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**DESIGN FOR OCCUPATIONAL SAFETY AND HEALTH: AN INTEGRATED MODEL FOR DESIGNERS’ KNOWLEDGE ASSESSMENT**

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**DESIGN FOR OCCUPATIONAL SAFETY AND HEALTH: AN INTEGRATED MODEL FOR DESIGNERS’ KNOWLEDGE ASSESSMENT**

One of the approaches to mitigate occupational safety and health (OSH) risk on construction projects is the design for occupational safety and health (DfOSH) initiative. The DfOSH initiative places a duty on designers to originate designs that are inherently safe for construction, maintenance, occupation and demolition. To achieve this goal, designers must possess appropriate knowledge of OSH risks as they relate to construction products. However, what constitutes DfOSH knowledge of designers is still not clear in the extant literature as well as in practice. Hence, this study systematically reviews literature of prior conceptualisations of the knowledge construct, undertakes contents analyses and provides a robust conceptualisation as a basis for its meaningful operationalisation with regards to DfOSH. The robust conceptualisation of the knowledge construct underpinned the development of a nomological network to operationalise the DfOSH knowledge of designers. The study presents knowledge regarding DfOSH as a multi-dimensional construct that can be measured at various levels of specificity. The integrated model can serve as a guide for clients to clarify the DfOSH knowledge of prospective designers in the procurement process. Respectively, designers intending to improve on their DfOSH knowledge can similarly be guided by this model to identify their DfOSH knowledge gaps and subsequently take steps to overcome such knowledge deficiencies. Additionally, the model invokes further studies, both theoretically and empirically, into how designers’ DfOSH knowledge can be effectively harnessed and enhanced for managing OSH risk.

Keywords: Design for Occupational Safety and Health, Prevention through design, Designers’ knowledge, Integrated model, Construction.

**INTRODUCTION**

The varied views and uncoordinated efforts of stakeholders along the construction supply chain partly explain the poor OSH risks management on projects (Willumsen et al., 2019). Previously, contractors mainly bore the responsibility of OSH risks management on construction projects (Hare et al., 2006). However, a deeper analysis of the root causes of sub-optimal OSH performance on construction projects is implicating project stakeholders (i.e. clients and designers) upstream of the construction supply chain. Their procurement and design decisions most often have impacts on OSH risk performance downstream of the supply chain. Hence, for effective project OSH risks management, a focus is now placed on stakeholders at the upstream of the supply chain in a philosophy termed as “prevention through design (DfOSH)” (Szymberski, 1997; Gambatese et al. 2005; Lingard et al., 2015). This philosophy places a moral, as well as in some jurisdictions a legal, duty on designers to originate designs or construction products that are inherently safe for construction, occupation, maintenance and demolition. Some researchers (for example, Gambatese et al., 2005; Goh and Chua, 2016) have advocated for awareness creation and capacity building among designers to enhance their contributions to project health and safety management, particularly at the pre-construction stage.

The nexus between procurement as well as design decisions and OSH risks downstream of the construction supply chain came to the attention of the European Union (EU) and its European Council (EC) responded by adopting Council Directive 1992/57/EEC on the implementation of minimum safety and health requirements at temporary or mobile construction sites. In 1994 the UK, which had been a full member of the EU until recently, transposed the Directive into UK legislation as part of the Construction (Design and Management) Regulations 1994 (CDM 1994). These Regulations imposed statutory safety and health duties on the traditional members (i.e. clients, designers, and contractors) of construction project supply chains. Since 1994, the UK’s Health and Safety Executive (HSE), the national regulatory authority for health and safety, has had to revise these Regulations twice – in 2007 (CDM 2007) and in 2015 (CDM 2015). One of the key changes made in CDM 2015 is the replacement of the requirement for *competences* of dutyholders with *skills, knowledge and experience (SKE)* of individual dutyholders and *organisational capability* where a dutyholder is an organisation.

Regulation 8(3) of the CDM 2015 puts on anyone appointing an individual CDM dutyholder, including a designer, a duty to take reasonable steps to satisfy itself that the appointee has the SKE and organizational capability (where the dutyholder is an organisation) to carry out the work in a way that secures health and safety. Respectively, a designer must not accept an appointment unless it has the SKE to carry out the assignment in way that secures health and safety. Failure to fulfil these duties is a criminal offence for which the appointer and the appointee may be prosecuted. Further, in the replacement of the CDM 2007 with CDM 2015, the HSE has indicated that the health and safety *competence* should be dealt with by way of professional bodies and the industry rather than by a regulatory requirement (HSE, 2014). However, there is a paucity of knowledge in the extant literature as well as a considerable amount of confusion in the construction industry as to what specifically constitutes DfOSH skills, knowledge, experience and organisational capability (for individual and corporate designers respectively) and more importantly how to measure these constructs. This study, thus, particularly aims at the explication and operationalisation of DfOSH knowledge of designers. It is expected that further studies investigate same for, skills, experience and organisational capability as they relate to individual and corporate designers respectively.

The study is structured in five sections. The first section provides an introduction and motivation for this study. The method or approach to the study is provided in the second section. The third section focuses on the meaning and theoretical model for measuring and assessing the DfOSH knowledge of designers. The fourth section offers some discussions on the model, points to areas for further research and indicates some practical applications of the study. In the last section, the conclusions of the study are presented.

**METHODS**

This study initially conceptualises the DfOSH knowledge construct of designers, and subsequently develops an integrated model for the operationalisation of the construct. To fulfil the first part, a systematic review of literature of how prior studies have sought to conceptualise knowledge of a worker was undertaken. This was to provide a basis for conceptual content analysis, synthesis and provision of a broad conceptualisation of the knowledge construct. Scopus was used as the main database for the literature search with additional information from Google Scholar. In comparison with other databases (e.g. PubMed, Web of Science and Google Scholar), Scopus has an extensive coverage in all fields including science, technology, social sciences, arts and humanities (Chadegani et al., 2013; Mongeon and Paul-Hus, 2016). The key search word or phrase was “Definition of knowledge”. The search word or phrase in Scopus returned 372 results. The search results covered over 10 subject categories such as construction; engineering; social science; economics and finance; medicine; education; psychology; arts and humanities; computer science; medicine; business, management and accounting, etc. The year range was 1964 to April 2020 as supplied by Scopus.

The identified publications were screened, preliminarily, by checking the abstracts to establish their usefulness to the review. 95 publications passed the eligibility stage. The screened publications were subsequently assessed for eligibility. The main criterion for eligibility was that the publication must clearly indicate a definition for the construct knowledge. 13 publications were subsequently included in the conceptual analysis and synthesis for the constructs knowledge. As not many publications specifically provided definitions for the constructs in the first search, the reference sections of the publications that provided specific definitions of the constructs were specifically analysed to locate additional relevant publications from Google Scholar in a second search. This second search added 10 more publications making a total of 23 publications that were finally considered for the conceptual analysis and synthesis of the construct knowledge. Figure 1 indicates the publication selection process adapted from Moher et al. (2009) PRISMA systematic literature review process.

The conceptualisation of the knowledge construct in the first part of the research approach provided a basis for identifying the common components that explicate the construct, at least from the perspective of previous studies. The common components identified also provided theoretical underpinnings in establishing specific domains or modes of measurement for the construct. Combined with Quinones et al. (1995) and Tesluk and Jacobs (1998)’s postulation of levels of specificity of construct measurement, a nomological network was developed to operationalise the knowledge construct as they relate to the designers’ ability to ensure DfOSH. A nomological network establishes a linkage between the theoretical construct and its observable attributes in an attempt to operationalise the construct (Cronbach and Meehl, 1955).

Publications identified from Scopus search

Definition of knowledge: n = 372

**Identification**

Publications after abstracts check

Definition of knowledge: n = 95

**Screening**

Publications excluded after screening

Definition of knowledge: n = 277

Publications assessed for eligibility

Definition of knowledge: n = 95

**Eligibility**

Publications excluded after eligibility check

Definition of knowledge: n = 82

Publications included in analysis and synthesis from Scopus

Definition of knowledge: n = 13

**Included**

Publications included from Google Scholar based on reference sections of Scopus publications

Definition of knowledge: n = 10

Publications used in analysis and synthesis

Definition of knowledge: n = 23

**Analysis and Synthesis**

*Figure 1: Publication selection process adapted from Moher et al. (2009)*

**MEANING AND THEORETICAL MODEL FOR MEASURING AND ASSESSING THE DfOSH KNOWLEDGE OF DESIGNERS**

**Meaning of knowledge construct**

Viewing from a cognitive psychology perspective, different kinds of knowledge can be distinguished, and the distinction between declarative and procedural knowledge is the most widely discussed (Baartman and de Bruijn 2011). Declarative knowledge is the factual information that a person knows and can be reported on (Anderson and Schunn, 2000). This is often termed as “know what” (Miller, 1990; Baartman and de Bruijn 2011; Śliwa and Kosicka, 2017). On the other hand, procedural knowledge is the connection or use of pieces of declarative knowledge and are usually knowledge that cannot be easily communicated (Baartman and de Bruijn 2011) and often considered as “know how” (Miller, 1990; Baartman and de Bruijn 2011; Śliwa and Kosicka, 2017). Tacit knowledge (Polanyi, 1958) is a critical part of this knowledge type. A third dimension of knowledge has emerged, referred to as strategic or metacognitive knowledge which pertains to knowledge about the task, context, problem-solving processes as well as oneself (Krathwahl, 2002; Pathuddin et al., 2018).

To elicit the understanding of the construct knowledge, a consideration is made to how researchers in the past have attempted to construe knowledge as indicated in Table 1. This approach provides a basis for a general understanding of the knowledge construct in order to ensure its objective and systematic measurement, particularly as it relates to designers’ ability to ensure DfOSH. As indicated in Table 1, the knowledge construct – at least from the perspective of researchers – deconstructs into three main components – information, experience and capability or ability.

Some researchers (for example, James, 1907; Plato, 1953; Sveiby and Lloyd, 1987; Mansfield, 1990; Engestrom, 1994; Blacker, 1995; Myers, 1996; Davenport et al., 1998; Nickols, 2000; Albino et al., 2001; David and Foray, 2003; Kakabadse et al., 2003; Gorelick and Tantawy-Monsou, 2005; ASME, 2010; Liu, 2015; Unger and Hopkins, 2016, Manu et al., 2019) understand or suggest knowledge from the perspective of a collection of *information* as indicated in Table 1. However, in the context of work (where performance is desired), information or a collection of it in itself is not useful unless it is situated in context (Aune, 1970) and targeted at a particular task (Kakabadse, et al., 2003; ASME, 2010). For instance, an individual can have information or a collection of it about farming practices. However, in the context of medical practice, that information or a collection of it is not useful and may not constitute knowledge. Context (Aune, 1970) justifies the worth of information and adds value to it (Sveiby and Lloyd, 1987) in our understanding of knowledge from the perspective of work.

Further, in understanding the knowledge construct, how the knowledge comes about is one element that explicates the construct. Some researchers (for example, James, 1907; Blacker, 1995; Alle, 1997; Davenport et al., 1998; Gorelick and Tantawy-Monsou, 2005; Liu, 2015; Unger and Hopkins, 2016; Manu et al., 2019), as indicated in Table 1, indicate or suggest that *experience* is the bedrock regarding the acquisition of information about a phenomenon or task which constitutes knowledge. In addition to experience, education or study (for example, Unger and Hopkins, 2016; Manu et al., 2019), as indicated in Table 1, is one avenue through which individuals can obtain relevant information, about a phenomenon, which constitutes knowledge. Generally, information obtained about a phenomenon which are recorded and passed on to others through education or study are based on other persons’ experiences and views. The underlying conditions and environments that support the validity of the information about a phenomenon may change and thus discredit or invalidate the information. Hence, information through education or study which constitutes knowledge may not be adequate in itself in establishing true knowledge. On the hand, experience as an avenue for information about a phenomenon provides an opportunity for the information to be proven and validated by the individual in certain contexts. This corroborates Plato (1953)’s conceptualisation of knowledge as “justified true belief”. Experience in this sense engenders a “moment of truth” in respect of information held about a phenomenon which constitutes knowledge.

*Table 1: Literature definitions of knowledge*

|  |  |
| --- | --- |
| Definition | Source |
| Collection of information and experience an individual possesses. | International Project Management Association (IPMA) (2015) |
| A body of information applied directly to the performance of a task. | American Society of Mechanical Engineers (ASME) (2010) |
| Understanding gained through experience or study. | Unger and Hopkins (2016) |
| A collection of immovable, ready-made facts. | Engestrom (1994) |
| Facts, information or data. | Mansfield (1990) |
| Information, facts or familiarity gained by experience or education; the practical or theoretical understanding of a subject etc. | Manu et al. (2019) |
| Consists of cognitive states needed to interpret and otherwise process information. | David and Foray (2003) |
| Justified true belief. | Plato (1953) |
| Information put to productive use. | Kakabadse, et al. (2003) |
| Meaningful and organised accumulation of information through experience, communication or inference. | Blacker (1995) |
| Value added information. | Sveiby and Lloyd (1987) |
| Information in context. | Aune (1970) |
| Understanding based on experience. | James (1907) |
| Experience or information that can be communicated or shared. | Allee (1997) |
| Data and information that inform an understanding of a situation, relationships, causal phenomena, and the theories and rules (both explicit and implicit) that underlie a given domain or problem. | Bennet and Bennet (2000) |
| A capacity to act. | Sveiby (1997) |
| Knowing about something, knowing how to do something, or accumulated facts or records. | Nickols (2000) |
| Processed information. | Myers (1996) |
| Information combined with experience, context, interpretation and reflection, a high-value form of information. | Davenport et al. (1998) |
| The capacity (potential or actual) to take effective action in varied and uncertain situations. | Bennet and Bennet (2008) |
| The know-how, experience, insight, and capabilities that assist teams and individuals in making correct and rapid decisions, taking action and creating new capabilities. | Gorelick and Tantawy-Monsou (2005) |
| The information possessed by an entity that enables the entity to carry out a task. | Albino et al. (2001) |
| Memory of experience of decision making by consciousness, from cognition, rational thinking to hypothesis and belief that leads to a solution to a problem. | Liu (2015) |

There are some researchers (for example, Sveiby, 1997; Albino et al., 2001; Gorelick and Tantawy-Monsou, 2005; Bennet and Bennet, 2008; Liu, 2015), as suggested in Table 1, who construe knowledge from the perspective of *capability* or *ability*. These researchers take the view that the existence of knowledge should make the individual functional or able to carry out a desirable task. This means true knowledge is not about an individual possessing a collection or body of information about a phenomenon but rather the ability of the individual to leverage the collection or body of information to perform a task. In that sense, what kind of information an individual, particularly the designer, must possess in order to be functional establishes a foundation for effective measurement of the individual’s knowledge.

An agreement does not exist in literature on the specific conceptualisation of the construct knowledge as indicated in Table 1. None of the prior conceptualisations of the construct knowledge considers all the critical components or elements that explicate the construct. Hence, a more robust conceptualization, which encapsulates all the critical elements that explicate the construct knowledge, will be necessary. Thus, from the perspective of work and what knowledge is required for, this study proceeds to define knowledge as the collection of information about a phenomenon in a given context obtained through study and experience that enables an individual to perform a task.

**Measurement of knowledge**

The development of a framework for the measurement of designers’ knowledge is based on Quinones et al. (1995)’s framework which was later extended by Tesluk and Jacobs (1998). See Quinones et al. (1995) and Tesluk and Jacobs (1998) for more details. Quinones et al. (1995) and Tesluk and Jacobs (1998) adopted a levels approach in the development of a framework for the measurement of worker experience. A levels perspective demands an appropriate definition of constructs and the domain of interest (dimensions of construct) as well as the level of measurement specificity (Klein et al., 1994). A levels perspective, in this case, forces the investigator to think conceptually about the individual, team, organisational and occupational issues as well as possible cross-level effects or domains (Quinones et al., 1995; Tesluk and Jacobs, 1998). The approach contrasts the domains or mode of measurement of the knowledge construct with the specific level where performance is required. In that sense, an opportunity is provided to ensure congruence and effective operationalisation of the knowledge construct in a nomological network. The nomological network has two main dimensions as *measurement mode* and *level of specificity.* There is a paucity of research on the measurement of the knowledge construct across occupations. Attempts have been made at measuring knowledge in the educational field (Phelps and Schilling, 2004; Hill et al., 2004) but those measurement approaches do so without providing congruence and operationalisation of knowledge across different levels of performance requirements. Emphasis of the researchers (Phelps and Schilling, 2004; Hill et al, 2004) have been on the domains of knowledge measures. For instance, Shulman (1986) in assessing and measuring a subject-matter knowledge for teaching by teachers proposed three dimensions as content knowledge; subject matter knowledge for teaching and curriculum knowledge. The first dimension, content knowledge, according to Shulman includes facts and concepts in the domain as well as why those facts and concepts are true. This dimension of teachers’ knowledge corroborated by other researchers (Ball, 1990; Hill et al., 2004) can be considered as declarative knowledge (Anderson and Schunn, 2000; Baartman and de Bruijn 2011).

The second dimension, subject matter knowledge for teaching, considers what makes a topic under a subject difficult or easy and most importantly how to teach it to the understanding of students. This is an insight beyond the declarative knowledge and focuses on stringing the declarative knowledge to achieve a goal. In essence, this dimension is considered as a procedural knowledge (Baartman and de Bruijn 2011).

The third dimension, curriculum knowledge, Shulman indicates involves how topics under a subject are both arranged within a school year and over longer periods of time as well as using curriculum resources, such as textbooks, to organise a programme of study for students. Insight in this domain requires a better appreciation of the environment and context and can be considered as a metacognitive knowledge (Krathwahl, 2002). The measurement of knowledge of an individual required to carry out a task can therefore be considered in the mode or domains of content, procedural and metacognitive information on the phenomenon. This naturally taxonomises the knowledge required by an individual to perform a task, particularly the designer – as indicated in Figure 2 – as content, procedural and metacognitive. Again, relating the domains of knowledge to some levels of performance specificity engenders some congruence and provides, somewhat, comprehensive framework for measuring the knowledge of an individual required to undertake a task, as shown in Figure 2. Each of the modes of the knowledge construct can be operationalised at five levels of specificity (task, job, work group, organisational and occupational) creating a 5 X 3 nomological network for measuring the DfOSH knowledge of a designer. Illustrations of measures or attributes of DfOSH knowledge, represented in each cell, are subsequently discussed. Designers can vary on their task content information with regard to DfOSH. While some designers may possess more task content information in respect of DfOSH, others may not. For instance, what a specific DfOSH task entails. Second, designers can vary on their task procedural information. Some designers may possess more tacit information than others regarding how a specific DfOSH task ought to be performed. Third, metacognitive information about tasks with regard to DfOSH is one dimension that can distinguish designers. Some designers may have more information about when a task required to ensure DfOSH ought to be performed in the design process as opposed to others.

Procedural Knowledge

Content Knowledge

Metacognitive Knowledge

**Level of Specificity**

|  |  |  |  |
| --- | --- | --- | --- |
| Occupational | Occupational content information (e.g. Architecture, Engineering, etc) | Occupational procedural information | Occupational metacognitive information |
| Organisational | Organisational content information | Organisational procedural information | Organisational metacognitive information |
| Work Group | Work group content information | Work group procedural information | Work group metacognitive information |
| Job | Job content information | Job procedural information | Job metacognitive information |
| Task | Task content information | Task procedural information | Task metacognitive information |
|  | Content | Procedural | Metacognitive |

**Measurement Mode**

*Figure 2: A conceptual framework of knowledge measures*

At the level of a job, designers can differ in respect of DfOSH job content information. While some designers may have more content information about a DfOSH job (a collection of different DfOSH tasks), others may not. Second, designers can vary on their procedural information possession about a DfOSH job. For example, some designers may possess more tacit information about how multiple or different DfOSH tasks can be performed during the design stage as opposed to others. Third, designers can vary on their job metacognitive information in respect of DfOSH. While some designers may have more information about when a DfOSH job has to be carried out and how it affects other jobs also aimed at DfOSH, others may not.

At the level of work group, designers can differ in respect of DfOSH work group content information. Most likely in a design, designers must work in or with groups. Possession of specific information about what work groups ought to do to ensure DfOSH on a project is one area that can distinguish designers. Second, work group procedural information is another dimension that can distinguish designers. While some designers may possess more information about the process or how groups work to ensure DfOSH during project designs, others may not. Third, designers can vary on work group metacognitive information. Possession of information about what other work groups are working on or have to work on, regarding the design, to achieve the goal of DfOSH can set designers apart.

At the level of organisation, designers can vary on organisational content information. Construction projects that require DfOSH initiative most likely will be delivered through organisations. Hence, specific information about organisational systems and structures required to deliver DfOSH on projects will be necessary. Possession of such information can vary among designers. Second, designers can vary on organisational procedural information. Some designers may have information about the processes and procedures required at the organisational level to ensure DfOSH on projects, while others may not. Third, designers can vary on organisational metacognitive information in respect of DfOSH. Some designers may possess information about different organisations and how each can make a contribution to DfOSH. Again, they may possess information about the effect of each organisation’s decision in respect of DfOSH on the other so as to ensure optimal decision making. Information in this respect as possessed by designers can vary.

At the level of occupation, designers can vary on occupational content information. That will depend on the type of designer’s occupation, whether an architect, civil engineer or services engineer. For example, in a building project design, an architect may have more involvement and possess more OSH risks information about the design as opposed to a services engineer who only focuses on a section of the entire design. Second, designers can vary on occupational procedural information. For example, some designers may be more familiar with standards and protocols adopted by some professional bodies in respect of DfOSH than others. Third, designers can vary on occupational metacognitive information. Information about which occupations or professions may be required on designs to make effective contributions to DfOSH may not be possessed or obvious to all designers and hence distinguish designers.

**DISCUSSIONS AND POINTERS FOR FUTURE DIRECTIONS FOR DESIGNER’S SKE RESEARCH**

The construct knowledge as it relates to the designer, particularly for optimal OSH risk management, is considered as multi-dimensional in its measurements. Construing the knowledge of a designer from a single or narrow perspective can potentially undermine a useful measurement of it. Further, such a narrow view of it will not only undermine a useful measurement but can also impair the judgements and decisions of project clients who have to assess and select designers based on their knowledge. Additionally, the knowledge constructs, with regard to the designer, must be considered as multi-level. The DfOSH knowledge of designers cannot be assumed to exist at all levels (from a task to an occupational level). The knowledge that is required at the task level may not be the same as required at the occupational level.

Further, the knowledge construct, as they relate to the designer must be considered as dynamic (Teece, 2012). Knowledge, as they reside in designers, can be considered as assets (Andreu and Ciborra, 1996; Adaku et al., 2018). In that regard, it can increase through deliberate and conscious efforts by individuals or deteriorate as a result of lack of individuals’ self-efficacy and neglect. Over time, the knowledge of designers can increase or deteriorate along the mode of measurement or the level of specificity. Hence, an industry framework that seeks to capture the dynamics of designers’ knowledge will be a useful one. Such frameworks could be in the form of knowledge maturity models.

Future studies on designers’ knowledge should focus on testing the measures (particularly within the cells) of the knowledge construct empirically to distill the most relevant ones having regard to the current practice. Again, in such an empirical test, attention should be paid to what constitutes each measure as well as the evidence or indicator that must be adduced to assess that measure, in practice. As earlier indicated, the knowledge of designers, with responsibility for effective OSH risks management, can increase or deteriorate. Thus, future studies on designers’ knowledge should investigate the enablers or constraints of designers’ knowledge development. This proposed models or nomological network to measure the knowledge of designers with responsibility for DfOSH cannot be deemed to be complete. Hence, further studies are invited to extend the network to deepen our understanding and measurement of the designer’s DfOSH knowledge.

**Practical application of the model**

The suggested model for the measurement and assessment of the designer’s DfOSH knowledge can support project clients to clarify the required knowledge of designers in the procurement process. In this case, the attributes of DfOSH knowledge as indicated by the model can inform pre-tender interview questions or pre-qualification questionnaires of project clients in the selection of designers. Respectively, the model can also serve as a guide for designers intending to develop their DfOSH knowledge by providing domains and levels of specificity relevant for such attainment. In other words, designers can look to the attributes of DfOSH knowledge specified by the model, identify gaps in their DfOSH knowledge and take appropriate steps to overcome such knowledge deficiencies. Some countries have public specifications that assist clients in assessing and selecting designers. For example, in the UK, the publicly available specification (PAS) 91 is one such instrument for construction-related procurement and this model can inform it. The core criteria of safety schemes in procurement (SSIP), a private sector initiative in the UK to assist project clients in the procurement of health and safety services, can benefit from this model.

**CONCLUSIONS**

In some parts of the world, such as the UK, Regulations (e.g., CDM 2015) have been developed to place a duty on designers to originate designs that are inherently safe for construction, occupation, maintenance and demolition. However, there is a paucity of knowledge and misunderstanding as to what specifically constitutes DfOSH knowledge of designers and more importantly how to measure it, in the literature and practice. This study has, thus, sought to investigate and deepen knowledge in this regard in a number of ways. First, it explicates or conceptualises the constructs knowledge as a basis for its meaningful operationalisation. Second, it provides a comprehensive model or framework for an effective operationalisation of the designer’s DfOSH knowledge. It presents knowledge, in respect of design for occupational safety and health (DfOSH), as a multi-dimensional construct that can be operationalised at various levels of specificity.

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**DECLARATION OF CONFLICT OF INTEREST**

None

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