of PtD. The focus here should be on PtD that is fit for purpose in DCs such as Nigeria, designed to meet their needs and the contexts of the countries therein. The regulation or standardisation of the training and education of PtD can ensure that this objective is achieved. However, DCs' regulatory environment has its unique challenges, a barrier strategic measure such as PtD. Consequently, professional bodies and the details are covered elsewhere in this paper. This by no ways suggests that this is a silver bullet but just one of the subtle ways of achieving and improving PtD where there are limited government involvement and a poor regulatory environment. Lingard et al. (2012) find that external stakeholders such as insurance companies, the state government, and supermarket chains have a positive and significant influence in decision making concerning OHS. Hence, granted the strategic and significant role that external stakeholders play in PtD outcome, Lingard et al. (2012) recommend greater recognition of their role. They also suggest that these external stakeholders are critical for achieving a better outcome for PtD.

The findings on the difference in knowledge and practice of PtD due to geographic locations can offer insight to develop PtD implementation strategies that consider the local disparity on OHS knowledge in Nigeria. The can be beneficial to contractors, designers, design organisations, policymakers and even academics. Also, the finding on the strategic role of the knowledge and awareness of PtD including being a core dependent factor for sustainable PtD in Nigeria can inform initial or major strategies on OSH improvement in organisations and even the country, especially in companies with limited resources for OSH that want to strategically target an OSH challenge. Further, the interviewees ' acknowledgement of the need for experts to design out hazards suggests designers’ self-awareness of their capabilities

on PtD which is an opportunity to inculcate the adequate competence level of standard for PtD.

The lack of cooperation from project team-related barriers including the conflict in the project team and demotivation for PtD from clients and contractors could inspire research on training on the team or group dynamics in OHS management. This would offer insight and knowledge into the attitude, culture and value for PtD needed to foster it. The study has several theoretical implications of which one is the interpretivist/constructivist insight into the barriers to the implementation of PtD in Nigeria which is also country context-based.

CONCLUSIONS AND RECOMMENDATIONS

The limited research on PtD in DCs is the basis for this research which examined the barriers to PtD and other OSH responsibilities for designers in DCs through social constructivism with Nigeria as a case study. The study explains inconclusive findings in the extant studies where there is a disconnect between the high level of awareness of PtD and considerable education on it, and the poor implementation of it. It was found that the quality of education and training PtD that the designers receive can explain this. This includes the fact that while PtD is not covered in some universities' curriculum, the content of some PtD training and lessons does not meet designers' needs. Further explanations of the limited knowledge of PtD and the high awareness of PtD but low adoption of it may be explained by the interviewees' geographic location. Key cities in Nigeria such as Lagos, Abuja and Port Harcourt, record a higher level of knowledge and attitude towards OSH and a higher level of OSH regulation. Other barriers include the fear of liability from PtD and the lack of cooperation from the project team. The study further expands on the extant knowledge of the barriers of PtD — increase in project cost and duration — showing the causal inference on the lack of general knowledge and awareness of PtD of the client and project team. Literature suggests that lack of provision of PtD training in universities or other higher education institutions have implication for the quality and level of PtD knowledge, the findings of the current study support this in that there is a difference in the qualiaty of training provided which may not adequately cover PtD to meet the needs of designers. Enforcement of statutory-based PtD obligations for designers currently remains a key barrier and is indicated to remain the same when and if the relevant statute is in place.

The study recommends the involvement or contribution of professional bodies in the regulation of PtD education. Their role would include driving the inclusion of PtD in the education curricula by ensuring that it is covered in professional examinations and continuous professional developments. The quality of training and education of PtD needs attention to ensure that it is fit for purpose, including meeting the competence needs of designers, a recommendation for policymakers and stakeholders in the construction industry. There should be a standard or framework for the contents of PtD training, just as competencies for PtD. It is anticipated that the willingness of the interviewees to advance their knowledge of PtD would catalyse this. There should be sensitisation of designers and clients to reduce the fear of liability from PtD, a recommendation for stakeholders in the construction industry. The study has not examined the eduction background of the designers as a core unit of analysis, a limitation of the study. Hence, there is the need to further examine the education background of designers, a determinant of knowledge of PtD among designers. Consequently,

further research (preferably using mixed-methods) on this is recommended. This will provide contextual in-depth qualitative insight and test any hypotheses and propositions that may emerge. This includes, for example, that there is no difference in the PtD knowledge of designers with formal and informal education of the subject. Further research can seek to understand the context-based PtD competence requirements of designers in Nigeria. Given the contextual differences between developed and developing countries and the rise in the decolonisation of education curricula, the need for such research is emphasised. It is possible that if an analytical framework based on this is used in the current study, it will offer additional context-based insight, a possible limitation of this study. Further studies can also examine the subsection, causal inferences among the critical barriers.

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