THE HUMAN CONTRIBUTION TO UNSAFE CONSTRUCTION ACTS AND CONDITIONS IN THE CENTRAL REGION OF SOUTH AFRICA

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There are limited empirical studies on acts and conditions that influence safety on construction sites in South Africa. To close this gap, two phenomenology research projects assessed the link between accidents, unsafe acts, and poor working conditions on construction sites in South Africa. The studies show that there is a relationship between unsafe acts, working conditions, and accidents. The studies also affirm the notion that accidents stem from human contributions through varying failure types. For example, situational failure occurs when workers violate standard operating procedures and ignore safety rules due to work pressures. Also, unsafe working conditions are either created by workers when proper use of tools, plants, and equipment are ignored, or set up by management when workers are forced to work at heights and inclement weather without adequate protection. The two reported studies reinforce the view that people produce unsafe acts that are implicated in errors and violations that leads to harm in the workplace. There is, therefore, a major scope for tackling routine and situational failures on construction sites.

Keywords: construction industry, unsafe acts, unsafe conditions, site work

BACKGROUND

In 'working construction,' the nature of the industry regarding the kind of work and its impact on people is illustrated (Paap, 2006). Paap (2006) and other authors show that physical work in construction is a dangerous task that is undertaken in outdoor operations. The physical work may involve working at heights, and working with complicated on-site machinery (Carter and Smith, 2006; Chi, Yang, and Chen, 2009; Chi, Han, and Kim, 2012; Dong and Platner, 2004). The intricacies of physical construction activities combine with the attitudes and behaviours of people to produce consequences that are detrimental to their health, safety, and wellbeing.

Human failure due to violations, for example, could emerge from systemic problems in the workplace (Lingard, Pink, Hayes, McDermott, and Harley, 2016). An analogy of this idea is when people assume different roles on a project site based on their health and safety (H&S) predispositions that could be influenced by time pressures, experience, risk perception, and safety culture (Choudhry and Fang, 2008; Oswald, Sherratt, and Smith, 2013). The prevailing culture in a workplace can either be safe or unsafe (Reason, 1998; Zou, 2010). Where unsafe culture exists, it is more likely to be involved in the causation

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Emuze, F (2017) The Human Contribution to Unsafe Construction Acts and Conditions in the Central Region of South Africa *In:* Chan, P W and Neilson, C J (Eds) *Proceeding of the 33rd Annual ARCOM Conference,* 4-6 September 2017, Cambridge, UK, Association of Researchers in Construction Management, 330-339.

of organisational rather than an individual accident (Reason, 1998; Zou, 2010). The work of Reason on accident causation shows how organisational factors, local workplace conditions, and individual or team unsafe acts could break down defences in a system and produce adverse outcomes (Reason, 2016).

When workers exhibit traits and actions considered dangerous in a workplace, they are sometimes likened to be 'human-as-hazard' (Reason, 2008). One reason for referring to workers as a hazard is the observed ability of the acts of people to break down the defences within a system with detrimental results that implicate safety (Reason, 1990; Reason, 2008). For example, through human fallibility (which can only be moderated) activated hazards may become risks that people, 'as agents,' convert into accidents through human failure (errors and violations) (Reason, 1990, 1995, 1998; Reason, 2008).

In construction, management actions/inactions, unsafe acts of workers, non-human-related events, hazardous conditions within normal construction site activities, have been established as the root causes of accidents (Abdelhamid and Everett, 2000). Some of these causes 'morph' and continue to harm people in South African construction (Emuze and Smallwood, 2012a; Emuze and Smallwood, 2012b; Emuze, van Eeden, and Geminiani, 2015).

Although accidents could be explained in different ways depending on the aspects addressed by a model (Katsakiori, Sakellaropoulos, and Manatakis, 2009), the critical theories found in 'person model' and 'system model' of unsafe acts indict the contributions of individuals to accident manifestation. According to Reason (2008), the person model views unsafe acts as arising from wayward mental processes in the form of forgetfulness, inattention, distraction, carelessness, poor motivation, inadequate knowledge, skills and experience, culpable negligence and recklessness. In contrast to the person model, a system model goes beyond local events to identify contributory factors in the workplace, organisation, and the complete system in a context. The implication of the system view is that frontline construction workers may not always be the instigators of an accident. Rather, resident pathogens that have accumulated for a long time in the workplace may have instigated the manifestation of an accident (Reason, 1990, 2016). The resident pathogens metaphor lay emphasis on causal factors existing in a system before an accident sequence begins (Moray, 2005). The disadvantage of the system model is its utmost attention to the system, which ignores human contributions and then instils "learned helplessness" in people (Reason, 2008: 103).

As a result of the human contributions mentioned above, two exploratory studies sought responses to "what is the relationship between working conditions and accidents; and why unsafe acts and conditions are of greater concerns in construction." The studies were conducted in the central region of South Africa in 2016 to explore possible responses to the postulated questions. The next section of this paper presents the research method of the two studies. After the method section, a short version of the results from the studies is used to lay the foundation for a discussion on human contributions to unsafe acts and conditions in construction.

RESEARCH METHOD

This paper reports on two similar phenomenology studies that were conducted in the central region of South Africa (Bloemfontein and Kimberly) in 2016. The two studies attempted what Silverman referred to as 'situated phenomenology' to produce the data that are intended to be illustrative (Silverman, 2013). The first study obtained the views of construction professionals responsible for safety on project sites in Kimberly, South

Africa (Study A). Face-to-face interviews were conducted on several project sites with 22 professionals. Before the compilation of the interview guide, four accidents records were textually analysed to observe the issues around the topic. A safety manager that was interviewed at the early stage of the study provided access to the accident records of the construction firm where he is employed. It is unclear if the safety manager witnessed the four accidents, but he provided verbal information to clarify observations in the records. The four cases found in the safety record of the firm were used by the safety manager to buttress the view that accidents involve human constructions. The identified issues were after that used to compile the open-ended questions of the interviews. The semi-structured interviews follow the reviewed literature and the findings of analysed accident records. The data collection process began with an email and telephonic approach of contractors busy with projects within Kimberly, South Africa. The interviewees were purposively selected, and they were free to elaborate on all the questions based on their experiences. With various job titles such as H&S Manager, Site Agent, Safety Officer, and Civil Engineer, the field work was able to engage professionals occupying site management positions. All the 22 interviewees in this study have post-secondary qualifications in the built environment disciplines, and the average length of working experience recorded for the cohort was 16 years.

The second phenomenology study was conducted among contractors in Bloemfontein, South Africa (Study B). The face-to-face interviewing of workers, their supervisors, and managers on seven construction sites were done with the aid of a protocol that contains open-ended questions that were informed by the central research question. The interviewees were contacted through email and telephone to ascertain that they are busy on projects within Bloemfontein and they are willing to participant in the study. Eleven contractors were contacted, but four declined to take part in the study. All the interviews took place on project sites. The seven interviewees in this particular study include three safety officers, two artisans (electrician and carpenter), one assistant SHEQ (Safety, Health, Environment & Quality) manager, and a managing director who also doubles as the project manager for his firm. The interviewees have tertiary construction educational qualifications, and the length of their construction industry working experience ranged from 5 to 29 years.

In total, 29 interviews were conducted in the two studies and the transcribed data were thematically analysed. Thematic analysis, which involves identifying, interpreting and reporting patterns was used. Working through the interview data helped the analysis to integrate perceptions together with the central research question (Ritchie, Lewis, Nicholls, and Ormston, 2013).

RESEARCH FINDINGS

Examples of Site Accidents

Four accident cases in a particular company were analysed before the start of the interviews in Study A. The cases were provided by a safety manager who gave access to company safety records. The record shows that the four accidents occurred between 2012 and 2015. In Case 1 that took place on the 21 August 2012, a worker was injured while working with a crusher. The accident happened when the foreman wanted to adjust the track on a conveyor while removing a tramp iron from a magnet. When the conveyor started, the worker managed to hold onto the gantry of the magnet while his lower body was pulled under the magnet. Fellow workers raised the alarm and the conveyor was stopped. The employee sustained injuries to his back and leg. In Case 2 that happened on the 24 of April 2014, a worker suffered a head and neck injury in the workplace.

While working next to a structure that was being erected on the site, a 16m piece of roof sheeting was blown off the structure by the wind. The roof sheet landed on the worker's head, and he fell to the ground, unconscious. Luckily, the worker was wearing a hard hat, which protected his head. The worker was taken to hospital where he was treated. After medical treatment, the employee was sent home and returned to work after some days off. In Case 3 (14 October 2014), a worker was injured on site when himself and a fellow worker were busy replacing bin liners on a Komatsu plant. A steel plate that was gouged came loose, popped off the container surface and fell against the employee's left ankle. The accident resulted into instant skin graze, and the worker was rushed to the closest hospital for treatment. The worker returned to work after medical treatments and some days off. In case 4 (6 of February 2015), a worker was injured on site while busy working in an excavation. There was a sudden ground dislodgement, and the employee was almost buried alive. An ambulance was called, and paramedics treated him on the scene. He was after that taken to a clinic where a computerized tomography scan was done. Although there were no internal injuries or broken bones, the doctor booked the injured worker off to resume light duties some days after the accident. These four cases that were extracted from a single company underline the relationship that exists between accidents and physical work in construction.

Besides the four accident cases outlined in Study A, the interviewees in Study B confirmed that minor accidents do occur on their project sites. The Study B interviewees have experienced consistent hand injuries, cuts, and lacerations in construction. Other types of harm cited by the Study B interviewees include eye injuries, body injuries caused by workers trapped between equipment or caught in confined spaces, head injuries caused by falling objects, and electrocution. These examples of accidents recorded in both studies are individual in nature (and not organisational accidents) and they appear to have elements of human constructions, through acts and conditions.

Perceptions of Unsafe Working Conditions

Regarding unsafe working conditions, an interviewee stated that it is a state created by the work environment on a construction site. The interviewees suggest that there is a relationship between accidents and working conditions on project sites. One interviewee said that tight deadlines and the resultant hurried activities could cause accidents. The interviewed safety manager made the comment that the safer the working conditions, the fewer the accidents. He emphasized the importance of providing workers with protective gears, reliable machinery and good haul roads. Another safety officer focused on the importance of daily safety checks. A common concern among the interviewees is working at heights, which often creates a major likelihood of accidents. The interviewees opine that people working at heights should be physically and medically fit. Some of the examples included workers using wrongly erected scaffolding and labourers falling into excavations that were not properly barricaded. Many of the interviewees named 'human error' as the leading cause of most accidents. Two interviewees found that working long hours was a risk factor as people make mistakes when they are fatigued. Another interviewee suggests that alcoholics among working crews constitute 'human-as-hazard.' Also, when asked to discuss the factors that determine the state of working conditions on their project sites, the interviewees agreed that topography and site layout are crucial to safety. They explained that factors such as adequate working space allow people to be safe and orderly. They decided that when a site is congested and chaotic, working conditions will deteriorate. A few interviewees say that the priority that management places on safety management and the way that they enforce it could also determine the working conditions in a site.

Also, an interviewee stated that workers could also cause unsafe conditions. The interviewee says "…not doing proper housekeeping, leaving materials lying around the workplace or leaving equipment or machinery on standby unattended" are conditions created by workers. In contrast, an interviewee stated that sometimes unsafe conditions are caused by management when they are:

> …forcing labourers to work in an environment that are not safe, such as expecting labourers to work on the scaffold, which is not safe because of lack of alternative or forcing people to work in poor conditions. Weather is an instance of a poor condition, for example, wind can blow things to labourers' eyes when not wearing safety goggles, or a strong wind, which can blow a person who is at the top of the building down.

Another cited example is the first-hand experience of the students conducting interviews on sites in 2016. The students observed and took pictures of electric wires that were running through stagnated water on a particular site. This is an example of an unsafe condition which is created by workers (but appears to be allowed by management). The site shows that wooden shutter planks are left carelessly on the ground near walkways, which are used as formwork to support a concrete structure. When the shutter planks are removed from hardened concrete, they have protruding nails on them, which could injure people on the site.

Perceptions of Unsafe Acts

According to six interviewees, unsafe acts is what people do that is not safe or how people act towards their work and how they behave towards it when they are not working with standard procedures and methods. An interviewee regarded unsafe acts as the omissions by workers that are not safe. The six interviewees contend that unsafe acts are typical acts observed on construction sites. Some cited acts include working with a grinder without wearing safety goggles and ear plugs, working on scaffolding that is not structurally safe, working on a high scaffold without safety harnesses, not using equipment or tools in a recommended manner, and working under the influence of substances - drugs or alcohol (or both). The interviewees say that unsafe acts are caused by workers through their behaviours and attitudes that are underpinned by ignorance and negligence. Other causes of unsafe acts reported by the interviewees comprise of lack of concentration (inattention), poor knowledge of the implications of acts (whether it is safe or not), and lack of safety information.

In brief, most interviewees perceive that carelessness and complacency pose a serious threat to safety management. For example, one safety officer mentioned that he witnessed workers climbing onto scaffolding they know to be unsafe. The cited incidence is a clear case of violations on sites. Most interviewees also say the negligence of employees regarding the use of allocated protective gears and safety harnesses when working at heights. Another interviewee mentioned that even though barricades are put in place, workers deliberately ignore the risks of falling or tripping. Other interviewees indicated unsafe acts such as not following proper procedures, and using untested work methods.

Regulating Unsafe Acts and Working Conditions

After these cited improper practices, questions regarding compliance were asked in the two studies. In response, most interviewees suggest that regulations positively influence working conditions. For instance, some of them say that regulations 'forced people to pay attention to housekeeping.' Some interviewees were confident that regulations helped with the smooth running of construction sites. Many interviewees contend that toolbox talk is beneficial and when handled correctly, it significantly promotes safe and healthy

working conditions. An interviewee mentioned the need for safety personnel on project sites to understand the work to be done. However, some interviewees were of the opinion that excessive regulations reduced the pace of operations, while others perceive that certain regulations were not applicable to specific construction operations. For instance in Study A, interviewee seven indicated that "...workers are likely to get hand injuries because they use bricks, trowel, grinders, hammers, etc., which are liable to damage or injure their hands". Whereas Interviewee six say "bricklayers always complain that they don't sense the brick when wearing safety gloves, they prefer to use their bare hands as it speeds up their building process."

The nature of work and the preference of workers to follow a particular method is in the spotlight in these comments. When asked about the causes of accidents that they have encountered in the industry, the interviewees were of the opinion that unsafe acts observed through negligence, poor attitude and behaviour of workers, and unsafe conditions are primary origins of accidents. A comment that is indicting the industry was made by an experienced interviewee, who says:

> …unsafe acts and unsafe conditions (such as poor housing keeping) cannot be blamed all the time; people have to think about direct causes and indirect causes of accidents.

Study A and Study B recorded divergent views on whether unsafe acts and conditions could be avoided in construction. For example, two interviewees stated that in their opinions, "...unsafe acts cannot be prevented because they are caused by employees' behaviour towards their work, and such acts are difficult to change or modify". However, interviewee 7 in Study A stated that all unsafe acts and conditions could be prevented if a proper safety management system (SMS) is deployed on a site. More importantly, all the interviewees concur that weather is the only unsafe condition that cannot be prevented because it is not subject to human control. In a nutshell, the interviewees were in agreement that training (context specific workshops), education, enhanced safety awareness, and appropriate safety programmes could reduce accidents caused by unsafe acts and conditions. Also worthy of note is the view that management commitment is central to the efficacy of mitigation efforts required for the eradication of unsafe acts and conditions. The reason why management must be involved is rooted in the idea that safety management is an expense that management cannot avoid. As an illustration, an interviewee opines that:

> …safety has to start from the top and then cascade to the bottom because if people from the top are not interested in health and safety, so shall the individuals in the workplace because no one is motivating or showing them that safety is a priority.

While noting the veracity of this particular comment, the author of this paper subscribe to the notion that safety is more than a priority. Rather it should be viewed as a value. Furthermore, it is notable that the interviewees perceive that compliance safety may be used to curtail unsafe acts and conditions. One interviewee cited an example. He noted that where workers (such as bricklayers that prefer to lay bricks without protective gloves) are being told to wear appropriate Personal Protective Equipment (PPE), and they refuse; compliance to regulations could be used to modify such behaviours.

So in theory, the interviewees were in support of the notion that regulations will be useful, but in practice, their opinions differ. For example, some of the interviewees noted that regulations have an adverse impact on them regarding the cost of compliance. The interviewees noted that companies have to register all their workers (the author is of the view that this is referring to compensation insurance that is mandated by legislation in South Africa). The concern of the interviewees is based on the premise that the

registration of workers is expensive. The question is, if compliance is expensive, what about the cost of an accident? Another hypothetical example cited by one interviewee is that if there is an incident on site and a fatality is recorded, there is a possibility that the responsible contractor may serve a jail term because of the liability regarding the workers under his/her supervision. An interviewee opines that:

> …where H&S is not taken into considerations, the biggest challenge that companies experience is the loss of money, because it is the company's responsibility to pay for labourers' medical bills if they get injured in the workplace and also to pay for damages to the property.

It is also worth noting that an interviewee claimed that a major challenge of compliance enforcement is workers' attitudes and behaviours to safety. The interviewee implied that working with people is difficult:

> ...because some of them when you tell them what to do, they will inform you that they have been working in the industry for a very long time, and no one will tell them how to do their work.

A relatively common challenge also recorded is that contractors are forced to work with unskilled local workers from host communities of projects. Three interviewees perceive that most contractors complain that strict compliance with safety reduces their onsite production because:

> ...there are certain tasks that safety inspectors do not allow workers to do. In some cases, where activities are suspended due to working at heights without safety harnesses, safety officers will not let them proceed until they have been supplied.

DISCUSSION

Study A and Study B link unsafe acts with unsafe working conditions in construction. The two studies highlight the widely reported perception that unsafe acts and poor working conditions are the forerunners to accidents in the construction industry (Shin, Lee, Park, Moon, and Han, 2014). Both Study A and B also highlight human failure types that exist on construction sites. Of the widely reported human failure types, which include slip (commission), lapse (omission), mistake (both rule and knowledge bases), and non-compliances (routine, situational and exceptional) (Reason, 1990), Study A and Study B suggest that routine and situational human failure types are dominant on sites in the region. The implication is that deliberate deviation from rules, regulations, and safe working procedures, which is known as 'violations' are common among construction workers. It, therefore, appears that non-compliance has become the 'norm' so much that the interviewees contend that enforcement of regulations and regular daily inspection is required on sites.

The observations from the two South African studies, however, resonate with the Australian study reported by Lingard et al., (2016). The Australian study shows how safety rule violations in the construction industry have become routine (Lingard et al., 2016). Similar to the opinions of the interviewees in the two South African studies, the violations appear not to be deliberate acts of sabotage by workers in Australia. Rather, violations such as 'the gap between work as imagined and work as done' are routinely undertaken by construction workers (Lingard et al., 2016). Examples of routine deviations are illustrated by the interviewees in Study B, who say that the unsafe acts are seen through negligence, poor attitudes and behaviours of workers, and unsafe conditions are primary origins of accidents in the industry. As an illustration, an interviewee in Study B indicated that:

> …bricklayers always complain that they don't sense the brick when wearing safety gloves, they prefer to use their bare hands as it speeds up their building process.

The nature of work and the preference of workers to follow a particular method is in the spotlight. The preference of employees to follow what they perceive to be suitable for them is unintentionally making violations routine in construction operations. Also worthy of note is the situational human failure type reported in both Study A and Study B. Situational failures occur when workers deliberately take shortcuts and fail to follow safe working procedures to fast-track the completion of activities. The situational non-compliance is dictated by context-specific factors such as time pressure, workload, inappropriate tools, and unsuitable equipment (Alper and Karsh, 2009). In effect, work pressures from tight deadlines and rush activities to maintain production in construction reduces levels of compliance with safety rules (Guo, Yiu, and González, 2016), and by so doing, work pressure is promoting situational human failure in construction.

The routine and situational human failure types highlighted in the two South African studies highlight the influence that frontline workers and management have on unsafe acts and conditions. The influence implies critical theories found in the 'person model' and 'system model' of unsafe acts (Reason, 2008). For example, the behaviour of workers in the construction industry is influenced by time pressures, training, experience, risk perception, safety culture, and management (Oswald et al., 2013). The substance abuse incidents cited by interviewees in this paper also emerge as a significant factor in Oswald et al., (2013).

The above discussion suggests that the cursive nature of the causes of unsafe acts and conditions require a better understanding of how to eliminate them in construction.

CONCLUSIONS

The studies reported upon in this paper reinforce the notion that unsafe acts and conditions could work with resident pathogens to produce accidents. For example, the studies suggest that accidents and working conditions are linked through human contributions (unsafe acts). Such contributions are manifest through attitudes and behaviours of people in construction. Also, the unsafe conditions created by man (both management and their workers) occurs in various ways. By forcing workers to complete tasks on elevated platforms without the use of mandated safety harnesses perpetuate unsafe conditions on sites. The narrative in this paper shows that unsafe conditions can be controlled and it is subject to modification if concerned people are willing to make an effort. Although the interviewees in the reported studies mentioned that enhanced training, education, management commitment and enforcement of regulations would reduce the problem, there is a reason to argue that these measures can only produce marginal improvements until there is a definite shift in the mind-set of the people concerned. The change in the mind-set is what would alter the attitudes and behaviours of workers so that they do not engender unsafe outcomes.

The shift is mind-set is also required to tackle unsafe acts that produce both routine and situational human failures on construction sites. There is a clear indication that no matter how rules are implemented or enforced on sites, with less commitment from concerned parties, accidents caused by unsafe acts and conditions will continue in the industry. Unsafe acts and conditions are therefore of major concern in construction where they have the tendency to transform into practice 'norms'. In effect, people have to learn that safety begins with them, and then, it has to start from people at the management levels where conditions in workplaces are controlled.

ACKNOWLEDGEMENTS

In developing this paper, the author has drawn on treatises produced by his students in 2016. The author gratefully recognises Andre van Zyl, Darryn van Zyl, and Gaelebale Moeti. The contributions of the two anonymous reviewers of this paper are also appreciated.

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