FACTORS INFLUENCING SAFETY BEHAVIOURS OF CONSTRUCTION WORKERS

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ABSTRACT

Construction industry is known to be one of the most accident-prone of work sectors around the globe. Although the construction output is less in Sri Lanka, compared to developed countries in general, the magnitude of the accident rate in the construction industry is still significantly high. Most of the occupational accidents are due to the unsafe behaviours of the worker. Thus, studying the people factor in OSH is an effective way to manage OSH at work sites. The paper therefore focuses to investigate and prioritise the factors affecting construction workers' safety behaviours.

The study was structured in several steps. Initially in-depth knowledge gained regarding the research stream which was sorted upon the degree of relevance to the study. A total of 18 factors affecting construction workers' safety behaviours were identified through an extensive literature survey. Data collection was carried out through a survey which consisted of two rounds. The first round was conducted to validate the factors found in literature; to the Sri Lankan context and in the second round, experts were asked to rate those factors according to their degree of influence. Experts' rankings were used to calculate the Mean Score of Influence (MSI) of each factor and according to the MSI values, the factors were prioritised.

Findings of the study revealed the most influencing personal factor was age while the most influencing organisational factor was OSH incentives. The least influencing factors were work-mates' safety concern and provision of PPE respectively under the categories, personal and organisational. These findings could be helpful in better understanding the construction workforce and in designing OSH systems for the construction industry.

Keywords: *Construction Industry; Construction Worker; Occupational Safety and Health; Safety Behaviours.*

1. INTRODUCTION

1.1. OCCUPATIONAL SAFETY AND HEALTH AND CONSTRUCTION INDUSTRY

Occupational Safety and Health (OSH) encompasses the social, mental and physical well-being of workers that is the whole person (Alli, 2008). Thus, successful OSH practice requires the collaboration and participation of both employers and workers in health and safety programmes, and involves the consideration of issues relating to occupational medicine, industrial hygiene, toxicology, education, engineering safety, ergonomics, psychology, etc. (International Labour Organisation (ILO), 1996). The ultimate goal is an organisation aiming to improve its OSH performance, so that accidents and ill health are eliminated and work forms part of a satisfying life to the benefit of both the individual and the organisation (Health and Safety Executive (HSE), 1997).

Construction is the activity which creates all types of new facilities, as well as the maintenance and repair of existing facilities. Construction activities such as working at heights, demolition, removal or disturbance of asbestos, work at trenches or shafts, temporary supports for structural alterations, powered mobile plant, explosives, confined spaces, work that is in, on or near: electrical installations or services; telecommunications towers; pressurised gas distribution mains or piping; contaminated or flammable atmospheres; chemical, fuel or refrigerant lines are often relate to high risk activities (Rameezdeen, 2006; WorkSafe, 2013). Thus, the industry is considered as one of the most hazard and accident prone of industries worldwide. This fact is often proven by the statistics relating to construction

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accidents. A large number of construction accidents are reported and thousands of workers are killed or injured on construction sites each year (Liu, 2013). According to statistics, in 2003-2004, there were 3,760 major injuries in construction in the UK (HSE, 2005). More alarmingly, during 2004-2005, there were 69 construction fatalities in the UK, representing one-third of all worker deaths in that period (HSE, 2006). Moreover, in the US construction sector, there were 817 recorded fatalities in 2012 (Bureau of Labor Statistics (BLS), 2013). Only in years 2011 and 2012, there were an estimated total of 1.4 million lost working days: 818 thousand due to ill health and 584 thousand due to workplace injury in the UK construction industry (HSE, 2013). Thus, it is evident that the poor safety performance of the construction industry continues to give international cause for concern.

Sri Lanka is also considered to be one of the most vulnerable countries, and is ranked at a low level for safety performance due to lack of improvement measures (De Silva and Wimalaratne, 2012). Further, though the construction output is less in Sri Lanka, compared to developed countries in general, the magnitude of the accident rate in the construction industry is still significantly high as reported in other countries such as USA (Chau *et al*., 2004), UK (Sacks *et al*., 2009), Hong Kong (Siu, *et al*., 2004) and Singapore (Chau and Goh, 2004). The annual accidents in the construction sites were 750-900 and among them 50-60 were fatal (Amarasinghe, 2011). Further, this annual figure was represented a more than 30 percent of accidents which was about 13 times higher than in the other industries in Sri Lanka (Rameezdeen, *et al*., 2003; Amarasinghe, 2009). Thereby, Sri Lankan construction industry is in a proven need to adhere to OSH more than any other industry.

1.2. SAFETY BEHAVIOUR

An accident is commonly known as an unwanted event that is never scheduled or planned. Raouf (2011) defined occupational accidents as unplanned occurrences which result in injuries, fatalities, loss of production or damage to property and assets.

Abdelhamid and Everett (2000) indicated that, workplace accidents in construction occur due to three root causes such as (1) failing to identify an unsafe condition that existed before an activity was started or that developed after an activity was started, (2) deciding to proceed with a work activity after the worker identifies an existing unsafe condition, and (3) deciding to act unsafely regardless of initial conditions of the work environment. They further highlighted that inefficient management decisions, unsafe acts of workers or co-workers, non-human-related events, and unsafe condition of the sites have become natural part of the construction site, continuing construction accidents (Abdelhamid and Everett, 2000). Further, more than 80% of accidents were due to employee behaviour or the human factor, in the form of acts or omissions, and thus safety behaviour has become a critical concept (Burton, 2012).

Heinrich (1931), been the pioneer of this concept, asserted that most safety problems (almost 90%) are the result of human error, which he called unsafe acts. His ratio of 88:10:2 states that 88% of accidents were caused by unsafe behaviours, 10% by unsafe conditions, and the remaining 2% by unpreventable causes. Later in 2006, a similar accident ratio that is 80:20 ratio was given by Hemoud, and Al-Asfoor (2006), broadly concerning unsafe behaviours (80%), and unsafe conditions (20%). This ratio was further improved as 96:4 if human factor aspects such as equipment/process design and work procedures to have an influence on the unsafe conditions (i.e. 80% of the 20% of the unsafe conditions is added to the original 80% of the unsafe behaviours and resulting in 80%+ 16%= 96%) (Hemoud, and Al-Asfoor, 2006). As such, it indicated that the human unsafe acts element is even more contributing to accidents. Thus, it is apparent that the human factor in managing OSH in an organisational setting is of utmost important. Hence, improving safety behaviours to reduce unsafe acts by the employees becomes a proven need. As a result, boosting of the behaviour based approach to OSH management is believed to be ensuring method to reduce injury rates.

The behavioural based approach to safety is focused exclusively on the observable, measurable behaviours critical to safety at a particular facility (Burton, 2012).The application of behavioural research to the solution of human problems is building and demonstrating the first effective and reliable technology of behaviour change in human history (Cambridge Centre for Behavioural Studies, n.d.). In workplaces with troublesome rates of unsafe performance, safety behaviour programs, properly implemented, produce significant improvements in safe performance and major reductions in workplace injuries and illnesses (Cambridge Centre for Behavioural Studies, n.d.). Thus, it is important to recognise

safety behaviour of workers in improving the overall safety performance of an organisation. By identifying the factors that enhance the safety behaviour of workers, how safe behaviours can be inculcated within the construction industry could be examined. Thus, the research focuses on safety behaviour of construction workers and the influencing factors of those.

1.3. SAFETY BEHAVIOUR OF CONSTRUCTION WORKERS

Literature provided a number of factors that have influence on safety behaviour of construction workers. These factors can be broadly grouped under two main categories, namely, 'personal' and 'organisational'. The personal factors included 'Age' (Hinze, 1997; Sawacha *et al*., 1999; Carpenter, 2002; Parker, 2007; Seixas, 2008; Choudhry *et al*., 2009), 'Marital Status' (Fang *et al*., 2006; Choudhry and Fang, 2008), 'Number of Dependants' (Fang *et al*., 2006; Choudhry and Fang, 2008), 'Educational Level' (Hinze, 1997; Carpenter, 2002; Parker, 2007; Seixas, 2008; Masood and Choudhry, 2012), 'Knowledge on Safety' (Fang *et al*., 2006; Idirimanna and Jayawardena, 2011; Masood and Choudhry, 2012), 'Experience' (Siu *et al*., 2003; (Choudhry and Fang, 2008; Masood and Choudhry, 2012), 'Gender' (Hinze, 1997; Carpenter, 2002; Parker, 2007; Seixas, 2008; Masood and Choudhry, 2012), 'Drinking habits'(Fang *et al*., 2006; Masood and Choudhry, 2012), 'Work related pressure'(Choudhry and Fang, 2008), and 'Work-mates' safety behaviour' (Sawacha *et al*., 1999; Choudhry and Fang, 2008).

Under the category, 'organisational factors', a total of eight factors were identified as 'Management commitment'(Sawacha *et al*., 1999; Pidgeon and O'Leary, 2000; Mohamed, 2003; Choudhry *et al*., 2007), 'Provision of Personal Protective Equipment (PPE)' (Sawacha *et al*., 1999; Choudhry and Fang, 2008), 'Tidy site' (Choudhry and Fang, 2008), 'Safety training and awareness' (Wilson, 1989; Mohamed, 2003; Choudhry and Fang, 2008), 'Site layout' (Choudhry and Fang, 2008), OSH monitoring and feedback systems' (Sawacha *et al*., 1999; Pidgeon and O'Leary, 2000; Mohamed, 2003), 'OSH incentives'(Sawacha *et al*., 1999; Choudhry and Fang, 2008), and 'Employment type'(Pidgeon and O'Leary, 2000; Rowlinson, 2003).

In this research, these identified factors were validated to the local context through an expert survey. This is discussed under next section.

2. RESEARCH METHOD

The research was structured into several steps. Initially in-depth knowledge gained regarding the research stream which was sorted upon the degree of relevance to the study. In literature, a total of 18 factors influencing safety behaviours were identified. In order to get the identified factors validated for Sri Lankan construction industry, a preliminary survey (1st round of the survey) was undertaken. Hence the survey was designed into two rounds.

Table 1: Interviewee Profile

Interviewee Group	Interviewee	Years of Experience
Group A	General Manager - Projects (1)	20+
	Safety Engineer (2)	10+
	Safety Officer (3)	12
Group B	Deputy General Manager - Project Coordinating (4)	24+
	Manager - OSH (5)	15
	Health and Safety Executive (6)	9
Group C	Project Manager (7)	19+
	Manager HSE (8)	20+
	Safety Officer (9)	8+

In round 1, three group discussions were held with the management of three reputed construction companies in Sri Lanka who dominate the industry with construction of majority of building projects done and ongoing in the country. (refer Table 1 for interviewee groups' profile). Each interview was held for 40-45 minutes. At the beginning of the discussion, a brief introduction of the research was

provided to the interviewees with the purpose of explaining the background and the objectives of the research. Then the identified 18 factors were introduced under two categories, personal and organisational. Behaviours of these factors were discussed and elaborated. Further, other specific factors with regards to Sri Lankan construction context were elicited. Subsequently, the original list of factors was moderated according to these experts' opinion.

In round 2, interviews were conducted to attain the interviewees' judgements on how those factors would affect safety behaviour of local workers. All the nine interviewees from the three groups of round 1 were individually approached for this exercise. A 5-point Likert scale (5 being the most influential) was used to elicit the subjective decisions on degrees of influence of the validated factors to safety behaviour of local workers.

3. RESEARCH FINDINGS AND DISCUSSION

3.1. INFLUENCING FACTORS OF SAFETY BEHAVIOUR

In round 1 of the survey, experts in all three groups agreed with all 18 factors identified through the literature survey. However, though the 'gender' is important on safety behaviour of workers, experts pointed out that as there are no female workers currently working on construction sites of their companies, the relevancy of this factor to Sri Lankan context remains questionable. Hence, this factor was deleted from the list. Moreover, an additional factor, 'previous exposure to OSH accidents' was recommended.

When organisational factors were considered, all the factors but 'employment type' was agreed as of substantial influence to safety behaviour. Experts showed that, type of employment has less cause for safety behaviour of a person. They clarified that a person's safety depends not on his employment type but on his personal and environmental factors. This may be due to all type of employment in the construction industry involve high risks. Table 2 denotes the moderated list of 17 factors, categorised under Personal and Organisasional factors from round 1.

Table 2: Moderated List of Factors Influencing Safety Behaviour of Construction Workers

Personal Factors	Organisational Factors
1. Age	1. Management commitment
2. Marital status	2. Provision PPE
3. Number of dependants	3. Tidy site
4. Educational level	4. Safety training and awareness
5. Knowledge on safety	5. Site layout
6. Experience	6. OSH monitoring and feedback systems
7. Drinking habits	7. OSH incentives
8. Work related pressure	
9. Work-mates' safety behaviour	
10. Previous exposure to OSH accidents	

3.2. DEGREE OF INFLUENCE OF IDENTIFIED FACTORS

The degree of influence of the validated factors on safety behaviour of construction workers were obtained using individual interviews of the experts and the data collected from the second round of the interviews were then analysed according to the Mean Score of Influence (MSI).

Table 3: Degree of Influence of Factors on Safety Behaviours of Construction Workers

Personal Factors	MSI	Rank
Age	4.89	1
Work related pressure	4.78	2
Previous exposure to OSH accidents	4.67	3
Knowledge on safety	4.55	4
Experience	4.55	4
Educational level	4.00	6
Drinking habits	3.89	7
Number of dependants	3.78	8
Marital status	3.55	9
Work-mates' safety behaviour	3.44	10

Organisational Factor	MSI	Rank
OSH incentives	4.89	1
OSH monitoring and feedback systems	4.67	2
Safety training and awareness	4.44	3
Management commitment	4.33	4
Tidy site	4.00	5
Site layout	3.67	6
Provision PPE	3.44	7

Table 3 presents the MSI values and ranking of the influencing factors accordingly. According to these values, it is apparent that both personal and organisational factors are more or less importance to safety behaviour of construction workers. Moreover, each factor in both the categories has reach a MSI value over 3.00, implying that they have a substantial influence on safety behaviours. Among them, Age, work related pressure and previous exposure to OSH accidents can be identified as the highest three influential in personal category while OSH incentives and OSH monitoring and feedback systems are the top influential in organisational category. The following section discusses the rationale of these ratings.

3.3. PERSONAL FACTORS

Age - Hinze (1997) identified that substantial influence has been determined for demographic factors as personal characteristics as age, and other personal information (gender, marital status, education level, working experience in the industry) can influence individual safety behaviour. Siu *et al*. (2003) investigated age difference in safety attitudes and safety performance in Hong Kong construction workers with data from 374 Chinese construction workers from 27 construction sites. The study found that the older workers exhibited more positive attitudes toward safety. Experts also have observed that the workers who are older in age are more cautious about work safety than youngsters in the industry. Young people are energetic and often reckless, but as they age the physical agility and daringness of workers tame and they tend to behave more safely for their own protection.

Work related pressure - It is common that the work pressure is high when the deadlines are nearing. As a result lack of consideration to perform work safety is observed among the workers, due to their urging to take shortcuts while performing their tasks (Choudhry and Fang, 2008). Experts further pointed out that when the company has to finish a planned project on time, workers have to perform the task quickly in order to get the job done rather than work safely. Thus, the value of safety over performance pressure is often overlooked, not only by workers but also the management, and that could lead to higher accident rates.

Previous exposure to OSH accidents - This factor was added to the existing list by the experts interviewed, stating that workers who have faced occupational accidents tend to be more careful onsite.

These workers know the consequences of an accident and difficulties associated by experience. So, they strongly feel the need to behave in a safer manner while they work.

Knowledge on Safety - Knowledge on safety also plays a major role in enhancing safety behaviours of employees (Fang *et al*., 2006; Idirimanna and Jayawardena, 2011; Masood and Choudhry, 2012). Further, experts also clarified that if the workers don't, or even worse, don't want to understand why or how safety matters in construction, there is a bigger chance of them behaving unsafely during their work hours. So, knowledge in safety matters very much to develop safety behaviours onsite.

Experience - More experienced workers in the industry are less likely to be behaving unsafe manner while they work (Siu *et al*., 2003; Choudhry and Fang, 2008; Masood, and Choudhry, 2012). Experts suggest that, experience let the workers know what sort of danger they are dealing with and what would the consequences be of work related accidents in construction. Thus, workers with more years of experience in the industry would naturally accustomed to safe behaviours than those with less experience, as per the experts. Young workers are more prone to accidents than old workers. This suggests that with the passage of time workers get more experience and are thus aware of safety requirements. The best trained construction workers 'learned by doing' or by gaining experience. New workers watch what experienced workers do and then copy them. Nevertheless, it is a continual learning process and one's perception of doing the work can be changed or modified by subsequent experiences. They revealed that pooling of knowledge and experiences provides more options in solving problems. Experts suggest that, experience let the workers know what sort of danger they are dealing with and what would the consequences be of work related accidents in construction.

Educational level - Educational level does have a positive impact on safety behaviour of workers (Hinze, 1997). Experts agreed that it is easier to maintain safety standards when the workforce consists of individuals with a sound educational background. According to the experts, individuals with good education see the importance of following safety guidelines in work. Their workforces consist mostly of junior school pass outs and people with secondary education (Advanced Level – A/L). According to the interviewees, people with secondary education are easier to handle and to get complied with safety practices than those with an education level of primary or lower.

Drinking habits - Drinking habits can also affect the safety behaviour of workers. Alcohol impairment at work can put the drinker and others at greater risk of injury, particularly in workplaces where heavy machinery is involved (Frone, 2009). It has been estimated that 20%–25% of workplace accidents are alcohol related (Henderson *et al*., 1996). According to the experts, drinking habits can alter a person's risk perception and influence their attitude about safety.

Marital status and number of dependents - Workers also tend to be more careful in what they do when their social responsibilities are higher (Fang *et al*., 2006; Choudhry and Fang, 2008). Experts did argue that workers who are married and have more dependants in their families tend to follow safety instructions and guidelines onsite than others. However, they insisted that a detailed survey is necessary to pinpoint just how much, because when dealing with people, the results can be surprising.

Work-mates' safety behaviour - Safety behaviour of fellow workers can be a possitve influence to improve a worker's safety behaviour onsite (Sawacha *et al*., 1999; Choudhry and Fang, 2008). All the three groups agreed that no worker wants to be highlighted with a bad reputation, in case of safety or otherwise. They asserted that, it may psychologically affect the worker not to fall out of the flock by working safely, if their work-mates follow the safety protocols and work safely during construction. However, as clarified by the experts, this factor doesn't always motivate the employee to follow safety rules. It might depend on the mood, and attitude of the worker.

3.4. ORGANISATIONAL FACTORS

OSH Incentives – Tangible reward for following OSH protocols and procedures are recognised as a good way to get the workers to comply with OSH systems in an organisational setting. (Sawacha *et al*., 1999; Choudhry and Fang, 2008). Experts all agreed that incentives have always been a strong motivator for workers, OSH or otherwise. When OSH incentives are awarded the organisation is giving the worker a good reason to behave safely at work. According to experts it is a tangible reward for the worker. Thus, OSH incentives play a major role in influencing safety behaviours on site.

OSH monitoring and feedback mechanisms - OSH monitoring systems and feedback mechanisms must be there to monitor employee behaviour towards safety. If these systems are well design to capture every error and rectify them, employees automatically adhere to these systems (Sawacha *et al*., 1999; Pidgeon and O'Leary, 2000; Mohamed, 2003). Experts argued that organisations already have these systems but the problem is the continuous monitoring. They viewed that without continuous monitoring any good system can fail eventually. Also, monitoring process will give the workers a sense of been watched over and that will definitely influence safety behaviours. Further, experts pointed out that the workers might not take the system seriously without proper monitoring of the system.

Safety training and awareness - According to OHSAS 18001:2007 - Occupational Health and Safety Management Systems, an introduction to safety policy together with an effective training programme is necessary for an organisation. Experts identified training and awareness programmes for workers is also important. They will be a guide to proper and safe way of behaving while work and will clarify the need of safety while work. All three organisations stated that they conduct safety briefs twice every week and safety induction is a must for their employees.

Management commitment - Management commitment to safety is vital if an organisation wants to promote safe behaviours among the workers (Choudhry *et al*., 2007). Current management practices of OSH include but not limited to controlling the workers' safe and healthy behaviour, centralised OSH management unit, resources and insurance policies, OSH documentation, and OSH committee (De Silva and Wimalaratne, 2012). According to experts, there is so little that can be expected from workers regarding safety if the top management's attitude to safety is dull. An interviewee viewed that, people want to get the work done one way or another. So if they see no commitment from the top management to anything l*et al*ong safety, the management cannot expect much from them.

Tidy site - Cleanliness and tidiness of the construction site is a must to ensure accident free environment (Choudhry and Fang, 2008). The need of tidy site is been emphasised in quality standards as well. For example, as mentioned in specification for buildings (2012) published by Architectural Services Department of Hong Kong, under the British Standards' General specification for buildings (2012), cleanliness on site is been acknowledged as important. It states that the materials and plant need to be stored neatly, rubbish and debris as they accumulate must be removed and site must be kept clean and tidy. Experts highlighted the importance of clean and tidy sites for improving safety behaviours. It is part of improving the job condition to minimise the risk of accidents in the physical environment.

Site Layout - The planned and organised site layout can be helpful to mitigate the risk to construction workers and influence safety behaviours in them (Choudhry and Fang, 2008). The experts agreed that sites which are properly planned are more likely to improve safety behaviour by reducing the causes of accidents on site. For example by guarding machinery or prohibiting access to certain areas accidents can be prevented on site. Also, by properly planning and establishing labour camps, the risk to workers onsite can be minimised.

Provision of PPE - Provision and use of the correct type of equipment for a job, and the provision and use of protective clothing and equipment are prerequisite for improving safety behaviour (Sawacha *et al*., 1999; Choudhry and Fang, 2008). Experts clarified that it's organisations' responsibility to provide those to the workers for they enable the worker to safely perform his work. However, experts revealed that although they provide their workers the necessary PPEs, they do not where them unless they are closely supervised. Often the organisations have to force the workers to wear PPE while they work.

4. CONCLUSIONS

The paper presents the findings on factors influencing construction workers' safety behaviour, validated and prioritised by the industry experts. These factors were compiled from an in-depth literature review and further validated by a group of experts from the industry. In this paper, the identified factors are presented under two categories; namely, personal and organisational. Under personal category, study identified ten factors, namely, age, marital status, number of dependents, educational level, knowledge on safety, experience, gender, and drinking habits, work related pressure, work-mates' safety behaviour. Management commitment, OSH monitoring and feedback mechanisms, Safety training and awareness, OSH incentives, Tidy site, Site layout, Employment type and provision of PPE are the factors identified under organisational category.

These factors were validated and moderated by the industry experts in the round 1 of the preliminary study undertaken. Two factors, namely, 'gender' and 'employment type', were omitted from the list considering the Sri Lankan context and significance to the subject matter, respectively. An addition was made to the list as 'previous exposure to OSH accidents'. This moderated list of factors was then rated using a Likert scale of 1 to 5 (5 being the most influential) for their degree of influence on safety behaviour of construction workers, by the same set of experts and the results revealed that all the factors are substantial when it comes to safety behaviour. However, age and OSH incentives were the most influential in their respective categories while work-mates' safety behaviour and provision of PPE were the least influential.

These findings could be helpful in better understanding the construction workforce. That understanding can be utilised in designing and implementing OSH systems for the construction industry. Also, the knowledge acquired from this study can be helpful in deciding how to influence the workers to behave in a safer manner onsite.

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