**Assessment of Health and Safety Risk Perception of Site Managers, Supervisors and Workers in Tanzania Urban Construction Sites**

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**ABSTRACT**

Risk perceptions play a prominent role in the decisions people make, that is, differences in risk perception lie at the heart of disagreements about the best course of action between the individual and their context. In the construction industry risk perception holds a central position in health and safety risk management through risk assessment and risk communication. Construction site managers and supervisors, as individuals, are regarded as having greater impact on project performance in relation to health and safety risk. Their assessment and communication of risk depends largely on their perception of risk. This paper is part of an ongoing research to develop a conceptual framework for health and safety risk assessment and communication in Tanzanian urban construction workplaces. It presents preliminary fieldwork results of which 20 construction site managers, 10 gang supervisors and 50 workers were interviewed on how they characterize and rank risk in different activities in construction projects under two trades namely concrete casting and block laying trades. Twenty large construction sites were purposively selected. The findings are based on site managers’ perception of health and safety risk, and factors influencing such perception(s) of risk.

**Key words:** Risk perception, health and safety risk, site managers, supervisors, workers and construction sites
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1. Introduction

Construction industry is an important part of the economy in Tanzania, often seen as a driver of economic growth. Typically, the Tanzania construction industry accounts for more than 50% of capital formation, and constitutes 5.7% of the Gross Domestic Product. Owing to its relatively labour-intensive nature, construction work provides opportunities for employment for wide ranges of people who are skilled, and the urban poor who do not have much skill (Well, 2007). Employment created by construction workplaces has a significant impact on urban poverty alleviation (Laurence et al 2008). Despite its importance, the construction industry is considered risky, with frequent and high accident rates, health problems of workers, practitioners and end users (Mombeki, 2005; Kikwasi 2010). Currently, construction sites are ranked as the second most dangerous place to work, after mining workplaces (Mbuya and Lema, 2004; ILO, 2005). The concern globally and particularly in Tanzania is how to make construction workplaces a safe and healthy place to work in.

A lot of efforts have been made to change the health and safety situation in the Tanzania construction industry. Such efforts include the formation of different regulations such as the Occupational Health and Safety Act, 2004; the Contractors Registration Board (CRB) Act No. 17/1997; and the Employment and Labour Relations Act (EALRA) No. 6/2004. Risk assessment and communication has been the cornerstone of these regulations, and all employers are required to assess the health and safety risks to workers and any other person who may be affected by their undertaking. However, in risk assessment and communication much depends on how people involved in the process perceive risk. People make varied decisions depending on their perception of risk. Such perceptions lie at the heart of disagreements about the best course of action and control measures. In the construction sites, site managers and gang supervisors play an important role in ensuring safety in the workplace, and employees conform to safety rules and procedures when they find fairness in their supervisor’s action (Yule, Flin & Murdy, 2007). This paper will share some insights obtained from an investigation study on how site managers, gang supervisors and workers characterize and rank risk in concrete casting and brick laying activities in urban construction sites in Tanzania.

2.0 Risk and Risk Perception

Risk perception
Risk is a multi-facet concept and there is no single definition on what risk is. According to Fischhoff et al. (1987), for example, risk is the existence of threats to life or health. Risk is also regarded as exposure to the chance of injury or loss (Hertz and Thomas, 1983), and the likelihood that harm will occur (Health and Safety Commission, 1995). On the one hand, risk is closely connected to uncertainty and is a commonly used term in all kinds of contexts, but it is more often related to the negative outcome of an event (Ward and Chapman, 2003).

Numerous studies of risk perception have been carried out with regard to the psychology of risk perception and risk assessment for individuals (Irizarry and Abraham, 2007; Rohrmann, 2007; Loushine, 2010). Accordingly, risk perception is based on people's judgments and evaluations of hazards they are or might be exposed to. On the other hand, risk perceptions are interpretations of the world, based on experiences and/or beliefs. They are embedded in the norms, value systems and cultural idiosyncrasies of societies (Finucane & Holup, 2006; French et al., 2006). When risks are misinterpreted workers can have inappropriate risk behaviours.

Weber (2001) reviews three approaches by which risk perception has been studied: the axiomatic measurement paradigm, the socio-cultural paradigm, and the psychometric paradigm. Studies within the axiomatic measurement paradigm have focused on the way in which people subjectively transform objective risk information, i.e., possible consequences of risky choice options such as mortality rates or financial losses and their likelihood of occurrence, in ways that reflect the impact that these events have on their lives. Studies within the socio-cultural paradigm have examined the effect of group- and culture-level variables on risk perception. Research within the psychometric paradigm has identified people’s emotional reactions to risky situations that affect judgments of the riskiness of physical, environmental, and material risks in ways that go beyond their objective consequences. Wilde (1982) developed the risk homeostasis theory which states that an individual’s behavior in risky situations is determined by a desire for cost minimization, which explains how behavior can be in accordance with risks, even subjectively perceived risks, without an ever-repeated process of conscious risk evaluation.

Factors influencing risk perception

The experience of construction workers and their knowledge of safety are important factors to consider in the evaluation of their risk perception. An evaluation of the relationships between workers’ attitude towards safety and the incidence of injuries on high rise building projects in Jakarta Indonesia found that ‘safety performance [was] primarily affected by individuals’ attitudes towards safety’ (Koesmargono, 1998: 32). Once an individual has an attitude to an object, things related to the object are seen in a selective way. He found that workers’ attitudes to safety were affected by age, work experience, level of education, and safety training experience. The same findings were revealed on a study done by Rohrmann (2007) in which workers’ experience, age and background of safety training were found to be related to the tendency of reporting any accidents or near misses on the site. Their perception on the need to report accidents and near misses was high due to their awareness of the importance of safety on the
A study with previously injured oil workers working on offshore installations found that the experience of an injury influenced their overall perception of the work environment. Worker behavior regarding safety may be influenced by the worker’s perception of what is safe or unsafe. Based on this perception, decisions are made when to adopt or not adopt required safety precautions. This relationship was observed by Huang and Hinze (2003), who found that approximately 33.3% of all accidents are caused by a misjudgment of hazardous situations. Figure 1 summarizes factors affecting risk perception of the individuals.

**Figure 1:** Risk perception factors

Figure 1 (above) indicates that risk perception is based on individual attitude or behavior of accepting risk. However, attitude and behavior are affected by an individual’s education background, age, working experience, and training in health and safety.

**Health and safety risk on block layers (masonry) and concrete casting**

Block layers are engaged in building and renovating houses, offices, and industrial complexes using blocks and mortar. The most demanding activity in concreting is moving/transporting concrete, cement, and sand to the required areas. Concrete are manually transported and compacted in repetitive ways for more than eight hours a day. For block layers, the most demanding task in terms of physical work is the one-handed repetitive lifting of blocks with a bent lower back for more than six hours a day. At the work site, the most demanding task for both concreters and block layers in terms of physical work is the manual transportation of bricks, blocks, concrete, and mortar. This involves the manual lifting and carrying of materials and pushing/pulling wheelbarrows for more than six hours every working day. Block layers and concreters are exposed to dust when sawing bricks/blocks or when mixing cement/glue. Mortar contains cement. Cement is alkaline, and regular prolonged skin contact can result in skin complaints. Again, block layers and concreters are exposed to noise caused by equipment such as the concrete mixer present in their environment, to impulse noise when positioning bricks
and when chipping blocks to size, to noise caused by cutting bricks/blocks, and by work involving power tools (drilling, sawing, grinding) or when compacting concrete.

Both concreters and block layers are at high risk of occupational accidents. Injuries can be a result of bumping into something, tripping or slipping, being trapped by a swinging load, being hit by falling material or equipment, or by a load falling from a crane, being hit by falling or collapsing scaffolding, or being trapped by a falling pile of stones or a toppling wheelbarrow. There is the risk of falling from floors or scaffolding, caused by missing railings or floor jambs not being closed up or sealed off, or as a result of slipping off a ladder. Inadequate lighting hampers work and increases the likelihood of accidents. Figures 2 and 3 show workers in block laying and concrete casting in one of construction sites in Tanzania.

Figure 2. Block layers and a concrete casting gang at a construction site

Figure 3. Concrete transportation and compacting in a construction site
Figure 2 and Figure 3 show the typical practice of concrete casting and block laying in a risk situation without proper protection. Workers are subject to manual handling, chemicals (cement), dust, too much bending and twisting while laying blocks and compacting concrete, and falling from height. The main question which this study sought to answer was how workers and their supervisors perceive risk in their workplaces.

3. Methodology

Twenty ongoing large construction sites were selected as a survey through purposive sampling. All the construction sites were multi-storey buildings with more than 10 storeys. A questionnaire was used to collect information. From the construction sites twenty site managers, ten gang leaders and fifty workers were asked to rank their perception of different risks in concrete casting and block laying process, especially in wall construction. Eight health and safety risks were identified from literature on concrete casting and block laying. Site managers, supervisors and workers were asked to rank in a 1-5 Likert scale. 1= very likely to occur, 2= likely to occur, 3= moderate, 4= not very likely to occur, and 5= not likely to occur (i.e., no chances of occurrence). Other parts of the questionnaire were designed to profile the participants in terms of their level of involvement in construction, gender, employment status, level of education, construction-related qualifications and experience, exposure to injury and illness, exposure to construction H&S training and information. The data were analyzed using SPSS.

4. Discussion of Findings

Demographic characteristics of the respondents

All 80 respondents were men as most activities in concrete casting and block laying are done by men in Tanzania. Respondents’ ages ranged between 20 and 45 years where the majority (50 or 63%) fell within the range of 25 years to 35 years, followed by 30 (37%) respondents ranging between 36 and 45 years of age. There were no respondents of the age above 46. The finding contradicts the study done by Irizarry and Abraham (2006) on risk perception among iron workers, and found that the majority of their respondents were over 40 years of age. In the current study the majority (63%) ranged between 25 and 35 years of age. This study brings out the opinion that since concrete casting and block laying activities require one to be physically strong, they are not activities that the aged would prefer. The respondents’ level of education and their experiences are as presented in Figure 4 below.
Figure 4 indicates that almost half of the respondents (48.7%) had only primary education; followed by 38.7% who had primary education with vocation training. 6.3% each has lower secondary education and university education. In terms of experience, half of the respondents (50%) reported 6 to 10 years of experience in construction, followed by 36% with experience of 1 to 5 years. Only 14% have experience for more than ten years. From the data it can be observed that there is a large variability in the level of experience of the respondents.

Knowledge on construction health and safety

Site managers/ gang supervisors and workers were asked to respond to whether or not they had been to any training on health and safety. The responses are indicated on Table 1.

Table 1: Knowledge on health and safety risk of the respondents

<table>
<thead>
<tr>
<th>A workers</th>
<th>Frequency of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nr</td>
</tr>
<tr>
<td>1 Have you ever received any training related to health and safety in construction sites?</td>
<td>50</td>
</tr>
<tr>
<td>2 Have you been trained in proper use of Personal Protective Equipment?</td>
<td>50</td>
</tr>
<tr>
<td>3 Have you ever been involved in an accident while performing your task?</td>
<td>50</td>
</tr>
<tr>
<td>4 Have you ever been injured while performing your tasks?</td>
<td>50</td>
</tr>
<tr>
<td>5 Do you think that Personal Protective Equipment affects the productivity?</td>
<td>50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B Site managers/gang supervisors</th>
<th>Frequency of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Have you ever received any training related to health and safety in construction sites?</td>
<td>30</td>
</tr>
<tr>
<td>2 Have you ever been trained in proper use of the Personal Protective Equipment?</td>
<td>30</td>
</tr>
<tr>
<td>3 Have you ever seen one of your workers being involved in an accident while performing his/her task?</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Have you ever seen one of your workers being injured while performing his/her tasks?</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>5</td>
<td>Do you think that Personal Protective Equipment affects the productivity?</td>
</tr>
</tbody>
</table>

Table 1 shows that the majority of the workers (60%) do not receive any formal health and safety training. However, half of the respondents (50%) have received training on how to use the Personal Protective Equipment (PPE). On the other side, 34% of the respondents have been involved in accidents while performing their tasks. 64% have been injured while performing concrete casting works and block laying without being involved in accidents. This finding suggests that although majority of the workers had no formal health and safety training, but to some extent they have been subjected to either accidents or injury. The experience of accident or injury changed the way these workers perceived risk. On the other side, one third (36%) of the workers believe that PPE affects their productivity. This is interesting because the same workers would not make use of the PPE to minimize accidents. This affects construction projects, especially when time is pressing. The findings tally with those in the study done by Mombeki, (2005) on compliance on Tanzania construction sites. On the other side, all supervisors have received health and safety training, and they have witnessed their workers getting accidents, sustaining injuries. 17% of the supervisors believe that the PPE affects productivity of their workers.

**Risk perception**

Site managers, gang supervisors and workers were asked to indicate qualitatively their probability of occurrence when working on a situation of hazards. The Likert scale was used where 1 = very likely to occur, 2 likely to occur, 3 = moderate, 4 = not very likely to occur, and 5 = No likely to occur at all (i.e., no chances of occurrence). The results are as indicated in Table 2 and Table 3. The mean score for the results is 3.0.

**Table 2: Descriptive Statistics of the risk perception of workers**

<table>
<thead>
<tr>
<th>workers</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>falling from height</td>
<td>50</td>
<td>1</td>
<td>5</td>
<td>2.92</td>
<td>1.047</td>
</tr>
<tr>
<td>falling object</td>
<td>50</td>
<td>2</td>
<td>5</td>
<td>3.04</td>
<td>.989</td>
</tr>
<tr>
<td>neck, arm pain due to manual handling</td>
<td>50</td>
<td>1</td>
<td>4</td>
<td>2.86</td>
<td>.969</td>
</tr>
<tr>
<td>crushed by moving object</td>
<td>50</td>
<td>2</td>
<td>5</td>
<td>3.60</td>
<td>1.195</td>
</tr>
<tr>
<td>hearing loss due to noise</td>
<td>50</td>
<td>1</td>
<td>4</td>
<td>2.66</td>
<td>1.081</td>
</tr>
<tr>
<td>respiratory illness due to dust on site</td>
<td>50</td>
<td>1</td>
<td>5</td>
<td>2.62</td>
<td>1.193</td>
</tr>
<tr>
<td>musculatory disorder due to bending and twisting</td>
<td>50</td>
<td>2</td>
<td>5</td>
<td>3.04</td>
<td>.856</td>
</tr>
</tbody>
</table>
It may be clearly seen in Table 2 and Table 3 that both groups (workers and supervisors) completely indicate that the probability of falling from height, arm and neck pain, hearing loss and respiratory illness from dust are moderate in their occurrence. However, being hit by falling objects was perceived differently between workers and supervisors. While supervisors said that being hit by a falling object was likely to occur, workers said that there were no chances at all of being hit by falling objects. Workers also felt that musculatory disorders and being crushed by moving objects in the sites were not likely to occur. In such a situation where differences exist in the perception of risk, it is suggested that more communication be done to bridge such a gap between supervisors and workers.

### Factors affecting risk perception

To ascertain factors affecting risk perception, cross tabulation was performed on risk and demographic characteristics of the respondents. One risk was selected based on common perception of both supervisors and workers. The risk selected was falling from height. Again demographic characteristics such as level of education, experience, age and knowledge on health and safety were selected. The results are presented in Table 4.
Table 4 indicates a strong correlation between the age of the respondent and the perception of likelihood of falling from height. As the age of the respondents increased, the perception on health and safety risk also increased. A higher percentage of respondents of the age between 36 and 45 indicated that falling from height was either very likely to occur (17%), likely to occur (40%) or moderate (30%). Only 13% indicated that falling from height was not likely to occur. This finding suggests that elders are more cautious of risk due to their experience or exposure to different risk situations.

Table 4 also shows that there is a strong correlation between experience and the ranking of health and safety risk. One third of the respondents with 1 to 5 years of experience indicate that falling from height while performing a task was either not very likely to occur (28), or no chances of occurring at all (7%). As the experience increased from 6 to 10 years, the number of respondents indicating that falling from height was likely to occur or very likely to occur increased too. At the same time, the number of respondents indicating that falling from height was not likely to occur decreased. As the experience increased from 10 to 15, all respondents in this group indicated that falling from height was likely to occur or that chances of occurrence were moderate. This finding is contrary with the study done by Che Hassan et al, (2007), where respondents with more experience rated risk low due to the fact that they had developed confidence, having worked long in risk situations. This indicates that with more experience workers are likely to be exposed to different health and safety training or being involved in accidents/injury which shape their risk perception.

Table 4 also indicates that there is a strong correlation between education level and ranking health and safety risks. The majority of the respondents with primary education ranked falling from height as moderate while few of them indicated that falling was either
not very likely to occur or not likely to occur at all. As the education level increased the number of respondents indicating that falling from height would not occur decreased. Table 4 also indicates that there is no correlation between training in health and safety and the ranking of health and safety risks. Although a significant number of the respondents had received some type of safety training, its effectiveness in reducing accidents could not be determined from the data. This mismatch could be attributed to the contents of the training programme.

5. Conclusions

Risk perception by site managers, supervisors, and workers on a concreting and block lying reveal that both supervisors and workers perceive that the possibility of arm and neck pain, hearing loss, respiratory illness due to dust, and falling from height was moderate in occurrence. While supervisors acknowledge cases of musculatory disorder and being hit by falling objects on concrete casting and block lying, workers have different views. They perceive that there is no musculatory disorder and being hit by falling objects in the concreting and block laying process. With regard to the health and safety training, the findings reveal that the majority of the workers do not have formal training on health and safety issues. All supervisors have had health and safety training at some point. However there is no strong correlation between training and risk perception. The findings also reveal a strong correlation between one’s experience and risk perception. As the experience increased there was more consciousness on health and risk. Additionally, there is a correlation between the level of education and risk perception. Respondents with higher education perceive risk more compared to those with lower education. Age also has a strong correlation with the perception of risk. As age increases, the perception of risk gets changed. It is recommended that when carrying out health and safety programmes in construction sites, the workers’ age, experience and education level should be considered.

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