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REDUCING HUMAN FAILURE IN CONSTRUCTION WITH THE ‘TRAINING-WITHIN-INDUSTRY’ METHOD

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ABSTRACT

The purpose of this paper is to explain how a lean production tool, the ‘Training-within-Industry’ (TWI) would help to identify and eliminate safety related waste in construction. TWI is commonly used to transfer knowledge and skills needed to improve work methods. The tool also helps to maintain a good working relationship between the employers and employees. This paper presents a multiple case study conducted to understand the application of TWI in a worksite better. The research shows that inadequate training of workers contributes to variability and waste manifestation that precede accidents in construction. The study also contends that there is a significant scope TWI deployment in construction due to the inability of supervisors and working to ‘see’ safety waste unfolding on their worksites. For example, the guidelines herein outlined could reduce human failures (safety errors and violations) with the use of the lean construction tool.

KEYWORDS

Construction industry, Human Failures, Knowledge, Skills, Training-within-Industry

INTRODUCTION

According to Reason (2008), human failure in the form of errors and violation is a set of unplanned actions that produce unforeseen incidents and accidents within the workplace. It is connected to multiple factors that beget complex cause analysis (Misiurek and Misiurek 2017; Dekker, 2014). It is a significant problem in the labour-intensive and mechanical workplaces. For example, Sarhan et al. (2017) argue that the working conditions in the construction industry affect the behaviour of the workers.

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The literature shows that accidents produced by human failure are part of the waste in the workplace (Sarhan et al., 2017; Misiurek and Misiurek, 2017). Waste is described as losses produced by activities, which influences the direct and indirect costs of the project, but do not add value to the project from the point of the client (Aziz and Hafez, 2013). An accident is waste that is linked to people in construction, because it costs both human and non-human lives (Larios et al., 2012). It typically results in either minor or major injuries or even fatalities (Albert et al., 2014). Accidents are often highly complex and are the result of unsafe acts and conditions in industry (Smith et al., 2017).

Perlman et al. (2014) explain that most accidents in the construction industry are the result of system failures situated in human actions. However, there is a notion that an accident that is linked to human activities and decisions should not be blamed on employees alone. Dekker (2014) states that people do not intentionally under perform, and when there are accidents at the workplace, management must investigate the events beyond the victims.

Furthermore, most people are of two minds regarding the role of people in creating and breaking safety systems (Dekker, 2014a). Human behaviour across all industries plays a significant role in accidents (Chidambaram, 2016). Most accidents across all sectors occur because of failure with causes rooted in human behaviour that include lack of maintenance and a poor safety culture (Chidambaram, 2016). Most of the time, accidents are influenced by the employers' and employees' working culture that is connected to actions and decisions in the workplace (Gibb et al., 2014; Yorio and Wachter 2014). Safety culture is described as a framework of reference for employees to make sense of safety measures in the workplace and adapt their behaviour (Shen et al., 2015).

According to Reason (2008), there is no universally agreed definition of human failure, but there are four essential elements, namely the intention, the action, the outcome, and the context. Furthermore, human failure can be viewed with two main modes, which include the person model and the systems model (Reason, 2000). The person model focuses either on the mistake, error, slips or lapse of individuals (employees) by blaming them for forgetfulness, inattention, or moral weakness. The system model focuses on the condition under which individuals work and tries to build defences to avert the error and or mitigate their effects (Reason, 2000).

The preceding discussion indicates that human failure and its effects distort project outcomes. In other words, there is a need to remove it from construction. A method for removing it is called TWI, which is succinctly explained in the next section of the paper.

TRAINING-WITHIN-INDUSTRY (TWI) METHOD

The foundation of the TWI method was laid in the United States of America (USA) in 1940 during World War II (Dzubakova and Koptak, 2015). TWI formed part of the Toyota Production System (TPS), which is also known as "Lean Production System" (Dzubakova and Koptak, 2015). TPS is a management system designed for the absolute elimination of waste in the workplace (Shingo, 2005). The literature shows that human failure causing accident is a waste. In construction 'accidents' is an activity that consumes time due to investigation process which needs to take place without adding value to the final product due to the absence of the injured person (Misiurek and Misiurek, 2017).

The implementation of TWI is focused on training production leaders, masters, foreman, and experienced operators (Huntzinger, 2016; Allen, 1919). TWI help to transfer knowledge and skills of management in instructing employees (Job Instruction), building good relations between employees (Job Relation) and improving working methods (Job Methods) (Sinocchi and Bernstein, 2016). TWI is grounded on the three J-program (Huntzinger, 2006). The relation between TWI and lean is recognised in the three J-program. For example, Job Instruction relates to standardization of work, job method affects continues improvement, and job relation influences respect for people (Pereira et al., 2016).TWI promotes 'learning by doing' that implies solving production problems with the guidance of a properly trained instructor (supervisor) (Allen, 1919). The impact of this method is influenced by management since an instructor must have a sound knowledge of the problem before training someone else (Graupp and Wrona, 2010). The introduction of TWI in a workplace is grounded on the three J-program (J=Job), the job instruction (JI), job methods (JM), and job relations (JR) (Huntzinger, 2006). The three programs are highlighted as follows:

Job Instruction Training (JIT): the principal objectives of JIT, which is linked to standardisation of work, in human activities are to teach instructors how to develop a well-trained workforce (Huntzinger 2016 citing Allen, 1919). Allen (1919) states that it is essential for an instructor to be skilled in instruction or training to be able to reduce waste. Such waste is not limited to defects, rework, accidents, and damage to a plant. An instructor must be skilled with respect to how to instruct regardless of how much he/she knows the work because knowing the work does not mean that an instructor will be able to teach his/her team how to do the job (Allen, 1919). Dinero (2010) argues that if an individual has not learned the work, then an instructor has not taught the learner how to do the job correctly, which explains the slogan of JIT.

Job Method Training (JMT): The aims of JMT that is related to continuous improvement is to help instructors to produce quality products in suitable or less time by making the best use of employed workers, machines, and material (Huntzinger 2016). According to Dinero (2010), JMT is like JIT in that the workers analyse a given task detailed by the instructor, but the difference is that it focuses on improving how the job is done. JMT is very important in reducing mistakes, errors, and lapses. Huntzinger (2006 citing Imai, 1986) states that JMT is relates to teaching instructors how to schedule jobs into their fundamental processes, reorganising, and simplifying job tasks to improve production.

Job Relation Training (JRT): The notion of respect for people, which is at the heart of lean construction, is expressed in JRT. JRT aims to help instructors improve their skills to work with workers and endorse collaboration at the workplace (Imai, 1986). In terms of human activity in industries, the relationship between employers and employees is significant. Graupp and Wrona (2010) explain that JRT enables the instructor to possess the skills in leadership by teaching workers how to sidestep personnel problems by building a standard for good relations with all workers. JRT also influences the positive handling of personnel problems by treating every worker as an individual (an end).

RESEARCH METHODOLOGY

This research aims to establish possible ways of reducing human failure on construction sites using TWI. To achieve this goal, a case study strategy explains in Yin (2012) was adopted. The approach is chosen because of the need to learn from the causes of human failure and to provide a solution from the utility of TWI (Scott, 2016). The project cases were in Sandton and Bloemfontein cities in South Africa. The selection of the case projects was based on purposive sampling technique as explained by Yin (2014). The selected case projects provided access to site management contact sessions. There were four case projects, three in Sandton and one in Bloemfontein.

The data were collected using semi-structured interviews. The interview period was between 30 to 60 minutes in duration. The interview session in each case project was recorded. After that, the interview recording was transcribed and analysed using emergent themes and pattern matching (Yin, 2014).At the start of each interview, the description of the TWI method was presented to the interviewees because most of them were not familiar with the TWI method. This might be because lean is not yet mainstream in South African construction where conventional work procedure is the norm. The construction industry is still relying on labour-intensive methods to deliver the projects.

In this stage of the study, contractors were interviewed. Efforts were made to engage workers as well. But site managers who can implement form the cohort interviewed at this stage (Table 1).However, project consultants and construction workers will be interviewed at a later stage. After that, the researcher will evaluate the findings of the three teams and formulate the hypothesis, which will be tested to answer the broader research questions of the study.

Table 1: Research site and participants

Case projects	Interviewees	Response (No)
Case 1: General building project	Site agent (one) Supervisor (one) Health & safety manager (One) Health & safety officer (one)	4
Case 2: General building project	Construction manager (one) Site agent (One) Supervisor (One) Health & safety manager (one) Health & safety officer (two) Health & safety representative (one)	7
Case 3: General building project	Construction manager (one) Health & safety officer (one)	2
Case 4: General building project	Construction manager (one) Supervisor (two) Health & safety officer (one) Health & safety representative (one)	5
Total Interviewees		**18**

RESULTS FROM THE INTERVIEWS

The central research question guided the 18 interviews. The data was collected through semi-structured interviews. The interviews were unstructured so that the interviewees could reply to each question, based on their lived experience. The sub-headings are used to present the analysed data as follows.

FACTORS LEADING TO HUMAN FAILURE

This section focuses on describing the factors influencing human failure in construction. According to the interviewees, human failure is an area concerned with the development and advancement of the worksite, policy and regulations. It was mentioned that the construction industry is one of the industry employing a high number of unskilled workers. Most of the interviewees responded that human failure is a disease that is resistant to a natural cure. Because of this 'disease', there is a high number of accidents in the construction industry. For instance, a construction manager and site agent in case 2 responded that they are working very hard to promote safety on their site as they aim to comply with the tenets of the Construction Regulations fully. But they are still the victim of accidents, because they have so far failed to produce the zero-accident target indicated in the organisation policy. There are several reasons why the construction industry is failing to achieve the zero target. A health & safety manager in case 2 said that it is difficult for management to control the decisions and actions of the workers. The decisions and actions of the workers are one of the factors leading to accidents and these interviewees, for example argued that workers are often exposed to extreme inclement weather conditions that influence their choices. Interviewees in case 2 say that often, fatigue and working condition influences the decisions of workers. The working condition influences the way in which an activity will be carried out, for example:

"We are working day and night to deliver this project three months ahead of schedule. This has changed the method of construction; we are working Monday to Saturday. You can imagine the pressure we are working under not to forget that we are the human being who needs proper rest to be active and to think properly". The site management also mentioned the contributions of ignorance and negligence linked to general workers.

The construction industry comprises a wide range of activities that rely on workers, machinery and equipment. Machinery and equipment are operated by the workers in the industry. This lead to the explanation of a site agent and supervisor in case 1 where they argued that accidents should be blamed on the workers because they engage in many activities that expose them to mistakes and errors. According to them,

"Construction is a labour-intensive driven industry, it relies intensively on labourers, and most of our labourers put themselves in danger by not following the safety rules or comply with the risk assessment issued by the safety manager per activities".

The blame game continued as some interviewees argued that accidents are caused by clients and designers. The reason is that some clients propose building projects with constructability issues since they are then complex and dangerous to build. The architects and engineers design the proposed building, according to the client's specification, and the contractor must deal with the health &safety planning and monitoring while producing the project. Further, a construction manager and a health &safety officer in case 4 supported the statement of the interviewees in case 1 (blaming accidents on the workers). The interviewees mentioned that some workers on their sites are currently under investigation for failing to comply with health &safety regulations. The Department of Labour in South Africa is investigating them due to an incident which happened on the 08 October 2017. A worker was instructed to cut steel reinforcement. He failed to wear safety goggles while completing the task. The result of his omission is that a spark entered his eyes and he nearly lost his sight (vision). In contrast, other interviewees disagreed with the tendency to blame workers for all accidents. They argued that workers follow instruction, which was given by the site agent and the foreman. They asked, "why do we have to blame the workers when things go wrong?" In their opinion, the blame game accounts for the reason why the industry is producing a high number of accidents instead of implementing measures to identify, analyse and control accidents.

DISCUSSION

This section discusses how TWI could help to reverse the issues outlined earlier. As explained in the methodology sections, a short presentation on the introduction of the TWI method was presented to the interviewees before the start of each interview. However, it was observed that in all the four cases the contractors had appointed a health &safety team on site. Most of the interviewees explained that their safety management system is designed with compliance with the Construction Regulations in mind. The muted compliance is supported by education and training customised for workers upon appointment. They also have a risk assessment tool to identify, analyse and control factors which might lead to accidents.

To overcome these challenges of human failure in construction, knowledge regarding the causes of accidents is required to examine the level of safety and directions for changes of the construction culture (Sanchez et al., 2017). There are various methods which could be adopted to improve safety in construction. However, this study adopted the TWI method to reduce human failure in construction. It was discovered that all the respondents were not familiar with the TWI method. But in four cases, the contractors have health &safety appointees instructed to promote safety culture. Safety culture is described as the whole group of knowledge, habits, and behaviours that drive organisations to willingly apply safety approaches and procedures in the construction industry (Sanchez et al., 2017).

The TWI method could be introduced through the three J-Program. The first step to is to test if management, especially the construction manager and principal designers, fully understand the impact of human failure in terms of causing accidents in the construction industry. The second step is to introduce and teach standard work or job instruction. For management to be able to identify and reduce hazards, they should train their workers to follow standard work. This step would help management to stop blaming workers because standard practice would help them to know if they are complying with the safety rules. In the third step, JM is responsible for defining the method of construction to be adopted by management, and it would also help to identify hazards and to measure the safety risk of the activities. This process is akin to continuous improvement, which allows site management to improve their method of construction and be able to reduce waste while producing the greater quantities and quality of work in less time. The fourth step known as JM serves the respect for people purpose. JM is responsible for influencing how management teaches the notion of respect for people to foster positive working relationships on site. Failure to adopt this step would result in a waste of human actions. For example, an interviewee stated that human behaviour is a problem causing human failure on the site and that other workers are ignorant and negligent. A manager who respects his workers would not blame his workers but would try to investigate causes of failures before making a judgement. In effect, the TWI method would teach management some basic techniques regarding supervision of the work and how to improve the skills and knowledge of workers to promote an optimum safety culture on site.

CONCLUDING REMARKS

This paper highlights human failure concerning the TWI method. Figure 1 illustrates how the reduction of human failure could be promoted in construction. The factors of human failure are underlined in the literature were mentioned by the interviewees that participated in the construction site fieldwork. There are four essential elements of human failure. These include the intention, the action, the outcome, and the context. These elements are linked to the factors causing human failure as demonstrated in the graphical representation in Figure 1.

Although, the preliminary findings of the reported research do not provide answers regarding how to introduce the TWI method, the literature on the TWI method has been analysed to help in the design of the framework. The framework supports the idea that human failure in construction could be resolved and should not be blamed on workers alone. The framework is an attempt to guide construction firms in terms of how to reduce or eliminate human failure using the TWI method. The framework emphasises that the working culture in an organisation is a fundamental cause of the research problem. The organisational working cultures, decisions and actions often cause a systematic failure, which is connected to the human failure in the construction industry. The effect of human failure pushes either the intentional or unintentional failure causing accidents in the workplace. Most of the time when an accident happens, there are often people who are blamed. To solve the human failure issue, this study proposes that designers and construction teams should identify the problem (human failure) in the design and the execution phase of the project. After that, they should have the knowledge of work and responsibility regarding the impact of human failure in the workplace. After that, management must be trained and skilled regarding how to give instruction (job instruction (JI)). After that, they must be skilled in terms of how to improve construction methods (Job method (JM)). Then, they must be proficient in terms of how to develop respect (job respect (JR)) for people in construction. In effect, the skills of instruction flow with the skill of methods and relations.

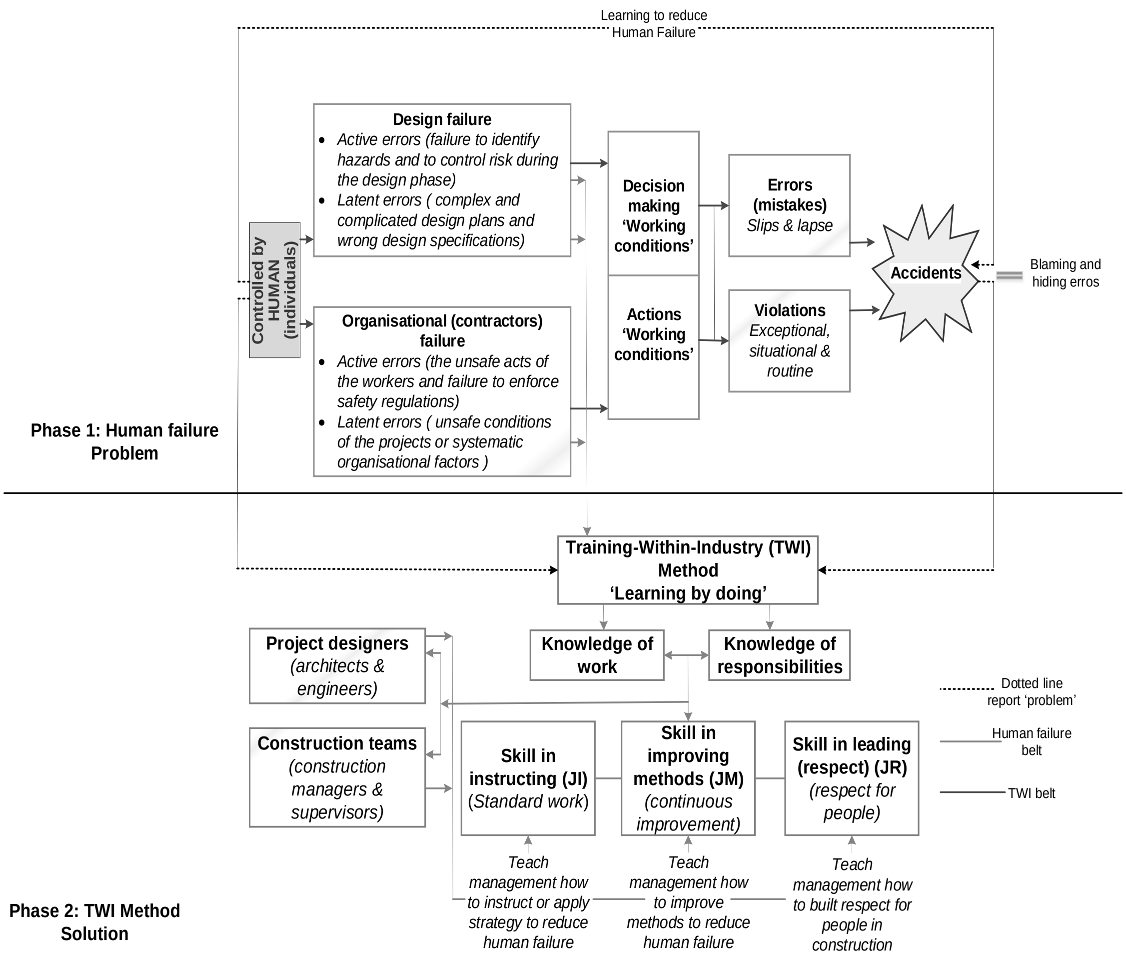

Figure 1: A conceptual human failure resolution framework (Author, 2017)

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