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Assessing on-site construction personnel hazard perception in a Middle Eastern developing country: An interactive graphical approach

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ABSTRACT

The construction industry is unarguably one of the most dangerous industries contributing to a high percentage of work-related injuries and fatalities. Despite various attempts at ensuring compliance with health and safety regulations and maintaining a safe working environment, the construction personnel attitude on jobsites remains one of the direct reasons behind reducing accidents. Therefore, assessing the hazard perception of the construction workforce is a substantial step in enhancing on-site safety management, especially in developing countries where construction safety is still at its infancy. In Lebanon, a Middle Eastern developing country, the construction industry has been characterized by an overall poor safety performance. Hence, the objective of this paper is to assess the awareness and perception of engineers, foremen and workers on the severity of various indoor hazardous activities and the importance of hardhat use through conducting a computer-based graphical interactive survey on different construction sites in Lebanon. Results revealed: (1) deficiencies in hazard perception among construction personnel, varying according to SHMS adoption by contractors, site characteristics, years of experience, and job position as well as (2) how the main incentive behind wearing a hardhat is actually having faced past incidents in lieu of self-motivation. The study findings together with recommendations issued for enhancing on-site construction personnel hazard and safety perception could be of significance to other regional developing countries.

1. Introduction

Construction is one of the riskiest industries worldwide (Guo and Yiu, 2015; Mneymneh et al., 2016; Abbas et al., 2016, Mneymneh et al., 2017). Despite the remarkable improvement of construction safety and health management that followed the Occupational Safety and Health Act (OSHA) of 1970 and the implementation of numerous safety measures, a sizeable number of construction works related injuries are still being reported (Huang and Hinze, 2006; Hallowell and Gambatese, 2009; Zou and Zhang, 2009; Kim et al., 2016). In 2014, the construction sector was responsible for 899 fatal injuries in the United States, second only to the trade and transportation sector with 1246 fatal injuries while the mining sector caused 183 (United States Department of Labor (2014)). According to the Health and Safety Executive (HSE, 2016), 66,000 non-fatal onsite injuries have been self-reported in 2015/2016 in the United Kingdom. The main causes of these injuries included being struck by objects or exposed to hazardous areas (Teizer et al., 2009).

As such, developed countries have invested remarkable efforts to enhance construction safety management and produce safety policies aiming to reduce work-related injuries. On the contrary, developing countries present weak commitment to construction safety. In Lebanon, a Middle Eastern developing country, a construction labor safety law exists but its enforcement is absent (Awwad et al., 2015). As a result, the Lebanese construction industry has been witnessing a large number of work-related injuries, with the highest percentage coming from the age category 20–29 (Nuwayhid et al., 2003). Despite the high levels of accidents, there have been no efforts targeted at studying and assessing on-site workforce awareness vis-à-vis hazardous activities and hardhat use in the Lebanese construction industry. This paper is the first to evaluate the construction personnel perception of hazards and safety in Lebanon by means of a computer-based interactive graphical survey rather than traditional questionnaires. Furthermore, the paper concludes by devising recommendations and improvement channels to enhance perception of potential hazards and importance of hardhat use which may be of great use to other developing countries in the region.

2. Background

The assessment of construction safety performance and practices is a

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fundamental part of safety management systems and has attracted the attention of many researchers (Sgourou et al., 2010, Shin et al., 2014; Wu et al., 2015). For instance, in the United States, the construction industry has been displaying higher rates of work-related injuries and fatalities than any other industry in the U.S (Huang and Hinze, 2006), mainly due to the use of heavy machinery and work under unfavorable conditions (Hallowell and Gambatese, 2009). The same applies to China and Australia (Zou and Zhang, 2009). As such, efforts have been channeled in the last years to devise extensive safety standards aiming at zero injury policies. As for the United Kingdom, Sherrat et al. (2013) assessed the status of safety on construction sites and indicated that, in addition to strict safety regulations and requirements such as European and UK laws, safety management systems are typically driven by high levels of safety culture and appreciation. Large contractors in the country were looking to engage with workers to improve cooperation and consciousness on construction sites. In other words, the study highlighted the shift in safety management policies from enforcement to engagement. On the other hand, as opposed to the aforementioned developed countries, developing countries have been displaying poor construction safety performance and evaluation (Bibb and Bust, 2006, Teo Ai Lin et al., 2008). Al-Humaidi and Tan (2010) stated that the construction industry accounts for over a third of the total work-related injuries in Kuwait. They evaluated recent accidents on different sites and concluded that the Kuwaiti construction sector is in a pressing need for improving safety regulations. Alkilani et al. (2013) collected data about the health and safety practices in Jordan, using field visits, discussions with construction personnel and semi-structured interviews and highlighted the main constraints hindering the proper implementation of health and safety rules. Raheem et al. (2016) worked on improving the existing safety situation of the Pakistani construction industry by proposing a framework that enhances the implementation of safety practices, and consequently joins the safety-related perceptual gaps between the stakeholders and regulatory authorities. Generally, studies suggested that underdeveloped regions still present inefficient safety records tracking, inadequate safety laws and regulations, lack of commitment and cooperation from clients and managers towards a healthy construction environment, and low levels of worker competence and safety training (Irumba, 2014, Chiocha et al., 2011). This applies as well to Lebanon, a developing country in the Middle East region. As a matter of fact, Awwad et al. (2015) was a first attempt at evaluating the construction safety practices in Lebanon. The study gathered data by conducting surveys and one-one interviews with different concerned parties including contractors, consultants, owners, insurance companies and governmental authorities. The results of this study showed weak commitment of construction stakeholders to safety practices, absence of enforcement of safety regulations, and poor safety education in the Lebanese construction industry. Nonetheless, this latter study did not include the perspective of on-site construction personnel other than project managers and safety officers on hazards and safety-related matters.

However, the on-site construction personnel perception of hazards remains one of the most crucial components of hazard exposure control and injury reduction on construction sites and has been the focus of many research efforts (Haslam et al., 2005, Carter and Smith, 2006; Hsu et al., 2012; Feng et al., 2014; Yu et al., 2014; Albert et al., 2014; Jeelani et al., 2017). As such, the impact of several factors on hazard perception has been studied. These include but are not limited to: job position, years of work experience, adoption of a safety and health management system (SHMS), site characteristics, etc. For instance, the impact of the job position on hazard and safety perception has been studied in various industries. Hallowel (2010) surveyed 22 different companies in the Pacific Northwest of the United States and interviewed 83 construction-related personnel in half-hour sessions, in order to assess the levels of safety hazards understanding and detect potential discrepancies between workers and managers. Results indicated high levels of perceived risk compared to tolerable risk values and the presence of a notable difference between the risk acceptance levels of workers and managers. Similarly, Chen et al. (2012) assessed the difference between perceptions of management and labor regarding construction safety practices. Results revealed that management is more aware than labor of construction site safety. Furthermore, in a recent study by Perlman et al. (2014), it was found that superintendents assessed the level of risk higher than students with little work experience and safety managers identified far more hazards than superintendent or student groups.

On the other hand, the impact of the years of work experience factor on hazard perception has been studied as well in several industries. For instance, Crundall et al. (2012) exposed drivers from different levels of experience to a series of hazards using a car simulator, with the aim to assess their hazard perception. Results showed that drivers with higher levels of experience were able to identify hazardous situations in a fast and more effective way. Similarly, in a study by Li et al. (2014) on situational awareness of first responders, results showed that the years of experience was the most impactful factor. The study suggested that requirements of first responders might change as their experience grew over time. Other research efforts investigated the ability of new entrants to the mining industry to recognize work-related hazards from several images of their work areas. It was found that the years of experience and age of the test subjects had an important effect on the workers' ability to identify hazards (Bahn 2013a). However, in the construction industry, a study by Perlman et al. (2014) suggested that the ability of superintendents to identify hazards is not positively correlated with their work experience in years.

Furthermore, the impact of adopting several characteristics of a SHMS (i.e. safety training, personal protective equipment (PPE) provision, presence of safety officers, etc.) on hazard and safety perception has been also studied in various industries. In the mining industry, for example, a study identified the importance of training, communication and documentation in enhancing hazard identification skills (Bahn 2012a; Bahn 2012b). Other prior research in the field of construction has generally attributed poor hazard recognition performance to ineffective training practices and shortcomings with traditional methods (Wilkins 2011, Perlman et al. 2014). The study conducted by Perlman et al. (2014) has stated, in particular, that formal, effective, and engaging safety trainings, safety directors and most importantly the constant presence of superintendents on site might play an essential role and highly influence the ability and performance of workers. In another study by Ulubeyli et al. (2014), a questionnaire survey was carried out with contractors and workers employed in several construction projects in Turkey. Results revealed that contractors overlooked safety training and were reluctant to invest in PPE whereas workers did not attach adequate importance to occupational training and safety.

Other studies have assessed the impact of site characteristics on hazard perception. According to Mitropoulos et al. (2005), the dynamic nature of construction projects makes it challenging for workers to visualize and predict tasks and hazards associated with it. Additionally, studies by Carter and Smith (2006) and Albert et al. (2013) stated that a large fraction of construction hazards remain unrecognized regardless of project type and project location. This is further confirmed in a recent study by Jeelani et al. (2017) that mentioned that workers may not possess complete knowledge on what hazards to expect and look for due to the presence of uncertainty and diversity across projects and situations.

On another hand, many studies have shown that psychological factors such as workload, organizational relationships, mental stress, job security, job satisfaction, supervision role and motivation, etc. can impact the perception and attitude of on-site construction personnel (Solís-Carcaño and Franco-Poot, 2014, Idrees et al., 2017). Garzon et al. (2013) analyzed the results obtained by questionnaires from several samples of construction workers from southern Spain. Their statistical study revealed that the worker safety attitude is influenced by the

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